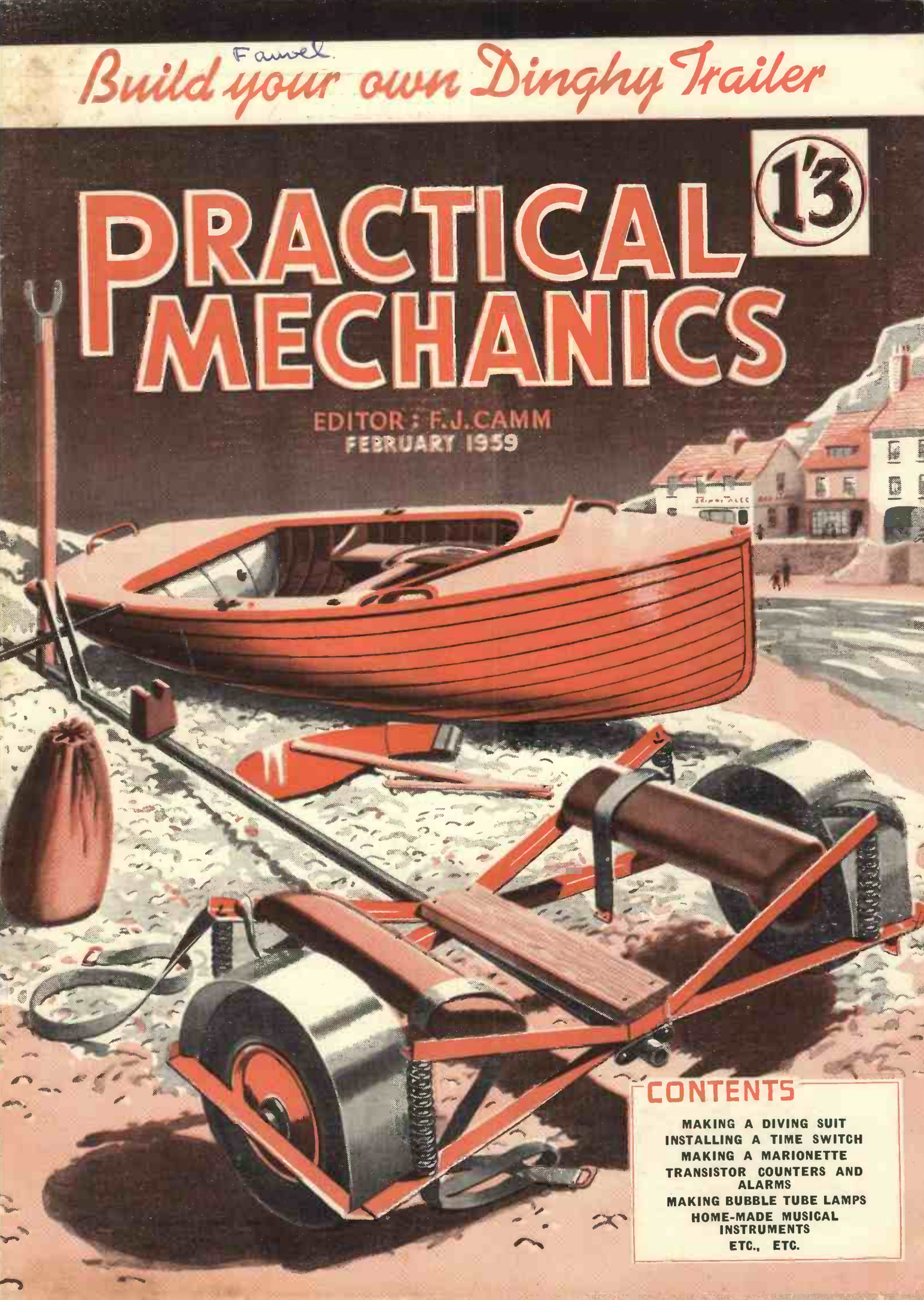
Build your own Dinghy Trailer

Fawcett

PRACTICAL MECHANICS

1/3

EDITOR : F.J.CAMM
FEBRUARY 1959



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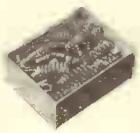

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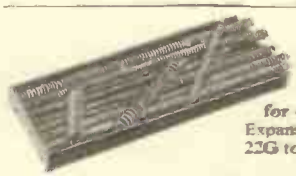

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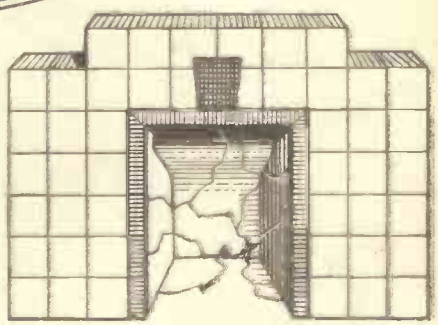

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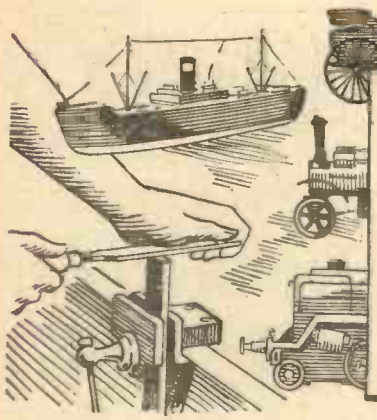

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CONTRIBUTIONS

The Editor will be pleased to consider articles of a practical nature suitable for publication in "Practical Mechanics." Such articles should be written on one side of the paper only, and should include the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor, "Practical Mechanics," George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

FAIR COMMENT

THE RUSSIAN MOON ROCKET

THE great scientific importance of the Russian Moon Rocket cannot be underestimated, for it has demonstrated beyond all doubt that it is possible to reach the moon and other planets. The rocket has penetrated outer space to the tune of 380,000 miles, the farthest yet. Undoubtedly intended to reach the moon, it missed its target, owing to the deflection caused by the moon, a factor which could have hardly been calculated. The important fact is, however, that the rocket went more or less to plan. There seemed to be no doubt whatever as to its success from the moment it was launched. The Russians were supremely confident and whilst it was on its outer journey, they gave most accurate information as to what it would subsequently do, together with accurate details of time. It is a momentous step forward into the space age. At the time of going to press, the rocket is taking up orbit about the sun and, according to the Russians, will take up its residence among the other planets as a permanent man-made planet in perpetuity. This presumes that there will be no disintegration of its structure due to speed or heat of the sun. The orbit will be slightly elliptical, and the round trip will be 214,750,000 miles, taking 15 months for each revolution or three months longer than the earth takes to go round the sun.

Thus we know that distance alone ceases to be one of the major problems.

Magnificent as the achievement is, there are many other vital problems to be solved before we can land people on the moon. We have yet to make a spaceship which can reach the moon and *return to earth*. At present, the rockets with their valuable scientific equipment are lost to us. Obviously the next step is to make a two-way rocket, and to design special apparatus to enable human beings to breathe; it is popularly assumed that the moon is without atmosphere.

The main effect of this success will be to cause other nations to speed up their space programmes, and we may expect startling developments within the next five years. It may cause Great Britain to take a more active part in space travel than it has done up to the present.

The fact that laws controlling interplanetary space travel are now being drafted is significant. The Americans see in the Russian developments the possibility of long-distance missiles which can cover at least 6,000 miles, and they are speeding up their programme with the object of drawing at least parallel with the Russian developments. It now seems quite obvious that space travel will be *de facto* within the next quarter of a century. It has not yet been established whether the moon has a magnetic field, but perhaps the Russians may explain this when the data sent back to earth from the instruments aboard the new rocket have been analysed.

THE P.H. EXHIBITION

IN every copy of the March issue of our companion journal, *The Practical Householder*, is a ticket entitling every purchaser to free entry into *The Practical Householder* Exhibition which takes place at Earls Court from February 18th to 28th. At this Do-It-Yourself exhibition will be staged daily demonstrations of woodworking, painting, wallpapering, use of power tools, metal working, to mention but a few of the subjects to be dealt with. Apart from that under one roof you will be able to examine all the tools and materials now produced for do-it-yourself enthusiasts, 3,977,000 of whom are readers of our companion journal, which is the leader in the field. It is now printed in photogravure with certain advertisements and features in full colour. I hope readers of this journal will visit the exhibition and will pay a visit to our Stand where experts will be available to discuss any problems you may have.—F. J. C.

The March, 1959, issue will be published on February 27th. Order it now!

Build Your Own Dinghy Trailer

By Cecil Hawkes

The completed trailer in use.

THIS boat trailer was designed specifically to transport a National 12ft. sailing dinghy, but with suitable modifications to the hull supports it would be capable of carrying light craft up to 14ft. over-all length. In practice the trailer has proved to have very good road holding qualities and the boat rides quite steadily behind the towing vehicle.

It Can Cost Less Than £15 to Build

Fig. 1.—The end of the backbone which is fitted to the hitching arrangement at the rear of the car.

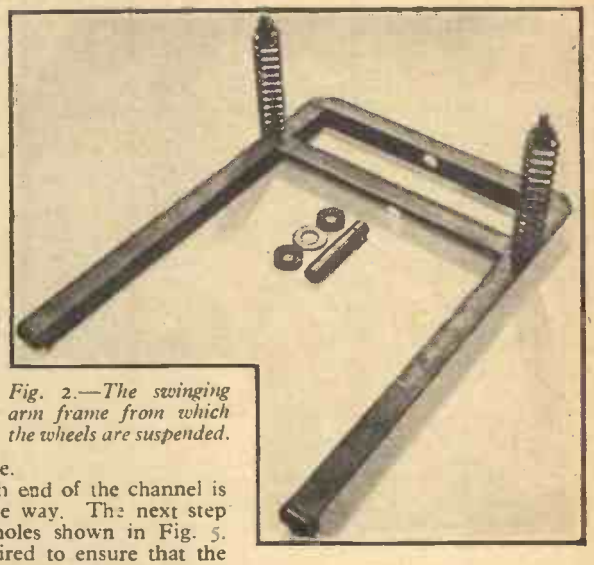


Fig. 2.—The swinging arm frame from which the wheels are suspended.

Backbone Construction

Start with the backbone of the trailer which consists of a 10ft. long, steel tube 2in. o.d. with a 3/16in. wall thickness. A scaffold pole is ideal, but preferably not galvanised. Brackets will have to be welded on this tube and metal that is not galvanised assists this. One end of the tube is flattened for about 6in. and a hole is drilled 1in. from the end to take a ½in. dia. bolt for attachment to the hitching arrangement at the rear of the car (Fig. 1).

Each wheel is suspended in a swinging arm frame (Fig. 2) which pivots from two brackets on the backbone (Figs. 3 and 4). A bracket is fashioned from a 6in. length of steel channel 1¼in. × 2⅜in. × 1¼in. with a web thickness of ¼in. Start by marking out the two 1in. radii and then drill a series of ¼in. dia. holes inside the line marked, a sharp blow with a hammer will knock out the piece of metal. File smooth the resulting ragged edge.

The recess at each end of the channel is removed in the same way. The next step is to drill all the holes shown in Fig. 5. Special care is required to ensure that the 5/16in. dia. holes for the pivot bolts are in line. The lugs are rounded off with a hacksaw and file. The two completed brackets are now welded on to the backbone tube as shown in Fig. 3. They should be held in position accurately by the ¼in. dia. bolts, making sure that the brackets are in line with each other. Angle iron 1½in. × 1½in. × 3/16in. is employed to make the two wheel carriers. see Figs. 2 and 6.

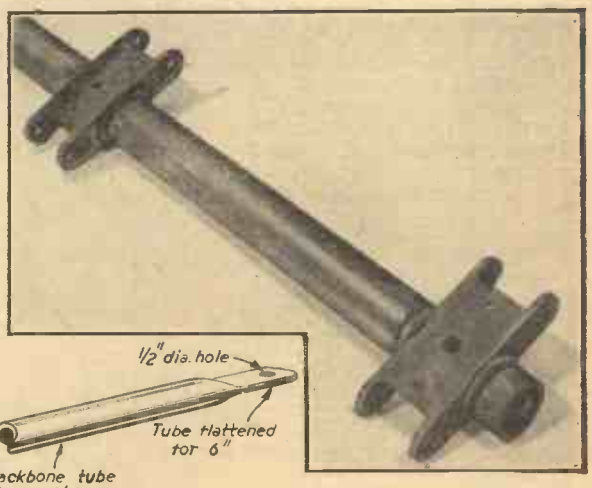


Fig. 3.—(Above) The completed brackets welded to the backbone tube

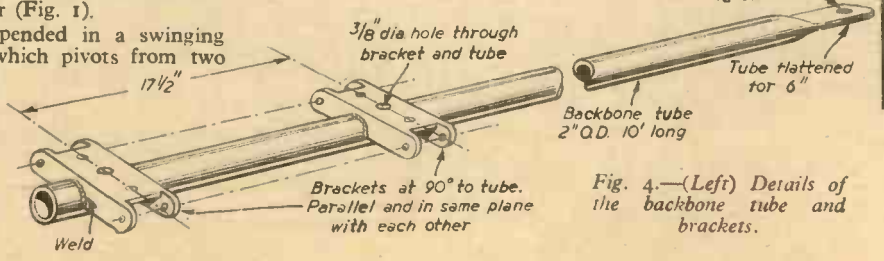


Fig. 4.—(Left) Details of the backbone tube and brackets.

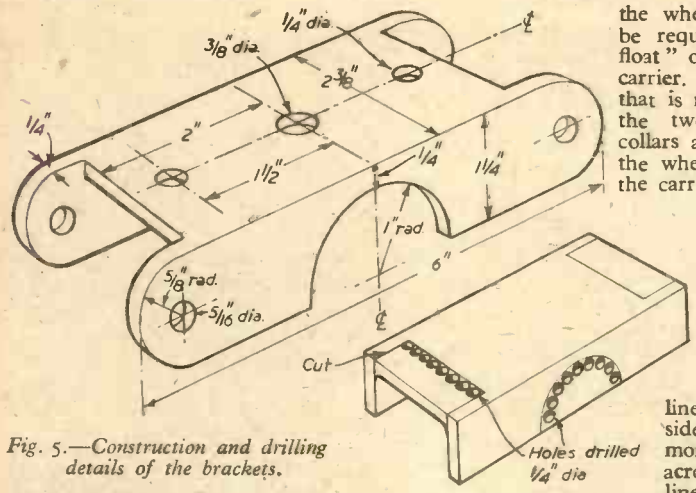


Fig. 5.—Construction and drilling details of the brackets.

Outside Frame

From a 6ft. length of angle iron, bend the outside frame. By making a saw-cut across one flange, the angle iron can be bent to a right angle quite easily. Small triangular-shaped pieces of metal are welded in the opening of the flanges at the corners making the frame rigid. A 14in. length of angle iron is welded in place to form the inner bearing of the wheel axle. Arrange the 1in. dia. hole so that the periphery of the axle will bear on the underside of the flange of the angle.

Pivot Points

The four pivot points (two to each carrier), are made by utilising car valve guides. They are the cast iron type, ⅜in. o.d. 5/16in. bore dia., cut to 1⅞in. long.

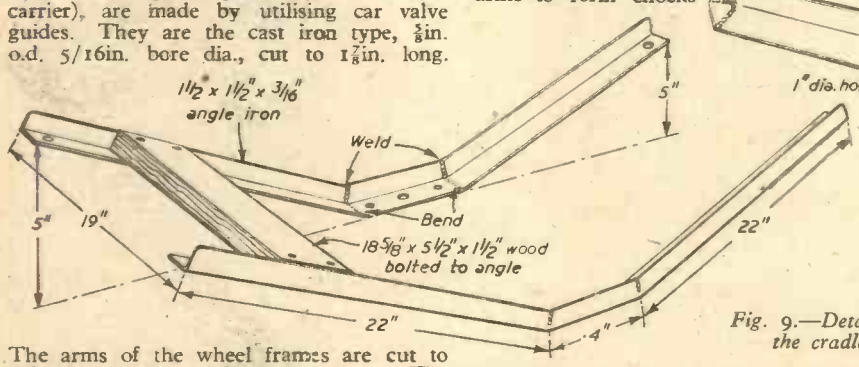


Fig. 9.—Details of the cradle.

The arms of the wheel frames are cut to 28in. long, measured from the corners The vertical side of the angle is cut away for 2in. from the end and the tongue that remains is then wrapped tightly round the centrally placed valve guide and welded to form an eye. Use 3in. × 5/16in. high tensile steel bolts with lock nuts for the pivot pins (see Fig. 7).

Wheels

Pnuematic tyred wheels, 14in. × 3in. with 1in. dia. roller bearings are used (Fig. 8). They are located on the 5½in. × 1in. dia. axle by collars set-screwed to the axle each side of the wheel hub. Washers may be required to take up "end float" of the axle in the wheel carrier. To change a wheel all that is necessary is to slack off the two set screws in the collars and draw out the axle, the wheel will then be free of the carrier.

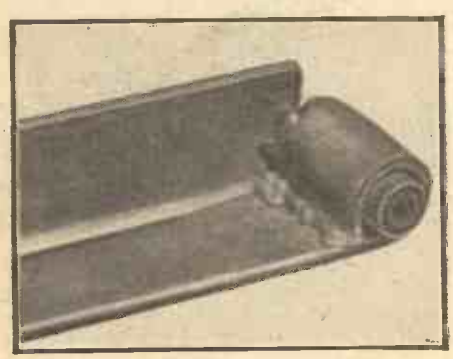


Fig. 7.—The pivot point.

Cradle and Chocks

The cradle is made up of two lengths of 1½in. × 1½in. × 3/16in. angle iron. See Fig. 9.

On a 48in. length of angle iron, draw a line in the centre; 2in. each side of this line make two more. Vee cuts are made across the flange on these lines. The angle iron is then bent so the vee cuts close up and then welded. Make the vee cuts ⅛in. wide at the top so the ends of the cradle are raised by 5in. The three holes in the centre correspond with the three holes in the top of the pivot brackets. A 3in. × ⅜in. bolt passes through the centre hole in each arm of the cradle, through the pivot brackets and through the backbone tube, being locked by nut and lock washers. Two pieces of timber 18⅝in. × 5½in. × 1½in. are bolted between the cradle arms to form chocks on which the bilge keels rest. They can be lightly padded and covered with canvas (Fig. 10). The exact position of these chocks along the cradle arms depends on the location of the bilge keels of the boat. A central piece of wood 18⅝in. × 4in. × 1½in., on which the keel rests, is also bolted to the cradle, but before fixing in position place a 4in. length of 1¼in. square timber under the rear end to tilt the plank forward slightly, to compensate for the curve of the keel. It may be necessary to do the same with the bilge chocks. Most of the weight of the boat is taken by the central piece of wood in the cradle. The ¼in. dia. bolts holding this piece pass through the pivot brackets each side of the ⅜in. dia. central bolt.

Springs

Road wheel springing of the trailer is achieved by the use of four coil springs 8in. long × 2in. dia. comprising about 13 coils of ¼in. dia. wire bolted between the

Fig. 8.—Pneumatic tyred wheels are used.

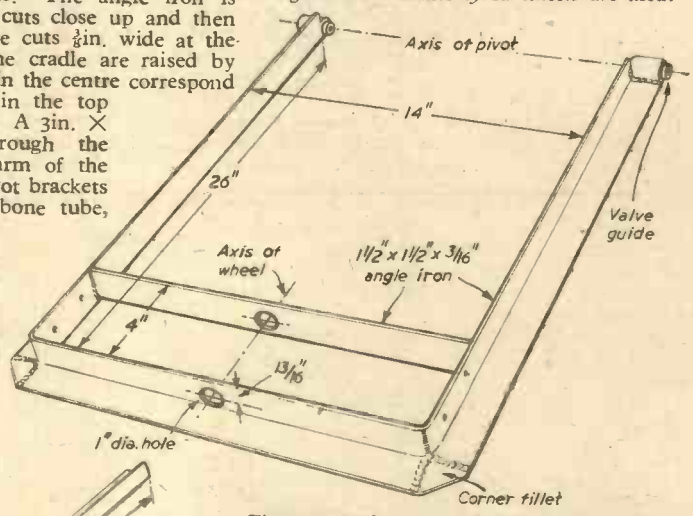


Fig. 6.—Angle iron to the above dimensions is employed to make the swinging arm frames.

pivoted wheel carriers and the cradle which is rigidly fixed to the backbone. The springs are held by 1½in. × ½in. dia. bolts. Drill ½in. dia. holes 21in. from the pivot points along the wheel carrier arms on the horizontal web of the angle iron, for the bottom fixture of the springs. Holes ½in. dia. drilled 1in. from the outer ends of the cradle arms, take the top bolts of the springs. When the trailer is loaded the wheel carrier arms should be almost horizontal. Fig. 10 shows the desired position.

The Mudguards

These are made from 5in. wide strips of 18g. aluminium 27in. long. At each corner pieces 1½in. × ½in. are cut out, the strip is then bent to a curve and the ends are tucked down in the wheel carrier frame and held by two ⅛in. dia. bolts each end. These

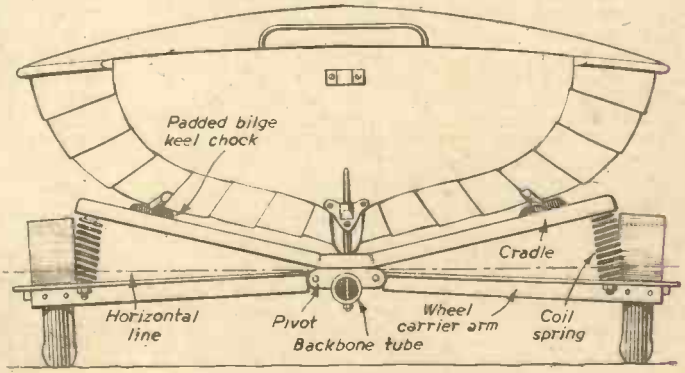


Fig. 10.—The loaded trailer.

LIST OF MATERIALS

10ft. of 2in. o.d. tube.
14ft. of 1½in. × 1½in. x 3/16in. angle iron.
1ft. of 1½in. × 2⅜in. × 1½in. channel.
4 8in. × 2in. dia. coil springs.
2 14in. × 3in. pneumatic wheels.
2 5½in. × 1in. dia. axles.
4 collars.
27in. × 10in. 18g. aluminium.
5ft. of 1½in. × ⅛in. strap iron.
1 3in. × 4in. × ¼in. mild steel plate.
4 car valve guides.
18in. of 1¼in. o.d. tubing.
4ft. of 5in. × 1½in. timber.
2ft. of 4in. × 1½in. timber.
6ft. of 2in. × 1½in. oak.
3 90in. × 2in. webbing straps.

mudguards are shown in Figs. 10 and 11. The forward chock is mounted on the backbone about 6ft. from the rear. A mild steel plate 4in. × 3in. × ¼in. is drilled to take two ⅜in. dia. c/s bolts and placed with the 4in. side across the backbone tube and held securely by the two bolts. A wood block 4in. × 3in. × 5in. high is mounted on the plate and held by four coach bolts. A deep vee cut is made on top to locate the keel (Fig. 12).

The Mast Support

This is a length of 2in. × 1½in. oak fixed in a vertical position to the backbone by a length of 1½in. × ⅛in. iron strap bent in U-form and attached to the backbone tube by a single horizontal nut and bolt. The strap is then screwed or bolted firmly each side of the timber. To give extra support, two pieces of strap iron are bolted diagonally from the backbone tube to the mast support just above the end of the U-shaped bracket (Fig. 13). The crutch is made by two pieces of strap iron bent to shape and screwed each side of the timber (see Fig. 13 (A)). The ½in. dia. holes at the end of each prong of the crutch are useful for passing rope through to hold the mast firmly. Line the inside of the crutch with a strip of thick felt. Manœvring handles are made from an 18in. length of 1⅛in. dia. light gauge tubing. It is placed centrally behind the mast support and under the two diagonal supporting straps and held by a single nut and bolt (see Fig. 13 (B)).

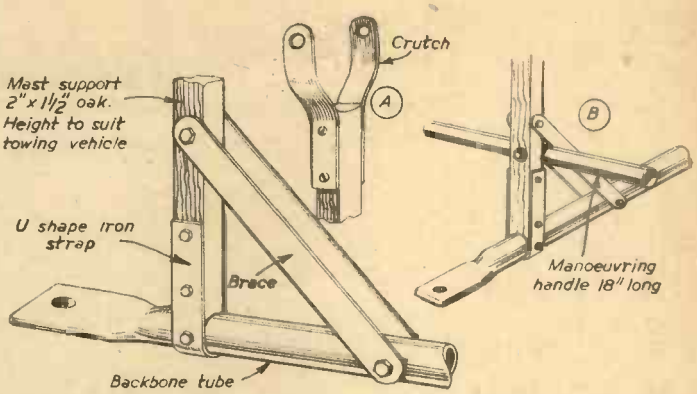


Fig. 13.—Details of the mast support, crutch and manœuvring handle.

To hold the boat securely to the trailer two webbing straps 7ft. 6in. long × 2in. wide with buckles are fastened to the underside of the timber forming the bilge chocks and passed over the boat and buckled to two short lengths of similar webbing which are attached to the opposite chock. At the forward end a webbing strap is passed over the bows and under the backbone tube and secured with a buckle.

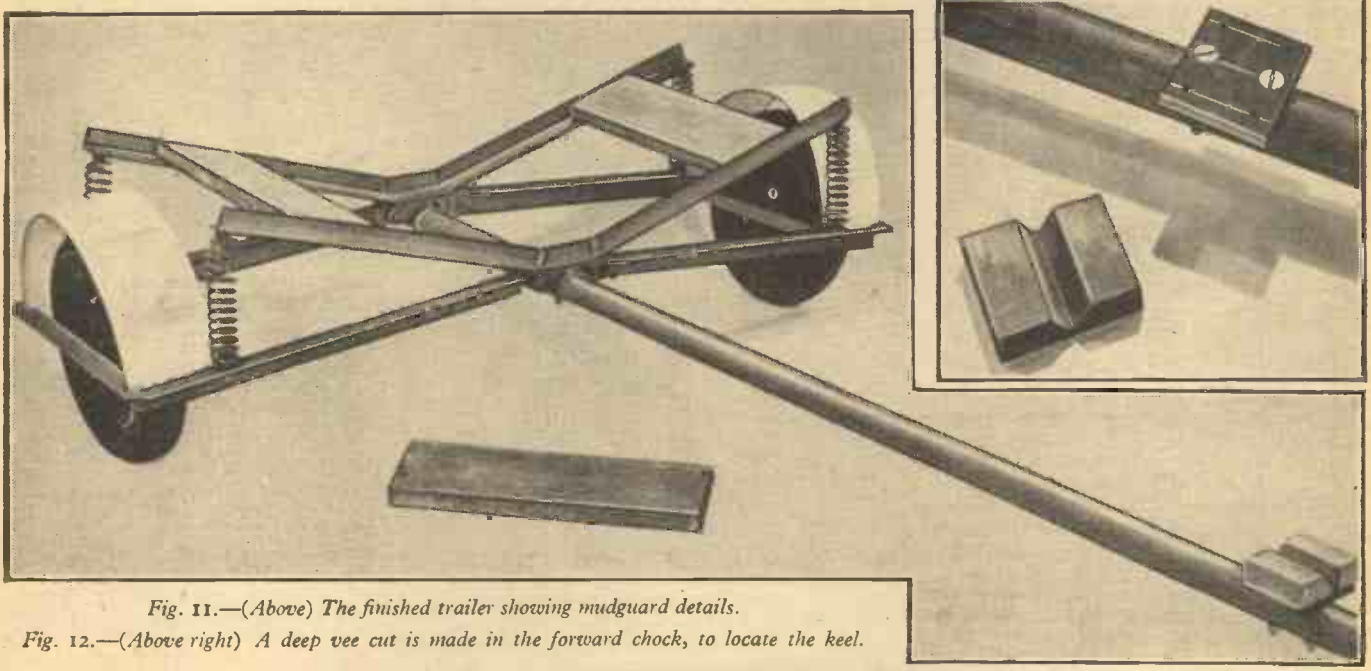


Fig. 11.—(Above) The finished trailer showing mudguard details.

