Practical MECHANICS

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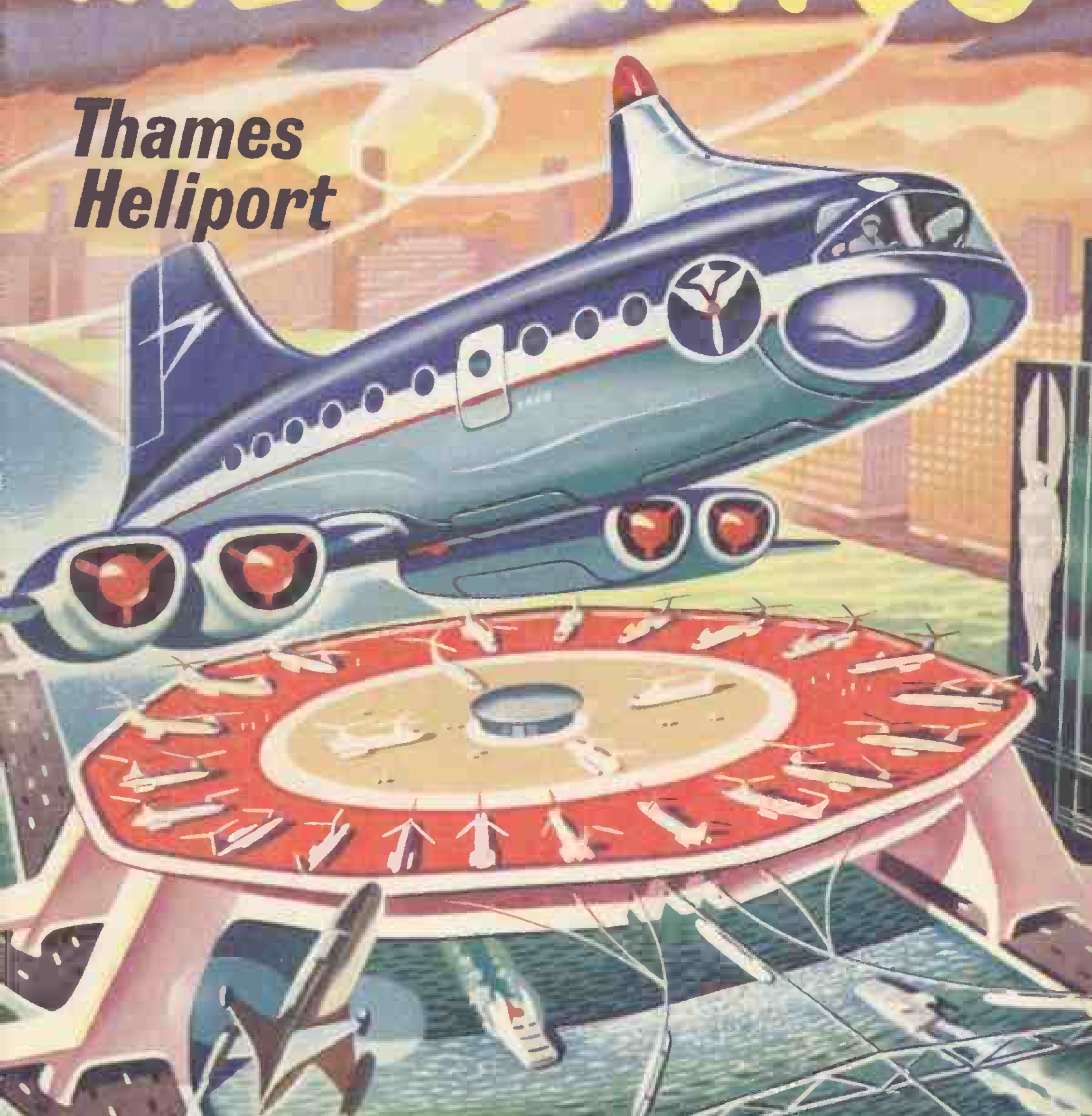
MARCH – 1962

Thames Heliport



Making a Dowelling Jig

FREE FLIGHT MODEL BIPLANE

Cast your own JEWELLERY

Practical

MECHANICS

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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

TRADITION DESTROYED

NO doubt many people have looked as we have looked with a sinking heart at the great, grim, barrack-like blocks of office buildings now making their appearance in many of London's main thoroughfares, buildings erected by the experts for people, or rather for Companies, Corporations etc., who in these days have almost entirely replaced the individual in business, whose interest is more for space than taste. To these bodies the history and character of an ancient City mean nothing at all. The buildings which these monstrosities supersede may have been of good, bad or indifferent architecture, but we can be quite sure that they were not soulless structures designed only in terms of window space and floor area, because the very essence of London was its infinite variety.

It is not that we want to see old things retained simply for the sake of retaining them. If that were to happen we should have a country cluttered with ancient monuments, and it would be an unfair imposition on the new generation which has a right to express itself in its own fashion, but once we lose all regard for the past, for character and intrinsic beauty, then indeed we shall be parting with a great and vital part of our national heritage.

THE UNIQUE WORKSHOP

Yet another reader has sent us a description of his workshop, and with due respect to the other workshops we have published, this one is indeed a great credit to its owner, Mr. Downie.

The tools and machinery he proudly displays are all of his own design and making. No doubt Mr. Downie has his own, or has access to, a foundry, for producing some of the intricate castings for these machines; but even so, before this is done the patterns have to be made.

When satisfactory castings have been produced they must be machined and for the building of precision equipment such as this, a great deal of know-how is required, plus an amount of enthusiasm and determination to carry the work through to its final conclusion.

On the construction of the actual workshop, the author has shown the same enthusiasm and has obviously had comfort and a sound protection for the workshop's contents foremost in his mind. The interior of the workshop has been adequately insulated and by switching on a forced convection heater within minutes he has comfort equivalent to that of his own Lounge.

Mr. Downie, besides following his full-time profession, is also a free-lance technical author and finds his workshop provides the right atmosphere for compiling new articles

G.P.O. WORK-TO-RULE

This has caused many readers to wonder what has become of the answers to their letters, some of which have taken quite a few days to reach us. In addition we have requests for specialized technical information which have to be passed on to one of our outside consultants and this has meant further delays until we receive a reply, or alternatively a reply is sent direct to the reader.

The April 1962, issue will be published on March 30th, 1962. Order it now!

WHAT DO WE KNOW ABOUT GAMMA RADIATION?

The discoveries made so far are explained by Donald Fraser

RESEARCHERS have concluded, after many balloon flights designed to study cosmic and gamma rays, that the only way to solve this problem is to get their instruments beyond the earth's atmosphere. The Explorer XI gamma ray astromony telescope satellite recently launched will now give scientists an opportunity to explore beyond the curtain of the earth's atmosphere.

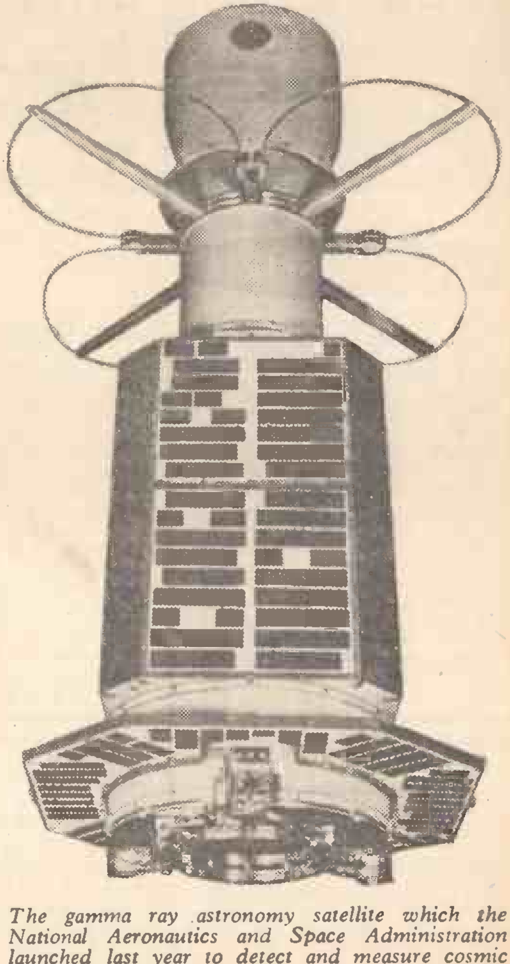
What is a gamma ray? Gamma radiation is electromagnetic in character, as are visible light, infra-red radiation, ultra-violet radiation and X-rays. Gamma rays have specific wave lengths as do X-rays and ultra-violet radiation and differ, of course, in thier source of generation.

Gamma radiation holds particular interest because it is associated with nuclear activity, which involves energetic processes unmatched elsewhere in nature. Scientists believe gamma rays to be keys to otherwise unattainable information about the elements making up the universe. Another reason for scientific interest is that gamma rays are not deflected by magnetic fields. Therefore, their source in space may be determined by the direction from which they come. This is not true of charged particles such as protons. Over much of the current century, studies have given scientists a greater understanding about the natural processes occurring in the region immediately surrounding this planet. Up to now the conclusions are that very fast and very small charged particles (protons—the so-called primary cosmic rays) bombard the air above us in the earth's atmosphere. The earth's magnetic field deflects the protons and they scatter through the upper atmosphere, interacting with the constituents of the atmosphere. These interactions result in the unleashing (breaking away) of atomic particles and the generation of gamma rays.

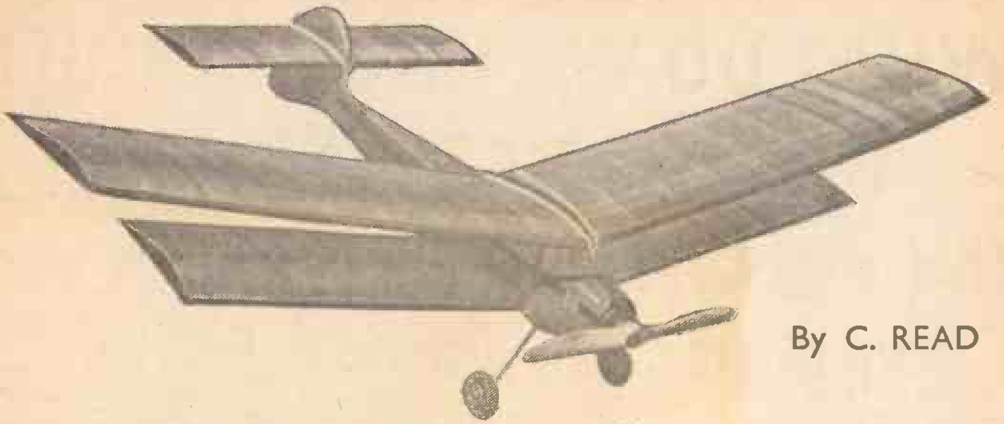
Laboratory and theoretical studies lead scientists to conclude that similar processes also occur in near and distant "outer space."

As the cosmic rays, atomic particles and gamma rays are directed toward earth, they react with the more dense atmosphere. The earth's atmosphere is so active in particle and gamma ray generation —so "noisy," in scientific parlance—that gamma rays generated beyond the atmosphere cannot be distinguished from local ones.

Well, it should not be long now before we learn a great deal more about this interesting subject. And that could lead us very far indeed.



The gamma ray astronomy satellite which the National Aeronautics and Space Administration launched last year to detect and measure cosmic gamma radiation from all directions in space. The satellite, which contained a gamma ray telescope, was launched by a four-stage Juno 11 vehicle.



By C. READ

free flight powered MODEL BIPLANE

THE use of sheet balsa in constructing the fuselage of this model results in a very strong structure, which is quick and easy to build.

Construction is commenced by cutting the fuselage sides from $\frac{1}{16}$in. sheet balsa, to the outline shown on the drawing. The $\frac{3}{16}$in. × $\frac{1}{8}$in. braces and $\frac{1}{8}$in. sheet doubler F9 are added to the inside of the fuselage sides around the cabin interior. It should be noted that these braces are on the inside of the fuselage and when assembled together with formers F1 to F3 give a very strong box-like structure where strength is needed most. Bend the u/c wire to shape and bind and cement to F1. Cement together the engine bearers and F1 and F2. When dry attach together with former F3 to the fuselage sides and set to one side to allow to set.

Cement the rear end of the fuselage sides together holding with pins until dry. Add formers F4 to F8 and check fuselage for alignment. The wing mount M1 is cut from $\frac{1}{8}$in. sheet and cemented in position followed by sheeting the top and bottom of the fuselage with $\frac{1}{16}$in. sheet cross grained. The underside of the cabin where the lower wing fits is not sheeted over.

The nose doubler F10 is added and the desired engine chosen to power the model, as it should now be fitted. A small F/F transparent fuel tank can be used if the particular engine chosen does not have a fuel tank attached.

A piece of block balsa together with F2A is well cemented in position and shaped to conform with the outline of the engine crankcase and tank. The engine used on the prototype model was a Frog 80, .8c.c. diesel driving a Frog 8 × 4 nylon prop, both of which can be obtained from any reputable model shop or mail order house. Finally sheet cover the underside of the fuselage forward of the u/c and well sand the completed structure. Cut a piece of $\frac{1}{4}$in. dia. dowel to fit where indicated for the attachment of the wings and use—$\frac{1}{8}$in. dia. dowel where shown for the tailplane attachment.

Although some designers attach the celluloid cabin covering after finishing the fuselage woodwork, I prefer to complete the whole fuselage, cover with coloured modelspan tissue and then dope three or four times, adding the celluloid and using a dark tissue preferably black to outline the cabin, also a flash down the fuselage sides. It is of course, possible to only clear dope the fuselage and then colour to choice, but it is well worth the additional time taken to cover with modelspan tissue as it increases the strength and prevents fuel soakage particularly around the engine installation.