Fig. 12.—(Above right) A deep vee cut is made in the forward chock, to locate the keel.

Bicycle with a New Shape

SCOO-PED is the name given to a revolutionary type of bicycle designed on the lines of a scooter and which has a reinforced fibreglass body. It is being launched by Elswick-Hopper Cycle and Motor Co. Ltd., of Barton-on-Humber, Lincs.

The fibreglass covers the frame, the gears, the forks, the chain and half of the wheels. The rider is thus protected from oil, grease and dirt. The fibreglass front legshields afford protection from the weather, road dust and spray from vehicles in front, etc. A special prop stand enables it to be parked upright just like a scooter or motor cycle.

It is practically impossible to fall off the Scoo-Ped. The machine has a very low centre of gravity and because the saddle is adjustable, both children and adults can place both feet on the ground whilst still in a sitting position. This is a great safety factor when performing emergency stops and waiting at traffic lights.

The cycle has a specially built 20in. frame made of high grade steel tubing. The sprung saddle is in silver grey, trimmed with contrasting material. The fibreglass body is finished in pearl grey, hand-lined in gold. The fibreglass itself is pliable, non-splintering and extremely durable.

The weight is 46lb. 12oz. and the price is 33 guineas.

The new Scoo-Ped.

Making a Marionette

C. C. Somerville Describes How to Make a Wooden Puppet

Fig. 1.—A puppet's character depends on the head and clothing, as can be seen from this completed marionette.

EVEN to the most uninitiated the stringed marionette is the highest form of puppetry and the heights of imagination, fantasy and caricature to which the marionette can rise are far above those possible in other forms.

Marionettes are, by definition, "jointed figures controlled from above by wires or strings"; they may vary in size from a few inches to several feet, but the most practical are between 12in. and 24in. high. There are many ways of making marionettes, limited only by the skill, materials and patience at the disposal of the puppeteer.

The puppet described here is 24in. high and is made entirely from wood. It has been so designed that, though requiring no specialised knowledge, it gives a high degree of satisfaction when carefully made. The sizes given are only suggestions and can be altered to give a larger or smaller puppet, provided the proportions are unaltered. The puppet's character, of course, is largely dependent on the head and clothing, as can be seen from Fig. 1, but the same basic construction is employed in every case.

The Body

Fig. 2 shows the body and legs which are made from ordinary 2in. × 4in. yellow pine or other soft wood. The design has been simplified so that all cuts can be made with a small coping saw and rounded off with rasp and sandpaper.

The torso (a) is joined to the pelvis (b) at the centre by a cord, leather thong or bootlace. The legs are attached to the pelvis by a strip of leather (c) which is glued into sawcuts made in the upper leg and lower pelvis.

The knee joint shown (d) is a limited tongue and groove joint. This is shown in detail in Fig. 3, and will require extra care to ensure free movement with no back bend.

A more simple joint could be devised but this would not give the same realism to the walking movement.

The ankle joint is a tongue pivoted on a panel pin within a slot cut into the foot (Fig. 3). This tongue may be eliminated and a large screw eye can take its place.

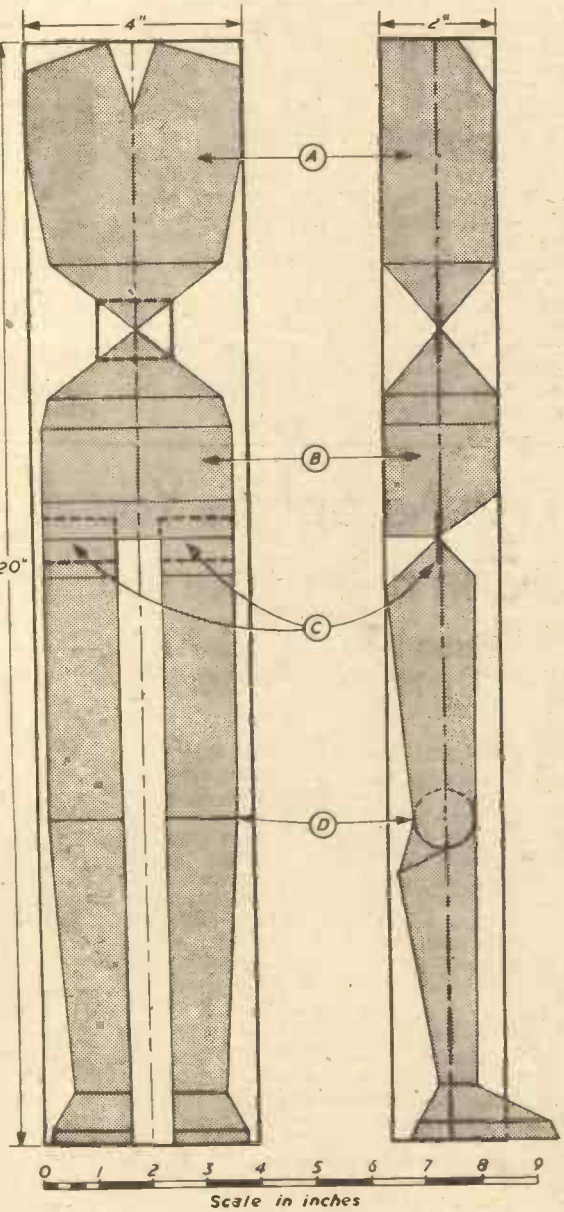


Fig. 2.—Details of the body and legs.

The Arms

Two 4in. pieces of ½in. dowel are cut for each arm. These are joined by interlocking screw eyes to form the elbow joint. The arm is attached at the shoulder by a screw eye in the dowel linked to a staple driven into the torso (Fig. 3).

Many methods are available for making the hands. One way is to draw the shape of an open hand on to a piece of ½in. plywood, carefully cut out with a fret-saw and then round off the fingers with a rasp. A small gouge is used to hollow out the palm and the whole hand is smoothed with glasspaper.

The Head

The basic head shape, a sphere or egg, is turned on a lathe from soft pine, redwood, or any other moderately soft wood. The piece of wood chosen for the head should be 3in. dia. after having been turned. The neck is 1in. long and can be turned as part of the head or it may be a dowel rod glued into the head later. Should you have no facilities for wood turning, there are on the market wooden balls of various sizes, the 3in. ones being ideal. These can be had from most handicraft stores and are sold

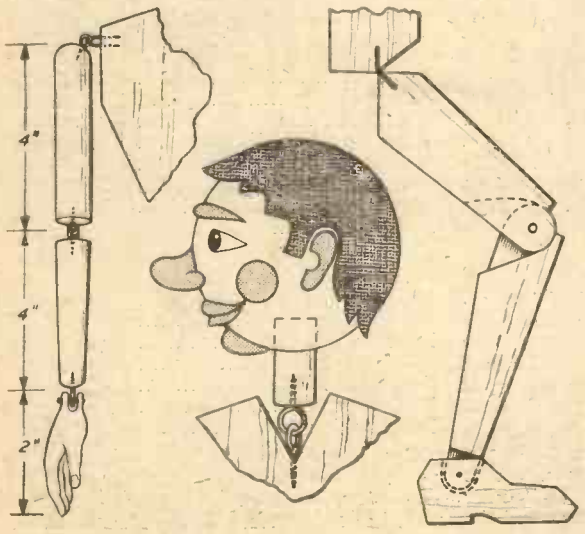


Fig. 3.—Details of the knee, ankle, arm and head joints.

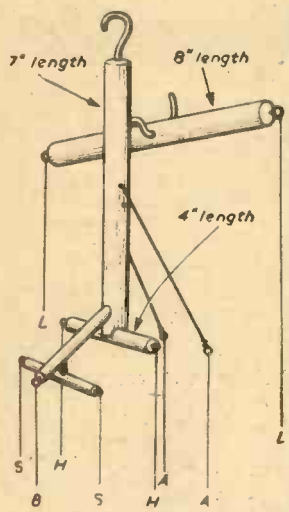


Fig. 4.—Construction of the control and string details.

for making contemporary table lamps.

The nose and ears can be cut from wood and glued on, or they can be modelled in plastic wood or a mixture of sawdust and glue. Depressions for the eyes, or some flattening of the cheeks can be easily done with a file and gives better characterisation. Felt, wool or string makes very good hair. Details of a typical head are shown in Fig. 3.

When painting the head use good bright colouring. Poster colours or oil colours can be used. A good coat of matt white is helpful in providing a groundwork for your painting. Paint boldly and avoid small detail, always remember that the paint on a puppet serves the same purpose as make-up on the actor. Remember to paint the neck, for when you come to dress the puppet you may find that the neck shows well above the collar.

The Control

The strings run from the puppet to a wooden contraption held in the operator's hand. This is known as the "control," "crutch" or "perch." The shape of this control and the position of the strings upon it are of the utmost importance; a good control is half the battle in the successful manipulation of the puppet.

A good perch is the "English Upright" (Fig. 4). This is constructed from scrap dowel roughly to the sizes given. The arm wires (A) are 3/32in. brass rod and are 6in. long. The head strings (H) must first be attached to screw eyes just above the puppet's ears. These are lengthened or shortened, according to the operator's height, to bring the control level with his chest when the puppet just touches the the floor. No. 18 carpet thread is a very suitable medium for stringing.

The shoulder strings (S) are attached to points just behind the puppet's shoulders, they must be just taut when the puppet is hanging from his head strings. String (B) goes to the lower back and strings (A) to holes drilled through the puppet's hands.

The leg strings (L) must be attached to tiny brass screw eyes set just above the knee of the puppet. The leg bar is removed from the cup hook on the control in order to walk the puppet, so care must be taken to allow just enough slack in these strings.

Dressing

Once the length and position of the strings have been determined the strings are removed in order to dress the puppet. Thin materials must be used so as not to hinder the movement of the joints. It is often policy to glue the garments on to the puppet as this seems to give better results than trying to fit stitched clothes. Keep the dress loose and simple with no buttons to catch the strings.

Manipulation

Realistic manipulation can only come with experiment and practice. The control is held in the left hand as shown (Fig. 5). The forefinger and thumb move the wires which control the hand and arm movements. By tilting the control from side to side a variety of head movements can be obtained. The bowing motion is very easily achieved by tilting the control forward.

The detachable leg bar is held in the right hand and rocked from side to side to obtain a walking movement. This movement is the most difficult, but once the rhythm is appreciated then it becomes easy.

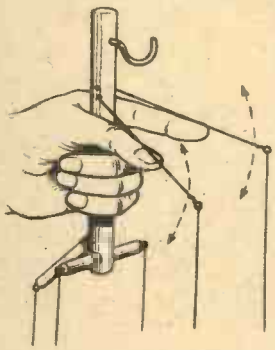


Fig. 5.—How the control is operated.

At first the puppet will be difficult to manage, but once the feeling of balance has been obtained you will find a whole variety of amusing and realistic movements possible.

An Aeroplane You Can Build Yourself

Plans for the Luton L.A.5 Major, Cost £20

The Luton L.A.5 Major in flight.

THE Luton L.A.5 Major is a high wing cabin monoplane of wooden construction. The wings fold back along the fuselage for ease of storage.

Originally designed and flown in 1939 and now brought up to date, this new aircraft may be purchased ready to fly or as a set of "do-it-yourself" plans for the enthusiast to construct. Like its single-seat sister the Luton Minor, the Major is a very simple machine to make and maintain and is capable of being built by the average handyman.

Construction

The aircraft is of robust and straightforward wooden construction. Simple two spar wings with ply-covered leading edge are braced with streamlined steel lift struts. The sturdy undercarriage is fitted with wheel brakes and steerable tail-wheel to facilitate operation from either grass or runway.

The airframe may be built for as little as £200 and, allowing about £300 for the engine, the plane can be completed for £500. All components and fittings may be obtained, if desired, ready for assembly.

Engine

Any engine between 60 and 90 h.p. may be fitted, such as the Mikron II and III, the Agusta G.A. 70/0, the Continental A-65, Porsche and Pobjoy. With a fuel consumption of less than five gallons of petrol per hour, the aircraft is extremely economical to operate. Fitted with full dual control, it is suitable for flying instruction, club operation, air touring and the week-end flyer who wants to own his own aeroplane. Costing no more than a good motor car, it will fly at over 100 m.p.h. and can land safely at 35 m.p.h. in a space no longer than the width of a football pitch. The Major does not need an aerodrome to fly from. Any field 150 yards long is good enough.

Interior Details

Pilot and passenger (or pupil and instructor) sit one behind the other in the roomy cabin. All-round visibility is provided by ample windows. Entry is gained by two large doors and a luggage compartment is provided to accommodate hand baggage.

The makers will, upon request, send a qualified representative to advise and help the home-builder who needs guidance. The completed aircraft is inspected by the Popular Flying Association who then recommend the Ministry of Transport and Civil Aviation to issue a permit to fly.

Specification	
Span	35ft. 2in.
Span (folded)	11ft. 8in.
Length	23ft. 9in.
Wing area	163 sq. ft.
Weight (empty)	600lb.
Weight (all-up)	1,030lb.
Useful load	430lb.
Fuel capacity	11 galls.
Performance	
Max. speed	105 m.p.h.
Cruising speed	95 m.p.h.
Stalling speed	35 m.p.h.
Initial climb	700ft./min.
Climb to 3,000ft.	6½ min.
Range (still air)	300 miles
Take-off run	80 yards
Landing run	50 yards

Sets of plans cost £20 which includes one year's subscription to the Popular Flying Association.

Phoenix Aircraft Ltd., Cranleigh, Surrey, will be glad to furnish further details upon request.

Home Made Musical Instruments

F. Hook Continues Constructional Details for Making Bamboo Pipes

(*Continued from page 186, January issue.*)

FILL the bottom end of the tube with a small rim of plastic wood, as indicated in Fig. 26. Alternatively, a small segment of cork may be glued in with balsa cement, as shown in Fig. 27. When these insertions are dry they may be gradually pared away to raise the pitch up once more to the correct note. These small pieces inserted in the end of the pipe will, in the main, only affect the lowest or fundamental note of the pipe.

Making the Finger Holes

There are six holes on the front of the pipe in line with the mouthpiece opening. Commence with the lowest hole which is centred at a quarter of the distance from the bottom

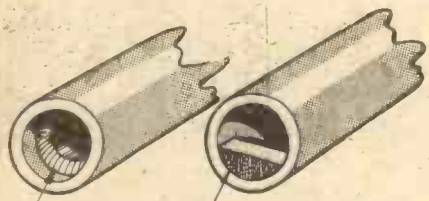


Fig. 26.—(Left) Fill the bottom end of the tube with a rim of plastic wood. *Fig. 27.—(Right) Alternatively cork may be used.*

end of the pipe and the mouthpiece opening. As shown in Fig. 28 this will be 2¾in. Drill a hole 3/16in. dia. Test the note with the piano. It will probably be flat. To sharpen the note gradually enlarge the hole with the penknife with the ground-away blade, already mentioned. Pare the bamboo in four directions as suggested in Fig. 29, i.e., with the grain in each direction and a smooth finish will result. Removal of wood from the side of the hole nearest to the mouthpiece will sharpen the pitch quicker. Aim to get a finished hole about ¼in. dia. when correctly in tune.

The first three holes should be thoroughly tested before passing on to the top three holes. Tune the first hole to E, the second to F sharp and the third to G.

The top three holes are all spaced ⅞in. apart and are tuned to A, B and C sharp respectively.

Opposite the top finger hole, but ¼in. lower on the back of the tube, the final hole is drilled. When this hole and all the remaining holes are uncovered the note should be D, an octave above the fundamental note given when all holes are covered.

A small harmonium, if in good tune, is a very useful accessory with which to tune these instruments. By wedging down the note required and using the foot to operate the bellows a steady continuous note may be produced, thus leaving the hands free to enlarge the holes a little at a time and test continuously until the note required is accurately in tune.

It should be noted that as bamboo is a natural material, no two bores of the tubes are identical. It is quite possible, therefore, that, due to these variations, the overall length of each instrument will not be exactly

Fig. 29.—Pare the bamboo in these four directions.

the same when tuned to the fundamental note. The narrower the bore the longer the tube will have to be, and *vice versa*. Thus, although an overall length of 10½in. is shown in Fig. 28 this will be by no means the same for every instrument. It is for this reason that the first hole is specified at the quarter distance.

Playing the Instrument

A certain delicacy is required in the blowing of bamboo pipes. This blowing should be effortless at all times and the air stream should pass steadily and smoothly into the pipe. Only in this way will a pure, clear and even tone be produced.

The air stream is controlled by a process known as tonguing. The note is attacked by placing the tip of the tongue at the back of the top teeth and then pronouncing the sound "Teu." At the same time let the stream of air proceed out between the lips and thus produce the note. To cut off the air stream return the tongue to the first position and the flow of air ceases.

The correct fingering of all notes of the scale of D major, including all accidentals, is shown in Fig. 30.

Adjustments to the Tuning of the Pipe

Atmospheric conditions seem to affect the general pitch of these pipes as is the case with most other instruments. These day to day variations may be corrected by the use of the small peg holes drilled near the mouthpiece. Should the scale be slightly sharp, one or more of the holes should be lightly plugged with a piece of pointed matchstick. If, on the other hand the instrument is flat then the reverse process is taken and one or more plugs are removed. It may be necessary even to drill an extra tuning hole. When,

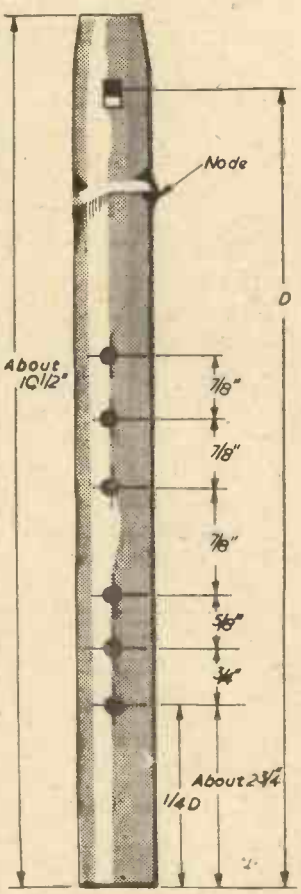


Fig. 28.—Finger holes for the treble pipe.

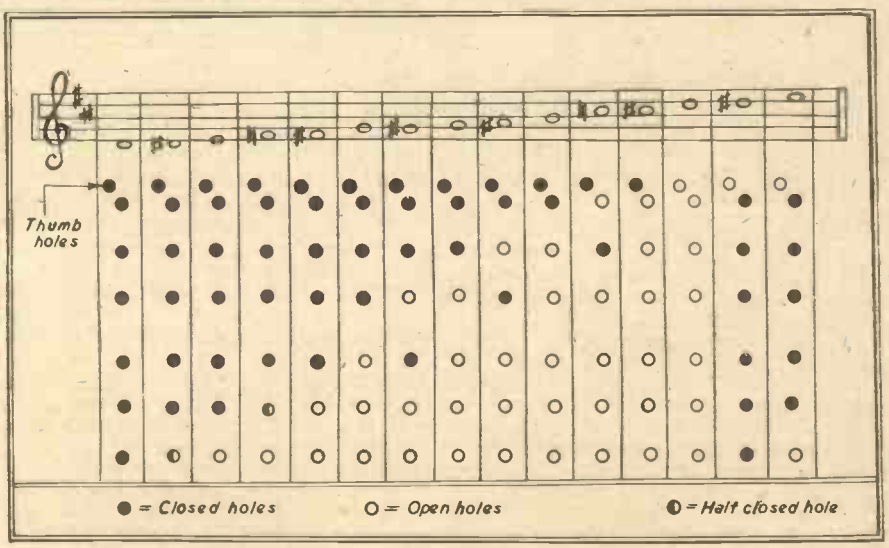


Fig. 30.—Fingering for the treble pipe.

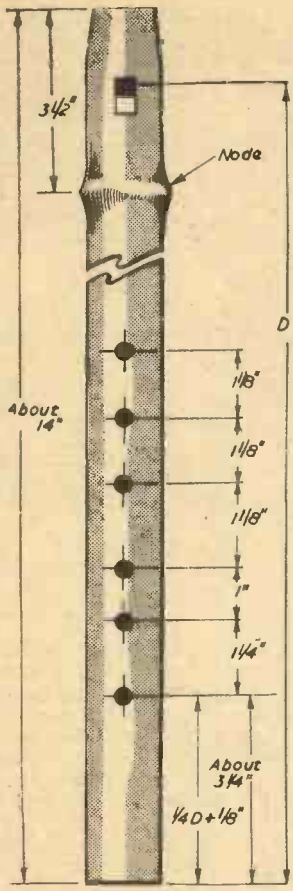


Fig. 31.—Finger holes for the alto pipe.

in the case of a pipe being sharp, all the peg holes have been filled and the instrument is still sharp—not a very frequent occurrence—a small metal band is slipped over the tube and pushed down the tube to overlap slightly the top of the rectangular opening from which the air escapes. This is shown in Fig. 25. A disadvantage of this remedy is that if the top of the hole is shaded too much the tone of the instrument will be seriously impaired.

Care of Bamboo Pipes

When not in use keep the pipe from extremes of temperature. At all costs avoid a dry, warm atmosphere.

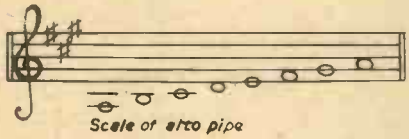


Fig. 32.—Tune the alto pipe to the scale of A major.

The bamboo wood may be left in its natural state apart from a light rubbing down with glasspaper. Wax may be applied if a natural finish is required.

To avoid the absorption of moisture inside the bore, the cork mouthpiece may be removed and the bore given a light dressing of boiled linseed oil with a small wad of cotton waste soaked in the oil. Remove the surplus oil by pushing through a piece of dry cotton waste before replacing the cork.

At all times keep the wind way clear of dust and other foreign matter. Be sure that the size of the holes has not been slightly altered if the instrument is painted.

An Alto Bamboo Pipe

There is a wide library of music aranged for the simple treble pipe already described. It is suggested that the reader should write to both W. Paxton & Co. Ltd., Dean Street, London and J.B. Cramer & Co. Ltd., 136, New Bond Street, London who will send a list of such publications. As with other instruments, greater pleasure can be had by playing in groups. For this purpose other instruments are required to play lower parts. Such pipes are the alto and tenor. The method of making these instruments is exactly the same as for the treble pipe except that measurements are different. The alto pipe is pitched in the key of A, an interval of a fourth below the treble and the tenor pipe is pitched an octave below the treble.

The materials required are a piece of bamboo tube 16in. long and with bore ⅝in. and a cork to fit tightly into the tube.

Construction

Select the tube so that the joint or node of the bamboo will be approximately 3½in. from the mouthpiece of the tube. Clear out the obstruction at the joint with the auger bit and remove all dust and pith from the bore.

Saw the mouthpiece as for the treble pipe, making the cut across the bore ⅜in. from the end. The wind-way opening is drilled 1⅛in. from the end of the end of the tube with a 3/16in. drill. Open out this hole to ¼in. square. The wind-way on the inside of the tube is 5/16in. wide at the end and narrowing down to the width of the square opening.

Next shave away the bottom side of the squared opening to a distance of ¼in. Do not make the edge sharp, but slightly blunt.

Fit a cork tightly in the mouthpiece to the top of the opening. On the cork file a "flat" ¼in. at the lower end and widening to ⅜in. at the end. Trim off unnecessary length of cork and file off the slope to fit the lips.

Before proceeding to tune the pipe, drill three 1/16in. tuning holes in the side of the instrument between 2in. and 2½in. from the extreme end of the tube.

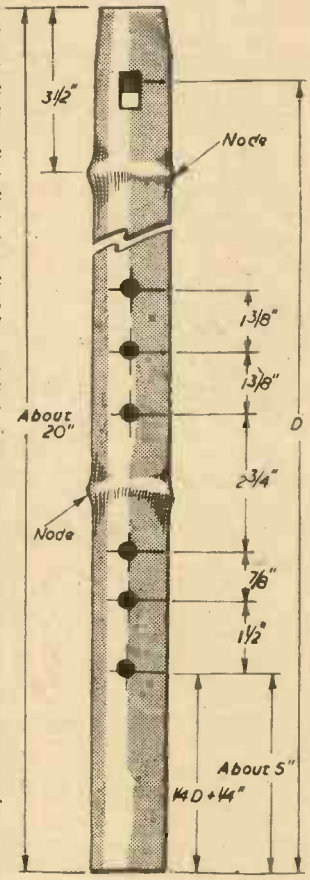


Fig. 33.—Finger holes for the tenor pipe.

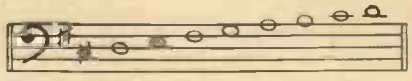


Fig. 34.—The tenor pipe should be tuned to scale of the bass clef.

Making the Finger Holes

The fundamental note of this instrument is A above middle C on the piano. Saw off pieces from the bottom end until this note is obtained.

The position of the first finger hole is calculated as explained for the treble pipe except that ⅛in. is added to the ¼ distance. See Fig. 31.

Drill the finger holes one at a time and tune to the scale of A major as shown in Fig. 32. If for reasons of varying size of bore in the bamboo the holes tend to become larger as work proceeds up the pipe increase the distance between the centres of the holes slightly. The thumb hole is placed exactly opposite the top front hole on the back of the tube.

A Tenor Bamboo Pipe

The materials required are a piece of bamboo tubing 21in. long with a bore of about 1⅛in. to 1¼in. dia. and a cork to fit the end of the tube tightly.

Construction

Select a piece of tubing with a node at a distance of about 3½in. from the mouthpiece end. There will probably be more than one joint in a length of 21in. so clear both obstructions with the auger bit.

The first cut across the tube for the mouthpiece is ⅜in. from the end. The opening for the mouthpiece is centred 1½in. from the end and is made ¼in. square. The wind-way inside the tube is 7/16in. wide narrowing down to the width of the opening. On the outside of the pipe the lower edge of the opening is sloped away for a distance of ⅜in. and the top edge can be quite sharp for this instrument.

Fit the mouthpiece cork in the usual way and make the "flat" ⅛in. wide at the narrow end widening out to ⅜in.

Tuning the Tenor Pipe

The scale of this pipe (shown in Fig. 33) is an octave below the treble and the music for it is written in the bass clef as can be seen in Fig. 34 which shows the scale of the instrument.

Three tuning holes in the side of the tube are drilled between 2½in and 3in. from the end of the tube, each 3/32in. dia. Tune to the fundamental note of D.

The first finger hole is positioned the usual quarter distance plus ½in. in this case. Place the remaining holes at the distances shown in Fig. 33. Should the first finger hole tend to be rather large, move up the centres of all the other holes between ⅛in. and ¼in. The thumb hole is placed at the back of the instrument but ½in. higher than the top front hole.

A Soprano Bamboo Pipe

The soprano pipe is a very suitable instrument for the young player to learn on. Due to its short length the holes are small and closely spaced.

The materials required are a piece of bamboo about 8½in. long and bore between ⅜in. and ½in. and a cork to fit tightly.

Construction

Make the first cross cut ⅜in. from the mouthpiece end. The opening is centred 1in. from the end and is opened out to be 3/16in. wide and 5/32in.

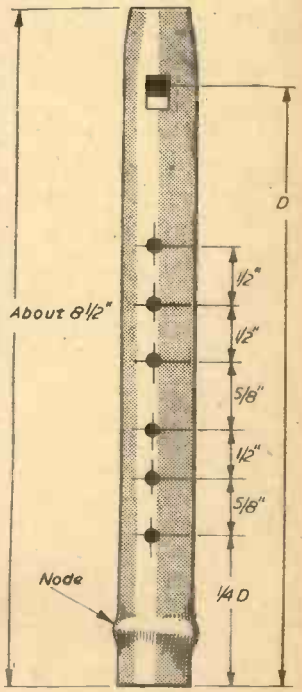


Fig. 35.—Finger holes for the soprano pipe.

(Concluded on page 238)

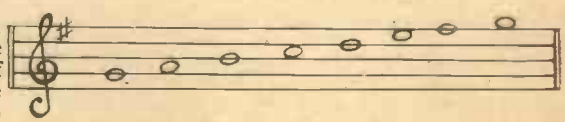


Fig. 36.—Scale of the soprano pipe.

BELLOWS CONSTRUCTION

By G. I. Lilley

They Can Be Made Quite Easily at Home

CAMERAS and enlargers should, where possible, be designed to take square type bellows, for not only are these easier to make, they also lend themselves more readily to perfect folding by hand methods.

Materials Used

Leather may be used for small bellows but larger sizes are generally made of a special leather cloth which, together with the black lining material, is perfectly light-tight. A suitable adhesive for sticking in the lining is "Boscotex 5S." Being non-tacky this spreads well and as it is not a quick-drying adhesive it gives plenty of time to work.

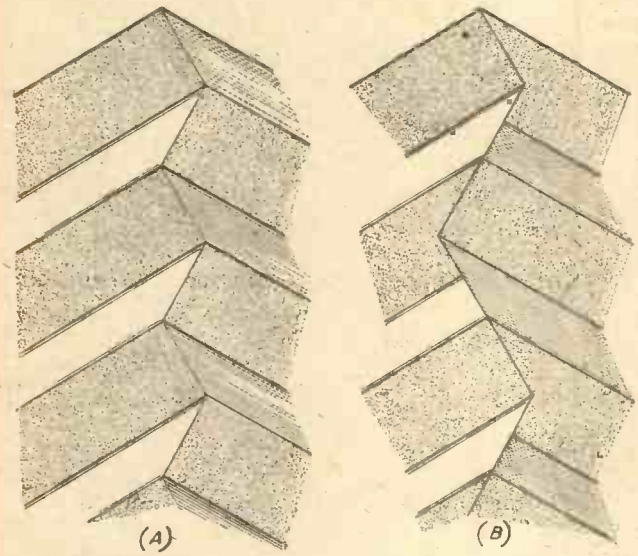


Fig. 1 (A).—Type of bellows most commonly seen; (B) An older type still in use on some cameras, etc.

There are two methods of folding bellows, as shown in Fig. 1. Type A is generally used to-day and is much neater in appearance. Since there are a lesser number of folds per section at the corners, this style is likely to be the more durable of the two.

Marking Out

Fig. 2 shows the lay-out of both square and taper type bellows. Great care must be taken in marking out the segments for taper bellows, since if these are not perfectly symmetrical correct alignment will be difficult to achieve.

When the leather cloth has been cut to shape five strips of thin black paper are cemented to it in the positions indicated by the dotted lines. These provide stiffening for the sides, the corners being left free for the extra suppleness required there. The width left between the dotted lines, which represents that amount of the cloth taken up by the corners, is equal to the width between the folds (Fig. 3). If 5S adhesive is used, it is only necessary to apply this to one surface, preferably the paper in this case, and the two may be pressed together immediately. A squeegee may be used with advantage for this process. When the adhesive has set the whole should be covered with a plain black cotton lining material, the adhesive being applied, as before, to the paper surface, and not the lining. Care must be taken at this stage to ensure that the corner zones are well covered with adhesive.

The Seam

A little attention may be given at this stage to the lay-out for the seam. It will be noticed in Fig. 2 that this is made to fall in the centre of a side, rather than at a corner. Now if the assembly in its present state were simply overlapped at the seam it would be found that the double thickness would not allow the finished bellows to close very compactly, therefore it is better to sandwich the paper stiffening, which should be butted rather than overlapped, as shown in Fig. 4. It is necessary, then, to leave a margin of both leather cloth and lining cloth along one edge, whereas the other edge may be cut flush.

Before the seam is joined it is necessary to put in the sectional folds, although the corner folds need not be marked at all; these will take their place quite naturally afterwards.

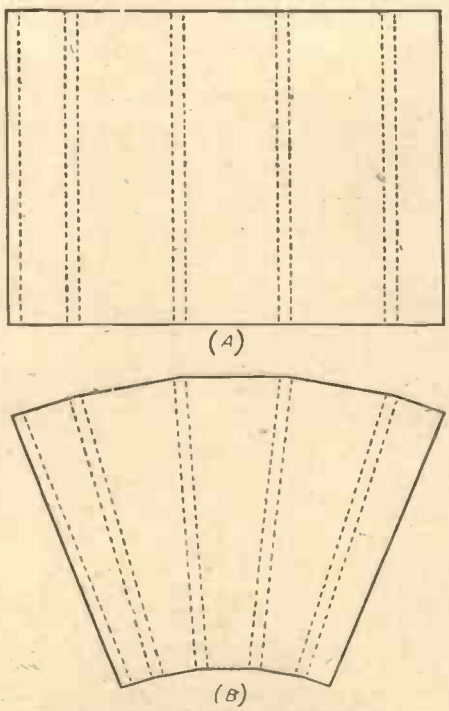


Fig. 2.—Marking out the bellows.

Folding

An effective method of folding is shown in Fig. 5. A straight piece of wood is held firmly against each line in turn and the cloth is folded upwards, the leather-cloth side being down. All the folds are made in this way, no account being taken of "inside" or "outside" folds in the finished bellows. For the "inside" folds the existing fold will be reversed after the seam has been joined. In the case of the taper style this operation is obviously more difficult and will require considerably more time, since the folds cannot be made straight across the cloth.

After the folds have been made the seam can be joined and the final folding of the corners may commence. Fig. 6 shows the inside folds being made with the aid of a rule. Working with one hand inside the bellows each alternate fold is pushed in and folded around the rule. Rather than work along one side it is better to work around all four sides together, putting in about three or four folds in each at a time. Note that the inside folds on any two adjacent sides are not in line but are interspaced.

Corner Folds

As work proceeds the corner folds will

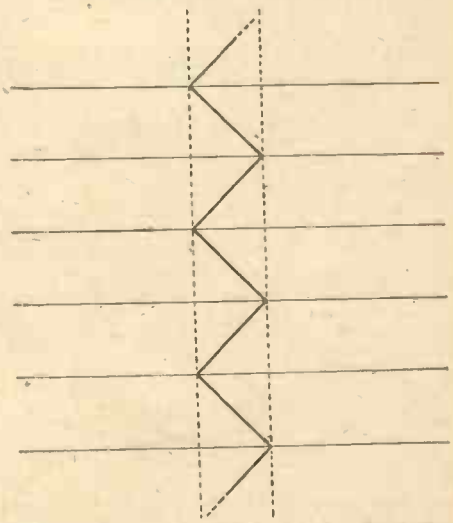


Fig. 3.—Determining the width of the corners.

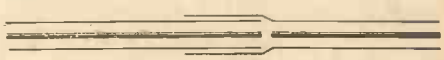


Fig. 4.—Details of the seam.

begin to take shape and may be given a little assistance with the finger and thumb of each hand, working with both hands outside. The importance of evenly spaced folds will be appreciated at this stage, for any variation in this respect will produce distorted corner folds.

When folding is completed the whole bellows should be collapsed and weighted down, to compress the creases.

The bellows is now ready for fitting to the framework of the camera or enlarger. The ends will need trimming to the nearest fold and an adhesive may be applied over the full width of the end sections. An "impact" type adhesive is best for this operation as it is not always easy to hold the bellows in place. Furthermore, the equipment would be ready for immediate testing.

Fig. 5 (Left).—Method of folding.

Fig. 6 (Right).—Inside folds being made with the aid of a rule.

35 mm. Size Exposures on 120 Film

S. Bird Tells "Reflex" Owners How it Can Be Done

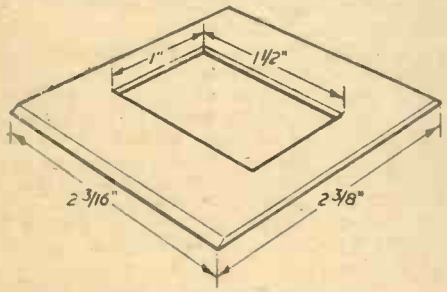


Fig. 1.—Mask for camera.

A ROLLEICORD film can be converted to 35 mm. as follows: first, the usual masks are required, and since the die-cast body of the Rolleicord lends itself admirably to the fitting of a mask in the film track, no difficulty should be experienced with this if the details of Fig. 1 are followed. The mask should be sprung into position, and the tapered edges go beneath two pressed metal projections to which the film rollers are secured. The mask must be sunk a little to avoid contact with the surface of the film.

When fitting the mask in the reflex hood, great accuracy is essential if close-up work is being done. With a ground glass screen placed across the film plane the area to be masked off in the reflex hood can easily be seen. Where no close-up work is undertaken, the problem of parallax does not arise, and if the mask is placed to cover objects 9ft. away from the camera, its position will be correct enough for objects to infinity.

If one does not wish to make a mask for the reflex screen, it is possible to take the reflex hood off by simply unscrewing the four screws holding the hood on to the main body of the camera and lifting out the hood complete. Turn the hood upside down and you will find that the ground glass side is facing you, mark the glass with a pencil to the measurements shown in Fig. 2. This will leave the screen clear for 2¼in. square and yet usable for 35 mm. size without placing a mask in the hood.

With the mask underneath the film plane properly fitted, two pencil marks are made on the camera body at A and B as in Fig. 3. The camera is then loaded in the normal way, but instead of using a good film, obtain an old used spool and two lengths of backing paper, cut one length of backing paper to the same length as a strip of film

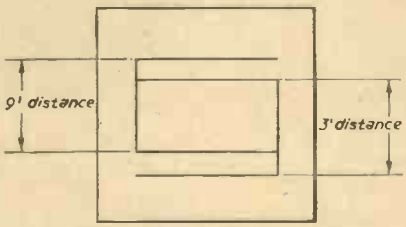


Fig. 2.—Details of reflex screen.

and stick down in the same position as the original film, respool the backing paper, taking care to wind back tightly the correct way.

Wind on until No. 1 shows in the red window, actuate the button to bring No. 1 on show at the side of the camera, when you have done this remove the camera back, but be very careful to maintain the film tension with your hand.

At the moment of the removal of the camera back, exposure No. 1 is in position. Maintaining tension on the film, a pencil mark is made on the backing paper ⅛in. below pencil mark B on the camera body. The winding knob clutch is now depressed and the film wound on until the mark on the backing paper coincides with mark A on the camera body.

If the peep window is observed at this moment it will be showing blank, and it is this blank that is now marked with a dot. This mark will permanently mark exposure No. 2. The position of exposure No. 3 is taken care of by the automatic film lock when the film is wound on following exposure No. 2. Again depressing the winding knob and marking the backing paper as previously indicated, the film is again wound until the pencil marks coincide and the exposure of No. 4 marked on the blank space in the peep window, if this is continued throughout the film the peep window will show 1, 0, 2, 0, 3, 0, 4, 0, 5, 0, 6, 0, 7, 0, etc., and the film spacing becomes alternatively automatic and visual.

If one wishes to change back to 2¼in. square halfway through the film, take the camera into the dark room and remove one end of the roll of film, take out the mask and replace the spool, the camera is now wound on to the next number shown on the numbering mechanism and is ready to take 2¼in. square.

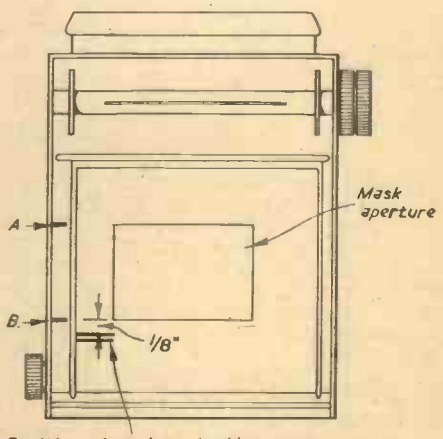


Fig. 3.—Back of camera.

BUBBLE-TUBE LAMPS

The Working Principles and How They Can Be Made at Home

By D. W. Godwin

MOST people must have seen these lamps at some time and watched the endless trail of bubbles passing up through a coloured fluid. It is not generally realised, however, that they may be easily made at home with little more than a length of glass tube and a suitable gas jet. Moreover, once the working principle has been grasped, they are capable of many novel designs.

In order to avoid any misunderstanding, it should be stated that the bubble tube is quite independent of the lamp, which merely supplies a small amount of heat (in addition to light). This heat can just as easily be provided by any other source, such as warm water. In fact, a long bubble tube projecting through the cork of a vacuum flask, filled with warm water, will operate all day.

The Working Principle

It is well known that the boiling point of a liquid drops as the air pressure is reduced. Water, or any of the more volatile liquids will boil furiously at normal temperatures, if the pressure be sufficiently low. The action will continue until equilibrium is restored, either through the increased pressure caused by the generated vapour, or by the drop in temperature of the unevaporated water due to the abstraction of latent heat. The important point is that the liquid establishes a delicate state of balance with its own vapour, and remains always on the verge of boiling. If any surface in contact with the vapour is cooled by even a single degree, compared with the liquid, a continuous process of distillation takes place.

Fig. 1 shows the simplest form of bubble tube, where a heat gradient is produced from A to B, either by warming A with the hand or cooling B with a damp blotting-paper wick. This device can be constructed in the form of a coiled spiral serpent.

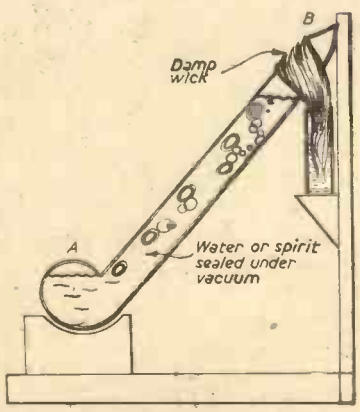


Fig. 1.—The simplest form of bubble tube.

The liquid may consist of coloured water or spirit.

The Two-liquid System

When the system contains two separate liquids of different boiling points the vapour/liquid balance will apply only to the most volatile component. If the two liquids are chosen, so that the most volatile liquid is also the most dense, then an interesting effect of the two-liquid bubble tube is obtained. The heavy, volatile liquid boils at the bottom of the inert liquid and vapour bubbles float to the surface carrying a little of the heavy liquid with them. Then the bubbles burst, the gas condenses and the heavy liquid falls to the bottom again. The two liquids may be dyed different colours to enhance the effect.

The inert liquid is normally plain water, which may be tinted by coloured ink or dye. The heavy volatile liquid may be carbon tetrachloride. Alternatives are chloroform or trichlorethylene. All of these are non-inflammable. Ball pen ink provides a suitable dye.

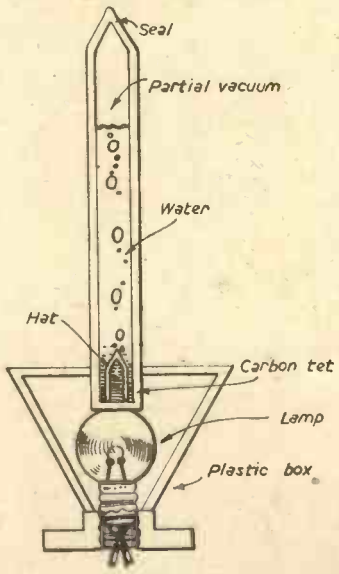


Fig. 2.—A completed bubble tube.

Fig. 2 shows a complete tube. This is two thirds filled with water and contains only a few drops of the active fluid at the bottom. The latter is covered by a special, loose glass hat which greatly increases the sensitivity. It achives this by holding a cushion of vapour and prevents loss of heat by water convection currents, and the sharp corners tend to promote boiling without bumping. It is also an interesting fact that liquids seem to boil at a slightly lower temperature when in contact with a gas face.

Constructing the Tubes

The glasswork is very simple, but a small pointed flame is essential. You will also require a pair of forceps as sold by any chemist.

First select a length of tube about 1½ times as long as the finished device and separate it from the main length by twirling in the flame and drawing off. The bottom should now be completed by more twirling and plucking out with the forceps, any excessively large blob of glass. When the bottom is reasonably uniform in thickness,

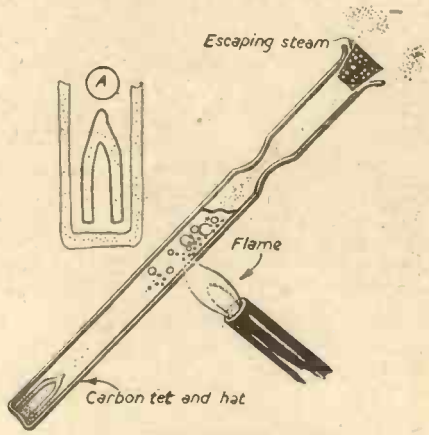


Fig. 3.—The filling operation.

it is flattened by pressing downwards on a firebrick or piece of asbestos.

The mouth is now heated and slightly tapered out to take a rubber bung. The glass hat should be made by drawing off a short length of smaller tube. Form a good button of solid glass on the top, or the hat will float up the tube. If the hat requires cutting and is too short to snap, wet the file scratch and touch with a pointed tip of molten glass, when it should crack neatly. Next insert the hat in the tube and form the seal-off neck. This is the most difficult part of the job. Use plenty of heat and try to let the glass sag in, rather than be stretched. The professional glassworker stretches and then compresses the neck alternately, so that the final wall thickness is comparable to the original tube.

Filling Operation

The water and carbon tetrachloride may now be tinted. For the former use ink or dye, while a discarded ball pen cartridge is ideal for the latter. Test for compatibility by shaking the two solutions together. No mixing should occur. For the best effect do not use more than a trace of colour in the water.

A slight excess of the water solution should now be worked into the main tube and very carefully boiled; a rubber bung being lightly rested in the tube mouth (see Fig. 3). When the air has been displaced by a steady flow of steam, the bung should be pressed home and the heat instantly removed.

The tube should now be cooled, and if the vacuum is good, a considerable amount of bubbling will take place.

The bung should be removed again and

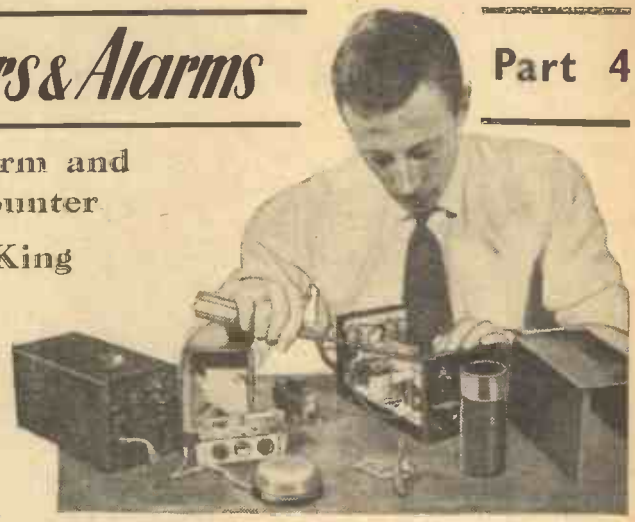
(*Concluded on page 241*)

Transistor-Operated Counters & Alarms

Part 4

Concluding the Alternative Burglar Alarm and Constructing a Transistor-operated Counter

By E. V. King



THE more robust 685 unit (Fig. 36) is used in a similar way to the 3011 unit described previously. Remove all wires and the metal rectifier (Fig. 35), the tag board near the solenoid and the switch situated under the tension adjuster, but leave the cam operated set of contacts. In Fig. 35 the contacts are shown separately so that the ratchet gear may be plainly understood.

On this relay there are nineteen pulses required to move the cam wheel round through just under 90°. Thus the contacts p and q will contact throughout 19 pulses and be open circuit on the 20th. This is the position in which the unit is set. A pointer knob may be fitted to the reverse end of the ratchet wheel shaft and four dots painted on the panel to show the four "set" positions in which p and q are open circuit. The knob can only be turned one way due to the ratchet action.

All other remarks made about the circuit, etc., using the other inching relay are relevant. There is a certain advantage in this system because it requires many more pulses before a thief unwittingly sets it safe again.

The inching relay system generally is easier to "re-set" than the other system, but both appear equally effective and reliable. Rather more power is required to operate the inchers, but it is only required when a thief appears or in some cases during re-setting, and in any case can be obtained from an ordinary D.C. power source as used for model trains or battery chargers.

A Transistor Operated Counter

This unit is basically the original photo-switch described last month with unwanted parts left out and a magnetically operated counter incorporated in the final relay contact circuit. Fig. 38 shows the completed counter.

Construction of Case

The parts are cut out and screwed together exactly as has already been described for the other units, but the back panel takes the shape and dimensions given in Fig. 39. The cavity is to take the P.O. counter which fits with the numbers to the rear. The tin-plate cover is exactly as described for previous units.

Fixing the Components

The modified Siemens relay (1,000 plus 1,000 Ω) is fitted in the position shown in Fig. 41. The P.O. type 3,000 relay is fitted with a bracket (as in Fig. 21) in the position shown between the PP1 and the Siemens relay.

The P.O. counter is fixed is an unconventional manner. It could be fixed by

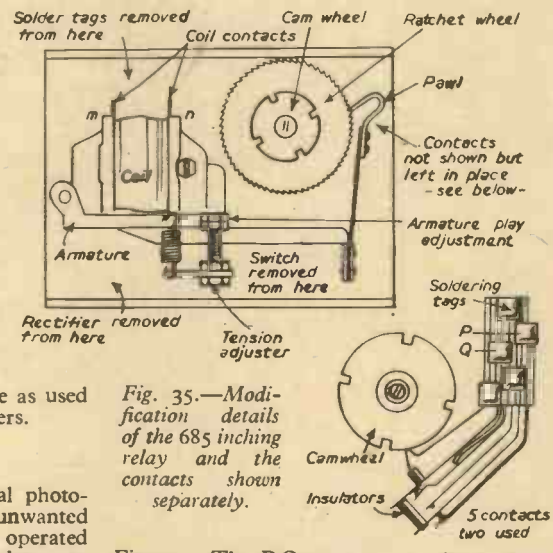


Fig. 35.—Modification details of the 685 inching relay and the contacts shown separately.

Parts Required for Photo Counter

T13. OCP71 or converted red spot (see November issue).

Ry5. Siemens H.S. relay or alternative, modified as described earlier. Sources of supply already given.

R11 if the 100 Ω alternative for Ry5 is used this should be 1,500 Ω. With the Siemens relay it is 500 Ω.

R10. 150 Ω ¼ watt.

R8, R9, 47 Ω (see text).

C6 and C5, 0.1 μF 500 v. working.

Ry6. P.O. type relay 200 Ω coil, one set of contacts only required but one modified as for the photo-switch is very suitable. Supply source already given.

B4. Ever Ready PP4 battery or other small capacity type, car battery or mains D.C. power supply (one will be described later in this series).

B5. Ever Ready PP1 or other large capacity 6 v. type.

P.O. Counter. G.P.O. type, counting up to 9,999. 3 Ω coil. Obtainable as type 11a from Messrs. L. Wilkinson (Croydon) Ltd., 19. Lansdowne Road, Croydon, Surrey. These are surplus and apart from requiring adjustment to the return spring are in perfect order. Type 17a is also probably suitable, but was not tried in the prototype.

Front panel and base as for photo-switch.

Back same size wood cut differently.

Cover as for photo-switch.

S6 a and b. Toggle switch, two poles one way.

Battery clips to suit PP1s (PP4 takes same size clips).

Lens and mounting arrangement as for light source and photo-switch.

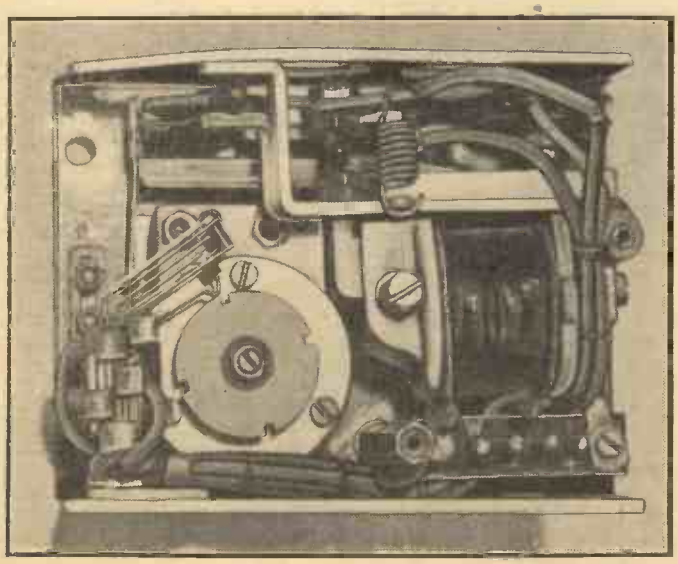


Fig. 36.—A top view of the unmodified 685 inching relay.

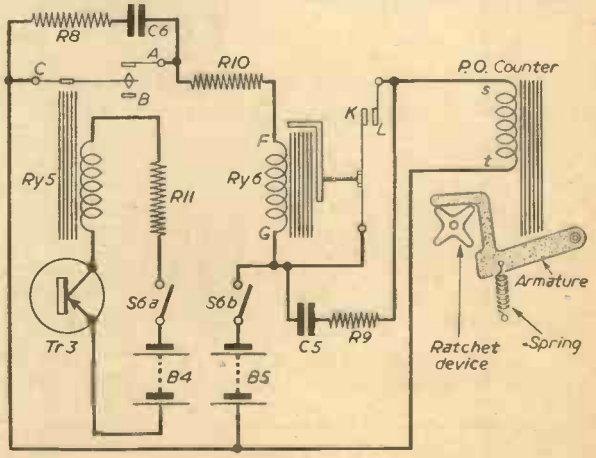
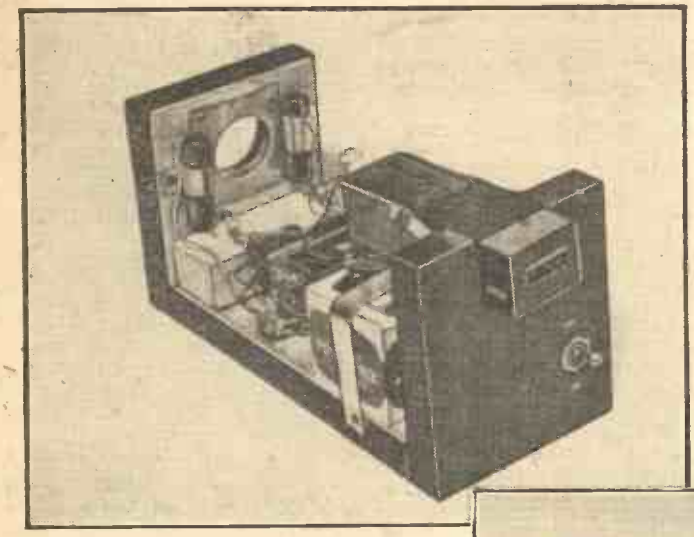


Fig. 37.—Circuit of the electronic transistor counter.



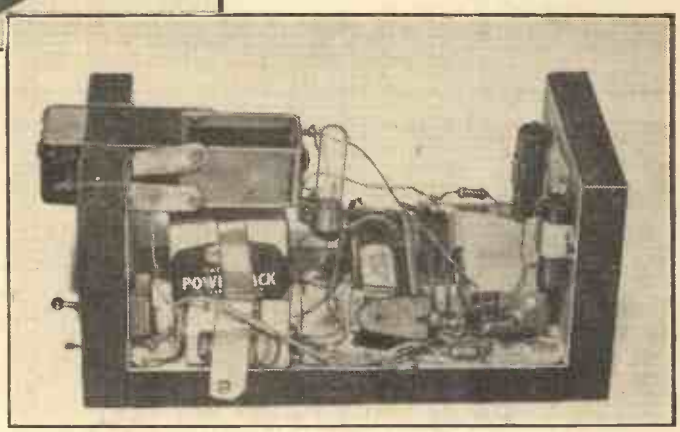


Fig. 38 (left and below).—Two views of the completed electronic transistor counter.

using the single bolt fitted and marked "not used" in Fig. 40c, but it was considered easier and a better job to make four small angle brackets to the dimensions of Fig. 40a. Holes (four in all) are drilled in the sides of the counter *exactly* as shown in Fig. 40c. Great care is needed in drilling these holes or you will puncture the solenoid inside. It is best to put a chisel or other flat piece of metal inside while drilling.