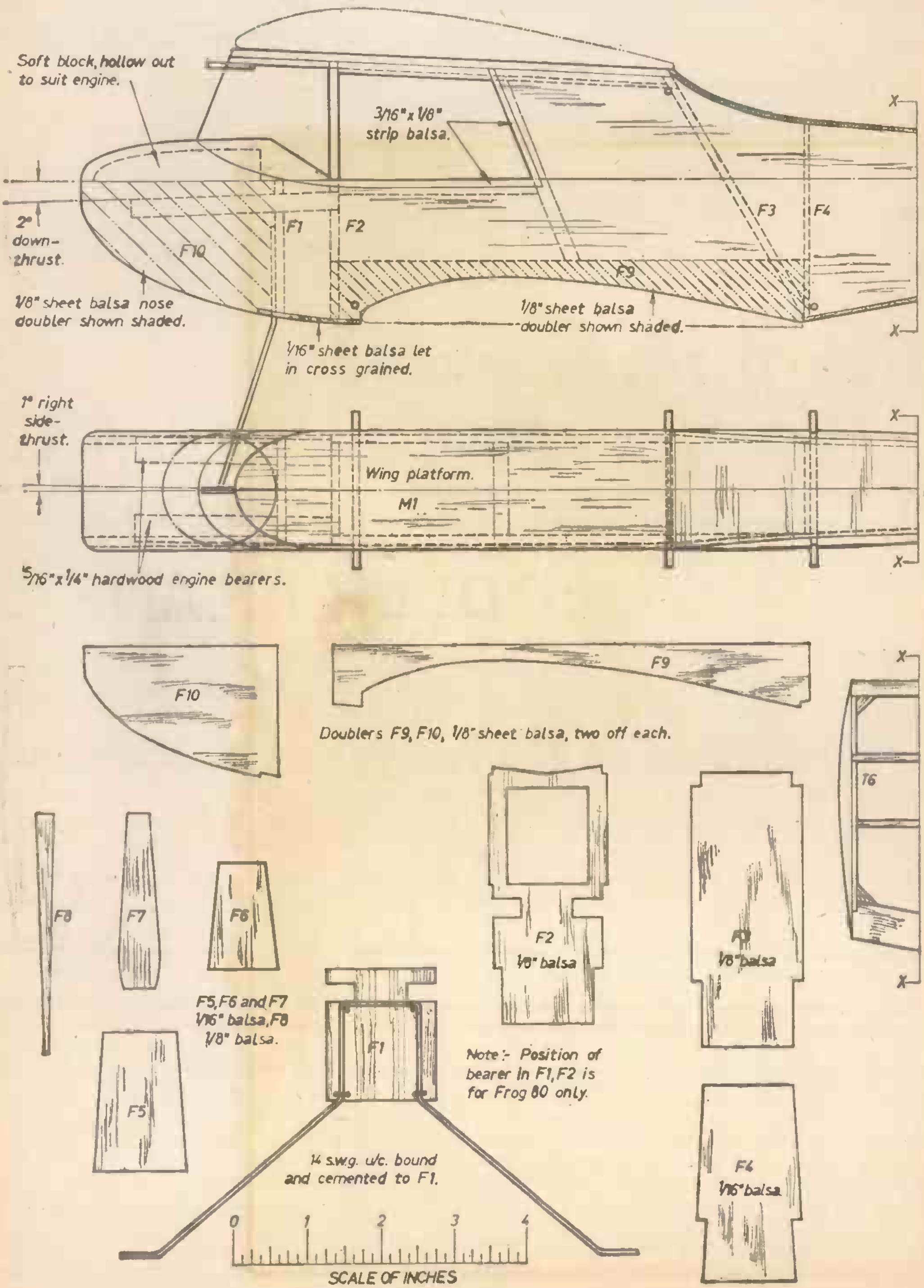
A pair of 1½in. wheels of the balloon type are soldered to the axles using small washers.

Wing Construction

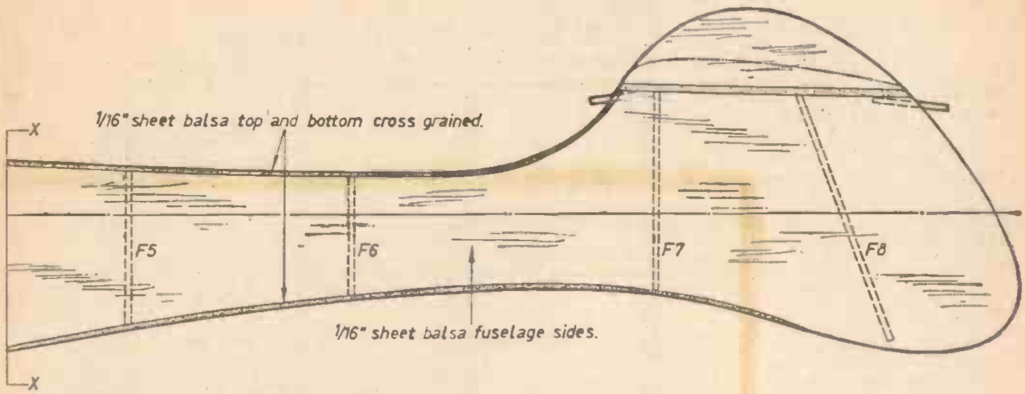
The wing structure is commenced by cutting ribs R1 $\frac{1}{8}$in. sheet and ribs R2 $\frac{1}{16}$in. sheet balsa. The trailing edges are notched to receive the ribs and the wing halves laid down and built directly over a full size drawing of the rib positions. Use of a good balsa wood, strong and not too heavy is advisable for the leading edge and wing spars. The top wing is built first in two halves and cemented together at the correct dihedral angle. This is done by means of laying one wing half flat on the building board and raising the opposite wing tip to double the dihedral for one wing. This will ensure that the dihedral is identical for both halves. Likewise the lower wing is built in the same manner. The wing tip blocks being cemented in position as well as all $\frac{1}{16}$in. sheet gussets, etc., to complete the framework.

Making the Tailplane

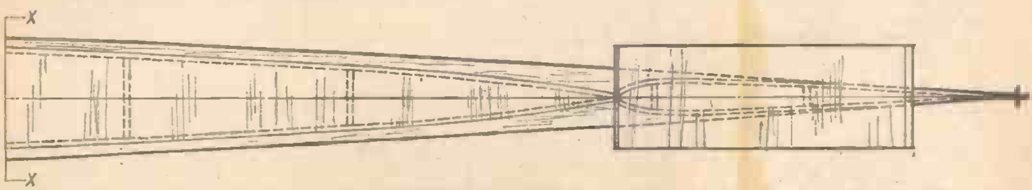
The tailplane is built flat over a full size drawing using balsa wood of a fairly light but not soft section for the spars and trailing edge. Cover the centre section with $\frac{1}{16}$in. sheet balsa and add tip blocks, etc.



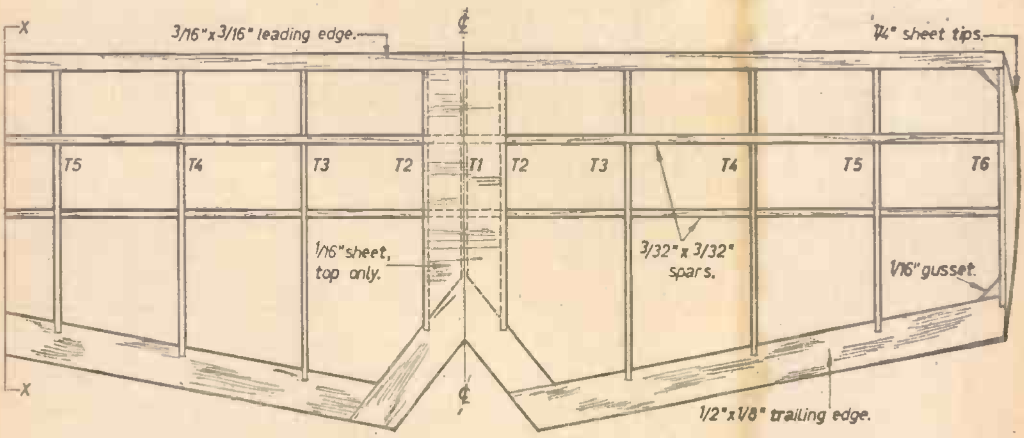
Soft block, hollow out to suit engine.
3/16" x 1/8" strip balsa.
2° down-thrust.
F1
F2
F3
F4
F9
F10
1/8" sheet balsa nose doubler shown shaded.
1/8" sheet balsa doubler shown shaded.
1/16" sheet balsa let in cross grained.
X
1° right side-thrust.
Wing platform.
M1
5/16" x 1/4" hardwood engine bearers.
Doublers F9, F10, 1/8" sheet balsa, two off each.
F8
F7
F6
F5
F5, F6 and F7 1/16" balsa, F8 1/8" balsa.
F2 1/8" balsa
F3 1/8" balsa
Note:- Position of bearer in F1, F2 is for Frog 80 only.
14 s.w.g. u/c. bound and cemented to F1.
F4 1/16" balsa
0 1 2 3 4
SCALE OF INCHES

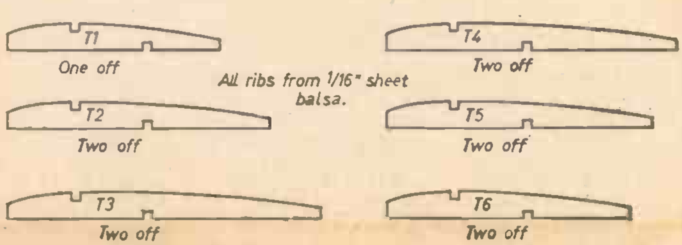


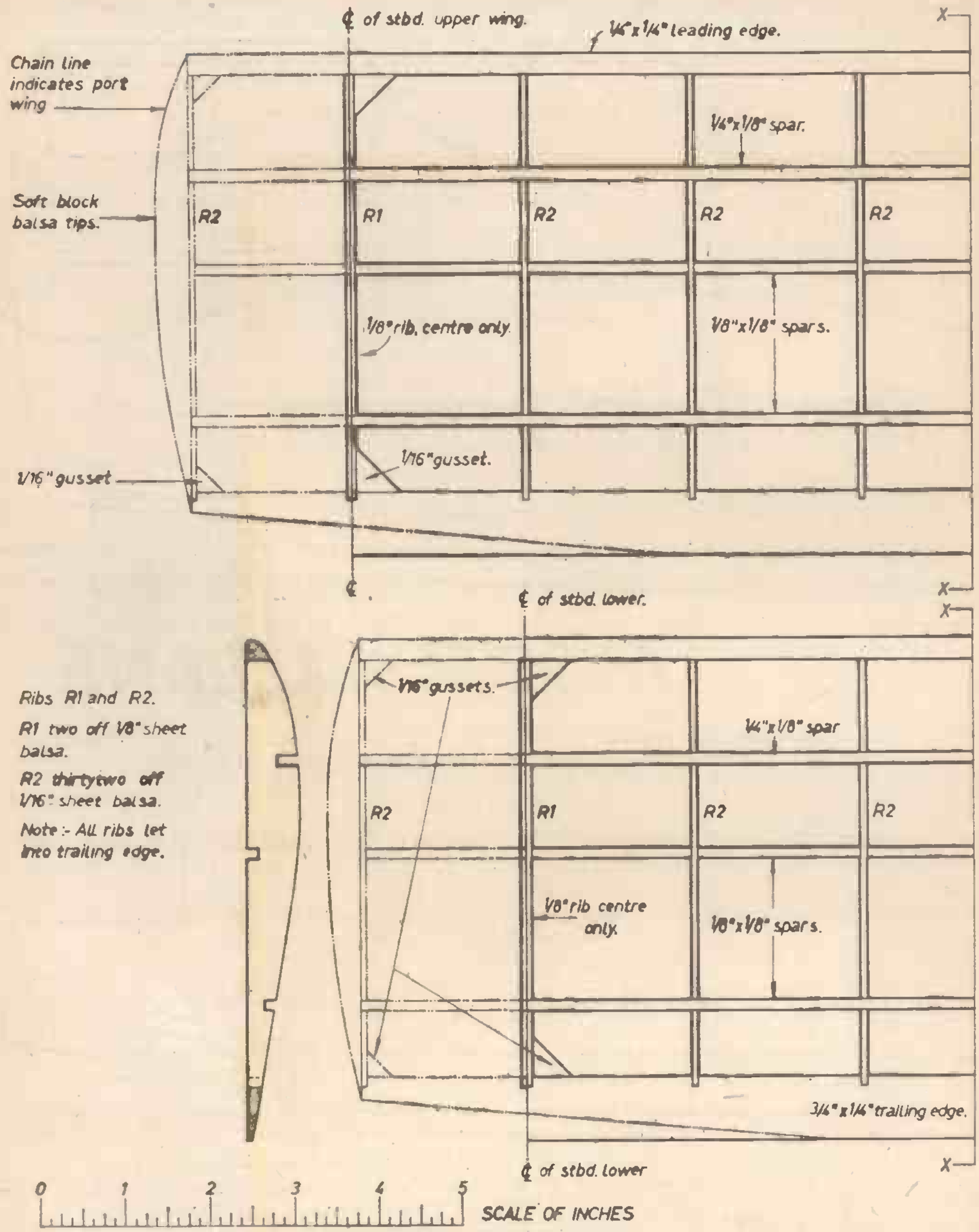
free flight powered



MODEL BIPLANE



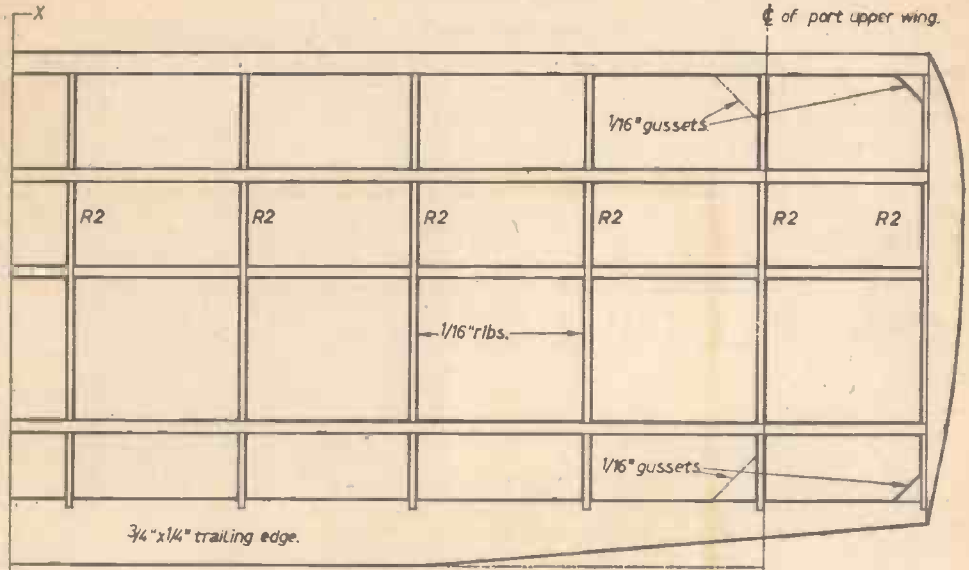


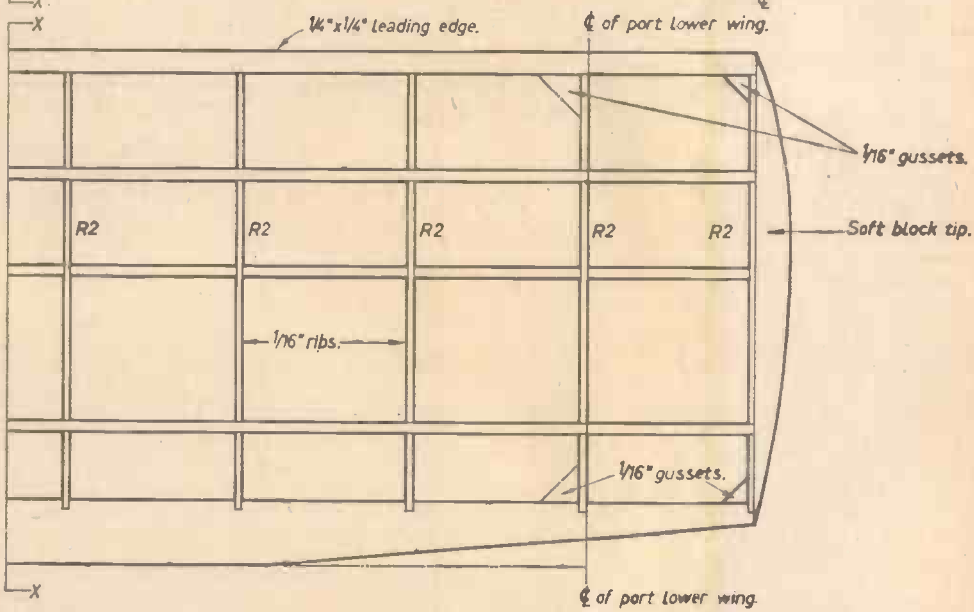


Sand both the wing and tail framework very carefully to a smooth finish, ensuring a smooth rib contour for covering. Covering is quite a simple job and few pieces are needed for the wings and tailplane. Lightweight modelspan is recommended and will ensure a strong surface after two or three coats of clear dope. The tailplane being of a light structure needs only 1 coat or 2 thin ones. After covering and doping the tailplane the upper fin is cut and shaped from $\frac{1}{4}$in. sheet balsa and cemented in position, covering with lightweight modelspan tissue doped on.