The brackets are fixed to the counter with short bolts and nuts as shown in Fig. 40b and in turn these are screwed to the back panel inside the unit. It is best to cut off the screw thread originally fitted for fixing purposes as it may get in the way of the transistor when it is in focus.

The toggle switch is mounted in the back panel, countersunk if necessary because of thickness. The modified red spot transistor or the OCP71 should be mounted on a flexible copper mount as in the previous units and must be fitted at the focal point of the lens between the second relay and the battery.

Two batteries are used. It was found that if Tr3 is driven from B5, when the device operates the voltage drop across the battery makes Tr3 inoperative and the unit will not go to its former static position when the "shadow" has passed. A combined battery clip is made and held with three countersunk wood screws as shown in Fig. 42.

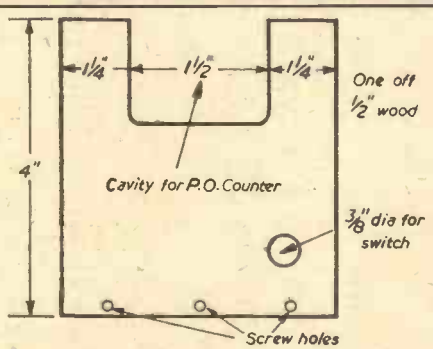


Fig. 39.—Rear panel of counter.

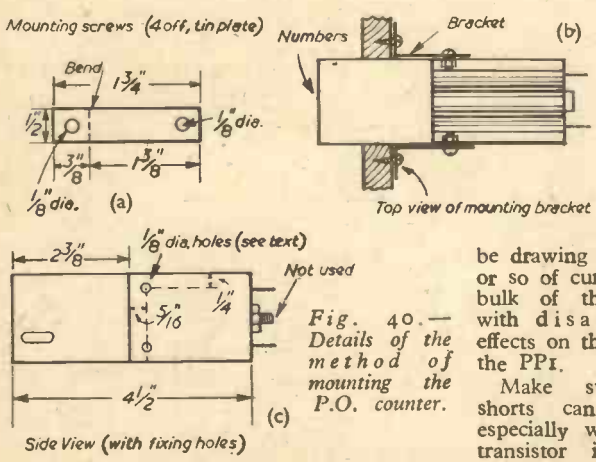


Fig. 40.—Details of the method of mounting the P.O. counter.

The tin-plate must not be wide enough to short on to the terminals.

The Wiring

As in the other units no special precautions are required. The component positions may be altered and the wires need not be short as is so often the case with electronic apparatus. The condensers and resistors may be fitted directly in circuit.

You must be very careful that you wire the counter to the correct contacts of the P.O. 3,000 relay or the counter will be drawing an amp. or so of current the bulk of the time, with disastrous effects on the life of the PP1.

Make sure no shorts can occur, especially when the transistor is being focused on its flexible mount. Note in Fig. 37 that Tr3 has its own small simple circuit and is remote from B5 circuit.

Relay Arcing

Arcing at the contacts is not good normally but when a relay is being used for counting it is likely to be used many thousands of times per day and even small sparks would ultimately render it useless. The author found that the small Siemens Relay gave more trouble in this direction than the larger P.O. 3,000 type. The 100 Ω alternative to the Siemens type quickly gave trouble if sparking was allowed at the points.

The condensers and resistors fitted across the points of the relays are to suppress the spark. It is difficult to state exact values as even the length of wires has an effect. Once fixed up readers may, if they wish, experiment with the values of R8 and R9, even leaving them out and taking the lead directly to C6 and C5. The value of C6 and C5 may be altered between .01 μF and about .5 μF. The only thing that they are for is to cut out the spark, therefore, when testing, do it in as dark a place as possible and examine the contacts with a magnifying glass as they operate. It is very difficult to cut the spark out completely.

After each 10,000 counts or so it is a good idea to draw a piece of fine paper across the primary relay contacts to clean them.

Testing

Fix the unit up with the light beam entering as in Fig. 41. Adjust the transistor so that the filament image falls on the junction or until on observation the primary relay is held in "by the light beam." When thus held the secondary relay will not be energised and will draw no current, the contacts k and l will not be touching and the counter will draw none either.

On passing the hand across the light beam the primary relay should release contacting C and A, completing the energising circuit of the second relay which in turn completes the circuit to the P.O. counter.

Should the battery be incapable of pulling the counter over or should the counter remain stuck, adjust the return spring by bending the holding strip with pointed

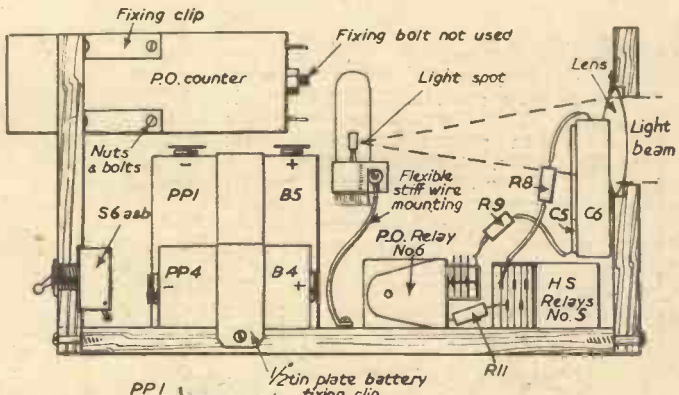


Fig. 41.—Side view of photo counter, showing the layout of components.

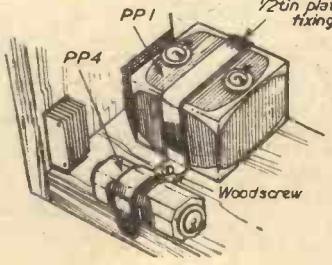


Fig. 42 (left).—Details of battery fixing.

pliers. Light clock oil will help with speedy operation of this unit.

The actual maximum speed depends on many factors, the tension of the relay springs, the voltage and internal resistance of the battery, the value of the anti-sparking condensers, etc., but as a rule it will count about five times per second. Faster speeds do not seem possible with this all electromagnetic equipment.

Uses for the Unit

All types of slow oscillatory movements may be counted, i.e., swings of a pendulum may be counted with *absolute accuracy* over a period of weeks, the counter going automatically back to 1 after 9999 is reached. In a similar way if a hole is cut in a wheel, or a strip fixed over the circumference, revolutions may be counted with ease. In some cases where one cannot get the beam to be cut by the wheel or pendulum a piece of mirror glued on may be used to reflect the light (angle of incidence equals angle of reflection).

People walking in or out of a shop, vehicles along a road, rabbits going in or out of a warren, fish passing a given point in an aquarium, objects passing along a conveyor belt and even callers at the front door of a house can be counted.

Novel Automatic House Bell Counter

If a small electric bell is wired into the circuit of Fig. 37 so that it is in parallel with the counter coil (i.e., connected to points s and t) the bell will ring while anything interrupts the light beam. The system already described under the sub-title "Party Games" (in the section dealing with a photo-changeover switch) is fixed up outside the front door. A small switch is fitted inside the door in the bell circuit to mute it if required. The counter will give an idea of the number of callers and in the absence of the tenants it will indicate if anyone has called. A strong short beam is advisable in winter, or fog may upset the working.

Party, Dance or Gala Novelty

The infra-red beam is made to shine across a Teddy Bear mounted on a gramophone turntable, which is set to revolve slowly. The turns are counted on the counter, the actual counter being hidden or wired into another room. If one revolution of the turntable causes two interruptions, remember to halve the result for a correct count of the number of the turns the bear has made.

The bear is set going and the idea is to guess how many times the bear has gone round, say, four hours later at a *definite time*. At a garden party a charge is made for each guess. Mathematically minded customers have great fun trying to estimate by calculation from the turns per minute on their watches! The nearest one is, of course, the winner.

An adaptation of this game is to have a weighted "object" swinging on a very long thread, instead of guessing turns the idea is to guess the number of complete swings. *(To be continued).*

Weather Controlled Window

A WINDOW controlled entirely by weather conditions has been designed by an American steel corporation. It is purely experimental and it is not intended to market it. If the temperature inside a house drops below a predetermined setting, the window closes automatically. It reacts in the same way to a strong wind, snow falls or rain.

When rain or snow contacts two electric eyes, which are just below the sill on the outside of the window, it completes a circuit, electronic relays then actuate an electric motor, which closes the window. A mechanical flapper over the window reacts to winds over certain velocities.

The window consists of four vents, each vent being made of two panes of glass, which are sealed tightly together after the air has been removed from between them. The window, therefore, acts as its own storm window.

N.P.L.'s Electronic Computer ACE

ONE of the world's largest and fastest electronic computing machines has begun to operate at the National Physical Laboratory. Its name is ACE (Automatic Computing Engine), and it can carry out any calculation process for which exact rules are known. Typical of its work is design calculation for high-speed aircraft and nuclear reactors. The emphasis in the N.P.L.'s use of ACE will, however, be into the general methods by which computations such as these can be carried out.

In the early post-war years Dr. A. M. Turing produced, with his collaborators at N.P.L., a logical design for a computer intended to carry some of the load of numerical calculations. From this a pilot-model ACE, one-sixth of the size of the present machine, was evolved to investigate the engineering problems which would arise in the full-scale machine. During its five-year life at N.P.L. it carried out a considerable amount of work, including extensive calculations to discover the cause of failure in the early Comet and led to the commercial production of the English Electric DEUCE computer.

The numbers and instructions have 48 binary digits (equivalent to 14 decimal digits). The working store consists of 800 words, and the backing store of four magnetic drums will contain a total of 32,768 words.

Mercury delay lines and magnetic drums (the working and backing stores respectively) are used for the storage of numerical data and instruction sequences, and both punched card and magnetic tape equipment are provided for input and output. The computer is controlled from a control desk which has some 160 keys and 300 signal lamps, in addition to audible and visual displays of the computation.

Lightest Metal

A RECENT series of experiments in the U.S.A. has indicated that the lightest known metal is lithium-6. This was established by measuring the spaces between the atoms of various metals.

Missile Camera

A CINÉ camera has been specially designed to travel in missiles and to record flight details. Aluminium castings are used and the camera weighs 8lb. It can withstand high gravity loads, severe vibrations and impact shocks caused when the missile is launched, accelerated and decelerated. A variation of camera speed from 12 to 600 pictures per second is possible and the camera is powered by a battery-driven motor.

New Force

A NEW force acting on the earth parallel to the equator has been discovered. This is the claim of a Russian scientist announced recently in a report from Moscow.

Printed Circuits—New Technique

IT may be possible to produce printed circuits for communication equipment and electronic computers by means of cathode metal "sputtering." In this technique ionised gas molecules bombard a cathode, from which atoms of metal are dislodged and redeposited on adjacent surfaces. Resistors, capacitors and leads may all be formed by this method.

Increase in Radioactive Fall-out

SCIENTISTS have ascertained that there has been a ten-fold increase in radioactivity since 1952. This was stated after a study had been made of deer antlers from deer that normally graze on Highland pastures, which are known to contain relatively high levels of radioactive fall-out. On the antlers of a deer shot in November, 1957, the radioactivity as measured by strontium-89 plus strontium-90 was 126 micro-microcuries per gram of calcium. The strontium activity found in the antlers of a deer shot in 1952 was only 11.2 micro-microcuries per gram of calcium. The scientists were from the department of food science at the Royal College of Science and Technology, Glasgow.

ACE consists of about 6,000 miniature electronic valves arranged in 10 large cabinets.

BY BALLOON TO AMERICA

Technical Details of a Modern Adventure

Fig. 1. — The balloon in its moorings.

AN attempt to cross the Atlantic in a 46-foot diameter balloon called "The Small World" was started recently. Fig. 1 shows the balloon in its moorings. It was launched from Teneriffe in the Canary Islands and the specially-designed car carries a crew of four. The wind provides the only means of propulsion.

The basket has been designed as a water-tight boat, which in the event of the balloon being forced to descend into the sea, would enable the crew to continue their journey. The basket is 15ft. 6in. long × 8ft. wide and much of the equipment is constructed with Dexion slotted angle. Horizontal propellers mounted on outriggers on each side of the basket are used to maintain the height of 800ft. at which it is intended to drift. The propellers are clearly shown in Fig. 2. Rotating these propellers in either direction will cause the balloon to either gain or lose height. They are rotated by means of four sets of pedals in the basket, which can be turned in unison by the crew. These pedals can also be used to operate an electric generator to power the radio or they can operate a winch for hoisting water ballast from the sea. Fig. 3 shows a member of the crew testing the pedals.

Extensive tests were carried out on the balloon in the 180ft. hanger which once housed the airship R100 at Cardington. The balloon was filled with hydrogen and remained filled for a week while super sensitive porosity meters measured leakage. The balloon was also attached to a spring balance and was weighed daily. An expected loss of 20 to 70 cu. ft. per day was anticipated, which would mean a loss of only 4lb. lift.

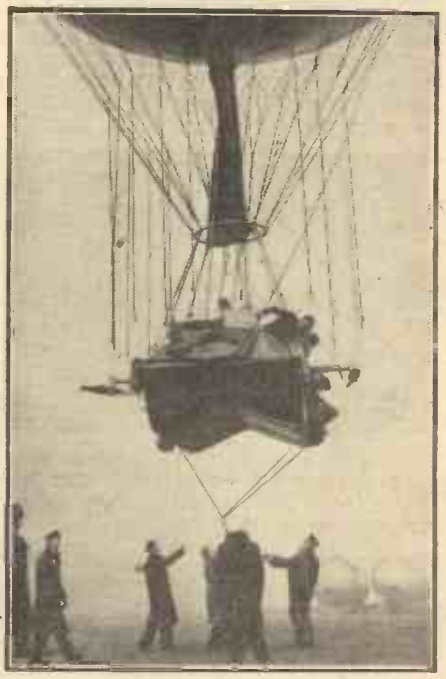


Fig. 2.—The horizontal propellers are clearly shown in this photograph.

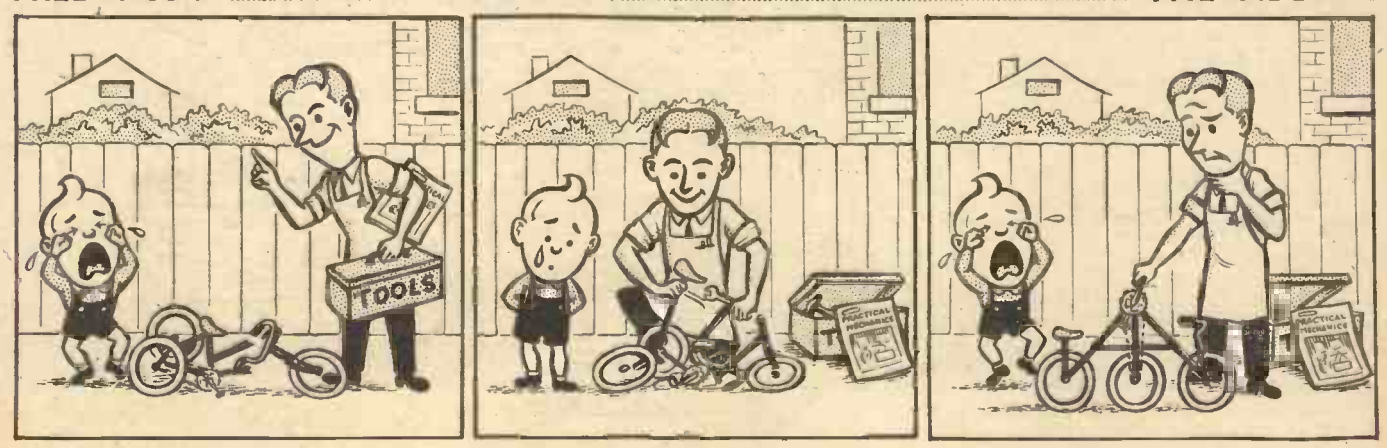
Fig. 3.—Colin Mudie, a member of the crew, testing the pedals.

Lost gas in the balloon can be replaced by means of a hydrogen generator which is part of the equipment included in the basket. An aluminium saucepan welded to the generator absorbs waste heat from the plant and can be used for warming food.

The leader of the expedition is Mr. Arnold Beaupres Eiloart and also in the crew is Mr. C. Mudie, naval architect and constructor of the car.

At the time of going to press, no news has been received regarding the success of the expedition.

FRED FIXIT ..... **THE FIDDLER**



Details of a Rubber-proofed Suit for Aqualung Divers

By R. J. Garvey

DIVING with an aqualung is now a popular sport but its enjoyment in this country is tempered, except at the height of summer, by the cold water. In any case, the waters in all parts of the world are cold some way below the surface. The underwater swimmers in our seas and rivers, therefore, or those venturing far below the surface, must protect themselves against the cold.

The necessary protection is given by a rubber-proofed suit. This is fitted with water-tight seals at the neck, wrists and ankles and, when worn over suitable underclothes, keeps the diver dry and warm. An alternative when the water is not too cold is a "wet suit," usually made of sponge rubber. This fits fairly tightly and although wet it prevents heat being carried away by the cold water which would otherwise be flowing over and in immediate contact with the body. This keeps the swimmer surprisingly warm and, worn in the summer, enables him to enjoy quite long periods in the water.

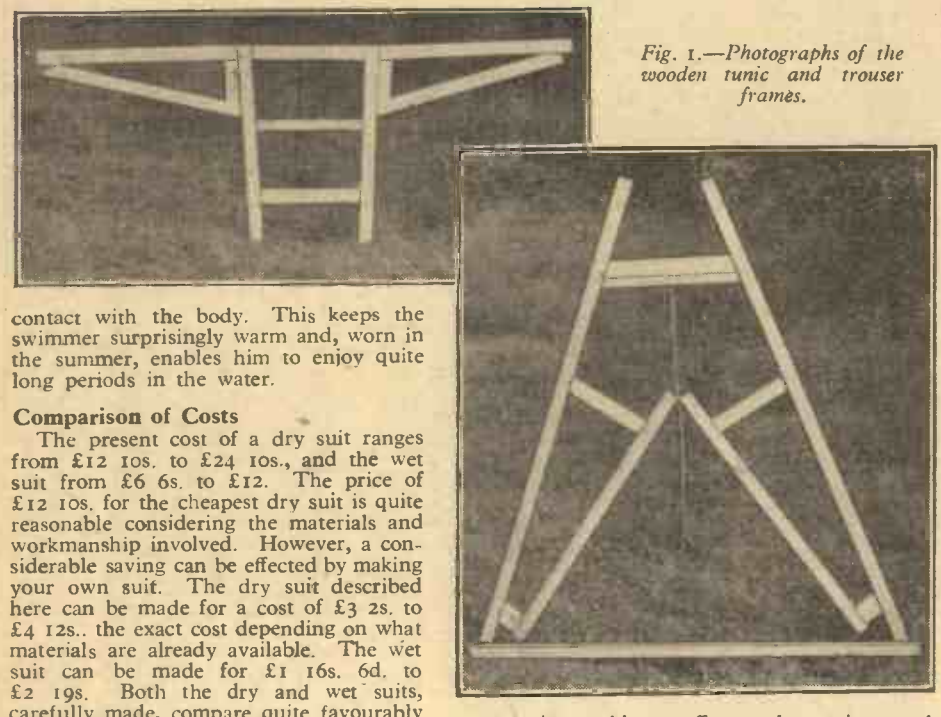


Fig. 1.—Photographs of the wooden tunic and trouser frames.

Comparison of Costs

The present cost of a dry suit ranges from £12 10s. to £24 10s., and the wet suit from £6 6s. to £12. The price of £12 10s. for the cheapest dry suit is quite reasonable considering the materials and workmanship involved. However, a considerable saving can be effected by making your own suit. The dry suit described here can be made for a cost of £3 2s. to £4 12s.. the exact cost depending on what materials are already available. The wet suit can be made for £1 16s. 6d. to £2 19s. Both the dry and wet suits, carefully made, compare quite favourably with the commercial ones.

How the Suits are Made

The dry suit is made by stretching suitable garments, preferably a long-sleeved vest and long pants, over wooden frames and then painting on an air-drying latex solution. The suit is then completed by securing rubber cuffs at the wrists and ankles, a rubber neck seal and waistbands. The rubber attachments provide the necessary water-tight seal. Water is kept out at the waist by rolling the two waistbands together, the roll being held in position at the waist with a rubber cummerbund. If desired, the suit can be fitted with a rubber hood and boots to give added protection.

The wet suit is made in a similar way to the dry one, but in this case a vest and short pants are required. These are proofed and fitted with rubber seals at the neck and wrists only. No attempt is made to seal off the suit completely but the cuffs and neck seal and a rubber cummerbund prevent the water flowing freely through the suit so that a layer of water is imprisoned against and warmed by the body.

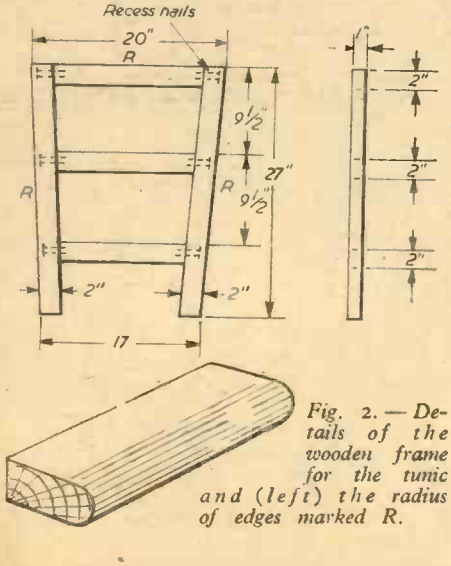


Fig. 2. — Details of the wooden frame for the tunic and (left) the radius of edges marked R.

Materials and Costs

Items which must be bought are:

	Price £	s.	d.
Neck seal		8	0
Cuffs, 2 pairs at 4s. 9d.		9	6
Cummerbunds, 3 at 7s. 6d.	1	2	6
Rubber tape, 6 yards × 1in. wide		3	10
Rubber solution, 8oz. tube		2	4
Latex solution (Revultex), 5lb. at 2s. 4d.		11	8
Packing and postage		4	6
Total cost	£3	2	4

The cost of the complete dry suit will depend on what improvisations can be made with existing materials. The basic garments, that is, the vest and pants, need not be new or in very good condition. Any holes or tears can be darned, patched or sewn up before applying the latex solution; the final result will be quite satisfactory since the garments simply provide a base for the rubber coating that is to be applied. Money can be saved on the wooden frames by improvising with whatever materials are to hand.

The neck seal, cuffs, cummerbunds, rubber tape and the tube of rubber solution, all made by the Dunlop company, can be purchased from sports outfitters specialising in underwater swimming equipment. In particular they are readily available from Andrews & Dalton, Ltd., 126, Hanworth Road, Hounslow, Middlesex.

The neck seal is supplied in one size only and the neck opening marked so that the wearer can cut a larger hole if necessary to suit individual requirements. The cuffs for the ankle and wrist seals are identical and of one size; they stretch sufficiently to suit all individual requirements. Cummerbunds are supplied in two or more sizes. Two of these are to be secured to the suit in the form of waistband

The complete divin

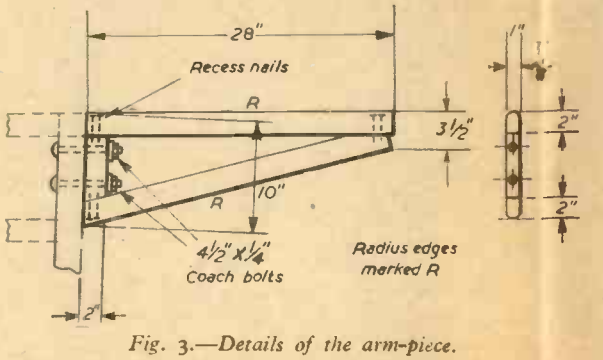


Fig. 3.—Details of the arm-piece.

and a Wet Suit for Aqualung and Skin Diving

extensions to the tunic and trousers. A tight fit is undesirable here and two cummerbunds of the largest size should be ordered. The third cummerbund will be worn to hold the rolled waistbands in position and a medium, or the smallest size, will be required.

The latex solution—trade name Revultex—is obtainable from Revertex, Ltd., Harlow, Essex. Head office: 51-55, Strand, London, W.C.2. This solution evaporates very quickly and the sealed container in which it is supplied should not be opened until the solution is about to be used.

g suit.

The remaining items required are the vest or a jersey, the long pants and some wooden laths for the frame. If these are not to hand, then they can be purchased for:

	£ s. d.
Vest or jersey	12 6
Long pants	7 6
Wood	10 0
Total	£1 10 0

Some difficulty may be experienced in the purchase of a long-sleeved vest. They are obtainable but usually at a prohibitive price. A government surplus store is the most likely supplier of a cheaper article. Interlock or a cotton and wool mixture is the best material for both vest and pants; this will not absorb too much of the latex solution and will allow the garments to be stretched to the correct size over the wooden frames. A long-sleeved sweater or jersey will suffice but it should not be too large, particularly around the waist, which should not measure more than 34in. unstretched. A larger garment can, however, be altered to the right size, if necessary, before proofing it with the latex solution.

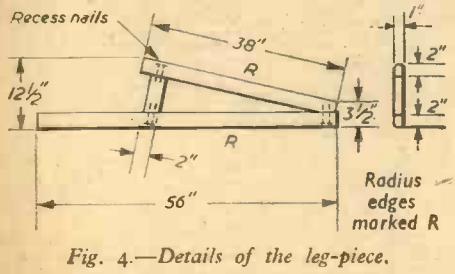


Fig. 4.—Details of the leg-piece.

Fig. 6.—Garments stretched over frames ready for proofing.

The neck of the jersey should not be too low; the rubber neck seal should overlap the neck of the sweater or jersey by at least 2in. all round. A woollen sweater can be used but the weave should not be too open otherwise the garment will absorb an excessive amount of the latex solution and the recommended quantity of 5lb. will prove insufficient. Thick absorbent garments should in any case be avoided if possible since they will absorb perspiration in use and it will be difficult to keep the suit dry and aired. Such garments may be worn under the suit but these can be more easily aired or changed if necessary. Purchase of the long pants presents no difficulty; most suitable ones are available from Marks & Spencers, Ltd., at the price quoted.

The size of the vest and pants should, of course, suit the intended wearer but they should not be too large or too small to be stretched over the wooden frames shown in Fig. 1, but providing the arms and legs are not too short, most garments will stretch to the right size. The dimensions given for these frames are for the average figure. They are not critical and it will be found that a suit made on the frames shown will fit most figures. If necessary, however, the frames must be of a size to suit individual requirements. Any necessary alteration to the size of the frames is considered in detail when describing their construction; but this matter should be borne in mind when purchasing the garments which are to be stretched over the frames.

The Wooden Frames

These are shown in Fig. 1 and their construction detailed in Figs. 2 to 5. The frames should preferably be made of 2in. × 1in. timber as shown. However, if such timber is not available or is too costly you can improvise with whatever materials are to hand. For example, broom handles will suffice for the arms and legs and planking can be used for the body of the tunic. If only a limited amount of wood is available then the frame for the trousers can be made first, the trousers proofed and the frame dismantled and the wood used to make the frame for the tunic. However, this will be a lengthy operation since the proofing must be done in two stages.

Note how all the outside edges of the frame are radiused. This is so that the garments are not stretched over any sharp corners when in position on the frames. Sharp corners would result in the latex solution forming into ridges along the edges. The frames should be not less than 1in. thick or again there will be difficulty in applying an even coating of latex around the outside edges of the garments.

The frames are designed so that they can be dismantled and removed from inside the garments. This is necessary as the vest and pants will not stretch sufficiently after proofing for them to be pulled off over the assembled frames. The arms are made separately and secured to the body with coach bolts. The two legs of the frame are identical and are made as separate units. They are then inserted into the pants and joined together with two rails as shown in Fig. 5. These rails can be nailed or screwed into position. Screws are preferable if the frames are to be used to make several suits.

There is no need to take a lot of trouble with the frames; but make them sufficiently

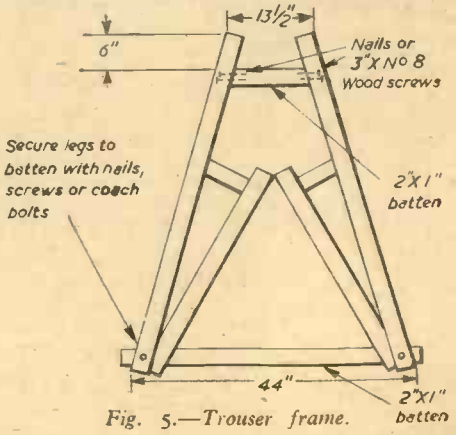


Fig. 5.—Trouser frame.

secure and robust to withstand the rough handling they will receive when the garments are being stretched into position, the latex applied and the complete assembly hung up to dry. There will be no saving of time or trouble if the frames collapse while in use. If the suit is being made by a member of a club such as the British Sub Aqua Club then it is worth while to pool the expense and effort in making a strong, durable frame that can be used to proof a number of suits for club members. The construction shown in Figs. 2 to 5 will be suitable in this case, but all joints should be glued as well as nailed and the rails on the trouser frame secured with screws, not nails.

The finished suit will not stretch very much and should therefore not fit too tightly. On the other hand it must not be too large or it will enclose too much air, even when vented, so that the diver will be too buoyant. The dimensions of the frames take account of this. In particular, a large arm hole is required; a tight fit here would make it difficult to get into the suit. Similarly, the size at the waist is important; the frames being dimensioned to give a waist measurement of about 36in. on the finished garments. If the waist were smaller it would be impossible to get the tunic over the arms and shoulders and to pull the trousers up over the hips. The waist should not, however, be much larger, otherwise it will be a bad fit and there will be difficulty in attaching the rubber waistbands. The trouser frame gives a leg opening at the bottom of the trousers of about 13in., which is just sufficient to permit the trouser leg to be eased over the ankle and heel. The opening should not be any larger or there will be difficulty in attaching the rubber ankle seal which is to be stretched over this circumference of 13in. and secured with rubber solution.

The frames were designed for an average figure of the following dimensions :

Chest (unexpanded)	36 in.
Waist	32 in.
Arm (armpit to wrist)	22 in.
Inside leg (crutch to ankle)	30 in.
Thigh (thickest part)	24 in.

If the wearer is not of average size, the frames must be dimensioned to suit his particular requirements. For example, a 40in. chest would require an additional inch on the width of the frames for the tunic. The width of the waist at the top of the trouser frame (Fig. 5) can be altered by splaying out the legs a greater or lesser amount, before fitting the rails at top and bottom. This should be done so that the legs of the frame always meet at the crutch.

Applying the Latex Solution

Patch or darn the garments if necessary. Remove all tapes and buttons and sew up the button holes and the fly on the pants. Remove any tape, hem or other reinforcement around the waist so that the pants can be stretched quite freely.

Now stretch the garments over the frames as shown in Figs. 6 and 7. It will be found convenient to bolt one arm of the frame into position then to pull the vest over this before inserting and attaching the other arm. Insert the legs of the trouser frame separately into the pants and fix them together with the top and bottom rails. Stretch the garments over the frames so that the length of the arms, legs and tunic is as shown in Fig. 7. Any excess in these lengths is, however, of no consequence at this stage; the garments can be trimmed to the correct size after proofing. Tack the garments into position at the waist and if necessary around the neck.

The garments are now ready for proofing. The latex is applied with a wide paint brush, or better still a whitewash or distemper brush. A small quantity of petrol will be required for cleaning the brush. The latex is in a solution of ammonia and it should not be used in a confined place—the smell is rather unpleasant.

Lamp black can be mixed with the Revultex to give a black finish to the suit. This is not essential but it will improve the appearance of the suit and the resistance of

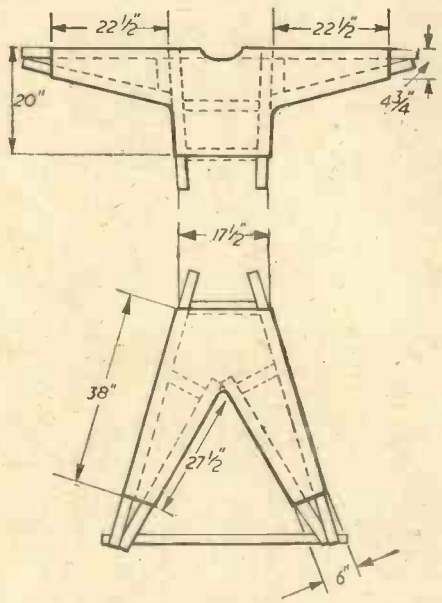


Fig. 7.—How the garments are stretched over the frames.

the rubber surface to the ageing effects of light. Two or three ounces of lamp black to each pound of Revultex is sufficient. This mixture will not appear very dark but it dries out quite black. Any undissolved carbon in the mixture will produce a lumpy surface on the suit. Take care, therefore, to mix the carbon well into the solution, then let it stand for half an hour or more so that any unmixed carbon dissolves; stir

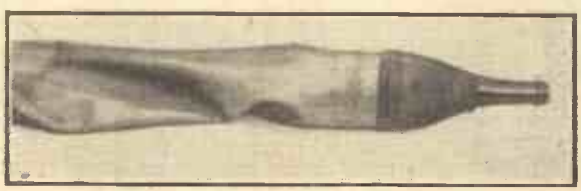


Fig. 8.—Attaching the wrist cuffs.

the mixture again and it is ready for use.

Apply the first coat of latex sparingly or the garments will soak up too much of the solution. The solution dries quickly and, in fact, tends to dry on the brush as it is being used; the solution must, therefore, be applied fairly quickly. Clean the brush immediately and thoroughly after use and take care to remove all particles of latex, particularly from the roots of the brush. If the brush is not cleaned properly then small particles of latex will be deposited on the garments when applying subsequent coats and it will be difficult to apply the latex evenly. Hang the suit up to dry in an airy place but away from direct heat or sunlight. It will be dry and ready for another coat after five hours but it is preferable to leave the suit longer, say, overnight, if possible. Apply at least four coats; there is no harm in applying further coats if there is sufficient solution.

Now dust the suit with french chalk and remove the frames. Remove the bolts securing the arms of the frame and withdraw the arm-pieces through the neck of the tunic. The tunic can now be pulled over the body of the frame. Remove the top and bottom rails of the trouser frame and withdraw each leg-piece.

Trimming to Correct Size

Before securing the rubber seals at the neck, wrists, waist and ankles it is necessary to trim the tunic and trousers to the right size, and to mark off the position of the rubber seals. A ball-point pen will be found quite effective for marking the suit.

Try the suit on over some old trousers and a sweater. The arms and legs of the suit may be of the correct length, but check this and mark off the correct length if necessary. The wrist and ankle seals will add about 2in. to the length of the arms and legs. Allow for this but do not cut the arms and legs too short. Leave sufficient length to allow for free movement of the limbs. Now mark off the position of your waist line on the tunic and trousers and cut them to overlap about 1in. at the waist. Allow sufficient room for bending when marking off the waist line on the trousers. The cuffs are to overlap 1½in. and the waistbands by 2in. on to the tunic and trousers. Mark off this amount of overlap on the suit; this will serve as a guide when attaching the cuffs and waistband.

Put the tunic and the neck seal on and then get somebody to outline the position of the neck seal on the tunic. Make sure that the tunic and neck seal are dressed down properly on your shoulders. The neck seal may be uncomfortably tight but do not enlarge the neck opening in the seal at this stage; it is better to leave this until you have used the suit and are quite sure that it is too tight. Remove the neck seal and tunic and cut the neck opening in the tunic to provide an overlap of about 2in. beyond the outline of the rubber neck seal.

Securing the Wrist and Ankle Seals

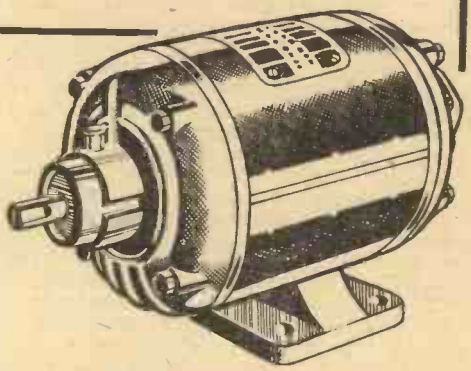
The rubber seals are secured with ordinary rubber solution as used for puncture repairs; a fair quantity of solution is required and the recommended 8oz. tube is the most economical purchase.

The method of attaching the wrist seals is shown in Fig. 8. Roughen the surfaces that are to be stuck together with emery cloth and then stretch the sleeves over two bottles of about 3½in. diameter. Bottles—of the right size—are most suitable since the tapered neck provides a good seating for the rubber cuffs; however, a tin or any other cylindrical former will suffice. Ease the cuffs into position so that they overlap the sleeves by about 1½in., that is, to the marks previously made on the sleeves. Now fold this overlap back and apply rubber solution to the two surfaces that are to be stuck together. Wait until the surfaces are tacky and then press them firmly together. Make sure the cuffs are stuck well down, particularly around the edges, and then bind the joints as tightly as possible with several turns of ½in. insulating tape. Leave the joints for a few hours or longer, then remove the binding. Stick a band of 1in. rubber tape around the sleeve so that it covers the edge of the cuff. Again roughen the two surfaces that are to be stuck together and bind the joint as tightly as possible with ½in. insulating tape.

(To be continued)

Single- to Three-phase Conversion

J. L. Watts Describes Methods of Overcoming the Various Difficulties Encountered



THE standard adopted for electrical power supplies in this country is 415 volts three-phase at 50 cycles. A three-phase induction motor has an advantage over a single-phase motor in that a three-phase motor of given dimensions and speed may develop about 50 per cent. greater horse power than a single-phase motor of the same dimensions and speed, a desirable feature where space is limited or the motor is to be built into the driven machine. For this reason it is seldom practicable to rewind a single-phase motor to operate as a single-phase motor of the same horse power and speed. One reason why the horse-power/size ratio of a three-phase motor is generally greater than that of a single-phase motor is that a three-phase induction motor is inherently self starting, whilst a single-phase induction motor is not. Some of the stator slots of the single-phase motor have to be occupied by windings which are used almost entirely for creating a torque to start the motor, which windings are often inactive once the motor has been accelerated to about 75 per cent. of its working speed.

Conversion Difficulties

Difficulty sometimes occurs due to plant which is fitted with a three-phase motor, or motors, being required to operate in a district where there is only a single-phase supply available. There may not be room on, or in, the machine to accommodate a single-phase motor, or motors, of the required horse power at the required speed. Whilst a three-phase motor can often be controlled by means of a simple direct-on-line push-button starter, a more complicated starter may be required for a single-phase motor over one horse power or so. Whilst a push-button controlled starter can be obtained for any single-phase motor the size and cost of such a starter may be much greater than in the case of a three-phase starter. In addition, the starting torque created by a single-phase motor may be less than that of a three-phase motor. However, there are various methods which can be employed to obtain a three-phase supply of any required voltage from single-phase mains of the required frequency.

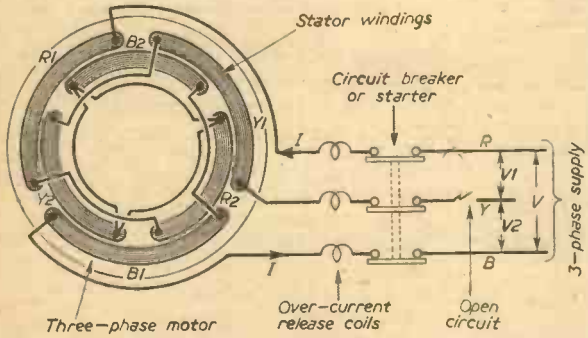


Fig. 1.—Connections of a three-phase motor with open-circuit in one phase.

Operation of a Three-phase Motor on a Single-phase Supply

When a three-phase induction motor is running from a three-phase supply the currents in each of the three phases of the stator windings reach peak values successively at intervals of one-sixth of a cycle of the A.C. supply. Since the three phases of the stator windings are distributed round the stator core the stator currents produce peak values of magnetic flux in different parts of the motor at different instants. These fluxes combine to create a magnetic field of constant value which revolves round the stator core at synchronous speed. The synchronous speed in revs. per second is equal to the frequency of the supply divided by the number of pairs of poles for which the stator is wound. The revolving magnetic field or flux cuts the conductors on the rotor, inducing current in these conductors which react with the revolving flux to create the motor torque which causes the motor to run at slightly less than the synchronous speed of the motor.

A three-phase motor will not be self-starting when switched on to a three-phase supply if one supply line is open-circuited,

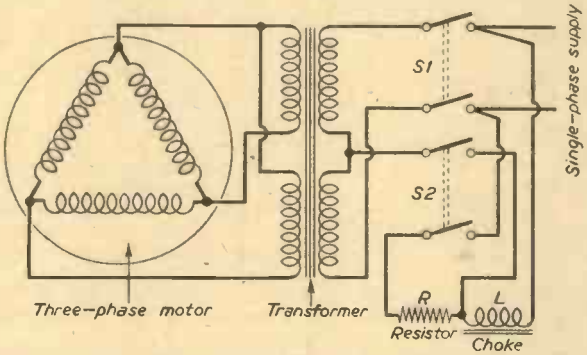


Fig. 2.—One method of starting a three-phase motor from a single-phase supply.

although the motor will usually accelerate and run in whichever direction it is started by hand before switching on. However, once the three-phase motor has been started up it will continue to run when one of the three-phase supply lines to the motor is interrupted, as in Fig. 1. The motor will develop torque so that it will continue to drive its load unless this is excessive. However, the current I in each of the two intact supply lines to the motor will be greater than that which flowed in each of the three lines when these were all connected to the motor. Thus it may be necessary to reduce the load on the motor when one supply line is interrupted, in order to avoid over-heating and possible burn-out of the windings, or the over-current releases tripping the starter.

The current is no longer equally distributed in the three phases of the stator windings, so that they produce peak magnetic fluxes of different values in different parts of the stator at different instants. However, the induced currents in the rotor conductors also create magnetic flux which combines with the stator flux to produce a resultant flux which still revolves round the stator at synchronous speed, although its strength changes somewhat as it travels round the stator. In its passage round the stator the revolving magnetic flux induces three-phase voltages in the distributed stator windings, in spite of the fact that the motor is running from a single-phase supply derived from two phases only of a three-phase supply. These three-phase voltages, of supply frequency, exist at the three stator terminals of the motor, and can be used to feed other three-phase motors which will themselves be self starting when switched on to the stator terminals of the three-phase motor running from a single-phase supply.

The Simple Ferraris-Arno System and its Limitations

This is the principle of the Ferraris-Arno system whereby a three-phase squirrel-cage or preferably a slip-ring motor can be used as a single-phase to three-phase converter, It is, in fact, possible to run a three-phase motor on a machine direct from a single-phase supply of the correct voltage and frequency, provided means can be adopted to start the motor. Owing to the changed current distribution in the stator windings, however, the motor would be liable to overheat and possibly burn out if the motor was run on more than about 60 per cent. of its rated horse power.

It is, however, possible to use a three-phase load motor up to about 67 to 70 per cent. of its rated horse power when supplied through a three-phase induction motor of adequate size operating as a single-phase to three-phase converter. The master or pilot motor should have a rating of at least twice that of the largest three-phase motor to be fed from it. In practice where a pilot motor serves several three-phase motors the rating of the pilot motor is often about 10 to 15 per cent. of the total rating of the three-phase motors which are connected to it. It will be appreciated that if a three-phase pilot motor fed from a single-phase supply supplies three-phase motors the latter machines will also act as single to three-phase converters once they have been started from the pilot motor. The three-phase voltages obtained from the pilot motor will not be exactly equal on load, partly due to the volt drop in the stator windings. The voltages V_1 and V_2 indicated in Fig. 1 may be about 85 to 90 per cent. of the single-phase line voltage V on full load. If the three-phase voltage required differs from the voltage of the available single-phase supply the required three-phase

voltage can be obtained by passing the output of the pilot motor through a transformer, or auto-transformer, of suitable ratio. Where several three-phase motors are fed through a pilot motor they may be rated up to 75 to 80 per cent. of the rated horse power if they are seldom fully loaded simultaneously.

Improved Pilot Motor System

The pilot motor itself may be used to provide mechanical power up to about 25 per cent. of its rated horse power, as well as supplying a three-phase output. Where more than one three-phase motor is fed from the pilot motor, the load motors, especially those of high rating with low-impedance stator windings, will tend to become electrically overloaded, if they are called upon to drive more than about 75 to 80 per cent. of the rated horse power. This effect can be minimised if the third phase of the stator windings of the pilot motor is wound with more than the normal number of turns, preferably with tappings brought out to a switch. The increased voltage generated or induced in this phase then compensates for the impedance volt drop in this winding. If three-phase load motors are required to be run practically on their rated horse power without overheating when fed from the pilot motor, however, the latter motor should have a rating greater than the combined rating of the load motors, and should have no mechanical load.

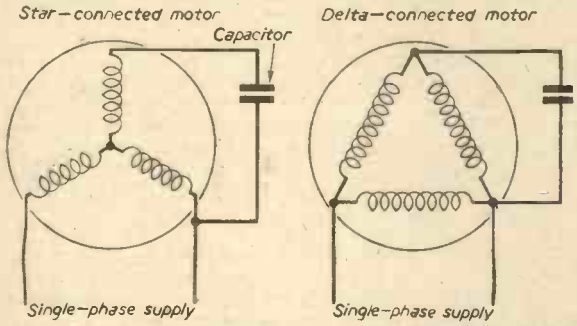


Fig. 3.—Capacitor methods of starting three-phase motors on a single-phase supply.

Methods of Starting a Three-phase Motor on Single Phase

So far no mention has been made of the method of starting the three-phase pilot motor from the single-phase supply. If the machine is quite small it can generally be started up by spinning the unloaded rotor round by a cord wound on the shaft, or by other means, before switching two of its stator terminals on to the single-phase supply. It should be noted that the phase sequence of the three-phase output from the pilot motor is determined by its direction of rotation; this means that the three-phase load motors will start and run in the opposite direction when switched on if the rotation of the pilot motor is reversed.

Fig. 2 shows one method which may be employed to start the three-phase motor from the single-phase supply. This utilises a single-phase transformer with its secondary windings wound in two halves which are connected to the motor as shown. The centre point of the primary winding of the transformer is connected to a phase-splitting device comprising the resistor R and the choke coil L. The motor is started by closing the switches S_1 and S_2. The phase-splitting device creates a phase displacement to start the motor. Once the motor has been run up to speed the switch S_2 is opened.

Capacitor Starting

Another method of starting a three-phase motor from a single-phase supply utilises a capacitor for creating a phase displacement of the voltage applied to the third stator terminal, as indicated in Fig. 3. Fig. 3a refers to a motor having star-connected stator windings, whilst Fig. 3b refers to a motor having delta-connected stator windings. The value of capacitor used to create the best starting torque depends on the design of the motor and is best found by experiment. Once the motor has been started it is an advantage to connect a capacitor of lower value in place of the starting capacitor. A running capacitor of about 7 μF per horse power may be suitable for a 415 volt motor, or about 21 μF per horse power for a 240 volt motor.

Such methods can be used to start a three-phase pilot motor or to start and run a three-phase load motor directly from a single-phase supply. However, when a three-phase load motor is used directly from a single-phase supply in this way it should not be loaded to more than about 80 per cent. of its rated value in order to avoid overheating. Furthermore, the maximum, or pull-out, torque developed by the motor may only be about half that obtained when the motor is fed from three-phase mains, which is undesirable for a motor which may be subject to peak loads of high value. It may be possible to use a three-phase 415 volt motor on 240 volt mains if the stator windings are connected in star, by reconnecting the stator windings in delta.

Use of Capacitors on Conversion System

More equal three-phase voltages are obtainable if the pilot motor is used as a capacitor motor, as indicated in Fig. 4. When the pilot motor is started up with no three-phase load motors connected to it the current through the capacitor causes the voltage of the third (artificial) phase to rise to more than that between the single-phase mains. When the load motors are switched on the power fed through the capacitor is practically constant; on increased three-phase load, this power tends to pass through the three-phase load motors rather than through the pilot motor. On further increase of load an increasing amount of power is supplied to the third phase from the single-phase mains through the pilot motor.

In this way the capacitor acts as a phase converter of fixed rating, whilst the pilot motor passes a varying amount of positive or negative power, depending on the three-phase load. On no load, the voltage between L_3 and L_1 exceeds that between L_1 and L_2, the voltages tending to become equal as the load rises to a certain value. Further increase of load past that point causes the voltage between L_3 and L_1 to fall below that between L_1 and L_2. If the voltage difference exceeds the desired amount another converter may be connected in parallel with the first. However, a still more constant voltage on varying load may be obtained by using capacitors of variable capacitance which can be switched on and off as required.

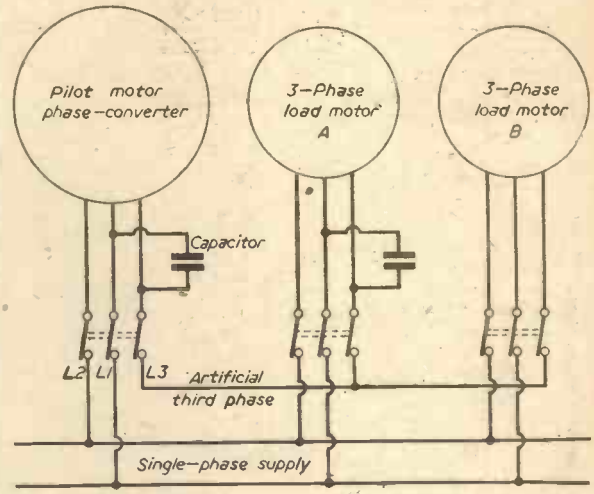


Fig. 4.—Use of phase-converter for feeding three-phase motors from single-phase mains.

Fig. 4 shows a converter or pilot motor which is used to supply two three-phase motors A and B. It will be noted that a capacitor is provided in parallel with one phase of the stator windings of the motor A, thus the capacitance between the lines L_1 and L_3 is automatically increased when this motor is switched on. By using capacitors with the motors in this way the efficiency and power factor of the system is improved, and when the pilot motor is run unloaded and has a rating not less than half the sum of the total ratings of the three-phase load motors the latter motors can be run on practically their rated horse power.

A Distribution Panel *for the* Darkroom

Wiring Details are Given by C. A. Oldroyd

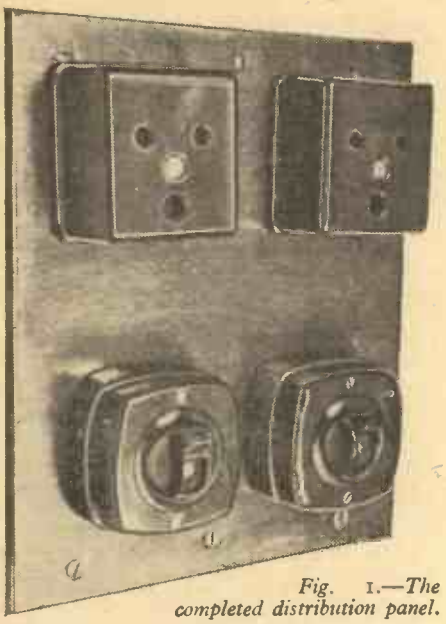


Fig. 1.—The completed distribution panel.

AMATEURS who use the kitchen as a darkroom will, usually, have only one electric outlet available. Normally this is used for a vacuum cleaner, a small fan, or a radiator. In some cases the socket of the kitchen lamp provides the one and only outlet, and using this can be dangerous as no earth connection is provided as with a three-pin socket. How an additional earth lead can be fitted, when using a lampholder as outlet, is described later.

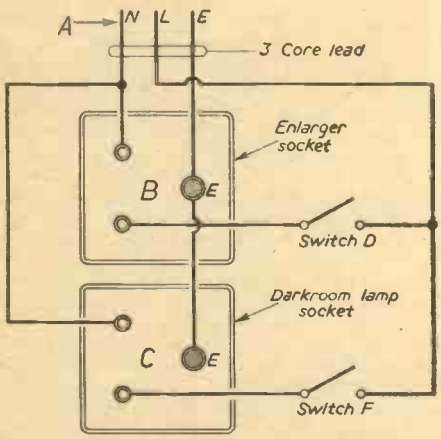


Fig. 2.—Distribution panel wiring.

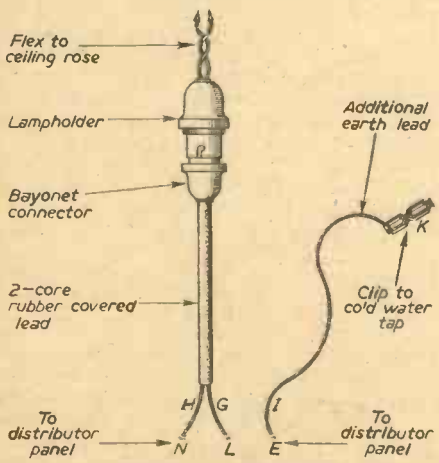


Fig. 3.—Connecting the distribution panel in the bathroom.

Securing Two Outlets

Even if a regular three-contact outlet is available, it provides only one connection, and it is preferable to have two outlets, one supplying the enlarger the other the darkroom lamp. To duplicate the outlet in this fashion a simple distributor can be made up, as shown in the photograph, Fig. 1, and in Fig. 2. The two outlets are controlled by two switches; this allows the darkroom lamp to be switched off when focusing the enlarger. Critical focus is more easily obtained in total darkness. Another advantage of the distributor panel is that much shorter leads can be used for enlarger and darkroom lamp connections than when these leads run to the only available outlet in the room.

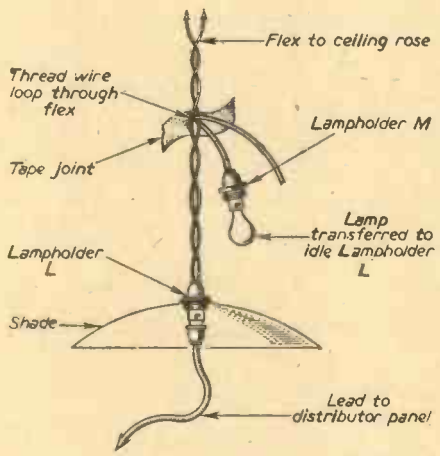


Fig. 4.—Using an "idle" lampholder.

The wiring of the distributor panel is shown in Fig. 2; A is the connecting lead to the outlet, preferably three-core cab tire cable. N is the neutral lead, L the live one, and E the earth connection. Switch D controls socket B, and switch F the socket C. The panel of the distributor was made of seven-ply wood and at the two narrow sides ¾in. square battens were fitted to the underside, thus keeping the rubber-covered connecting wires well clear of the work table.

The white light available from the lamp fitted in the kitchen is very useful for the setting up of the gear, checking temperatures with a thermometer, and examining fixed prints.