A suggested colour scheme would be all red with black trim along the fuselage sides and leading edges of both wing and tailplane. The model should now be ready for test flying, which must be done on a fairly calm day.

If a tendency to dive is noticed during hand





launching glide tests a small piece of $\frac{1}{32}$in. scrap wood should be inserted under the trailing edge of the tailplane. Likewise, if the model tends to stall the packing piece should be inserted under the leading edge. Should this not prove satisfactory a small amount of lead shot can be added to either the nose or tail of the model to cure any diving/stalling tendency.

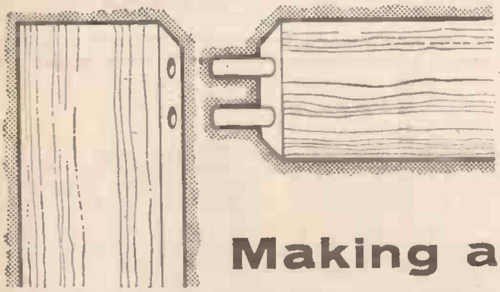
By using a smaller propeller than recommended, ballast will, of course, have to be added to the nose to balance the model at the C.G. position, this is shown on the drawing.

LIST OF MATERIALS

Balsa

Sheet	**Qty**		**Qty**
1/16" x 3" x 36"	3	1/8" x 3" x 36"	1
Strip			
3/16" x 1/8"	1	1/4" x 1/4"	3
1/4" x 1/8"	3	3/16" x 3/16"	1
1/8" x 1/8"	6	3/32" x 3/32"	1
3/4" x 1/4"	3	1/2" x 1/8"	1
14 Swg. Wire		1 36" length	
1/8" Ply. 1 1/2" x 6"		3/16" x 1/4" hardboard 9"	
1 pr. 1 1/2" wheels		1/8" and 1/16" dowel 18"	

Scrap block balsa. Cement. Dope.



Making a DOWELLING JIG

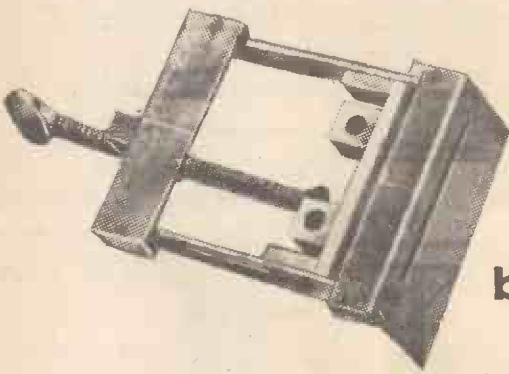


Fig. 1. (Left).—The completed jig. (Above).—the jig in use.

by Jameson Erroll

THIS piece of apparatus provides for the accurate drilling of holes for dowelling joints. It eliminates any possibility of boring out of the vertical, of holes being not central in relation to the work, or of their being unequally spaced.

Two drill guides are required for each size of dowel and, in the present case, six have been made covering $\frac{1}{4}$in., $\frac{5}{16}$in. and $\frac{3}{8}$in. Work of any length can be dealt with; the frame will accommodate a thickness up to approximately five inches; and the holes can be spaced from $\frac{3}{4}$in. to $2\frac{1}{2}$in. apart. It can be used alike for hand or power drilling, and constructional dimensions can be varied within reasonable limits.

Fig. 1 conveys a general impression of the completed jig, and Fig. 2 is an exploded view of the frame assembly less the guide holder and guides.

The Drill Guides

These are cut from $\frac{3}{4}$in. × $\frac{3}{4}$in. mild steel and all are one inch long and shouldered at one end as shown top left in Fig. 2. Carefully mark the centres for drilling and bore two each for the dowel sizes required. When this is done, score the gauge mark along the centre with a fine hacksaw or thin file; this greatly assists in setting the guides equi-distant from the centre gauge mark on the holder and in aligning them with the work. Now drill $\frac{9}{64}$in. holes in the centre of the shoulders and tap $\frac{3}{16}$in. Whitworth. These holes may be blind (about $\frac{5}{16}$in. deep) or drilled through to the centre; the latter is somewhat easier since a finishing tap can be used, and the waste cut away by the thread of the tap will not clog. Two $\frac{3}{16}$in. Whit. round-head bolts $\frac{1}{4}$in. long with steel washers will be needed to tighten any pair to the guide holder.

The Guide Holder

This is built up from $1\frac{1}{4}$in. × $\frac{3}{4}$in. × $\frac{1}{4}$in.; $\frac{1}{4}$in. × $\frac{1}{4}$in.; and $\frac{1}{4}$in. × $\frac{1}{8}$in. mild steel as clearly shown top right Fig. 2. Shoulders are cut in the side blocks to receive the $\frac{1}{4}$in. square bars which are fastened with 8B.A. counter-sunk steel bolts $\frac{5}{8}$in. long. The holes to receive them are blind—about $\frac{1}{2}$in. deep—and are drilled with a No. 50 drill and then tapped. When fixing these bars to the shouldered sides it is as well to separate them with a dummy length of $\frac{1}{4}$in. square steel to ensure they are fixed exactly $\frac{1}{4}$in. apart throughout so that the shoulders of the drill guides slide comfortably between them. The side guides, of $\frac{1}{4}$in. × $\frac{1}{8}$in. steel, are fastened centrally with 8B.A. C/S bolts and, as will be seen, have a 2B.A. central hole to lock them against the side bars of the frame in a similar manner to that used to lock the drill guides. This hole may be drilled right through and be fitted with a $\frac{3}{8}$in. × 2B.A. bolt and washer.

The Frame

This accommodates the guide holder (which can slide backwards and forwards within it) and incorporates a cramp for locking the work in position. Fig. 2 shows that it is composed of steel angle, slide bars and blocks, a clamping plate, and part of a G cramp. The effective length of this G cramp decides the overall depth of the frame and, consequently, the thickness of wood it will accommodate. The 5in. cramp used by the author happened to be spare, but it is, perhaps, rather on the long side since one rarely deals with timber more than 3in. square—4in. at the outside—such as heavy table legs which, in any case, would undoubtedly be mortised and tenoned, not dowelled. A 3in. cramp might well be found to fulfil all normal requirements, and if a smaller cramp is used the length of the side bars should be reduced accordingly—make them $\frac{1}{2}$in. longer overall than the length of the cramp.

First assemble the sides as shown in both Fig. 2 and Fig. 2 (centre). They are of $\frac{1}{4}$in. × $\frac{1}{8}$in. mild steel fastened to $\frac{7}{8}$in. × $\frac{3}{4}$in. × $\frac{1}{4}$in. end blocks with four 8B.A. C/S bolts; ensure even spacing by using a dummy piece of $\frac{1}{4}$in. steel as already mentioned.

The clamping plate end of the frame is constructed from a $4\frac{1}{2}$in. length of $\frac{3}{4}$in. angle $\frac{1}{8}$in. thick to which is fastened a piece of sheet steel $4\frac{1}{2}$in. × $2\frac{1}{2}$in. × $\frac{1}{16}$in.. Note to use angle steel (not iron) as the former is dead square and has a finished right-angle inside whereas iron, although more or less square, has a slightly rounded internal angle which precludes accurate fitting unless filed away—a somewhat laborious procedure. Fig. 2 (bottom) shows a rear view of this part of the frame, and it will be seen that, when assembled, a $\frac{1}{4}$in. wide slot 3in. long has to be cut through both angle and plate. This is best done by drilling a number of $\frac{7}{32}$in. holes and finishing off with a thin file. This slot enables adjustment of the screws locking the drill guides to the holder and is an essential feature.

The steel angle at the other end, cut from a $4\frac{1}{2}$in. length of $1\frac{1}{2}$in. × $\frac{1}{8}$in. with one side reduced to a width of 1in. (to clear the guide holes when dealing with narrow work), forms the fourth side of the frame and carries the threaded cramp. This latter is fastened with two short pieces of angle steel $\frac{3}{4}$in. × $\frac{1}{8}$in. each $1\frac{1}{4}$in. long. The shank of G cramp carrying the female thread is cut to the required length, filed perfectly square and smooth, and wedged and bolted between the two pieces of angle steel as depicted in Fig. 2. Both angles are then fastened to the side blocks of the frame with 4 B.A. R/H bolts vertically and horizontally. The vertical boring can be a ' through ' one, while the horizontal one is a blind tap about $\frac{1}{2}$in. deep and accommodates a bolt $\frac{1}{2}$in. long as against the $\frac{3}{4}$in. bolt used vertically. Note when assembling previous to boring that the guide holder should first be inserted to ensure that the sides are at just the right distance apart to furnish a sliding fit, free from side play.

Operation

To assist in positioning the work in the frame and the drill guides in the proper position, file gauge lines on the top surface of both angle plates and along the top edges of the sides. Those on the plates are centre lines; those on the sides are, first, 1in. from the inside of the clamping plate, and then at one inch intervals therefrom. Both sets of gauge marks may be elaborated with $\frac{1}{2}$in., $\frac{1}{4}$in. and even $\frac{1}{8}$in. lines if desired, but the author has found that with finished sizes of planed wood running into sixteenths and even thirty-seconds, it is better to use the one-inch intervals as focus points and measure off accurately from them with an ordinary ruler.

Mark a centre pencil line on one of the pieces of wood to be dowel-jointed and cross it with two other lines marking the distance apart of the

(Continued on page 277)

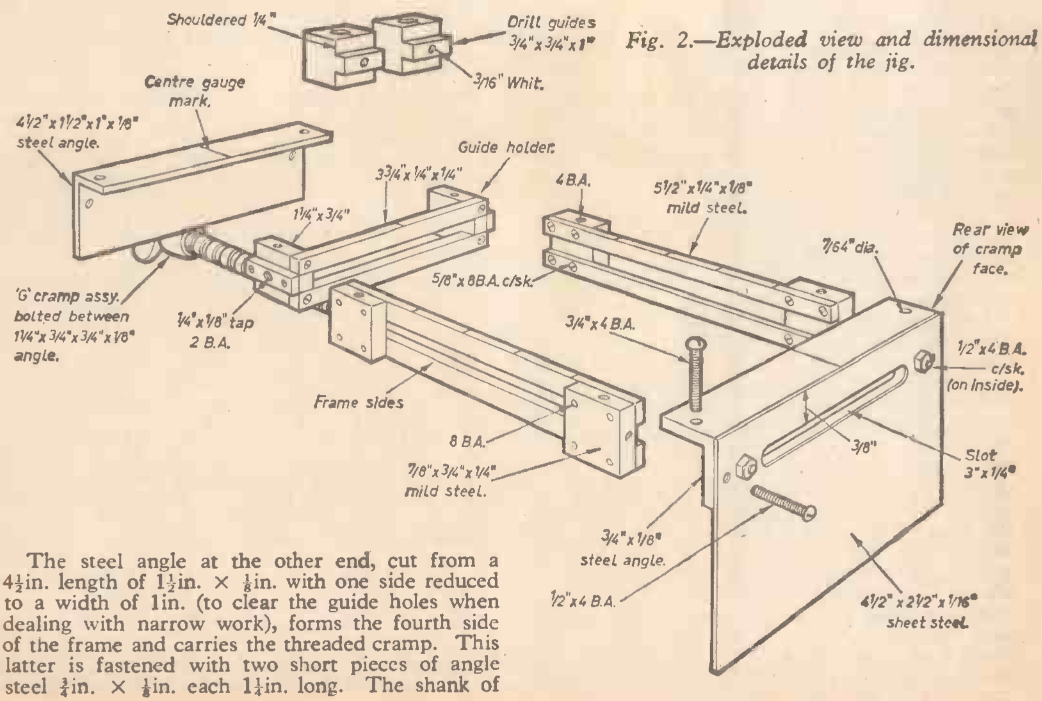
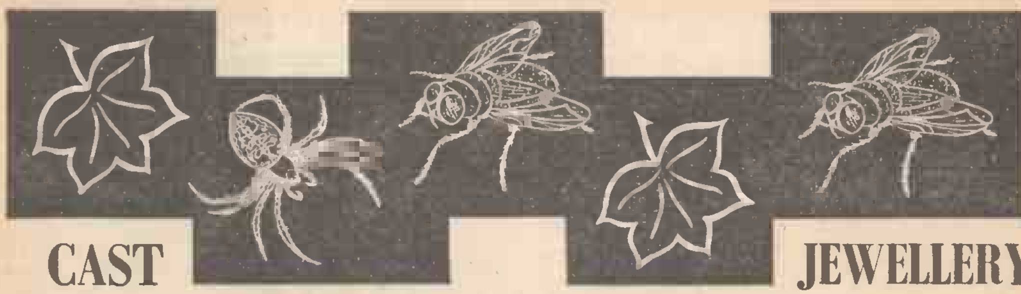


Fig. 2.—Exploded view and dimensional details of the jig.



CAST YOUR OWN PIECES OF JEWELLERY

as described by J. A. Waller

A BIRTHDAY or anniversary present to the lady of the household which may take the form of a charm bracelet, necklace or an unusual pair of earrings, is apparently outside the scope of the average individual who prefers to attempt making an exclusive model rather than the mass produced article purchased in the shops, but with a little care and practice he can soon attain a degree of skill which will enable him to produce the necessary pieces at a fraction of the cost he would normally expect to pay.

The suggestion that molten metal is used in the process immediately perturbs many readers as they fear their ability to work with such material, but if handling is performed with just that extra emphasis on care and the remarks given here are closely followed, there is little more danger than making a soldered joint.

Centrifugal casting which is the method employed for this class of work will produce accurately practically anything in the miniature decorative field even to the thin legs of a spider or the gossamer wings of a bluebottle, though the chief problem with these castings is to devise some way to prevent the thin sections from being caught in clothing and broken off. Not everyone has the financial resources to make a heavy and unusual gold bracelet, nor is it suggested that such an article is produced as a first attempt, but as the method is applicable to all metals the urge soon comes for something more elaborate and expensive looking than some simple detail in brass and aluminium and the search goes on for junk pieces of the rarer metals as casting material. So instead of disposing of that old silver teapot for an odd few shillings, flatten it into a convenient size and use it for the production of this decorative jewellery.

Tools

The tools for this work are not difficult or expensive to acquire—equipment in the nature of a polishing lathe or the usual type of electric drill having a polishing attachment—are refinements which, if already owned can be used with advantage, but it is suggested that the absolute beginner tries his hand at making several castings before turning his attention to the finishing methods as ideas will suggest themselves which may allow the use of existing equipment with little or no modification.

A special casting plaster is necessary and this is purchased from any good dental suppliers together with some modelling wax, and in view of the precise nature of these castings, you should not omit to mention that this material is required for the accurate production of castings. A blowpipe, foot bellows, fire clay pot for melting the metal are needed unless, of course, other means are available, and though the writer has never tried the method, oil firing on a small scale is possible. Fine files, emery cloth, tiny drills, snips, vice, hack saw, artists paint brush, odd pieces of wire, pins and pliers, are all articles which may be eventually pressed into use as the work proceeds and the only simple parts which require making are the miniature moulding ring and pot depicted at Fig. 1.

These pieces are sawn from brass tube—steel will do of course, but as you will leave them lying around in the shed or garage for periods, brass does not rust and is ready for immediate use. Solder a "floor" on to the pot or preferably introduce a screwed cap if you possess a lathe, but whatever idea is applied, see that this floor is really secure. Drill two holes for a wire handle and again make sure the ends are bent over to prevent any pos-

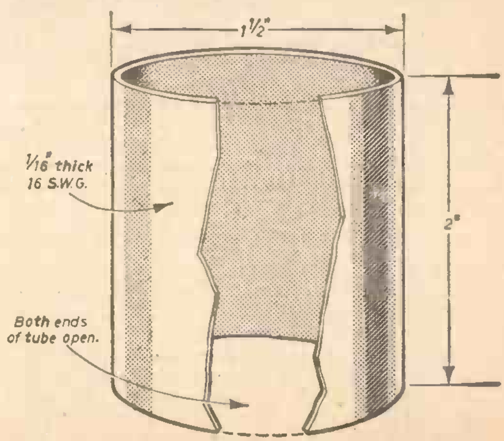
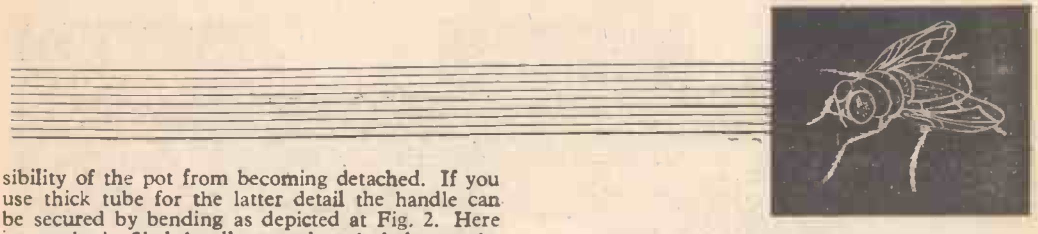


Fig. 1.—A series of rings made to these dimensions will be adequate for most items of jewellery.



sibility of the pot from becoming detached. If you use thick tube for the latter detail the handle can be secured by bending as depicted at Fig. 2. Here an angle is filed locally round each hole on the inside and this permits the wire to be bent on the inside but it still allows the assembly of a casting ring. Incidentally the latter should slide easily in the tube and the best way to achieve this is to purchase a piece of tube with an outside diameter equal to the inside diameter of a pot but polish it with emery cloth until it drops easily into the pot. Finally an old dog lead—the stout chain type with a clip to go over the wire handle is useful as the pot and casting ring will require rotating quickly above the head when the metal is in the mould in order to obtain the centrifugal force necessary to ensure the metal completely fills the cavity, and a chain of this type overcomes the possibility of a pot being flung outward as rotation commences.

The Casting Process

A point the reader should remember is that an object which is being cast should be made from either a material which will burn up easily or a wax that also burns away as a flame is applied, and though it is possible to use metal and wood patterns for the process as in orthodox large-scale moulding work, this description is confined to using the easily burnt-up materials. The earlier mention of insects means that a ready made field is available as these "patterns" will burn up and leave an excellent cavity for the molten metal, so first catch your insect and if a word of advice is required, the obvious point to make is that attempts to swat a large bluebottle that may stray into the house or workshop will naturally damage the delicate wings and legs. The best way is to close all doors and windows and give the insect a spray with one of the proprietary liquids such as "Flit" and wait for it to digest this cloud of insecticide. At this stage the reader should avoid ultra delicate subjects—the casting of a moth is feasible but naturally it needs handling with extreme care otherwise the wings are damaged.

Now cover an ordinary domestic pin with a layer of wax spread evenly until it becomes a $\frac{1}{16}$in. diameter and then gently scrape off this material from the point for a distance of $\frac{1}{16}$in. Push the pin into the insect—into the underneath, or belly portion—and then insert the pin head into a piece of wax about the size of a sixpence as portrayed at Fig. 3. There is no need to melt the wax for this operation as a piece thoroughly warmed is easily moulded into the desired shape.

Leave this pattern for half an hour to harden and in the meantime mix the plaster in a thickness the consistency of cream. Do this carefully and it is advisable not to add further plaster once the operation of mixing has commenced otherwise you may find this will ruin the mixture and you must start again. Next paint over the insect and pin with this mixture—this is obviously an operation which requires a delicate touch. So do not attempt to save two or three minutes at this point in an endeavour to speed matters up — but carefully go over all portions of the fly's anatomy using the paint brush and make sure that no blobs or air bubbles remain on the surface. Place the ring over this pattern—a flat piece of glass or tile is useful for this because the smooth surface is afterwards easily washed clean—and then add more plaster until the ring is completely filled as illustrated at Fig. 4. The plaster will set in about half an hour so you will find it practicable to "mass produce" these patterns by making say half a dozen at a time.

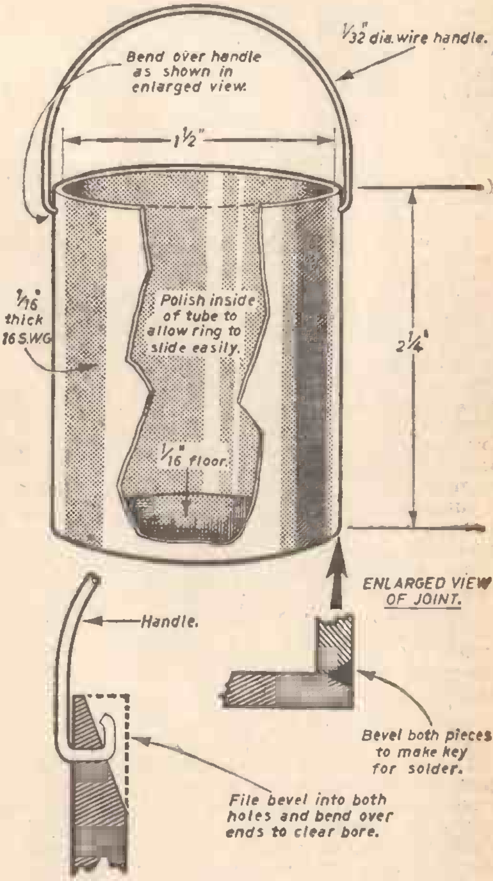
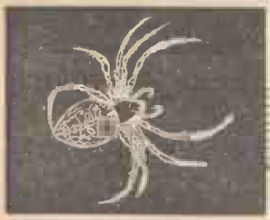


Fig. 2.—If the handle of this type of pot is carefully made no difficulty is experienced in loading the rings prior to making the actual cast.



Final Preparation

Once the plaster is hard the final preparation of a mould can commence and the first stage is to gently prise out the piece of wax which is visible when the ring is reversed on the tile. If a gas flame is directed on to it for ten seconds this will soften it sufficiently to make the insertion of a pointed penknife easy. Now grip the pin head with a pair of pliers and gently withdraw this item from the plaster coating. The emphasis on this occasion is on the word gently, because if the cast collapses the work must be carried out again as it is dangerous to attempt the operation of swinging even the tiny amount of molten material required here with a broken mould.

You must now rid the mould of the corpse—the author apologises to readers for the apparent gruesomeness of this work, but it is in fact not so revolting as the description suggests—and for this a small stand over a Bunsen burner is preferable because it leaves both hands free for subsequent manipulation. Light the gas and remember there is no need to roar the flame especially if there is a suspicion that the mould is not perfectly dry which it will not be after only the elapse of thirty minutes, so use only a flame about an inch long and let this enter the hole made by the pin. Remember with moisture present the mould is easily ruined so again do not rush matters. After half an hour the wax should have evaporated from the sprue—this is the technical term in foundry practice for the passage into a mould—and the insect should have been sufficiently cremated for it to be merely particles of dust. Tap the ring gently with a 3in. nail to persuade any specks to fall through the sprue hole. This operation of drying the mould and clearing the cavity takes a comparatively long time and a reader should preferably allow an extra quarter of an hour for the gas flame to thoroughly complete the work rather than leave particles in the mould which will naturally ruin the final casting. After a lengthy period in the flame the plaster will assume a red colour and this shows the mould is dry and casting can commence.

Preparing the Metal

While this has been going on you can prepare the pieces of metal for melting and as the article you will eventually produce is small, there is a tendency to cut up the scrap into minute pieces. This is a mistake as the pressure supplied by the bellows can blow pieces away and so make the operation difficult. Stand the ring with the wire handle on a suitable plate or preferably a sheet of asbestos, pick up the plaster-filled ring, turn it over and drop this into that member. You now have virtually a tiny bucket filled with plaster, and then place the cubes of metal on the top cavity of the plaster, turn on the gas and direct the flame on to this area. If you co-ordinate these movements, and having the equipment in a state of readiness is an obvious solution to the problem, everything should go ahead without difficulty. Keep the flame about 3in. from the metal and do not have a high pressure for the first minute or so, but gradually increase this by turning down the gas or increasing the air supply until a very hot flame is enveloping the material. When the metal is molten—use a fire clay rod to ascertain whether the whole cavity is in this condition—and if this check is satisfactory, quickly turn down the gas, clip the dog chain on to the handle and swing the pot round and round for about a dozen times. This operation introduces centrifugal force and forces the molten metal down the tiny sprue to completely fill the cavity. Put the pot back on the asbestos sheet and leave it alone for ten minutes and do not attempt to prod the material because if you have not produced a perfect casting by the swinging process, no further action on your part will make any difference now.

Aften ten minutes the pot is dropped into a bucket of cold water and this action naturally softens the plaster and allows you to pick up the cast from the water. Remembering if you dig the plaster with a steel rod the delicate contours are easily ruined, so simply let the water do the work for you and complete the operation if necessary by allowing a tap to run over it for a few moments.

Do not be in too much of a hurry to cut off the sprue as this is ideal for holding the cast in a vice or chuck while polishing takes place. The initial cleaning is preferably performed by dropping the "insect" into a jar containing acid—hydrochloric diluted with five parts of water appears suitable, and then washing it for three minutes under a running tap.

Each article is then soldered on to a dip or pin—these are usually purchased from a local store retailing do-it-yourself materials for craft work and jewellery etc., or a reader can design one to suit his own particular case. The chief point to remember during soldering is to use as little of this material as possible and for the work specially made irons from scraps of copper and small pairs of tweezers are an asset.

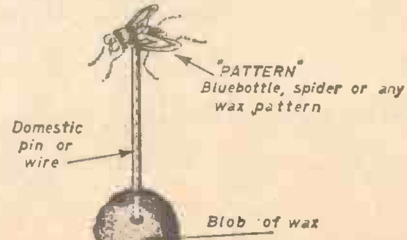


Fig. 3.—The "pattern", runner and a blob of wax to make entry of the molten plaster easy as the quick rotation commences.

Materials

Aluminium though easy to melt does not give a sufficiently sharp cast for small details, so unless the articles are in the region of a penny for size, the author suggests this metal should be avoided. Copper casts well and has the added attraction it plates easily. There are several varieties of brass and there is a wide difference between an old cast ornament and a dozen brass bolts, so some experimentation is essential in order to determine which is the best metal in this case.

Gold and silver are the luxury metals and a reader will naturally only turn to these after some experience with the others, but both cast well and a brooch or a pair of earrings of modern design made from old gold trinkets make an ideal gift.

Leaves and simple flowers made initially in wax are also cast by this method, in fact any design is possible provided the pattern is easily removed in the manner suggested earlier in this article. The production of a necklace in the form of a series of leaves hanging from a thin chain is really centrifugal casing at its best, and some care in the choice of the pattern is essential as each detail must match the adjoining member closely in order to introduce a degree of uniformity in the finished product.

Choose a leaf or number of leaves where the veins stand out boldly—a small ivy leaf or rose leaf is ideal for the work, so go around snipping them off with a reasonably long stem which can act as the runner for the molten metal when the mould is prepared. The leathery-like surface and slightly greater thickness makes it possible to run plaster round them without much fear of breakage, so choose each leaf with a view to ensuring a close match in size, shape and perhaps thickness.

Wax Pattern

The work of making the mould is similar to that described earlier but the making of wax pattern calls for the gentle pressing of a piece of soft wax into a shallow cavity made in the plaster. Press the leaf just beneath the top face of that material and allow it to dry thoroughly. This eventually gives the wax pattern a slightly extra thickness and so provide stronger castings which are not readily discernible unless a close examination is made. The back of a leaf can be left smooth or with the usual veins according to your skill and patience, but it does not take long to make a further plaster cavity using the same leaf and hollow this by carefully warming the now thickened wax pattern and pressing this into the impression. It is best to use both moulds for this dual pressing operation and then the fingers will not tend to flatten the delicate shape already created on the wax member.

The remaining details regarding the preparation of the mould is identical to that used for making an insect cast though on this occasion the retention of the stalk is necessary after it has done duty as the metal runner for either finally forming the basis on which a tiny ring is soldered for attaching the leaf to the chain, or using the stalk and bending it over to a ring shape for the same purpose. One final word on the production of ivy leaves. If you cannot find a sufficient number of matching members use a pair of scissors to remedy any defects or even make a leaf from a larger one though observe the size of the veins to see that they are reasonably alike. An absolutely flat leaf does not conform with nature so when the parts have cooled enough to make handling an easy operation, gently persuade the edges to assume a curved outline by simply bending sections either up or down. However do not overdo this part of the proceedings but endeavour to make each detail appear as natural as possible.

A hobby of this type rather unusually demands slight mass production techniques to be employed especially when jewellery of the leaf character is needed, so make up a series of moulds in their respective rings—the latter are cheap to produce so saw off a dozen or so pieces of the same length in readiness for such methods—and then you can economise in gas as there is only a single melting stage because enough metal is available for a batch of parts and not for a single detail. Finally colouring the finished products either by a chemical process, painting or merely leaving them in their "natural" condition completes the work, or you may like to include rhinestones as an additional feature.

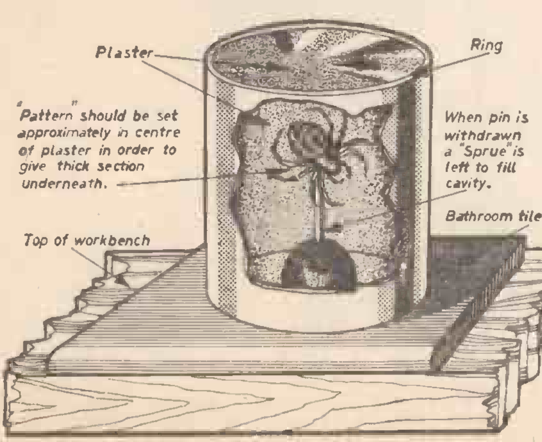
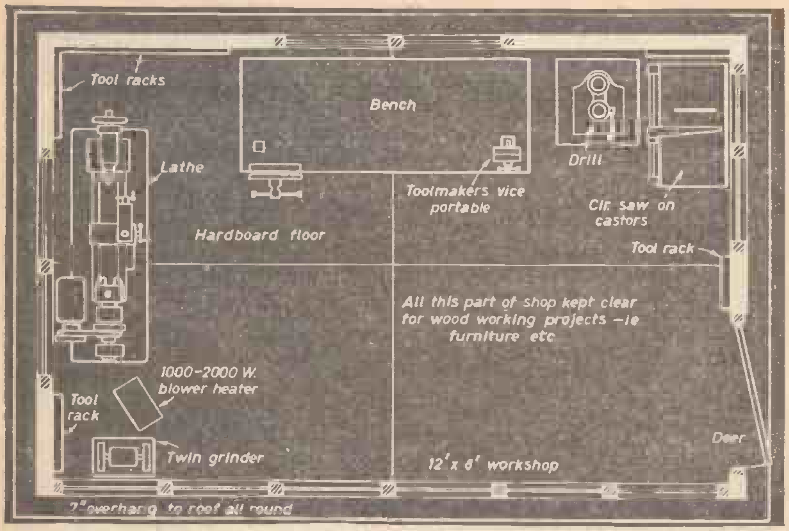


Fig. 4 (Left).—An old tile makes an ideal base on which to stand the pattern while the ring is filled with plaster.