Using the Bathroom

For the amateur who *must* use the bathroom for his printing and enlarging, the only available outlet, as sketched in Fig. 3, will be a lampholder suspended from the ceiling. This outlet is tapped with a bayonet connector in the lampholder and a two-core, rubber-covered cable. The two leads G and H are connected to the distributor panel as before, but an additional earth lead I must be provided. This is connected to the two contacts E in Fig. 2. The free end of the lead is fitted with a large clip K which grips the body of the cold water tap. Suitable clips are the type used for connecting wires to car batteries; they not only make good contact, but, being plated, this efficient contact is maintained in use.

"Idle" Lampholder

With an arrangement as described above the lamp must be taken out of the lampholder when the bayonet connector is to be inserted. A simple tip to save trouble, and broken lamps, is illustrated in Fig. 4, and merely consists of providing an additional "idle" lampholder M close to the one in regular use, L. A short loop of insulated wire is threaded through the flex lead going to the ceiling rose, with the bared ends fixed to the lampholder contacts in the usual way. (Of course, no electrical connection is made to this holder in any way.) The "idle" holder should be high enough to clear the shade. Tape the joint where the loop passes through the flex to prevent the loop working downwards. It is now a simple matter to take the lamp out of L, and insert it into the "idle" holder M where it will be safe until replaced into L.

The earth lead is, of course, of no use unless it is efficiently connected to the metal parts of an enlarger lamphouse, the frame of a metal darkroom lamp, and—if used—to the structure of the additional lamp providing white light. In the latter case three sockets should be fitted to the distributor panel, but no extra switch will be needed as most lamps have their own built-in switches.

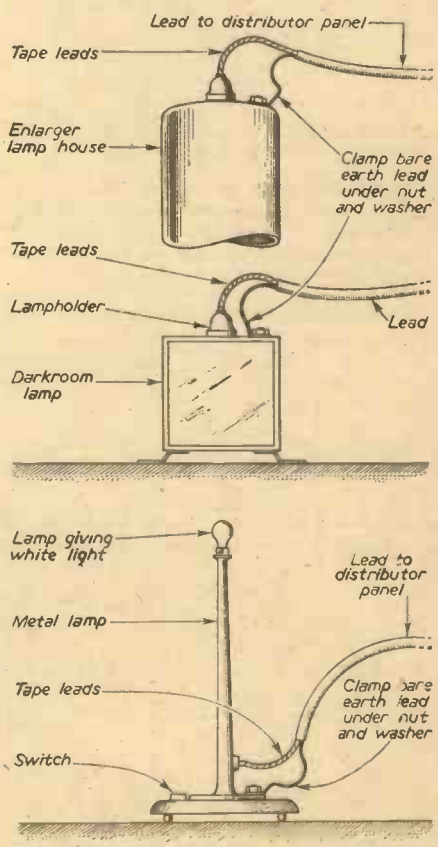
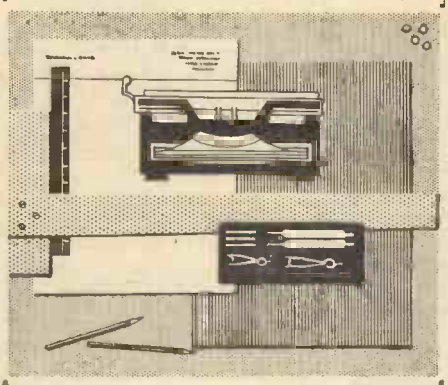


Fig. 5.—Electrical precautions in the improvised darkroom.

The suggested precautions are sketched, as a reminder, in Fig. 5. They may appear rather elaborate; but it pays to be careful with electricity in the improvised darkroom.

DRAFTING COMPLETE SPECIFICATIONS

By "Patent Agent"



Some Advice to the Inventor and Prospective Patentee

EITHER at the time of filing a Patent Application or at some time thereafter, a Complete Specification has to be filed and it is the content and form of this document more than anything else which determines the value of the Patent Grant accorded to the application. Indeed, the content and form of a Complete Specification can decide whether any grant at all of Letters Patent will be made in respect of the application. Where a grant is accorded the Complete Specification, including as is does the claims defining the scope of the monopolistic right granted, is the most important criterion in legal proceedings affecting infringement and validity of the patent.

Infringement of Patent

Usually when a patentee takes action in the Courts for infringement of his patent the defence to the action is two-fold. The defendant alleges that infringement has not taken place because on the one hand the acts complained of fall outside the monopolistic right which the patentee alleges he possesses by virtue of the claims of his patent and, on the other hand, if the acts complained of do fall within the alleged monopoly, that monopoly is invalid.

It follows from this that a patentee must be most careful in the wording of his specification to ensure that the statement of claim defining his monopoly is wide enough to prevent potential infringers performing the invention whilst escaping the terms of that statement. Also, the wording of the claims must not be so widely framed as to embrace things which will not work or things which were known before the date of the invention since in either of these eventualities the monopoly will be invalid.

The definition of the permissible limits of the claims is therefore of considerable importance and most skilful drafting is required in this and in other parts of a Complete Specification if the rights of the patentee are to be rendered effective.

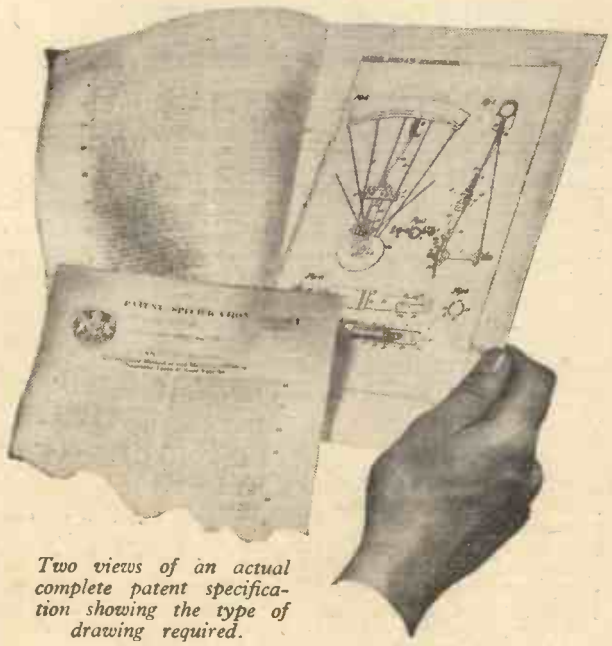
Claims

Before embarking upon the preparation of a Complete Specification it is clearly desirable that one should appreciate the standard of drafting which one has to achieve and this standard can be inferred from a knowledge of the rules which a Court will apply if and when it is called upon to attach a meaning to the monopoly claimed in the specification. A specification must be read as a whole and in the light of surrounding circumstances, regard being had to whether particular words used in the specification bear an unusual meaning. The function of the claims is to define clearly and with precision the monopoly claimed so that others may know the exact boundaries of the area within which they will be trespassers. Their primary object is to limit and not extend the monopoly. The claims must be read as part of the entire document and the forbidden field must be found in the language of the claims and not elsewhere. A patentee who describes an invention in the body of a specification obtains no monopoly unless it is claimed in the claims.

In addition to an appreciation of the rules of construction which set the standard to be achieved in a Complete Specification it is imperative that what is meant by a patentable invention should be fully understood before attempting to draft the specification and claims. This has been discussed in the article in the November issue relating to the preparation of Provisional Specifications.

Provisions of the Patent Act

Armed with a knowledge of the standard of drafting required and of what constitutes a patentable invention one can now turn to the provisions of the Patents Act 1949 relating to the requirements for Complete Specifications. These provisions fall into two classes, namely, express and implied provisions. The express provisions can be summarised by saying that every Complete Specification shall begin with a title; shall particularly describe the invention and the method by which it is to be performed; shall disclose the best method known to the applicant of performing the invention; and shall end with a claim or claims defining the scope of the invention. The claim or claims of the Complete Specification must further be clear and succinct; relate to a single invention; and be fairly based on the matter disclosed in the body of the Complete Specification.



Two views of an actual complete patent specification showing the type of drawing required.

Apart from these express provisions the Patents Act 1949 permits opposition and revocation proceedings to be commenced on a number of grounds and it is clearly the duty of the specification draftsman to do all he can to avoid such proceedings being commenced. The grounds of opposition and revocation insofar as they affect the content and form of the Complete Specification may suitably be grouped as grounds which are inherent in the specification itself and grounds which arise from relationship between the Complete Specification and the state of knowledge prior to the Complete Specification, this knowledge being evaluated from prior publications, prior patent rights and prior usage.

From a consideration of the express provisions of the Act, a Complete Specification would seem to comprise four parts, namely, a title, a description of the invention, a particular description of the best method of carrying out the invention, and a claim or claims defining the scope of the invention.

The approach of the specification draftsman to the parts of the specification involving the description of the invention and of the best method known of performing the invention, may be inferred primarily from the fact that it is a ground both of opposition and revocation that a Complete Specification does not sufficiently and fairly describe the invention and the method by which it is to be performed.

Addressees

In sufficiently and fairly describing the invention one has always to bear in mind the addressee of the specification. According to a judgment in a leading case, "a specification may be considered as addressed, at any rate primarily, to the persons who would in normal course have to act on the directions given for the performance. These persons may be assumed to possess not only a reasonable amount of common sense but also a competent knowledge of the art or arts which have to be called into play in carrying the patentee's directions into effect." In the same judgment it was made clear that more than one addressee may be required to put the invention into effect. For example, a chemist and an engineer may have to co-operate in the performance of an invention.

One can, therefore, presume a certain technical skill on the part of the person who reads the description with a view to carrying out the invention and a useful guide to the specification draftsman on the question of sufficiency is that he should describe the invention in so much detail as will permit its performance by persons skilled in the relevant technical subject-matter without further acts of invention. The courts have appreciated that certain design or even experimental work may have to be carried out before an invention disclosed in a Complete Specification can be carried out. Usually, for example, the drawings of a Complete Specification cannot and are not expected to be suitable as working drawings. Also it is not generally necessary to state the advantages of the invention except where the whole essence of the invention resides in the attainment of a particular advantage.

The burden on the applicant to disclose the best method known at the time of performing the invention is intended to ensure the good faith of the applicant. In the case where two methods of performing the invention are known it may be possible

by describing one of these to prevent access to the benefit of the other and thereby force upon the public an expensive and difficult process whilst keeping back a simple and cheap one. If such circumstances were proved in court, the patent would be invalid.

Turning now to the considerations to be borne in mind when drafting the claims of a Complete Specification it is necessary first of all that the claims should be fairly based on the matter disclosed in the specification. In other words, a claim should not be more extensive than what is described as being the invention.

In a famous case the description of the invention was concerned with a thermionic valve used to provide an improved form of amplifier. The main claim, however, was directed to the valve *per se* and was held to be invalid because it was not fairly based on the disclosure inasmuch as the claim should have also specified and been limited to the features which enabled the valve to be used in an amplifier.

Each claim must also be sufficiently and clearly defined so that a person skilled in the relevant subject-matter can ascertain whether or not a given apparatus or process falls within the claim. A patent can be revoked for uncertainty or ambiguity in the claims. Usually such words as "large" "small" "near," etc., should be avoided in claims unless it is certain that words of this kind will bear a definite meaning and the meaning intended to the competent reader of the specification.

However, the use of such words as "substantially as described" or "substantially as described and shown in the drawings" does not render a claim bad for ambiguity. Such expressions have frequently been considered by the courts and in one famous case the House of Lords decided that the only valid claim in a particular Complete Specification was one which was worded in this fashion. The safe view to be taken with regard to so-called omnibus claims which include expressions of this kind is that they will be construed narrowly by the courts and should, where drawings are filed, include a reference to the drawings.

A claim which defines an invention by the result to be achieved is not invalid for ambiguity so long as the result necessarily involves the introduction of some special feature into the integers of the claim. Often the only feasible way of obtaining suitable protection for an invention is to employ claims which are drawn in this manner.

Inutility

A further ground on which a patent may be revoked is that the invention so far as claimed in any claim of the Complete Specification is not useful. The word "useful" has come to bear a very definite meaning in Patent Law and relates solely to the scope of the claim. Inutility, as this ground is colloquially termed, should be distinguished from another ground on which a petition for revocation might be filed, namely false suggestion, which is the making of promises in the body of the specification which cannot be fulfilled in practice. As distinct from false suggestion, inutility means that a claim includes within its scope something which is not useful for the declared purposes set forth in the body of the specification. A patent is not bad for inutility if it is not commercially a success nor is it bad on this score because, owing to a later improvement, it is not used. Provided that everything within the claim fulfils the purpose declared in the specification the test of utility is satisfied.

As regards false suggestion, a patentee by an over optimistic promise of results in the descriptive parts of the specification may induce the belief that his claims are valid and may thus persuade people to take licences. A Complete Specification containing such deceiving promises will generally be invalid.

The Act provides that a claim will be invalid if it has been claimed in a valid claim of earlier priority date. It follows that if the specification draftsman is aware of any prior grant he must clearly distinguish his claims from those of the prior grant. In this connection the claims will not be considered as sufficiently distinguished if the only differences between them concern features which would be incorporated as matters of common general knowledge by persons performing the invention of the earlier claim.

It must be remembered when considering prior claiming that the priority of a claim is the date on which the matter on which that claim is based was first disclosed. Where a Complete Specification is filed after a Provisional Specification or, under international arrangements, in pursuance of an invention for which protection was first sought at an earlier date in an overseas territory, the priority date of some or all the claims may be earlier than the date on which the Complete Specification was filed.

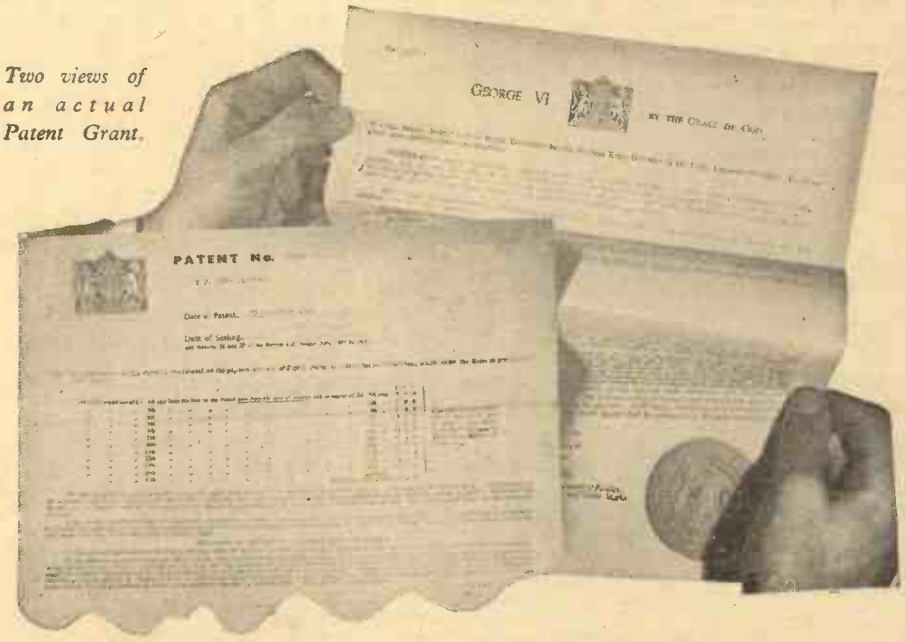
Prior Use

With regard to prior publication and prior user, the Act provides, as a ground of opposition or revocation, that a claim of a Complete Specification is invalid if it was known or used before its priority date. There are restrictions in the Act which deal with the classes of documents and the kinds of use which cannot be relied upon for supporting allegations of prior publication and prior user but, speaking generally, if the specification draftsman is aware of prior publications or prior users he should take care to see that his specification and claims disclose a patentable advance over what was known or used. This statement should, however, be treated with the greatest caution. If the Complete Specification does disclose something as being known either by way of a prior publication or a prior user, the Courts will hold a patentee to such a disclosure and, if it was made in error, the patentee could, as it were, by not having disclosed a patentable advance over the disclosure of prior art, talk himself out of valid protection for the invention. It follows, therefore, that where there is doubt about the merit of an invention in relation to a particular prior publication or user, the safest step is to omit from the Complete Specification any reference to that publication or user. It may be mentioned that as regards prior publication of an invention this has to be found in a single document and the specification draftsman should not, therefore, make statements of prior art which are based on mosaics of prior documents.

Following on from these considerations there is another ground of opposition and revocation, an examination of which leads one to the same conclusions. It is provided that a claim will be invalidated if it is obvious and clearly does not involve any inventive step having regard to what was known or used before the priority date of the claim. The determination of whether an invention is obvious has frequently caused difficulty before the Courts.

Summary

Having traversed the express and implied provisions of the Patents Act 1949 which are relevant to the form and content of Complete Specifications, the approach which should be adopted by the specification draughtsman can be summarised. First, a clear appreciation of the rules which govern the construction of such documents should be possessed together with a knowledge of what kind of inventions are embraced by the statute. The specification should be written in four parts, namely, a title, a description of the invention, a description of the best method of performing the invention, and a claim or claims defining the scope of the invention. The best practice is to draft the claims first so that one can ensure that the rest of the specification embraces sufficient disclosure of all the claims. Having drafted the claims, the description of the invention can be written and this will generally take the form of setting out the problem which the invention circumvents followed by a description of the invention itself. The problem which the invention deals with may be written in terms of disadvantages of prior proposals for dealing with the same or a similar problem. The statement of the invention which follows the analysis of the problem should be coterminus with the main claim or claims since, if it is narrower than these, the patent may be invalid for excessive width of claiming. In describing the best method of performing the invention, which is usually done with reference to drawings, it is generally advisable to describe the whole structure of an embodiment of the invention and follow this with a des-



Two views of an actual Patent Grant.

cription of the mode of operation. Advantages which are of the essence of the invention should be included here but the promise of advantages should clearly be realisable.

Checking the Claims

The descriptive parts of the specification should then be checked to make sure they disclose fairly the matter claimed and that they contain adequate instructions for the skilled addressee to perform the invention. Also, any dubious promises of results should be excised. Finally, the claims should be checked individually to ensure that they are each delimited to what is useful for the purposes declared in the specification; that they are succinct and free from ambiguity; that they are wide enough to prevent the invention being performed in any manner which escapes their scope; that they relate to a single invention; that they distinguish clearly from any known prior patent grant which may be valid; that they disclose a definite advance over any instances of prior art which are known and, particularly, which have been referred to in the specification; and that the advance over the prior art is not obvious.

Drawings

Drawings when required for a complete specification must conform to official rules in a number of respects. In the first place, they must be prepared on a good quality drawing paper, on sheets each measuring 13in. from top to bottom and either 8in. or 16in. wide. More than one sheet may be used to accommodate the number of figures required to illustrate the invention. The larger sheets of 13in. × 16in. are required for figures which cannot conveniently be drawn on the preferred smaller sheets of 13in. × 8in. In either case, the figures must be drawn in an upright position with respect to the 13in. side dimension of the sheet. The drawings must be prepared in durable, waterproof ink with firm lines. Sectional views must have the parts in section indicated by spaced section lines or cross-hatching and not by solid black. The number of figures must be sufficient to illustrate all the features of the invention. Each sheet should contain as many figures as needed without crowding and a clear ½in. margin must be left around each sheet. It is usual to omit centre lines on the figures. In the case of sectional views, it is necessary to indicate on the appropriate figure the section line on which the sectional view has been taken. It is frequently helpful to employ one or more perspective views to provide a good and clear illustration of the article or machine comprising the invention. It is not necessary for the figures to be drawn to scale, although this is desirable. Wording to indicate that the figures are to scale may not be placed on the drawings which, in general, must not bear any descriptive matter whatsoever. If, however, the invention relates to a number of instruments or units and each of these is shown diagrammatically, it is permissible for the drawings to bear descriptive matter to identify the instruments or units and their interconnections.

Drawings must be prepared in duplicate. One copy, termed the Original, must bear reference letters or numerals in durable, waterproof ink and not less than ⅛in. in height in order to identify the correspondingly numbered parts referred to in the descriptive portion of the Complete Specification. The second copy, termed the True Copy, must bear corresponding reference letters or numerals in black-lead pencil. As an alternative, two True Copies may be furnished, one being entirely without reference letters or numerals and the other being a soft paper print with reference letters or numerals in black ink. The Original drawings may be hand-made, in which case the True Copy drawings may be tracings. The Patent Office will, however, accept drawings made by photo-lithography.

Each sheet of the drawings must bear at the upper left-hand corner the name of the applicant followed by the number of the patent application and year, and at the upper right-hand corner a statement of sheets used, whether the particular drawing is an Original or True Copy and the number of the sheet. In addition, the signature of the applicant or his agent must be placed at the bottom right-hand corner of each sheet. The title of the invention does not have to be given on the drawings.

Professional Guidance

To draft a Complete Specification with regard to all these considerations is a task which is beyond the competence of people who have not been professionally trained or people who have not made a thorough study of the statutory provisions and the case law by which those provisions are interpreted. Those who cannot genuinely be said to have made such a study should always seek professional guidance in their search for patent protection.

BOOKS Received

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

The Nuclear Handbook. Consulting Editor O. R. Frisch, O.B.E., F.R.S. 650 pages approx. Price 50s. net.

THIS work is intended to provide the nuclear physicist with a day-to-day reference book and to this end contains basic information in condensed and tabulated form. A distinguished panel of highly qualified authors contributed the 19 separate sections, each one a recognised authority in his field. Both the scientist engaged in pure research and the technician dealing with nuclear physics from the point of view of its practical application will find this book of immense value. The comprehensive list of contents in the first few pages and the index at the end of the book will help the user to find the information he is looking for with the minimum of delay, whether it relates to basic theory or some other associated field.

Newnes Complete Amateur Photography. Edited by M. Lillington Hall. 387 pages. Price 30s. net.

THIS is a book for everyone who is interested in photography, from the beginner to the expert. The beginner can read through it without being confronted by jargon he cannot understand, technical terms being explained as they appear. The experienced photographer will be able to use this book to fill the gaps in his knowledge and perhaps as a guide to extend his photography into new fields. An impressive list of experts has been drawn on for contributions to the book, particularly the more specialised material. The aim is to provide a work, complete in itself, starting with fundamentals and covering the subject right through to the finished print, but still not forgetting some of the more specialised side branches of the hobby. Many drawings and photographs are included and there is also a comprehensive index.

Retail Pharmacist's Handbook. Advisory Editor H. G. Moss, M.P.S. 464 pages. Price 45s. net.

THIS is intended to be a standard work of reference for the bookshelves of both the established pharmacist and the man who contemplates setting up on his own in the future, helping the established man to keep up to date and giving valuable advice on essential matters to the prospective shop owner. A distinguished panel of authors has been drawn upon for contributions, each being an expert in his own field. There are three sections: A (the shop) surveys shop fronts, sunblinds, fittings, aids to display, the dispensary, lighting, heating and ventilating, as well as dealing separately with each counter, i.e., surgical, photographic, etc.

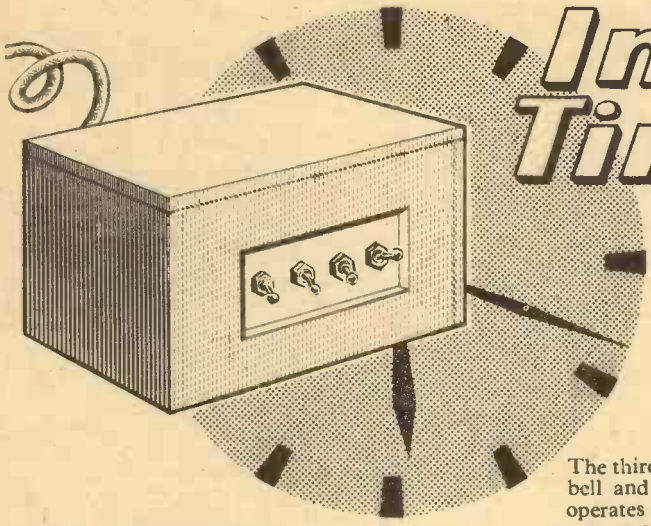
Section B deals with staff recruitment and staff training.

Section C deals with administration and includes information on general organisation, building goodwill, stock control and buying, buying or selling a pharmacy, starting a branch shop, forming a private limited liability company, accountancy, insurance and pension schemes and legal aspects. The book is extensively illustrated.

Water Treatment. By G. F. Mugele and A. Wiseman. 141 pages. Price 21s. net.

WATER in its natural state is almost invariably polluted and must be purified and treated before it is fit for human consumption. This book deals with the methods in use today and discusses the advantages and disadvantages peculiar to each. Increased consumption makes greater reliance on river water necessary and river water is subject to gross pollution. Methods of eliminating this pollution and of rendering the water more acceptable chemically are described in this book. The aspects surveyed are : collection and storage, filtration, chemical and other methods of treatment, swimming baths, synthetic detergents, mussel control, chemical and physical estimations.

A bibliography and index are included as well as several drawings and photographs.



Installing a Time Switch

H. B. Wilson Describes How to Adapt This Device to Your Own Requirements

THIS time-switch box has been in regular use since 1950. It consists of a wooden box with a lid and contains the time switch and an electric bell (see Fig. 1). The box was obtained as government surplus and varnished, but any box of the right dimensions or one specially made for the purpose would be suitable.

At the rear of the box there are two 2-amp. sockets and part of the front has been cut away to hold a piece of sheet aluminium containing four panel switches. The first two switches are on/off switches controlling whatever happens to be plugged into the sockets, say, a wireless and lamp, but these switches are not necessary if the apparatus which is plugged in have their own switches. The third switch controls the electric bell and the fourth switch, which operates from left to right and is two way, puts the time switch either in or out of circuit. If apparatus is permanently connected this switch is necessary for using apparatus at times when the time switch is in the off position.

If the time-switch box is placed in a bedroom, the alarm only need be used. The bell can be a direct off mains type as used in the prototype, or can be used in conjunction with a transformer in which case a larger box may be required. A buzzer could also be used. The alarm will go on ringing until switch number three is put off or until the time switch cuts it off which would be about half an hour afterwards assuming the shortest on/off period was used. This is an advantage over ordinary alarm clocks as far as heavy sleepers are concerned. Others may prefer to be awakened by a lamp and/or wireless.

The time switch can be used in a living-room to switch on the news or a favourite programme. The prototype time switch is a 2-amp. type, and a suitable circuit for it is shown in Fig. 2, but since it was made 5-amp. types have become available.

By using one of these, a 1 kilowatt electric fire could be switched on in the early morning thus warming a living-room. A three-pin plug would have to be used for this and a modified circuit is given in Fig. 3. Of course, the electric alarm need not be included in the box but could be kept separate and plugged in at the back. Fig. 4 shows a circuit suitable for this.

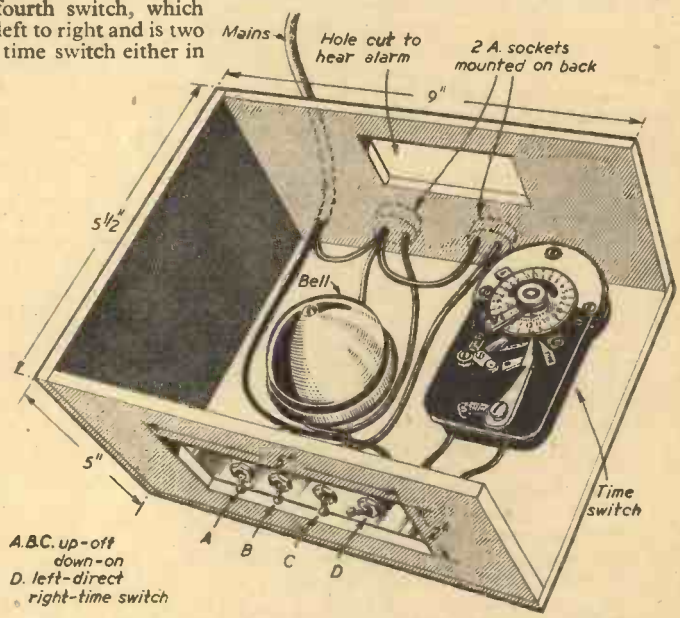


Fig. 1.—The time switch and bell are contained in a plain wooden box with a lid (not shown).