General plan of layout.

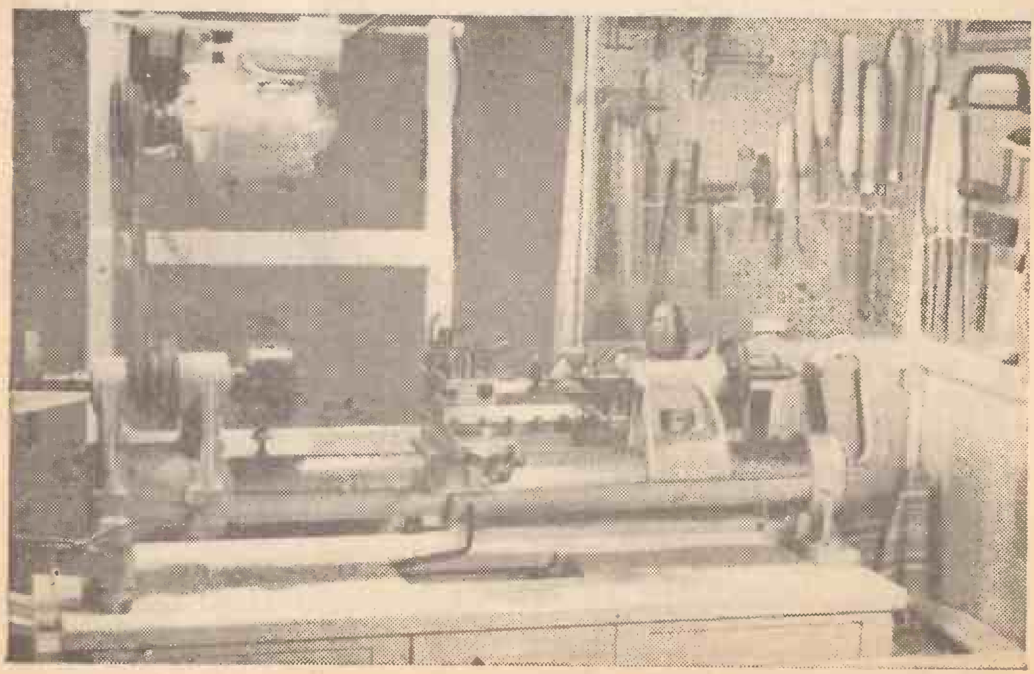
D. H. DOWNIE, A.M.I. Prod. E.

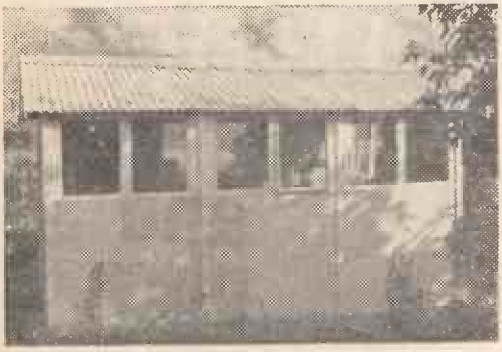
DESCRIBES HIS OWN WORKSHOP AND PROVIDES ILLUSTRATIONS OF THE MACHINES AND ACCESSORIES HE HAS DESIGNED AND BUILT FOR HIMSELF

A Reader's Workshop

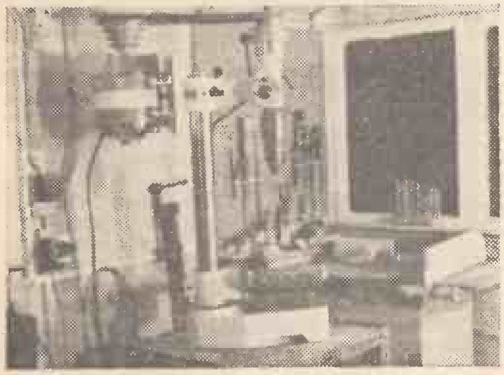
ALWAYS a keen workshop man, I had for many years made do with a small wooden shed, bench and hand tools. Later in life, design of small workshop machine tools and accessories. These, as I made them, were stored in various parts of the house. Finally, to house and use the machines I built my workshop during the summer vacation.

(Below).—The Lathe.





Front view of Workshop.



Drilling Machine and Saw Bench.

Constructional Details

With consideration for my neighbours, it is sited down the garden, and 75 feet from the house. It is 12ft x 8ft on a foundation of concrete slabs. Framing is 2ft x 2ft in 4ft sections, asbestos sheet covered. A corrugated asbestos ridge roof of 18in. pitch. The whole building is lined with ½in. "Tentest" insulating board, right up to the ridge. The floor is of $\frac{3}{16}$in. tempered hardboard painted on the underside with two coats of bitumen paint, and the surface sealed with a proprietary sealer. This floor is comfortable to the feet, easily kept clean, and tools dropped on to it suffer little damage.

Most workshops as sold have little window area for lighting, so necessary when doing good work, and it was partly because of this I designed my own. The 12ft front has windows the entire length, the other three sides have two windows each, hence any project in hand is lighted from all directions. Power is from 13 amp. fused sockets and lighting by a 5 amp circuit. Tool racks are in peg board in slotted battens, and can be easily lifted out. The tools are held in place by looped plastic clothes line. Easy to arrange, more efficient, cheaper and neater than metal clips.

Equipment

Machine equipment is a dual purpose metal and wood turning lathe, with accessories such as Buff

Corner Tool Racks at Lathe end of Workshop.

Flexible Shaft Tool, own design and making.

—grindstone—sanding disc with adjustable angle table. A rise and fall 8in. circular saw, mounted on castors, allows one to move it around easily whilst sawing large sheets. A ½in. capacity bench drill, four speeds, ¼ H.P. Motor, has accessories such as rebating cutters, mortising cutters, and a planing cutter which will handle strip wood up to 3in. wide. At present I am working on a flexible shaft tool to add to my equipment. The shop is heated by a 1000-2000 watt blower heater, and in a matter of minutes is comfortably warm, and keeps so owing to the insulation. The outside panels of the shop are finished in olive green oil paint, the striping and woodwork in bright yellow.

Readers may be interested to know that I designed and made all my mechanical equipment from the first sketches, wooden patterns, finally machining and fitting up.

What do I do there? Well, it's a quiet place to relax in after the pressure of Technical Teaching. I do jobs for the home as required, make photographic apparatus to help my hobby of Technical photography, design on my drawing board, and develop ideas for my students in Mechanical Engineering. Also it's an ideal place with the appropriate atmosphere to sit and write my articles on the design and making of workshop accessories.

magnets at work and play

G. A. W. Partridge describes how magnets can be put to practical uses in various ways and also provide amusement for the children

FOR only a few shillings you can obtain a small, powerful horse-shoe magnet from most hardware shops, and put it to numerous uses. Few people realise that these simple magnets can be of great practical value in the home and workshop. They can also entertain our children for hours on end and in later years teach them interesting scientific principles.

Fig. 1.

Let us look at the practical uses first. Fig. 1 shows how 'adverts' such as "Bed and Breakfast", or "Radio in excellent condition for sale" and so on can be attached to the window. The advert is printed on a card and placed outside the window. The keeper (metal bar that is usually held across the magnet poles) is placed in the centre of the card and the magnet put on the inside of the window pane in such a way that it holds the keeper and advert card to the window. Magnetism passes through glass quite easily. If the advert is painted on to a thin iron metal plate, the keeper can be dispensed with.

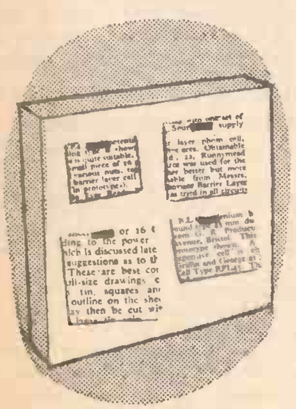


Fig. 2.

A magnetic notice - board is shown in Fig. 2. Four magnets are placed behind a cardboard sheet and with the aid of the keepers all sorts of information is kept in place. Fig. 3 shows how the magnets are held in position. Drawing-pin holes will not mar this board which would look well in small club-rooms.

Small soft iron or steel parts that roll off the bench and seemingly disappear on the floor can be quickly retrieved with a magnet. Tie a string to the magnet and drag it gently over the floor until it 'finds' the missing parts. Replace the keeper directly afterwards.

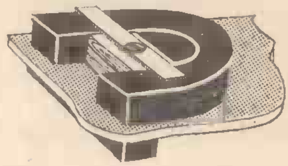


Fig. 3.

What about that cupboard door that has the annoying habit of swinging open due to a broken catch? Throw away the catch and fit a small horse - shoe magnet to the frame. Now mount a piece of soft iron in a suitable place inside the door (Fig. 4). A knob will, of course, have to be fitted so that the door can be pulled open. Large cupboards can be fitted with two magnets if necessary.

The following ideas are fairly well known. For instance, separating steel screws, nuts, etc., from a junk box of odds and ends needs little comment. A magnet lying on the writing desk is ideal for holding paper clips and pins. A small set of useful tools consisting of say, a large and a small screw-driver, a pair of pliers, and set of B.A. spanners can be neatly kept together ready for use by a couple of horse-shoe magnets. Some people like magnetic screwdrivers. Fig 5 shows how to magnetise a screwdriver and keep it that way.

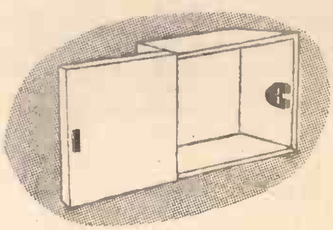


Fig. 4.

Let us now look at the educational possibilities.

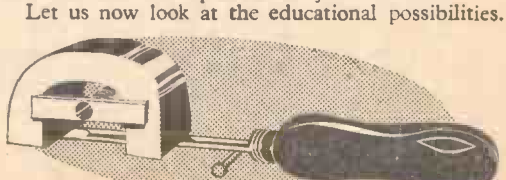
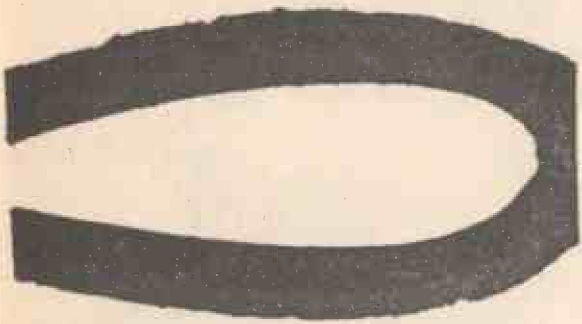


Fig. 5.—Magnetic Screwdriver.



Finally, here is a magnetic toy for small children. (Fig. 8.) The pins are magnetised by touching them on the poles of a magnet.

See how many pins can be caught and pulled out with the magnetic pin.

Only a few ideas have been described here but others will come to mind from time to time. How about thinking up a few magnetic games for that coming party?

Children find the following instructive novelties most interesting.

Magnetise a pin by stroking one pole of a magnet with it. Thread it through a piece of paper which is now allowed to float in a tumbler of water. Children will be interested in its North seeking properties. Lay a loop of wire over the pin and touch the ends with a small torch cell. See how the pin moves away which shows the principle of the electric motor.

Fig. 6.

Radio enthusiasts usually have a milliammeter movement in their shack. Fig. 6 shows how to explain the principle of the dynamo. Shake the magnet over the wire loop and the milliammeter needle will 'kick'! This keeps the children happy for some time as they try and see who can shake the hardest and produce the greatest amount of electricity.

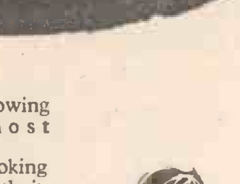


Fig. 7.

Lay the magnet flat on the table. Place a piece of cardboard over it and then sprinkle on some iron filings. Tap the card and the magnetic field will appear immediately. (Fig. 7.)

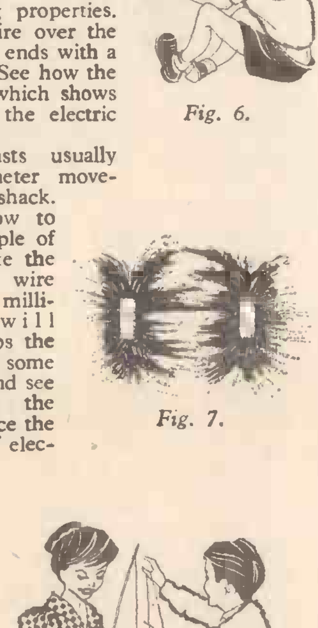


Fig. 8.

PUZZLE CORNER

FOUR very tired and hungry men entered a small country inn and asked for accommodation and something to eat. The landlord put them into one large room and apologised for being able to offer them only a large dish of boiled potatoes. When he brought the dish in, however, he found the four men had fallen asleep. He therefore put the cover on and left the dish near the fire.

Shortly afterwards, one of the men woke up, saw the potatoes, ate his share, i.e. one quarter of the total number, and then went to sleep again. Half an hour later the second man woke up and, not knowing that one had already eaten, himself consumed a quarter of the potatoes then in the dish and went to sleep.

In a little while the third man awoke, ate a quarter of the potatoes and fell asleep again.

When the fourth man woke up, not knowing the others had already eaten, he decided to eat his share but found that, for equal division without cutting, there should have been one more potato. He therefore mentally added one and ate a quarter of the total thus obtained.

When the four men awoke simultaneously they decided to eat up the potatoes but none of them disclosed that he had already eaten some of them. They were able to share the remaining potatoes without cutting.

What is the smallest number the landlord must have put in the dish when he first brought it in?

Answer

The first man would have consumed $\frac{1}{4}$ of the original number; the second man $\frac{3}{16}$ths; the third man $\frac{9}{64}$ths. At this stage, therefore, the total consumption had been $\frac{1}{4}+\frac{3}{16}+\frac{9}{64}=\frac{37}{64}$ leaving $\frac{27}{64}$ths of the original number still in the dish. Since the fourth man found he required one more potato for equal division and mentally added one (thus fictitiously bringing the remainder to $\frac{7}{16}$ths) he must have eaten $\frac{7}{64}$ths of the original number, thus bringing the consumed portion to $\frac{11}{16}$ths and the remainder to $\frac{5}{16}$ths. As they were able to divide this remainder equally between the four of them without cutting, there must have been 20 potatoes. Therefore, the original number was 64.

LATHE GADGETS

Part 3

TOOLPOST DRILLING AND MILLING SPINDLE

By L. C. MASON

IN many jobs the possession of a toolpost drilling and milling spindle helps very much in speeding up and producing a more accurate result, while in some cases it is only by the use of such an accessory that the machining of a job is made possible at all.

The spindle runs in plain close-fitting bearing bushes pressed in a tubular housing, which is gripped in a bored and split block designed to work in with the column of the adjustable toolpost recently described. The different assembly positions possible with the spindle housing block and column provide an infinite range of set-ups, especially when other accessories like angle plates and the vertical slide are brought into use as well.