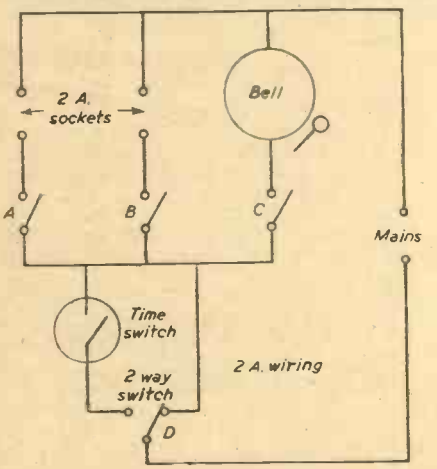


Fig. 2.—A suitable circuit for a prototype time switch.

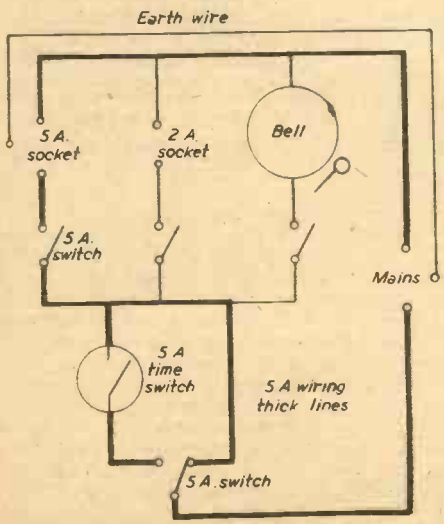


Fig. 3.—A modified circuit for a three-pin plug.

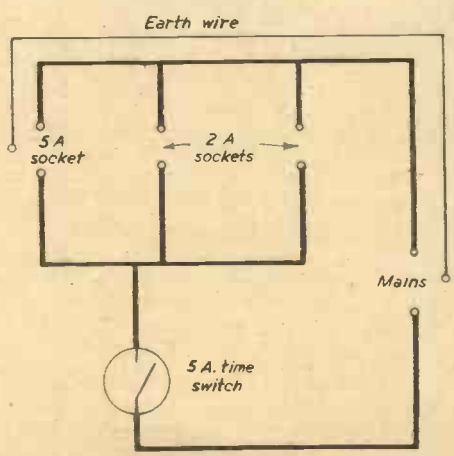


Fig. 4.—A simple circuit for when the alarm is not included in the box.

Construction

The bell is screwed to the box using the holes provided and the time switch is held in one corner of the box by two small strips of wood and prevented from lifting if the box is accidentally turned upside down by a bracket made from aluminium.

The aluminium sheet is held to the inside face of the box by screws. Wires are soldered to the panel switches and to avoid soldering, ordinary wall type switches would have to be used.

The time switch is available from J. Donohoe, 6, George Street, North Shields, Northumberland. It is a 5 amp. Venner at 53s. 6d.

Switches, sockets, bell or bell and transformer or buzzer and connecting wire are available from any good electrical shop.

Fig. 1.—Here the water acts only as a support for the tug.

Photographing Water

How This Element Can Add Interest to Your Pictures

By Arnold E. Bensusan

INEVITABLY, water features largely in many pictorial and record photographs. Lakes, rivers, streams and the sea, all draw the photographer like a magnet and with very good reason. There is some indefinable attraction about the sparkle of moving water and the quiet, soothing atmosphere of a still pool, and both form excellent stimuli for photography.

Lighting Angle

Water is, by its very nature, of little interest in the photographic sense unless its surface, surroundings or other features provide the central theme of the picture, and this is where the correct choice of lighting angle becomes all important. Direct, frontal illumination tends to flatten the contrasts formed by the movement of the water, and this kind of lighting should be reserved for occasions when the water acts only as a supporting effect for the main subject matter, as in Fig. 1.

Here, the accent is on the movement of

Fig. 2.—An against-the-light picture which relies on the sparkle of the water.

the tug, drawing the barges away from the side of the ship, and the action is emphasised by the white-tipped bow and stern waves which show the direction of the movement. The water beyond in the background is of little interest, and the flat lighting ensures that it does not take undue prominence.

There are other occasions when water must play a far larger part in the composition and attraction of the picture, and a photograph of this type is shown in Fig. 2. Imagine this picture with frontal lighting. The water would have an overall lighter tone, as would the hull and sails of the boat. The trees in the background would be lighter, and the effect of the sun shining through the clouds would be lost. With low, back lighting, a light patch of water extends right back into the picture area, silhouetting the boat and enabling the mast and sail to provide a link between the water and the sky. The evening sun, glistening on the water, adds the feeling of movement so necessary for a picture of this nature.

Use a Lens Hood

An efficient lens hood should always be used for pictures which include water, as the amount of reflected light is considerable. Where back lit water is concerned, the need is even greater and it is wise to take a further precaution by waiting for the sun to be obscured by a cloud, or by keeping it well away from the area covered by the camera lens. So far as the subject will permit, use a relatively slow shutter speed to catch the slightly blurred effect of the moving water. Where possible, 1/100th second should be employed but fast moving subjects may need, say, 1/250th of a second. The principal subject matter should, of course, be sharply focused but the foreground and background may be left to run slightly out of focus.

Reflection Pictures

Perfectly still water also provides interesting subject matter for pictorial photography and, in this case, the mirror effect of the surface may be used to good advantage. Then, the accent will usually be on the well-defined reflections obtained, and an example of this kind of picture is shown in Fig. 3. Lack of sharpness is only permissible in the far distance for, generally, the impression of a clear reflection must be retained. Frontal lighting is desirable, for it will not show up any small pieces of floating material, or any slight ripples.

Exposures for water photography should not be over generous, as the usual requirement is to retain some tone in the highlights but not necessarily to record a large amount of detail in the shadows. This applies particularly to against the light shots which rely on the water for the main subject matter, as the attraction is almost entirely in the sparkle of the water. Similarly, over-development of the negatives should be guarded against, or the contrast will be raised to an unmanageable degree and the highlights will not print through on to the paper without losing all the detail in other parts of the picture.

Since sharpness is so essential to the success of shots which include water, any trace of movement of the camera during exposure must be eliminated. Use a rigid tripod whenever possible and trip the shutter with the aid of a fairly long cable release.

Never print pictures of water on a smooth, matt paper. They will immediately lose all

Fig. 3.—This picture mainly features the reflections of the trees in the water.

their sparkle and, thus, their principal attraction. A glazed surface glossy paper is the first choice but, failing this, a velvet or semi-rough surfaced material with a high lustre can be used.

HOME MADE MUSICAL INSTRUMENTS

(*Concluded from page 220*)

deep. Make a wind-way as for the treble pipe. The slope on the bottom side of the opening should be only 3/16in. deep and should be blunt on the top edge.

Fit the mouthpiece cork and file on a flat as for the treble instrument. Trim off to be comfortable in the mouth.

Before proceeding to tune to the fundamental note, drill two tuning holes in the side of the pipe at a distance of 1½in. from the end of the tube.

The fundamental note is tuned to G, a fourth above the fundamental of the treble instrument. Calculate the distance up for the first hole as before, and then space the finger holes as shown in Fig. 35. The scale is that of G major shown in Fig. 36. The thumb hole is at the back but ¼in. lower than the top front hole.

Letters to the Editor

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

PROBLEMS OF THE UNIVERSE

Is Space Bounded?

SIR,—In your December issue Mr. J. Forster says: "If the universe began at a certain time what was there before that time?" and "If space is bounded what lies beyond the boundary?"

I venture to suggest that if both queries are correct, the answer must be "nothing"—not empty space. But is the human mind capable of defining "Nothing"? If space had a boundary how can the stellar universe recede at high speed into "nothing," or is it travelling in a huge curved space? Recent evolutionary theories suggest that: (1) the universe has started from a primeval gas cloud; that the universe has always existed and continuous creation is going on, viz., gas clouds, concentration into stars, decay and the process starting again.

With regard to Mr. W. Mills' statement in the December, 1958, issue, that water finds its own level, viz., a flat surface, Sir Alfred Russell Wallace proved that water in a canal showed a curved surface. That is, it followed the curvature of the earth as do the oceans.

Does a straight flat line exist only in our imagination? Einstein proved that light from the stars travels in a slight curve.—W. A. PATIENCE (Reading).

The Eclipse and the Planeists

SIR,—Mr. W. Mills, whose letter appeared in the December, 1958, issue, misconceives the problem.

Many years ago it was common knowledge in astronomical circles that a total eclipse of the sun would be seen along a curved line which could be fixed on the surface of the earth, passing through Strömstad in Sweden, at a definite time on 30 June, 1954. Directions for finding this line and date could be followed by any sixth-form schoolboy with a gift for accurate calculation. A necessity for this calculation was that it should be based on the spin of the earth round its own axis, and its rotation round the sun. If Mr. Mills wishes to convince any scientist that the earth is a plane, he will have to furnish a set of directions, on this assumption, enabling anyone to calculate the circumstances of the next eclipse.

I, and several thousand others, can testify that the eclipse of 1954 was seen from Strömstad at the appointed time. Can Mr. Mills produce a similar number of witnesses to the truth of his prediction?

Furthermore, the curvature of the earth means that one end of the Manchester Ship Canal from that city to Runcorn would be 16ft. below the straight line drawn as a level starting at the other end. Would Mr. Mills care to write to the engineers in charge of the canal, and ask them whether they know of such an error as the result of calculations which were based on what Mr. Mills considers a wrong assumption?—D. S. SPENCE (Hereford).

He Thinks the Earth is Flat!

SIR,—In the December issue, in "Letters To The Editor," I stated that water always finds its level, and you added the query, what about the tides?

What actually causes tides is neither here nor there. The fact that they ebb and flow clearly proves the above fact, otherwise there would neither be tides, nor currents in the oceans. There are no tides in lakes whatever their size.

According to the globe theory water never finds its level horizontally. All seas are great curved hills of water thousands of miles in extent, and thousands of miles high from the centre of the "globe," and wherever a person stands, that is his highest point, and on the sea he must always be looking *down*.

If you can make a heap of water in your garden in the same way that you can make a heap of mould, you are justified in believing the earth is a globe. Otherwise you may not. Some readers may think that gravitation is the answer, but that theory demolishes itself. If gravitation holds the oceans firmly on to the earth, there could neither be *tides, currents*, nor could rivers *flow down* to the sea.

For the above reasons I contend the earth must be a plane.—W. MILLS (London, N.4).

Comments in Rhyme

SIR,—With reference to W. Mills' letter in the December, 1958, issue:

Your letter, due to Mr. Mills,
With wonderment my spirit fills.
His arguments are of the sanest
Type, to issue from a Planeist.

For I observe with gratitude
He still believes in Latitude.
Which any sailor on the Seas
Knows to be measured in Degrees.

Since these are angular notation
Derived from vectoral rotation
We find the locus of each point
With circles pure in space, conjoint
To form a figure, known I fear
To mathematicians, as a Sphere!

Where may we find a man so able
To measure-up a billiard table
Not with a ruler, if you please,
But by a Sextant—in Degrees!

F. O. BROWNSON (Beds).

More Criticism of the Planeists

SIR,—I would be interested to know upon what reasoning W. Mills, whose letter appeared in the December, 1958, issue, bases his argument that if the earth is a globe, it would be impossible to get a line of 45 deg. or more to the sun from any latitude.

According to conventional astronomical theory, the sun's noonday altitude in latitude 51½ deg. N. (London for instance) varies between 38½ deg. and 62 deg. between March and September. I also do not see his point about the confused shadows on the sundial.

In terms of Planeist theories, how does one account for the necessity of making the angle of the sundials "style" agree with the latitude of the place in which it is set if correct time is to be recorded all the year round, whereas no adjustment has to be made for changes in longitude?

Results achieved in practice confirm or contradict the correctness of theories. For centuries, spherical trigonometry, which treats the earth as a globe, has consistently yielded results which navigators and astronomers both now, and for centuries past, know, and have known, they can trust.

Is there a Planeist equivalent of the Nautical Almanack?

It is more than two thousand years since Eratosthenes first measured the earth, and arrived at a result which does not differ widely from that accepted today. Centuries later, Kepler (1571-1630) established by observation the laws of planetary motion—laws which could only be refined by the great Sir Isaac Newton (1642-1727) who approached the same problem using his newly discovered law of gravitation. Some years later Henry Cavendish (1731-1810), using that same law, weighed the earth, and for its mass obtained a figure which if taken in conjunction with the size as established by Eratosthenes, will account for densities acceptable to geologists and others.

Is the unanimity of the results achieved by these men, and others, approaching allied fundamentals from different viewpoints, to be ignored, and lightly brushed aside in favour of theories "so simple that a child can follow them," as Mr. Mills claims?

Personally, I think not, and scientific considerations apart, what reason is there to suppose that Nature has moulded this planet much different from others? Although I keep an open mind on the question of flying saucers, I shall need a lot of convincing that I live on one!—V. D. BUTLER (Chester).

The Mystery of the Universe

SIR,—The mystery of the universe as conceived by the average person is the belief that matter has originated from nothing.

This is a conclusion which most people accept even without questioning whether there is such a state as nothing. It seems logical to me that you cannot create anything (matter) from nothing. The reasons are first, because there is nothing to create anything from and, secondly, because there is nothing to create anything with.

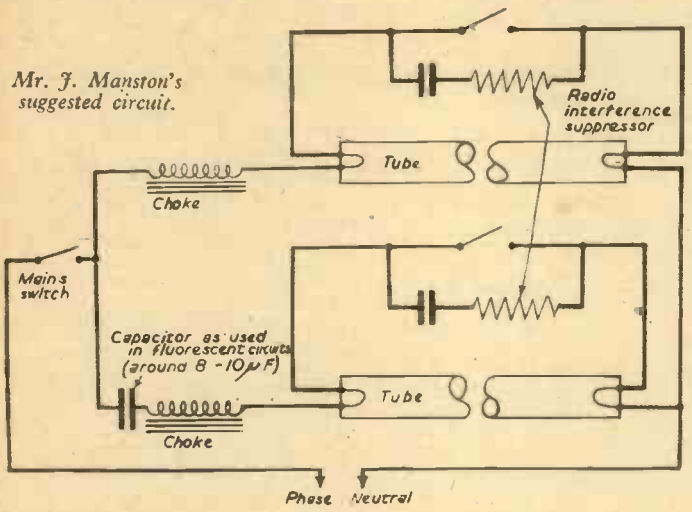
If this form of reasoning is valid then we are supposed to assume to the best of our intellectual ability that there is no such a state as nothing. If, being satisfied with these statements, then the only conclusion we can come to is that since matter does exist, and it has not been created, it must always have been there. Also we can't destroy matter (since we can't reduce it to nothing).

Therefore, matter can neither be created nor destroyed and this shows that the above conception of the mystery of the universe doesn't exist.

Some people also believe that matter is a phenomenon of the mind. If this is true then the mind must be something. If this is so, then the law still applies, since anything other than nothing (which doesn't exist) must be a form of matter.—J. WATERHOUSE (Clitheroe).

Phase Difference for Fluorescent Lights

SIR,—With regard to Mr. J. H. Jillings' query in the December issue, the split-phase circuit given below will eliminate stroboscopic effect. I have used this a great deal and have had no trouble. Both of the tubes should be of the same wattage and the chokes suitable for the tubes used.—J. MANSTON (Notts).



Mr. J. Manston's suggested circuit.

Extracting Hydrogen Gas from Water

SIR,—I should like to comment on your answer to Mr. Garland's query in the December, 1958, issue.

First, it is dangerous to electrolyse a salt solution because chlorine is given off at the anode and after further chemical reaction, hydrogen at the cathode. The oxygen is lost on the formation of sodium hydroxide. I am assuming that the salt used is sodium chloride or table salt.

In your answer it is also stated that a current of one amp. would take 85,000 hours to liberate the hydrogen from one gallon of water, or 8,500 hours if a current of 10 amps. is used. This statement is, I believe, wrong. One gallon of water weighs 10lb., 1lb. equals 450 grams., or in both cases very nearly. One gram of hydrogen is liberated by a current of 1 amp. for 96.470 secs., or for easy calculation, 100 secs. For every gram of hydrogen liberated 8 grams of oxygen are liberated, therefore, a current of 1 amp. for 100 secs. electrolyses 9 grams of water.

Since one gallon of water weighs 10×450 grams, a gallon at a current of 1 amp. would last $\frac{10 \times 450}{9}$ grams $= 10 \times 50$ seconds $= \frac{500 \times 100 \text{ (secs.)}}{60 \times 60}$ hrs. $= \frac{50 \times 10}{6 \times 6} = \frac{25 \times 5}{3 \times 3} = \frac{125}{9} = 13.888$ hrs.

I suggest, therefore, that a gallon of water electrolysed by a current of 1 amp. would last 13.888 hours.

Mr. Garland should use dilute sulphuric acidulated water for his experiments.—S. SEAGER (Staffs).

"Congratulations"

SIR,—I should like to add my tribute to the others received on the Silver Jubilee of PRACTICAL MECHANICS. I still have the 1936 Christmas number and, on looking through it again, I found an interesting article on power of the future, which contained the following statement: "Day by day, the world's resources of coal and oil grow less and less. There is, indeed, no doubt that a time will come when it will no longer pay to delve deep into the earth to bring up that increasingly scarce mineral, coal, or to sink deeper shafts up which to pump the last of nature's oil stores." That statement is interesting in the light of the recent news that it is proposed to close down hundreds of coal mines in Britain.

I was also interested in the description of F. J. Camm's Record All Wave Three radio receiver. I was in Bangkok, Siam, at the time I first read it and there was no broadcasting there in those days. I knew the Morse code and thought I could get some amusement if I had a small set. I applied for permission to operate a receiving set and still have in my possession the reply I received from the Siamese Post and Telegraph Department, stating that mine was the first application received and there was no law under which permission could be granted.

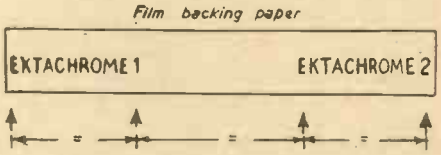
In conclusion, may I wish your magazine a successful future.—WILLIAM WELSH (Australia).

Doubling Number of Exposures

SIR,—Re D. E. Cragg's article in the December, 1958, issue.

I take 35 mm. size colour transparencies with my 120-2¼in. sq. camera by suitably masking the film and viewfinder—these I mount in 2in. × 2in. transparency holders which makes them most convenient for projection. The positioning of the film for taking the shots is very easily accomplished by buying Kodak Ektachrome film. This is simply loaded into the camera in the usual way and exposures taken on all numbers and letters E commencing the word Ektachrome which comes before each number on the backing paper, as will be seen below:—

Film backing paper



For black and white photography I use Ilford films, taking exposures on all numbers and first dots. This positioning can be readily checked by counting the number of clicks which the winding ratchet makes when winding the film to the next exposure position. These, of course, should decrease as the film is being used, but any two adjacent sets of clicks should not vary by any more than, say, two clicks.—HAROLD CLARKSON (Yorks).

BUBBLE TUBE LAMPS

(*Concluded from page 223*)

a few drops of the carbon tetrachloride added.

The previous procedure should now be repeated, but only *the top third* of the water must be heated. Care should be taken to avoid heating the glass above water level. As soon as the bung is in place, the tube may be tested by immersing the bottom in warm water. Providing that the top of the tube is cool, the bubbles should commence to rise almost at once.

A rubber corked tube (even a test tube) will work for many hours and is an interesting experiment. It will eventually fail through absorption of the active fluid by the rubber, unless this be of a synthetic, oil-proof variety.

Single liquid tubes, on the other hand, can use water or a volatile spirit which does not attack rubber (such as methylated ether). The latter is *highly inflammable* but the tube may be "boiled off" by holding in warm water while vapour is allowed to escape round the bung.

Where sealing is necessary the previously formed neck should be carefully heated until it can be drawn off. Care must be taken not to heat any flat area which could suck in and destroy the vacuum.

Operation

The flat base of the tube is normally rested upon an electric lamp of appropriate size (see Fig. 2), but any source of heat will suffice. A fountain effect may be obtained by several tubes splayed from a tin containing an electric lamp.

An interesting novelty would consist of a crown-shaped chandelier, the heaters consisting of a few turns of nichrome wire round each tube and in series with the lamps (see heading sketch). Endless variety is possible.

Where single liquid tubes can be used, these will normally operate with less heat gradient and can be used with merely a damp wick on the cold end.

PUZZLE CORNER

Around the World

1 Assume that the earth is a perfect sphere and that it is perfectly smooth and earth-solid, enabling a wire to be fitted snugly all round the Equator (25,000 miles round). This cable having been fitted, is cut, and an extra yard added. To take up this slack equally all round the earth some supports will be needed. How tall must these supports be?

2 Now suppose a string were tied round an orange, then cut and increased by a yard as before. What thickness of packing would be required?

3 Reverting to the string tied round the world, what would happen if, instead of supporting the slack with posts, we took it at one point and raised it as far as we could, hill fashion. How high would the apex of the slack reach above the earth?

Answers

1.—The supports will need to be 6in. high. As is well known the circumference of a circle is approximately 3.142 times the diameter. Thus if d = diameter of the earth, the circumference = 3.142d. After adding 36in. the new circumference will be 3.142d + 36in.

To get the new diameter we divide the circumference by 3.142, thus:

$$\frac{3.142d + 36}{3.142} = d + \frac{36}{3.142}$$

As this extra width is disposed equally on both sides of the diameter we divide by 2 to get the height of the posts, i.e., 11.45in. divided by 2 = 5.725in.

2.—The answer again is 5.725in. The thickness of the packing is quite independent of the size of the original article, for in the equation given above we have not given d any particular value.

3.—Approximately 130 yards.

TRADE NOTES

A Review of New Tools, Equipment, etc.

HOME POTTERY OUTFIT

BERNARD W. E. WEBBER (S.o.T.), of Phoenix Works, Broad Street, Hanley, Stoke - on - Trent, have placed on the market the Webcot Bijou Home Pottery Oufit which is ideal for the beginner and which costs £17 10s. Small pieces of pottery can be produced at home with this outfit which consists of a small eletric kiln, clay, glaze, stains, colours, underglaze, crayons, kiln furniture and temperature indicating cones, together with moulds and tools for making the clay shapes. Full instructions are provided and these include some helpful illustrations.

The Webcot "Bijou" home pottery outfit.

New C. F. & S. Plug-in Relays

THE Clifford & Snell plug-in relay system has just been extended by the introduction of the plug-in D.C. mains relay, type 2600B, for use in control systems where, because of the needs of speed control and injection breaking, the supply is from about 110 volts to 240 volts D.C. Also new is the plug-in Mercury switch relay, type 2600H, which can have (a) one or two mercury switches with N/O or N/C action rated at 6 amps.: at 500 volts or 240 volts D.C. (b) a fleeting contact or "quick-strike" mercury switch which gives a brief "make" when the relay is energised, but not when it is released, or the reverse. Both of the above relays are of heavy construction, but they are so compact that the total panel space each requires is within 2¼in. × 4in. including all clearances. The sole distributors are D. Robinson & Co., 717, London Road, Hounslow, Middx.

The new C.F. and S. Plug-in relay.

Avo Instrument Catalogue

WE have received a copy of the new 39 page, well illustrated Avo instrument catalogue, from Avo Limited, of Avocet House, 92-96, Vauxhall Bridge Road, London, S.W., this is also available to readers post free on request from the above address. The brochure is based on 35 years of successful experience as pioneers in the design and development of multi-range meters. Some completely new pieces of apparatus are listed including the AM signal generator, type 378, and "Prodclips" which are spring loaded and especially useful for reaching awkward test points. A large range of the already well-known electric and electronic testing instruments made by Avo are listed and illustrated.

Bondaglass Handbook

WE have received a copy of the new edition of the Bondaglass handbook, which costs 2s. from Bondaglass of 55, South End, Croydon, Surrey. The book contains many illustrations and helpful information for the user of glass fibre.

Drydex Searchlight Torch

A CHROMIUM-PLATED two-cell Drydex searchlight torch with a red plastic head has been introduced by Chloride Batteries Ltd., of Clifton Junction, Manchester. With a plastic lens, pre-focus bulb and a carry ring on the base, the 2CP20 torch is only 7½in. long and has a 3¼in. dia. head. Two Drydex T21 dry cells may be loaded through the base. The 2CP20 costs 13s. 6d. from most electrical stores.

The Drydex Searchlight torch.

LIGHTWEIGHT JERRICAN POURER

SPECIALLY designed to fit the claw-type neck of the 4½ gal. standard jerrican, this new, lightweight pourer has a cast aluminium body enabling it to handle most liquids with complete safety. Two steel claws hold the pourer rigidly in place, whilst the neoprene seal in the base ensures leakproof service. A breather tube is provided for steady dispensation of the liquid.

There is a lug on the upper surface of the spout enabling the pourer to be secured to the jerrican if required.

The pourer is supplied with two gauzes, a coarse one for use with dirty fuel or chemicals, and a very fine, water repellent gauze for separating fuel and water by retaining the water in the can.

The inside of the 7in. spout is tapered from 1⅛in. down to 1in. in order to accommodate a rubber tube to facilitate pouring into an awkwardly placed receptacle. The pourers cost 9s. each and are manufactured by J. E. Lesser and Sons, Ltd., of Green Lane, Hounslow, Middx.

The pourer fitted to a standard jerrican.

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.

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

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

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. Money refunded if dissatisfied. H. Gibbs, 75, Portmanmoor Road, Cardiff, S. Wales.

6IN. PLANING and Rebating Machines, 30in. overall, adjustable cut, heavy ballraces, £6/7/6; also 4½in., 5in. and 8in. Planers at low prices. Combination Woodworking Lathes, heavy-duty ballraced, £11/18/-. Build your own circular saw cheaply. New type Circular Saw Spindles from 37/6, full range for Saws up to 30in. diameter; also Combination Spindles for sawing and planing. All machines fully guaranteed; terms. Send 6d. for lists. Generous terms to trade. Ortan Lathes, Falcon Works, Costessey, Norwich. Dept. P.M.

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GEIGER COUNTERS COMPLETE WITH BATTERIES, £8.10.0 ea.
VACUUM PUMPS—EDWARDS. As new, £4.10.0 ea.
BALL RACES. ½" x 1" bore, ⅜" x 3/16" bore, ½" x ⅜" bore, 1/6 ea. ½" x ⅜" bore, 2/- ea. 2½" x 1" bore, 3/6 ea.
NEWALL INDICATOR CLOCK GAUGES. M/m new. 35/- ea.
GRAHAM VARIABLE SPEED GEARBOX coupled to 1/6 H.P. 115 v. 50/60 cycles, 2.8 amp. motor, output 0/166 r.p.m., £6.10.0 ea. Gearbox alone worth £10.0.0.
HYDROMETERS. Acid. 3/- ea.
MIN. MOTORS. 4½ v. reversible, totally enclosed. 5/- ea.
NIFE CELLS. 1.2 v. 3 amp. 3½" x 2½" x 1" unused, 5/- ea.; 48/- doz.
12 V. D.C. MOTORS. 3,300 r.p.m., 1/18 h.p., 22/6 ea.
PRISMS. Magnifying 1 3/16" sq. on adjustable frame, 2 filters, 5/- ea.
I.T.A. AERIALS. New. 3 element, 22/6; 5 element, 27/6. Co-ax. cable. 6d. per yd.; air spaced, 9d. per yd.
TANNOY MICROPHONES. With switch and lead, 7/6 ea.
MAINS POWER PACKS. 250 v. 80 m/amp., or stabilized 150 v. 80 m/amp. with 6.3 v. winding, 30/-.
MORSE KEYS. Small, 2/-; medium, 3/-; larger, 3/6. Buzzers, 3/- ea.
MOTORS. 28 v. geared 2½" x 1¼" diam., 12/6 ea.; less gears, 10/- ea.
VIBRATORS, OAK. 12 v. 4-pin, 5/- ea.
TORCH BULBS. Ever Ready 2.5 v. and 3.5 v., 16/- per 100, 9/- per 50.
PORTABLE COMPRESSOR UNITS. 12 v. D.C., £5.10.0.
HEADPHONES. Moving iron, low impedance, 6/-; high, 9/-; balanced armature, low, 10/-; high, 15/-; moving coil, low only, 10/- per pair.
KEY SWITCHES. D.P.C.O. each way, 2/6 ea.
B.S.A. REAMERS. Machine. No. 1 M.T.S., 23/64, 3/- ea.
GRINDING WHEELS. 5" x ½" x ½" bore, F/60, 4/- ea. 7" x 11" x ½" bore, 60P, 8/- ea.
RECTIFIERS. Selenium. 6-12 v. 1 amp., 6/-; 2 amp., 10/-; 4 amp., 16/-. 8 amp., 22/6. Transformers to suit. 1 amp., 10/6; 2 amp., 14/6; 4 amp., 17/6.
12-24 V. D.C. MOTORS. GEARED. small and powerful, 4-8 r.p.m., 25/- ea. Works from mains with suitable transformer and rectifier, i.e., 21 v., 16/-; 24 v., 30/- extra.