With straightforward mounting on the topslide the spindle can take up any position to which a turning tool can be set. Drilling bolt holes in items like cylinder covers without having to remove the job, mark out and drill, drilling rivet holes round a boiler barrel; endmilling flats or splines on a shaft, are all jobs which the spindle simplifies very much. When mounted on the vertical slide via the column the spindle can be rotated in a vertical plane. An extension bar clamped horizontally to the vertical slide to carry the spindle at its outer end brings it into use as a light vertical drill, with the advantages of indexed movements in all directions through the index collars on vertical slide and lathe movements.

The first item to be tackled is the mounting block, which is best shaped up from mild steel bar. A smaller version for a baby lathe was quite satisfactorily machined out of a piece of wrought iron. Mount the block in the four-jaw and face up at least one surface nicely flat, from which the others can be checked. If bright M.S. bar is used, the surfaces will probably be sufficiently good to need no machining at all. Re-chuck the block edgewise and square off the other four sides in turn. Mark off on the top surface the centre of the hole for the mounting coloumn, centre pop, and re-mount in the four-jaw with the punch mark running truly. Drill through and open up the hole by boring till it is an easy fit on the column. Mark out and drill for the clamping stud $\frac{3}{8}$in. B.S.F. tapping size and open up the outer half of the hole to $\frac{3}{8}$in. clearing. While not essential, this is the point at which to cut back and machine flat the seating for the clamp nut. This is best carried out by endmilling, with the block clamped flat against the face of the vertical slide. Saw the slit to allow of clamping, and tap the bottom half of the hole. If you now fit the clamp stud, washer and nut, the block can be clamped to the column in its working position for drilling and boring the long hole for the spindle sleeve.

Locate and centre punch the centre of the spindle housing bore, mount the block on the toolpost column, and line it up for drilling and boring by checking the centre pop against the point of the head centre and the squareness of the block against the faceplate. Drill through with successively larger drills held in the three-jaw, finishing the bore out to size with a small boring bar between centres. With the bore finished, fit the sleeve clamp screws and cut the slit, as for the big clamp stud.

All that remains on the block is to drill and tap for the height adjusting screw ($\frac{1}{4}$in. Whit.) and to drill a deeply countersunk oil hole to break into the spindle housing bore about midway along. This hole can very well be formed in the one operation with a centre drill.

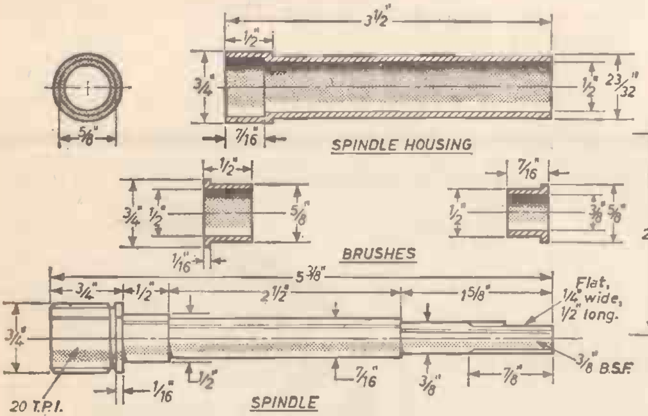
Next comes the spindle sleeve. Face each end of a suitable piece of round M.S. rod, finishing it to length. Turn the two outside diameters between centres, the smaller a close fit in the bore of the block. Transfer the piece to the chuck, and if the three-jaw doesn't hold it truly, use the four-jaw, setting the job to run really true with the outside diameter. Drill in at the centre and open up the hole by stages, taking it to $\frac{31}{64}$in. halfway into the piece. Drill the small end first. Reverse in the chuck, once more setting it to run true and drill as before to meet the first hole. Ream the complete hole $\frac{1}{2}$in. and open up the bore with a small boring tool to $\frac{5}{8}$in. for $\frac{7}{16}$in. deep.

The bushes are plain turning jobs from phosphor bronze or gunmetal. Bore them full reaming size before inserting them in the ends of the tubular housing, making them a light press fit, then ream right through both when in position. This will ensure the bores being in line and the correct size after any slight compression may have taken place through pressing into position. Mount the complete spindle in its working position in the block and drill the oil hole through, spotting through the hole in the block.

The spindle is turned from mild steel between centres, aiming for a close but free fit in the bearings. When the outside is finished, grip the large end in the four-jaw, set to run true, and with the small end supported on the back centre, screwcut the end 20 t.p.i., chasing up with the $\frac{3}{8}$in. B.S.F. die in the tailstock dieholder. Reverse the piece in the four-jaw, re-setting to run truly by the $\frac{1}{2}$in. diameter portion, and drill for the collet housing and work clearance hole. Finish the bore to size smooth and parallel with a small boring tool. Set the topside over to 20 deg and turn the taper in the end, opening up the mouth till it is $\frac{9}{16}$in. diameter at the face. Screw the 20 t.p.i. nose thread, shaping up with a chaser if possible.

To complete the spindle, file the driving flat on the $\frac{3}{8}$in., screwed portion.

Just by way of refinement, it will be found convenient for some set-ups to have the block turned over, thus bringing the oil hole underneath. An oil hole can very well be drilled on both faces the block, retaining one only in the sprindle housing. The spindle assembly can then be fitted so that its hole lines up with the upper one in the block, the lower hole in the block being automatically blanked off by the spindle housing.



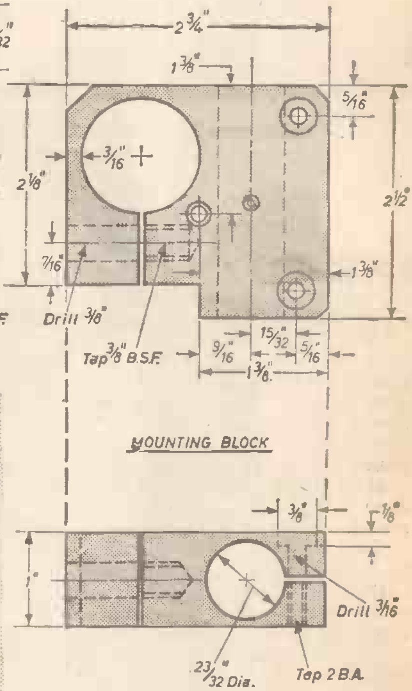
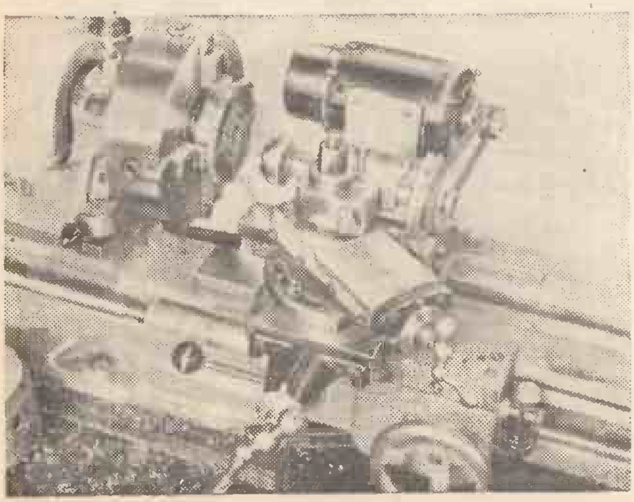


Fig. 3 (Above). — Constructional details and dimensions.



(Left).—Toolpost drilling and milling spindle set up on ML7 top slide for precise drilling.

THAMES SPAN HELIP

THE helicopter is undoubtedly one of the most versatile machines yet devised by the ingenuity of man, yet it would seem that its full potential has as yet been far from fully exploited.

One might reasonably have expected that by now we should have seen the helicopter in much fuller use as an industrial transport and passenger machine. To exploit this potential to the maximum effect the existence of city centre heliports is essential, for obviously if a heliport is situated outside the city limits the helicopter's greatest asset i.e., its ability to take off and land within its own length, is rendered negative. And yet one of the major problems involved in siting a heliport within a city centre is undoubtedly one of space. Most cities, of course, have their parks, and open spaces, but even the most avid enthusiast would hesitate to advocate the conversion of these into heliports. In the case of a city situated on a river, such as London, there is at least one possible alternative and that is to span the heliport across the river itself. Such an undertaking would be within the limits of present day technology and would offer enormous advantages. For a heliport of the dimensions envisaged could accommodate not only ferry services between the city centre and local airports, but also regular services between other cities and industrial centres, plus a margin for the inclusion of services to and from the Continent.

Decked

The heliport itself would consist of an upper landing deck, sub-divided to accommodate the various types of traffic it would be required to handle, goods, passengers etc. Immediately below the landing deck would be the passenger dispersal deck to which the passenger would proceed either by lift or escalator. A large part of this deck and the whole of the next deck would provide a vast parking area for passengers' cars plus a high percentage of space for city parking. Entry to, and exit from, the parking area would be via the ramps contained within the heliports' supporting columns which themselves would span multiple lane motorways cantilevered out over the water at a height which would not interfere with river traffic.

Distribution of Goods

Below the landing deck and the two parking decks would be at least two further decks for the distribution of goods. This distribution would be handled in three ways. Firstly by monorails running North, South, East and West for city perimeter

Helicopters for express goods transportation only, could operate between centres at large towns.

PORT

BY L. TURNER

delivery. Secondly by road, for local distribution and the third method would be by hovercraft which would handle riverside delivery. The monorail system would, of course, also accommodate a high percentage of passenger traffic. Linked with the heliport would be the control tower enforcing the strict landing procedures and full safety precautions particularly necessary in such a location, though it should be pointed out that in this respect the helicopter is the least accident prone of any form of air transport. Integral with the control tower would be administrative offices, hotel accommodation and monorail stations.

In time of course, the heliport, even one of the dimensions envisaged, might prove inadequate for the demands made upon it, but in such an event its unique siting position would make it possible to add further sections to cope with the increased demand.

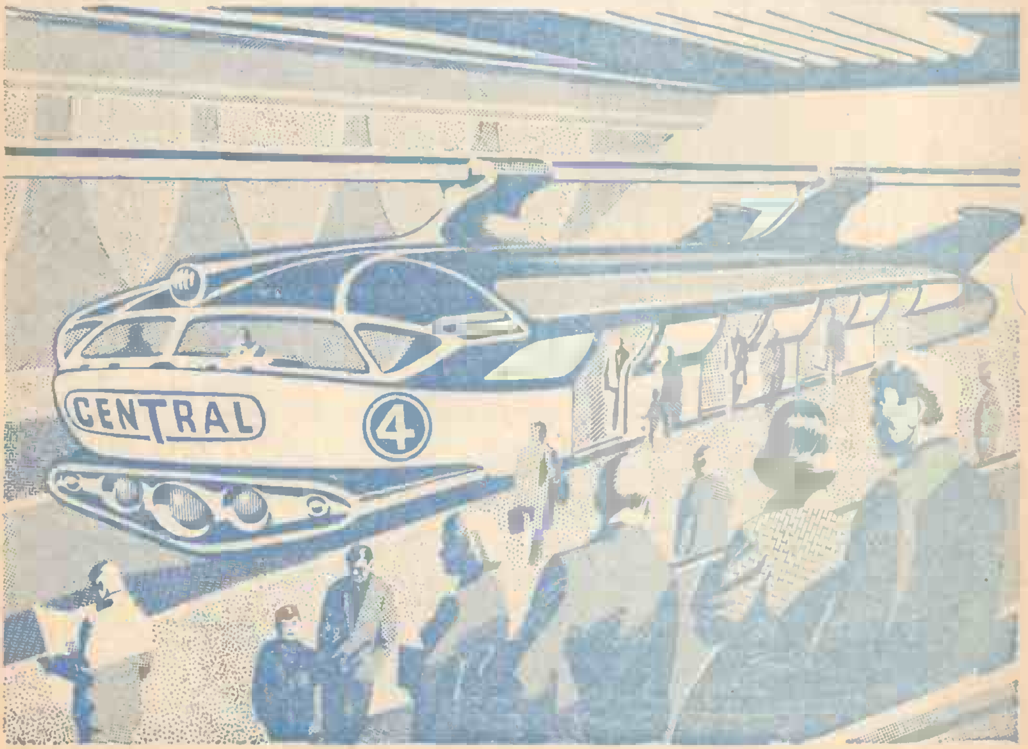
There are of course twin rotor heavy duty helicopters in existence which could be employed in this inter-city heliport system and further development will no doubt provide even larger and faster machines, possibly obtaining their greater speed through the employment of jet engines.

In addition, there are the possibilities offered by the vertical take-off craft which obtains its lifting thrust not from rotors but from downward directed jets, conversion to normal flight taking place once the vertical take-off craft is airborne. Considerable success has already been achieved with prototypes employing this system, and such a machine would be invaluable in the inter-city heliport link-up.

Advantages

In a world becoming rapidly more competitive the advantages to commerce and industry of the internal high-speed transport system envisaged would be enormous. Our road network in spite of the addition of motorways is still very far from adequate for the ever increasing demands made upon it and it seems doubtful upon present showings whether it will be for many years to come. Our system of railways, though obviously still essential for the transportation of material and goods in large bulk, lacks the element of speed (and some might add punctuality), so essential to the efficient functioning of modern industry. The heliport net-work system would therefore provide commerce and industry with a top gear transport system more in keeping with the demands of the space age.

Monorail services from city suburbs would bring passengers direct to heliport reception centre below flight deck.

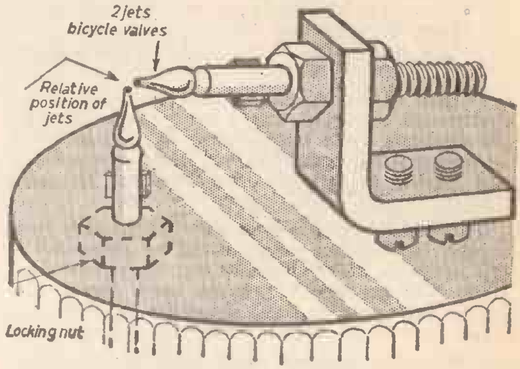


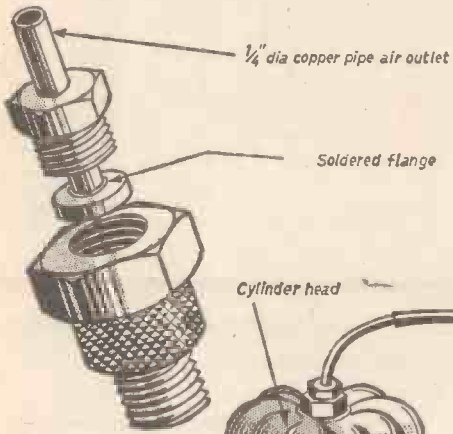
MAKING A SPRAY COMPRESSOR

By G. R. Gilbert

Fig. 1 (Right).—Details of the jets.

Fig. 2 (Below).—Section through sparking plug adapted for use as air outlet.





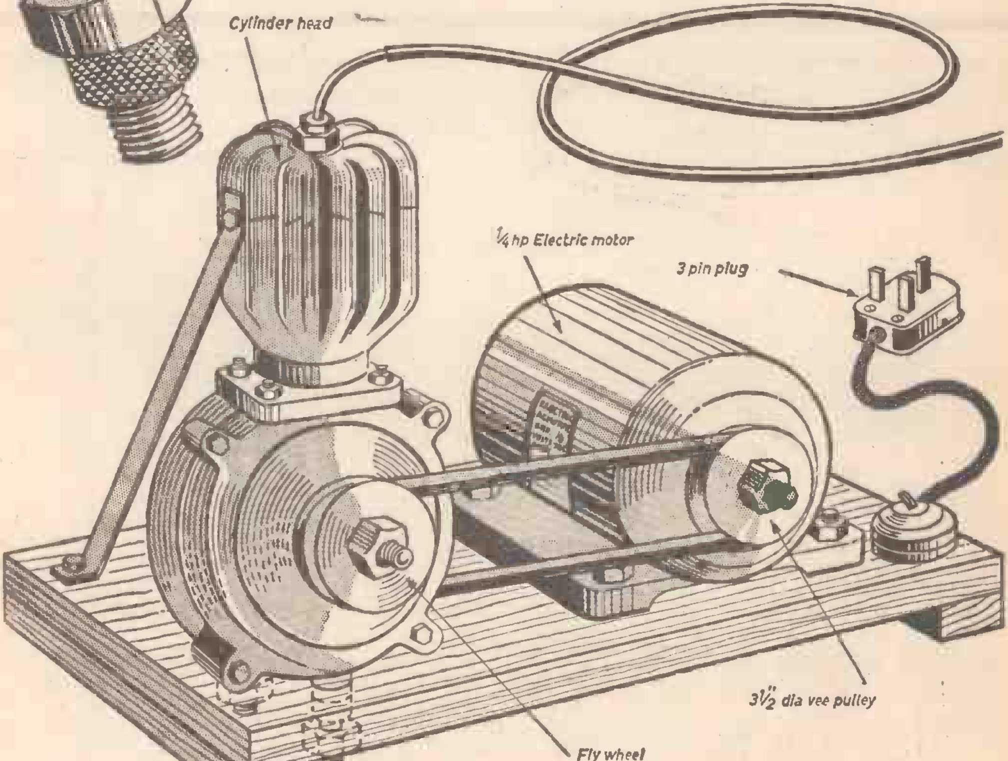


Fig. 3.—Set-up of compressor and motor.

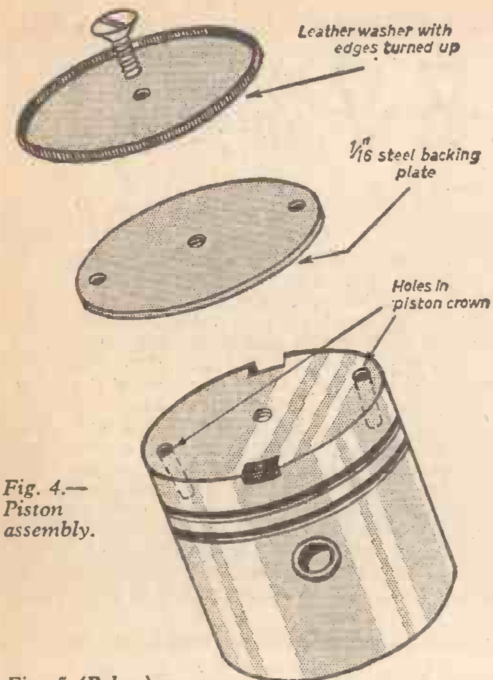
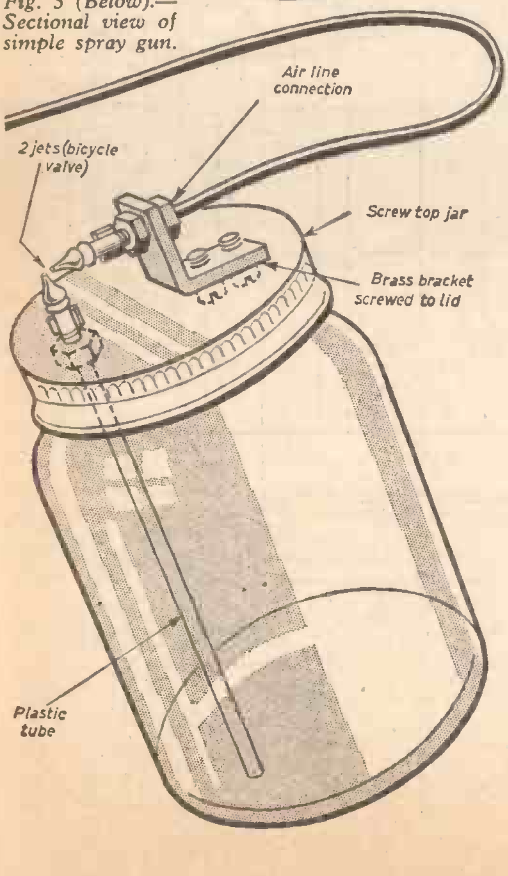


Fig. 4.—
Piston
assembly.

Fig. 5 (Below).—
Sectional view of
simple spray gun.



THE conversion of a small 2-stroke engine to work as a compressor suitable for paint spraying is a relatively simple job, the 50 c.c. Mini-Motor used in this instance involved the use of hand tools only (see Fig. 3).

Piston Modification

The biggest job is the necessary alterations to the piston. Begin by removing the cylinder head, and cylinder from the crank-case and the piston from the connecting rod. Should the gudgeon pin be tight in the piston, it can usually be pressed out after removing the circlips from their grooves and heating the piston with boiling water.

Metal Plate and Leather Washer

The crown of the piston is fitted with a leather washer, and the two cutaway portions on the top of the piston, are covered with a thin steel backing plate, so that it presents a flat surface for the leather. Cut and file the backing plate from $\frac{1}{16}$in. steel to roughly the same diameter as the piston, an exact fit in the bore of the cylinder is not essential, in fact a small gap all round is an advantage to help the compressor to take in air more easily. The gaps in the piston rings should be enlarged. The washer is cut from soft leather (the tongue from a shoe, or from a glove) about $\frac{3}{16}$in. larger in diameter than the piston. Washer and backing plate are fastened to the piston with a $\frac{1}{4}$in. Whit. screw in the centre. Temporarily fasten the packing plate to the piston and drill two $\frac{3}{16}$in. holes through the plate and piston crown near the edge, see Fig. 4.

Reassembly

Making sure that the holes in the plate and piston are aligned, assemble together with the leather washer and refit the piston to the connecting rod. After removing the inlet and exhaust pipes from the cylinder, blank off the ports with $\frac{1}{8}$in. metal, using the pipe flanges as patterns. When refitting the cylinders to the crankcase turn the edges of the leather washer upwards. With the piston near the top of its stroke, soak the leather with oil to make it supple and press the edges against the cylinder wall to make a shallow cup shape. The cylinder head can now be replaced minus the sparking plug.

The Crankcase

The work on the crankcase consists only in drilling a $\frac{1}{4}$in. hole to prevent pressure and vacuum alternately building up, by opening it to atmosphere. The upper of the two tapped holes originally used for fastening the roller guard is a convenient place for this hole. Remove the back plate carrying the coil and other electrical gear leaving only the flywheel fitted on one end of the crankshaft and a $3\frac{1}{2}$in. dia. vee pulley on the other.

The Air Outlet

To complete the actual work on the engine, a sparking plug of the type which dismantles must be adapted for an air outlet. Unscrew the halves of the plug and remove the centre electrode. A length of $\frac{1}{4}$in. dia. copper tube with a flange soldered at one end is assembled with a suitable screw in place of the electrode. This is shown in section in Fig. 2.

The action of the compressor is similar to that of an ordinary bicycle pump. On the downward

(Continued on page 270)

An Electronic Timer for Photographers

By G. W. McDONALD

THE process of enlarging photographs requires a good deal of concentration if shading and other creative work has to be done. Peering into the gloom of a darkroom at a clock face, or counting the ticks of a mechanical timer, is not conducive to good work. Why not let automation help you by passing the timing problem to this Electronic Timer? It will switch on the enlarger lamp and keep it on for the time required to give the previously found exposure and switch if off at the end of that time. It will repeat periods of time with a degree of accuracy sufficient for practical purposes from one second up to 100 seconds. By setting the switch to the position marked " Focus " the lamp is held on for a period of up to five minutes; the lamp may be extinguished at any time by re-setting the timing switches to zero. The finished timer can be seen in Fig. 1.

Circuit

The circuit (Fig. 2) is technically a simple one, and being A.C. mains operated from a three-core mains lead allows efficient earthing of the metal chassis. This makes it safe to use in any dark-room providing the mains lead is correctly wired up.

The timer operates as follow. When the mains switch S1 is closed, voltage is applied to the primary of transformer T1, and to the enlarger lamp via the contacts of relay REL. The lamp will remain lighted until the valves V1 and V2 heat up and a voltage appears across smoothing capacitors C2 and C3. The polarity of the voltage across the capacitors is shown in the circuit diagram. From the circuit diagram it will be seen that a positive voltage is applied to the grid and anode of valve V2, and it being a gas-filled thyratron type immediately passes current sufficient to cause the coil of relay REL to

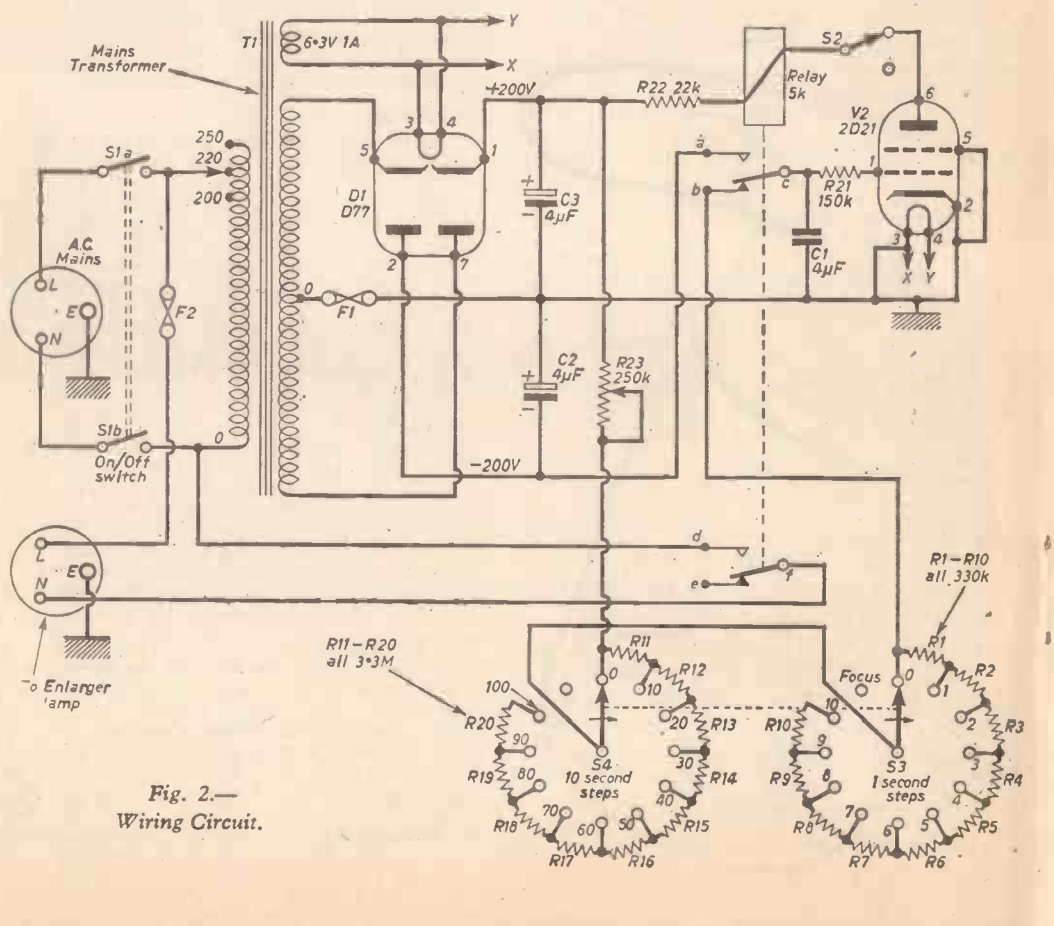


Fig. 2.—Wiring Circuit.

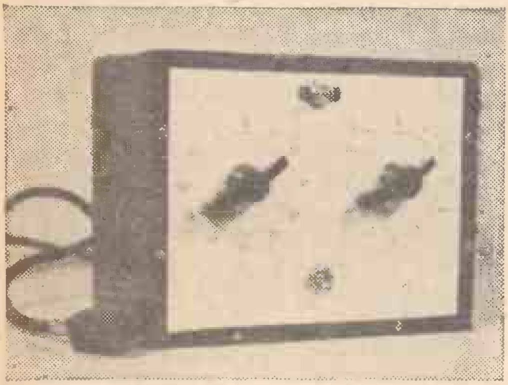
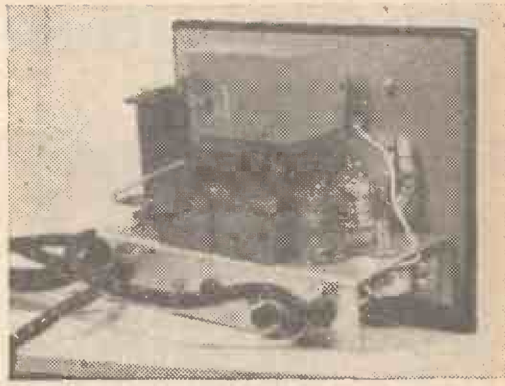


Fig. 1.—The finished Timer.



Top view showing position of components.

operate the armature and change over the contacts. The lamp now goes out and the timer is ready for use. Timing capacitor C1 is charged to a voltage of negative 250. This voltage across C1 when allowed to slowly leak away through the series of timing resistors R1 to R20 provides us with a range of intervals from one second to 100 seconds, during which the enlarger lamp may be lit.

To start the timing cycle the required time is selected on the rotary switches S3 and S4, and the re-cycle switch S2 is operated, momentarily breaking the anode circuit of valve V2. V2 now ceases to pass current, the relay REL operates and changes over the contacts so that the timing capacitor C1 is connected to the discharge resistors R1 to R20 as selected. At the same instant the enlarger lamp lights and will remain that way until the voltage across C1 becomes near zero, when by virtue of the voltages now on the grid and anode of V2 the relay will again operate, changing back the contacts and switching off the enlarger lamp. The timer is now ready for the next timing cycle which can be started simply by throwing the re-cycle switch S2.

The tolerance on the component values given in the Parts List are plus or minus 10 per cent. This has in practice turned out to be sufficient for the purpose of timing enlargements. Components of high tolerance are expensive and in order to keep the total cost to around £6, 10 per cent, tolerance components were selected.

The exposure time required for a particular enlargement is always found by the test strip method, and if the strip is timed on the timer the actual enlargement will turn out as the test strip did. This has been proved by the writer over a long period of time, using this timer.

For the technically minded the discharge time of the circuit is found by the following formula.

$$T = 0{\cdot}693 R.C.$$

where C is capacity in μF

R is value of discharge resistor in MΩ

T is time taken for voltage on C at fall to zero.

Practical considerations make the values in the Parts List differ from those arrived at by the above equation. Where cost is no consideration the use of high stability 1% tolerance resistors will give results in practice almost equal to those calculated. It will be noticed that a variable resistor R23 is placed in series with the discharge resistor chain. This is used to adjust the calibration on the one second to ten second range.