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FOR SALE (*Continued*)

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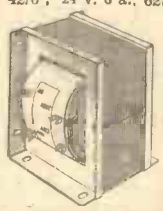

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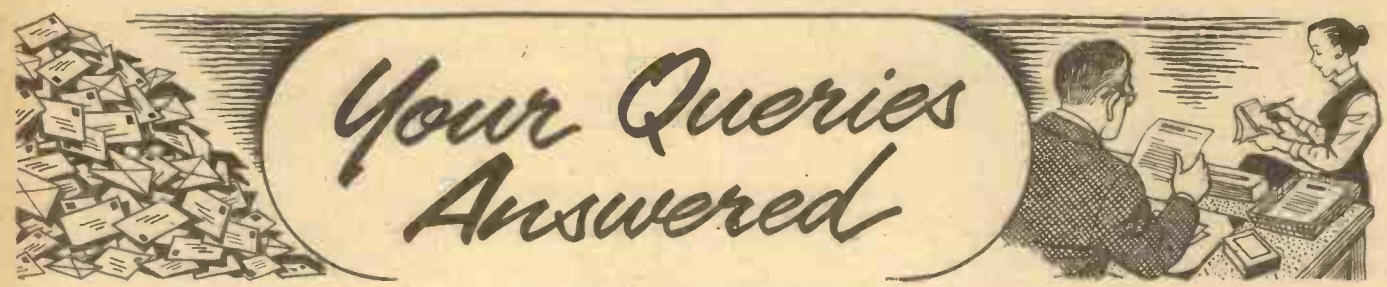

Barometer Principles

COULD you give me advice as to how to read and interpret the movements of an ordinary household barometer. The instrument I have is marked in inches and millibars.—P. M. Wakefield (Worcester).

THE majority of ordinary household barometers are based on springs with a small metal box, the latter having very little air inside. The pressure of air presses the side of the box whilst the small springs are used as a counter-balance. The mercury type barometer is based on a 30in. tube upon which the air pressure reacts to give readings which are sometimes transmitted to a dial showing the well known "rain, change, and fair" positions with a needle registering on a dial. It is generally accepted that the air pressure at sea level is around 15lb. p.s.i. and therefore the straight part of the mercury tube for this type of barometer is 30in. in length. The readings indicated show the air pressure which in turn indicates the nature of weather to be expected. High pressure readings, i.e., when the barometer reads over 29in., indicate a spell of fine weather resulting from high pressure formations in the atmosphere and when rain is imminent or similar rough conditions, areas of low pressure record low readings of 29 and under. It will be appreciated that with this class of barometer, if it is raised above sea level, or is installed in a flat at a high level, these readings must be calibrated by observation due to the increase in altitude. Many of these mercury barometers are so sensitive that even taking them from ground level to first floor level of an ordinary house will register a different reading.

Motor for Compressor

I HAVE a small compressor, bore 1in., stroke 1.125in., 2½in. "V"-pulley, together with a storage cylinder 1ft. 5½in. × 4in. dia. Could you tell me what size electric motor I will require to drive my compressor, also will I be able to use it for spraying my car and inflating the tyres? —A. J. Tebay (Yorks).

WE would suggest that you operate your compressor at a speed of 650 r.p.m.; through vee-belting from a ¼ h.p. motor. It may be necessary to increase this speed slightly, but that will be proven by actual practice.

There is no reason why this unit should not be used for the purposes indicated. A reservoir incorporating a filter, will be necessary for satisfactory paint spraying.

Damp Proofing a Brick Wall

EACH year I give a brick wall in my greenhouse a good coat of whitewash, but it is very damp and before long moss starts growing on it. The damp is due to earth coming half-way up the wall on the outside and this cannot be prevented. How can I solve this problem?—R. L. Moody (Scarborough).

IT is almost impossible to prevent dampness coming through a brick wall by applying treatment internally, unless this treatment consists of a special proprietary type of rendering applied by a specialist firm. An alternative method to this would be temporarily to excavate the earth on the other side of the wall and then when the wall has had the opportunity of drying out, give the external surface two good coats of hot tar or bitumen prior to returning the earth. It is essential to treat any waterproofing scheme at the source of the trouble.

With regard to the fungus which is growing on the walls internally, we suggest that the brickwork is given a sterilising treatment of a material such as Santobrite or Shirlan N.A. These materials should be kept clear of any of the plants in your greenhouse, since if it is splashed around it will probably inhibit the growth. When this treatment is dry we would suggest that the wall is given a coat of cement paint. This will not restrict evaporation and will prevent the wall from becoming waterlogged.

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

Dynamo Selection

I HAVE a 24 volt, 18 amp. ½ h.p. D.C. electric motor, it will also run on 12 volts, 10 amps. I wish to run the above motor direct from a dynamo or generator. Could you tell me what size dynamo or generator I shall need (i.e., amps. and watts). —B. C. Butler (Devon).

IN order to run the motor at its normal speed and on its rated horse power it should be fed with 18 amps. at 24 volts, which could be supplied from a dynamo rated at 432 watts. However, if the length of cable run between the dynamo and motor is long it would be advisable to use a dynamo rated for 18 amps. at about 30 volts (540 watts) in order to allow for volt drop in the cables. The voltage output of the dynamo could be controlled by means of a variable resistor in the shunt field circuit.

When run from a 12 volt supply a dynamo capable of giving 18 amps. at 12 volts should be used (220 watts). However, on 12 volts the motor will run at reduced speed and will develop no more than half its rated horse power.

Casting Large Objects

I WISH to cast some rather large objects. To cut the cost, I want to mix large amounts of sawdust, woodchips and other fillers with glue or plastic or other substance which would bind it together. Could you please suggest a mix that is possible? I am using a heated mould.—B. Collins (Sussex).

ALTHOUGH a simple mixture of thin glue and sawdust makes quite a good moulding composition, it is not pourable and must be pressed or rammed into the mould. This applies generally; if you want to use a large amount of filler you will have to accept the loss of pourability and, in consequence, the likelihood that the sluggish mix will not fill out the finer details. In practice, therefore, there is little that you can do except use a casting resin of low viscosity and experiment until you find the greatest proportion of sawdust that gives tolerable results. We cannot advise on this since it depends upon the fineness of the sawdust and, particularly, upon its original moisture content.

For general information on casting resins you should contact I.C.I. Ltd., Plastics Division, Black Fan Road, Welwyn, Herts.

Life of Magnets

WHAT is the probable life of bar magnets in a plastic tube placed end to end with like poles together when caused to

reciprocate continuously in the same plane? Does the material of which the magnets are made have any bearing on this?—J. Fielding (Cleckheaton).

IT is probable that there may be a fairly rapid reduction of the magnetic strength of each bar magnet, but that a certain amount of magnetism will be retained for a long time. It is impracticable to state the length of time required for the magnetic strength to fall to a certain percentage of the original, as this depends on many unknown factors.

As you suggest, one important factor is the material of which the magnets are made. A material of high coercivity is likely to give best results, such as Alcomax IV, Ilcomax III, Alnj (high coercivity) or Alnico (high coercivity).

Eliminating Air Holes in Casting

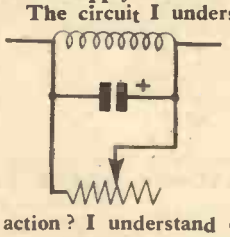
I AM making wax models of dolls, toys and animals, etc., for electroforming, and in casting same from wet plaster moulds I often get air holes in the surfaces. I have tried filling these with a paste made from the wax soaked in turps, but this is not very satisfactory, as the paste does not harden enough for polishing, especially on surfaces on which I sometimes require a high gloss. Also the holes sometimes being so minute and deep it is difficult to fill them. Could you please help me solve my problem?—F. Miller (Liverpool).

IT is probable that the "air holes" are caused by steam raised by the molten wax in contact with the wet plaster.

Instead of wetting the moulds you could try polishing the surface with blacklead grate polish. If this does not prove satisfactory, the plaster moulds could be coated with "A.C.M. Artists' Glaze." As plaster is very porous, two or more applications of the glaze will be required to give a highly glazed surface which will not be affected by heat or wax. The glaze is obtainable from E.M.H. Plastic Supplies, of 75, Welling Way, Welling, Kent.

Condenser Delay Circuits

COULD you please give me some information on condenser delay circuits? I need a relay to hold on for a variable time up to approximately 1 sec. on a 25 v. D.C. supply with a reasonable accuracy. The circuit I understand is as below. I



have experimented with a 6,000 ohm relay 250 μF 25 v. wkg. condenser and 25 k wirewound resistor. Can these values be reduced or improved for more accurate and positive action? I understand condensers are either not accurate or tend to lose their accuracy. Could you estimate the number of operations likely before this becomes serious?—R. Harrison (Southport).

YOUR circuit will work satisfactorily only if the electrolytic condenser has negligible leakage resistance. It is this property of electrolytic condensers which makes their performance unreliable. However, unless a more complicated circuit, using at least one valve, is employed, you will be restricted to your circuit. Design details are appended below to assist in the calculation of component parts:

With a milliameter in series with the relay, reduce the current through the energised relay until the controls just open. Note the current at this instant, say, I mA.

The coil "drop-out" voltage will therefore be I × R volts where R is the coil resistance in kilohms.

If the normal supply to the relay is E volts, calculate the ratio I × R/E. If this ratio is greater than 0.75, then the following formula is accurate enough, and gives a capacity which will provide a stable delay:

$$C = \frac{1000}{R\ [1 - I \times R/E]}\ \mu F$$

where C is the value of capacity required to hold the relay in for one second. For shorter times then the relay coil can be shunted with an external variable resistance as you have shown in your circuit.

Example: Say the "drop-out" current was found to be 4½ mA in a 6 k relay, then I × R=26 v. If the supply voltage were 35 v., then C would be

$$\frac{1000}{6\ [1 - 26/35]} = 775\ \mu F.$$

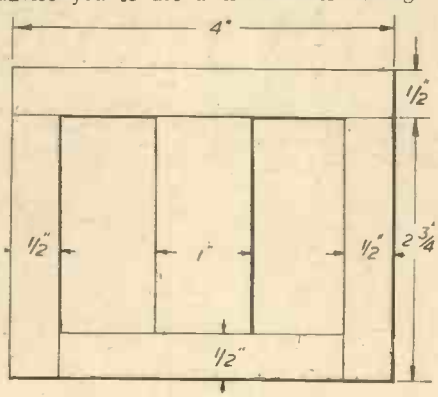
Thus inevitably large capacitor values will always result. A better method would be to use a lower resistance/higher current relay whose operating current heats a bimetal strip contact placed in series with the circuit, i.e., a *thermal* delay is more practicable in this instance.

Transformer Design

PLEASE give me details of a transformer with an A.C. input of two volts and an output of approximately 100 volts at 15 mA 25 c/s halfwave rectification.

The A.C. will be supplied by a cam and point operated motor so the transformer need only be a straightforward primary and secondary not centre tapped. Will you give me core size, turns and gauge of wire please?—W. J. Marshall (S.W.18).

IN view of the fact that the waveform of the input to the transformer is unknown, the output voltage of the transformer cannot be predicted with accuracy. We therefore advise you to use a transformer having a



Stamping dimensions.

tapped secondary winding so that you can use the tapping which gives you the best results in practice.

The transformer core could be built of Stalloy stampings approximately 0.014in. thick to the dimensions given above, the stampings being lightly insulated on one side. A bobbin or former, through which the centre limbs of the core will afterwards be threaded, should be wound with the primary coil having 32 turns of 14 s.w.g. D.S.C. wire. Over the primary should be wound a layer of leatheroid about 0.04in. thick before winding on the secondary winding having 4,000 turns of 36 s.w.g. enamelled wire with tappings at 3,600, 3,200, 2,800, 2,400, 2,000 and 1,600 turns. When assembling the core the insulated sides of the stampings should all face the same way, adjacent layers of stampings being reversed so that the joints in one layer are covered by the next layer. The stampings should be tightly packed, and clamped so as to avoid vibration.

Renewing Refrigerator Insulation

HAVING started to recondition my compressor type refrigerator, I removed the metal back panel, this caused a small amount of cork to fall out at the bottom. This cork has since been accidentally thrown away and my problem is how to reinsulate without pulling out and breaking the rest of the lining. What is a suitable insulator? Could I use glass wool of which I have plenty?—D. Anderson (Hants).

IT would, of course, be better to make good the insulation by means of granulated cork. This would not be from a viewpoint of insulation efficiency, but ease in effecting the repair.

Provided you can satisfactorily replace the lost cork with glass wool, there is no reason why this insulant should not be used. It is, in fact, in many ways the preferable medium; having not only good insulating qualities, but also being moisture resistant.

Monocular Lenses

PLEASE tell me what lenses I require to make a monocular like non-prismatic field glasses. What I want is a large image with good illumination. Prismatics may be more powerful but the image is small.—A. Bignell (Herts).

PRISMS do not magnify, but give a longer optical path, without a long tube. For a large image, or high magnification, you will have to have a long tube, as in a telescope, or employ prisms. If, however, you mean a large angle of view, then a short tube, without prisms, will be used. The illumination depends upon magnification and size of field lens, falling as magnification increases, and as the diameter of the lens is reduced.

For both good illumination and large magnification, very large lenses are necessary. But good illumination will be obtained with smaller lenses if only moderate magnification is required. You thus need to decide upon what you need.

The simple type of non-prismatic glass uses a convex field lens and concave eye lens, and can give a very brilliant image, but not high magnification. This is the type you require if by "large image" you mean that the field of view is wide, covering large objects or areas. Achromatic lenses are necessary for best results.

Information Sought

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

Projector Optics

PLEASE tell me which two, if any, of the following lenses I can use to construct a projector for 35 mm. colour slides:

2 at 41 mm. dia., focal length 8 cm.
1 at 38 mm. dia., focal length 10 cm.
1 at 51 mm. dia., focal length 18 cm.

I require a picture 40in. x 30in. at 10ft.—J. HARDY HAMMOND (Surrey).

Boosting a Heating System

MY central heating system is heated by an Ideal Standard No. 2A Autocrat solid fuel boiler which runs three radiators in my bungalow. Could I please have advice on a suitable electric water pump to boost the circulation of the system and also details of the installation of same?—A. POPPLEWELL (Lincs).

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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
Telegrams : Newnes, Rand, London

WHAT I THINK ... By F. J. C.

The British Cycling Federation

THE B.L.R.C. held its final meeting during December and there were the usual nostalgic valedictory messages on what amounts to the League's greatest victory after a struggle of more than twelve years. It now forms a partnership with the N.C.U. which after a long association with cycling, mostly of a negative character, submerges its identity within the framework of the new body. Let us hope that both bodies will settle down satisfactorily and that all will be well from now on.

It will only be so, however, if our advice is taken and the Augean stables are purged of those who have brought about the bitter struggle. The firebrands of the N.C.U., which bitterly opposed mass start racing and in its efforts to get it suppressed adopted questionable methods, must be removed from all offices so that smouldering remnants of their previous hates cannot be fanned into flame. There is sufficient new blood among the B.L.R.C., and young blood at that, to staff the new concern and to ensure that everything runs smoothly. I do not exclude from my criticism the cycling press, which instead of maintaining an attitude of strict neutrality, took up arms with those opposed to the League. Events have shown how wrong the opponents were, for the League has brought about a complete metamorphosis in the cyclist movement and has brought to light the underhand methods which have been a feature of cycling politics for so many years. Chairmen who rig meetings beforehand should find no place in the new organisation, and we hope that personnel entirely impartial and dissociated from any other cycling organisation, such as the C.T.C., will be selected.

For many years I have been advocating an entirely new body to govern cycling sport and now that it has come about I shall do my utmost to promote its interests, and to oppose any attempt by the old brigade to impose its will. One reader who wrote to me concerning the Federation, paid the compliment of stating that but for my advocacy and active defence of the League it could not have survived. Knowing the somewhat shady methods of the opponents, I certainly threw myself into the fray with great vigour and I was able to expose these methods in Government quarters, the net result being that no notice was taken of the opposition. I was able to show the reasons behind the opposition of the C.T.C. as well as the N.C.U., reasons which could not have been apparent to the Ministry of Transport. I wish the new federation well, and it can as hitherto rely upon me to defend them against any sniping tactics or rearguard action and Parthian shots of those who regard themselves as the proprietors of the sport.

The Knife and Fork Season

THIS is the season of dinners, prize presentations, and the usual congratulatory speeches and reviews of the year's doings. It has been customary and in accord with cycle tradition for a spirit of levity to pervade these annual bun fights and for practical jokes to be played on all and sundry. I wish that a little more dignity could be infused into these meetings, and that the humour and the jokes if thought to be necessary were on a higher plane. There is no need to turn an annual dinner into a bear garden. It is a regrettable thing that some of the older clubs are not quite blameless, the Bath Road Club Ltd., and the North Road Club Ltd. being notable for misplaced humour and unfunny practical jokes. If a club wishes to be taken seriously it should act seriously. Time and again I have heard visitors say that they would never accept an invitation from certain clubs again.

Some of these clubs go through a full toast list from the Loyal Toast down to the chairman. Toast lists, like speeches, need to be kept short. Many of the toasts could be combined. The toast of "The Chairman" could be combined with that of "The Club." There is no need for a separate toast for "The Press." It should be combined with the toast to "The Visitors."

Midhurst, Sussex, with its wealth of lovely period houses and old inns.

Motorway Traffic Regulations

THE Ministry of Transport has made traffic regulations for Britain's first motorway, the Preston By-pass, which was opened on December 5 last.

There are seven main rules. The effect of these rules, subject to certain exceptions and relaxations, is as follows:

One-way driving must be observed at all times on the dual carriageways.

Vehicles must not stop or remain at rest on the carriageways unless compelled to do so by the presence of any other vehicle, person or object.

If a vehicle breaks down or has to be stopped in an emergency, it must, as soon as is reasonably practicable, be moved on to the verge and, even there, it must not remain longer than necessary.

Vehicles on the carriageways must not be reversed except in special circumstances.

Vehicles must not be driven on to the verge except for the reasons given, nor may they be driven on to the central reservation.

Vehicles must not be driven on the motorway by learner drivers.

The motorway is not for the use of pedestrians except in certain specified circumstances and under certain conditions.

Regulation 13 allows certain traffic which is normally excluded to use the motorway on occasion or in emergency; Regulation 14 sets out certain general exceptions to the regulations and permits the Minister to relax the prohibitions and restrictions they impose.

The penalty for a breach of any of these regulations is a fine of up to £20 for a first offence.

Although the regulations apply only to Preston By-pass Motorway, the experience gained will be taken into consideration when drafting regulations for the London-Birmingham Motorway which is scheduled for completion by the end of October next year.

How to Obtain More Information From Your Map

THE amount of information it is possible to obtain from a map depends very largely on the type of map being used and for this reason small-scale maps are of limited use to the cyclist. A map scaled at ½in. to the mile will provide a fairly detailed picture of surrounding country, but the cyclist who is interested in map reading for its own sake as well as for its utilitarian value, would do well to purchase Ordnance Survey 1in. to one mile maps.

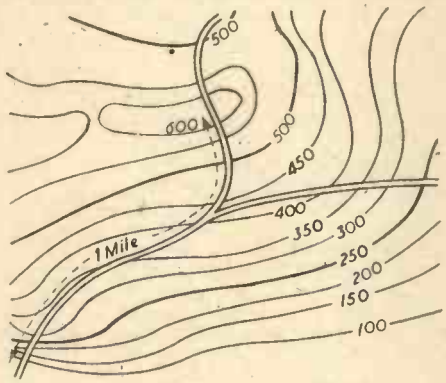

Fig. 1.—Measuring a gradient.

Gradients

One of the chief advantages of a large scale is that it enables the cyclist either to avoid high ground or, if riding for the view, to select the highest vantage point, merely by studying the map. Further, from a study of the contour lines as they cross the road, it is possible to work out the gradient of that particular section of the road. An example is given in Fig. 1. First measure the distance between the points on the road at the bottom of the hill and the top and then work out the rise, i.e., 600ft.—100ft.= 500ft. This rise is then divided into the distance between the top and bottom of the hill (in this case one mile). This gives an answer of approximately 1/10 which is expressed as "one-in-ten." This, of course, is merely the average rise and there may be considerable variation in the slope. In the example given the hill is a gradual one at the top and steeper at the bottom and a more accurate answer could be obtained by working out the gradient in two parts.

Noticing the spacing of contour lines where they cross a road gives some idea of the steepness of a hill and in the same way noting where they cross a river will give a good idea of the fall of a river bed and the type of river it is. Where the gradient is steep (contour lines are close together) a fast moving river with falls and rapids is indicated. When the course of the river lies along the bed of the valley with only a very slight fall, the river will be a placid meandering watercourse.

Map References

The easiest and shortest indication to any given spot on a map is by means of a map reference. A 1in. Ordnance Survey map is divided into one kilometre squares by means of "grid lines" and each of these grid lines has a number. If it is wished to indicate any particular square, the vertical line (easting) on the west side of the square is quoted followed by the horizontal one (northing) on its south side, thus the shaded square in Fig. 2 would be indicated by the number 0181. The vertical line is always given first. To pinpoint any particular spot in this square it must be divided in the imagination into 100 small squares (ten in each direction) and another figure added to each part of the reference for the larger square. The point indicated would therefore be 019815. Finally, the 100 kilometre square of which the 1 kilometre squares are part must be indicated by its letter reference and the full map reference would be TA019815.

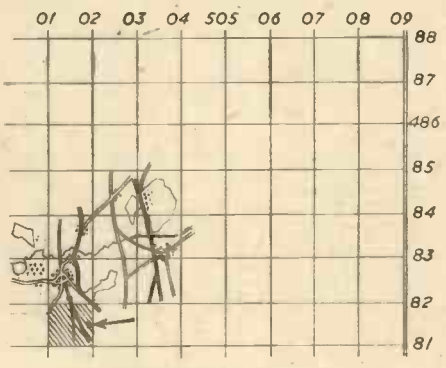

Fig. 2.—Grid references.

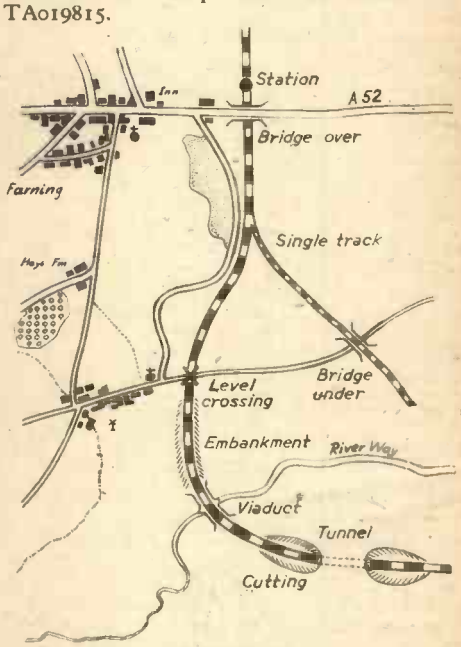

Fig. 3.—Features visible from the train window.

Conventional Signs

The conventional signs are included in a panel on every Ordnance Survey map and mostly they are simple to understand and recognise, but some practice is required to become familiar with them. If you have a long rail journey to work, an ideal opportunity is presented. It is surprising just how many features can be recognised from the train window and Fig. 3 will give some idea of the sort of thing which can be seen. Of course, many more features than would normally be seen have been condensed into a short distance in the sketch.

4 Gears Instead of 3 on a Unit Hub

THOSE cyclists who have a unit hub, which is a hub with the free wheel incorporated in the hub itself and on which ordinary fixed sprockets are fitted to form a variable gear, may be interested in a method of obtaining four gears instead of the usual three. This can also be applied to some forms of multi-speed block, where a long thread is provided on which interchangeable sprockets are screwed. With the unit hub, instead of screwing on three sprockets with the flanges pointing inwards in the usual way, the procedure shown at Fig. 1 is used. The first sprocket, or bottom gear, is screwed on in reverse with the flange to the outside edge and this is followed either by another sprocket fitted in the same way or by a special sprocket with the flange ground off (see illustration). A light engineering machine shop or a cycle shop of the more comprehensive type will be able to get this done. The sprocket which follows this should be fitted with its flange to the inside as shown. This idea is of primary interest to the racing man who wishes to change his gear frequently and for maximum convenience the ground sprocket should be a medium size one, say one with sixteen teeth.

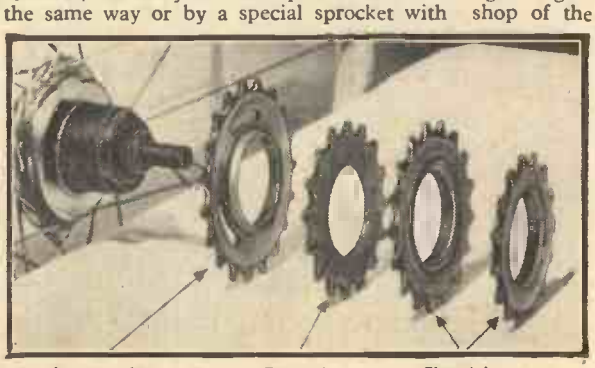

Fig. 1.—Arrangement of sprockets.

This idea must, of course, be used in conjunction with a four-speed changing mechanism. There is not sufficient travel with a three-speed mechanism to cover the four sprockets.

Huge Purchase High Speed Steel Tool Bits, hardened ready for use, essential to any lathe user, secure your stock now as these are really a good investment. 1/4" square, 2 1/2" long, 6/6 per doz. 5/16 sq., 3" long, 8/6 doz., 3/8" sq., 3" long, 12/- doz. ; 7/16" sq., 3 1/2" long, 15/- doz. Six doz. lots less 10 per cent.

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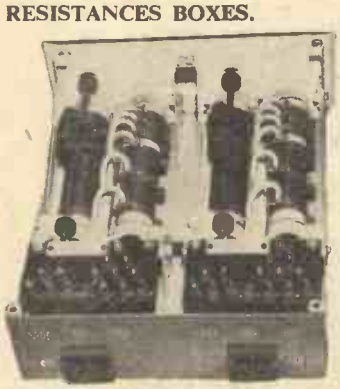

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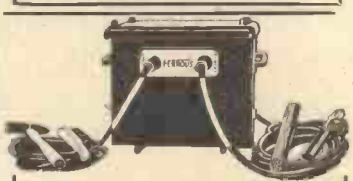

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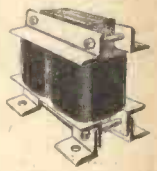

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