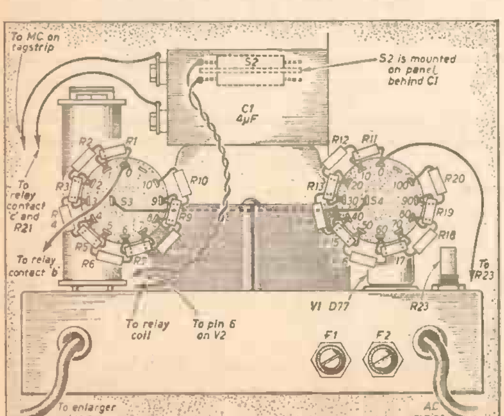


Fig. 3.—Top of Chassis Wiring.

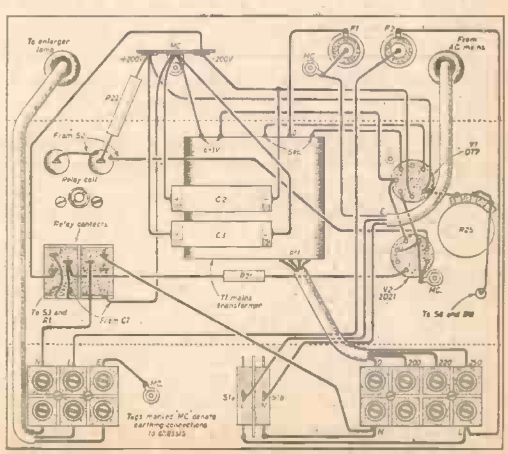
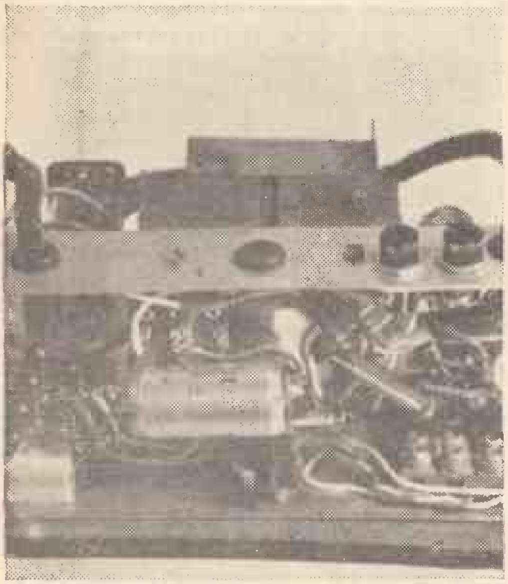


Fig. 4.—Underside of Chassis Wiring.



Under-chassis view of the Wiring.

Construction

No dimensions of the chassis will be given because this depends on individual requirements and the size of the components available. The wiring should be clear from Figs. 2, 3 and 4. The mains input and the output leads to the enlarger are fitted with non-reversible plugs and sockets, these fittings are obtainable from all good electrical stores. Their use ensures continuity of the safety earthing system.

In order to avoid overloading the variable resistor R23, the selector switch should not be moved from "FOCUS" to ZERO, but from "FOCUS" to the ten-second position. This allows the full charge on capacitor C1 to discharge slowly through the timing resistors R1 to R19 thus limiting the discharge current through R23 to a value which it can safely handle.

PARTS LIST

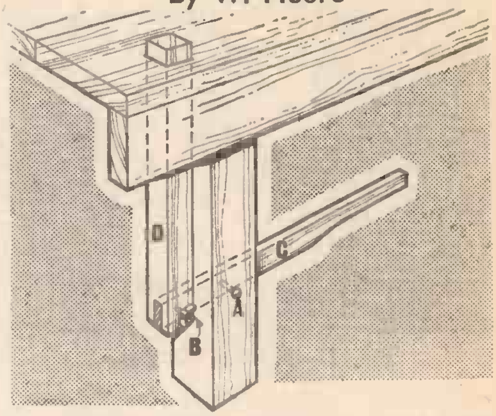
S1	Two-pole ON/OFF switch
S2	Single-pole, two-way switch
S3, S4	12-way 1-pole wafer switches
F1	Panel mounting fuse holder with 100mA. fuse
F2	Panel mounting fuse holder with 1A. fuse
C1	4μF. 350V. D.C. paper foil capacitor
C2, C3	4μF. 350V. D.C. electrolytic capacitor
Resistors	
R1-R10	330 K Ω ¼W.
R11-R20	3·3M Ω ¼W.
R21	150K Ω ¼W.
R22	20K Ω ½W.
R23	250K Ω variable
V1	D77 or 6AL5
V2	2D21 or EN91
T1	Mains transformer 220/250V. primary Secondary 250-0-250V., 30mA., 6·3V. 1A.
Relay	P.O. Type 3000. 5000 Ω coil, two change-over contacts.

Sundries

Two pointer knobs, two valve holders B7G, two 3-pin non-reversible plugs and sockets, 2yd. 3-core, flex resin-cored solder, connecting wire, 20 s.w.g. alloy chassis.

AN ADJUSTABLE BENCH STOP

By W. Moore



A WOOD bench stop will not "nick" your plane iron. The stop portion "D" is made of Beech but any close-grained hardwood is suitable. It is 2in. square.

First, a mortise is cut in the bench top to give a neat fit for "D". It slides on the bench leg to give it support. A slot or mortise is cut in the back of the bench leg to allow the handle "C" free movement.

The handle is 1in. thick and 2in. wide and is fitted into an open mortise in lower end of stop "D". The length depends on your requirements. The bolts "A" and "B" are $\frac{5}{16}$in. and of a length to suit the bench leg and stop. A wing nut on the bolt that attaches the handle to the leg is convenient to adjust for working. If you wish to work this by foot, you can make "D" longer so that the handle is closer to the floor.

This stop allows raising and lowering by handle alone without the need for constant loosening or tightening a nut.

MINI-MOTOR AS A COMPRESSOR

(Continued from page 267)

stroke air is drawn through the holes in the piston and past the leather washer; on the upward stroke the washer is pressed against the cylinder walls and compresses the air, forcing it through the air outlet. The compressor is mounted with two $\frac{5}{16}$in. Whit. bolts in the holes at the base of the crankcase and is driven by a ¼ h.p. motor at about 1,500 r.m.p.

The compressor delivers air in sufficient volume and pressure to operate a gun of the type sold for use with a hand or foot pump.

Spraygun

For those wishing to make up their own gun a brief description of the author's is given in Fig. 5. The critical point to watch is the angle at which the two jets meet. The air jet must be half covered by the paint jet. The angle must be a couple of degrees less than a right-angle, and is best found by trial and error. The connection between compressor and gun can be made with the rubber tubing used on some cars which are fitted with suction operated windscreen wipers. This is sold at most motor accessory shops.

Described by A. E. WARD

BY cutting out portions of a simply folded sheet of paper you can quickly form the word "goodbye". As a novel concluding item in the programme of an amateur magician, the trick to be described will be of real value.

Take a sheet of thin quality paper having dimensions roughly in the proportions of a sheet of foolscap (approximately 8in. x 13in.). Newsprint will be ideal. Fig. 1 illustrates how the paper should be folded before you begin cutting. Study the stages A, B and C. Hold the paper as shown in Fig. 2 and commence cutting away the shaded areas working from right to left. In general you will cut through all the thickness of paper, but, as you proceed, it will be necessary for you to pay attention to the following details.

Cutting the Window

In order to cut out the window (third shaded area from the right) you must first fold the paper as indicated by the dotted line PQ. At D you must only cut through the top two thicknesses of paper and at E, again, you must only cut through the top two thicknesses.

Open out the paper to obtain Fig. 3. Start cutting at the left side this time and begin by cutting out the shaded areas which will give you the last two letters of the word "goodbye". Fold along the dotted line RS to obtain the hollow "fork" of the Y. Actually, at this stage, the Y will in fact resemble an X. Then "round off" the other partly formed letters by cutting out all the other shaded areas.

In conclusion open out the paper to its original size and finish forming the letters of the word by trimming away the base of the letter X shape to form the required Y and shorten the top "hook" of the first letter to make it resemble a G. Hold up your completed word (left) and display it against a dark background.

At first, when you are acquiring the slight skill needed to perform the stunt smartly and successfully, your progress may be slow and you will perhaps make mistakes. It will be a help if you pencil in the shaded areas before cutting.

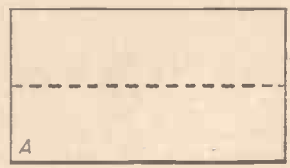


FIG 1

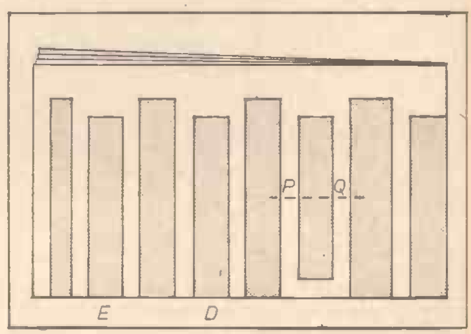


FIG 2

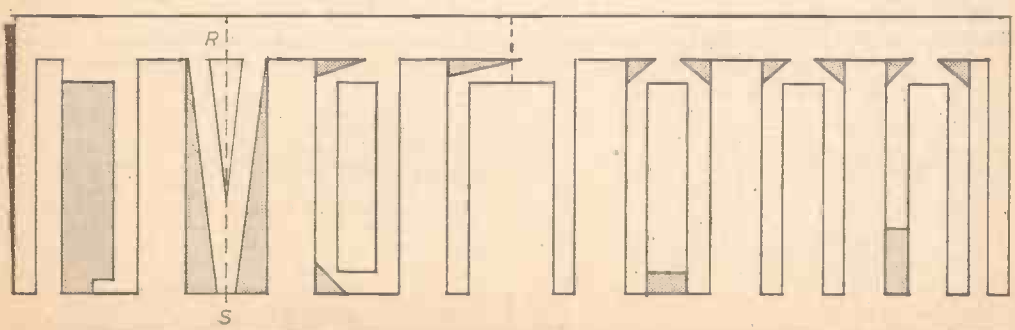
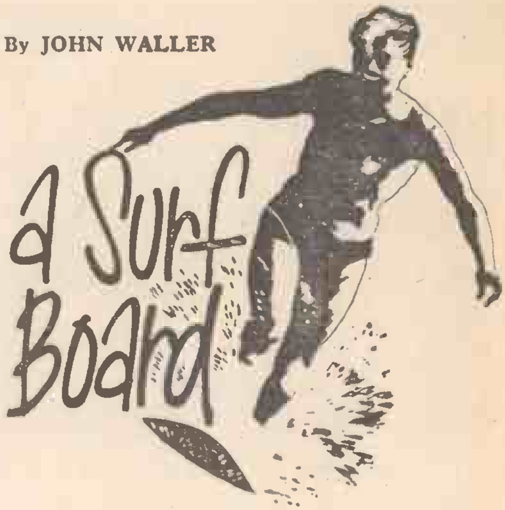


FIG 3

a Surf Board

By JOHN WALLER

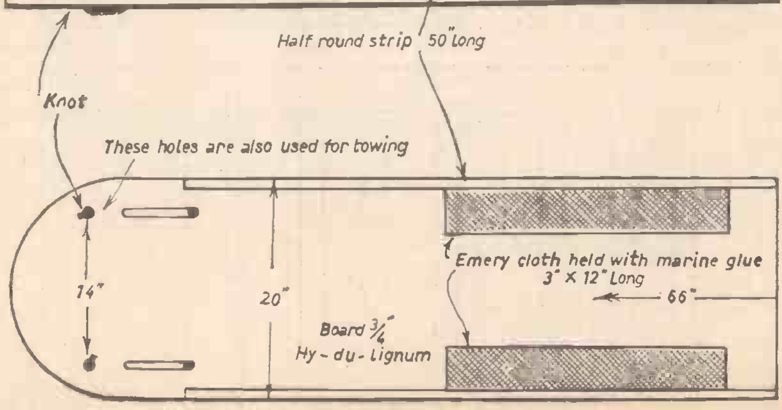


FOR strong swimmers surf riding is undoubtedly an added attraction to a seaside holiday and in these days when road transport is so readily available the problem of carrying the essential equipment from the home is not so difficult; thus the making of a board in time for the next summer holiday is now worth while, especially as such a construction can save some £10 and requires so little skill in accomplishing a first-class result.

Thick plywood is an ideal material for the board but unfortunately not all material of this type is applicable for long periods in water and particularly salt water, so care in selecting the wood is essential before work can commence. One product which an intending users can perhaps try is Hy-du-lignum—a board which resembles plywood but is a much more superior article and is impervious to water even after long periods of immersion—and also it is immensely strong and will not break despite all the abuses encountered in this sport. The board is made by subjecting layers of specially selected timber to a heavy pressure with a thin layer of adhesive between them; thus the result is a detail which does not bend or warp.

The dimensions given in this illustration make an ideal surf board but they can be varied slightly to suit available material. Assuming a piece of board is ordered it is well to remember then there is no need to leave the usual finishing allowance as a few minutes application with a coarse file will soon remove any ragged edges which have been left by the sawing process. If any readers consider that using a file on wood is not good practice, they can be assured in this case because Hy-du-lignum is incorporated on many occasions in press tool construction for the making of aircraft parts, and filing and scraping by the tool fitters in question is their method of working this material. Mark out the radial end with the aid of a pair of old drawing dividers or simply a piece of string anchored to the pivot point by a pin and with the other end holding a scriber or sharp nail which performs the duties of a marking medium. Cut off the surplus and finish with a file as this will assuredly produce a better surface than the traditional spoke shave or similar woodworking tool.

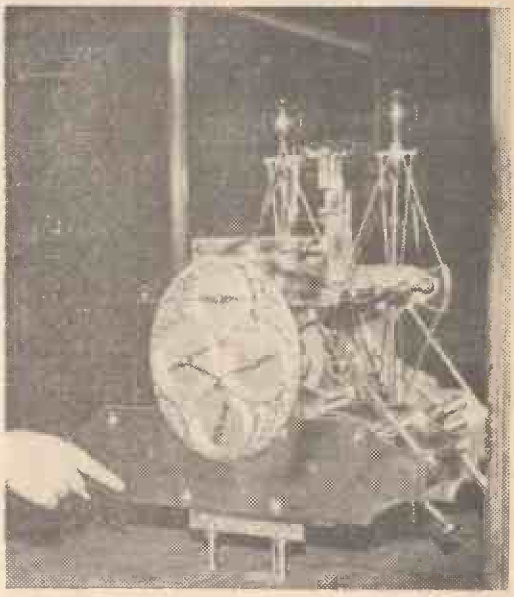
Drill two holes each side for the rope—nylon cord is ideal if obtainable—but make sure the edges of all the holes are carefully rounded off to prevent any rubbing action from fraying the rope. A substantial knot will hold the rope and a further fixing is unnecessary, and this method is also preferable because it allows an adjustment from the



Despite their simplicity, surf boards are expensive items of equipment but one which will give endless hours of amusement is seen here and is easily made in a weekend for a fraction of the normal cost.

(Continued on page 286)

SCIENCE NOTES



Cellulose from Volga Reeds

THE vast, formerly useless reed beds in the Volga delta will soon be exploited by a big new cellulose factory near Astrakhan, producing cardboard, raw materials for plastics and valuable protein yeasts for fodder.

The reed beds produce some 40 million tons a year, but in the past reeds were used only for handicrafts and for fuel.

Now the reeds will be used in the manufacture of a wide variety of building materials—including plaster, excellent "tiles", "parquet flooring", roofing slabs, door and window frames, and even certain machine parts.

The new factory provides for a continuous flow of the raw material from the banks of the Volga.

The cardboard-making machine, over 12ft wide, will move at the rate of well over 300ft a minute and produce 240 tons a day.

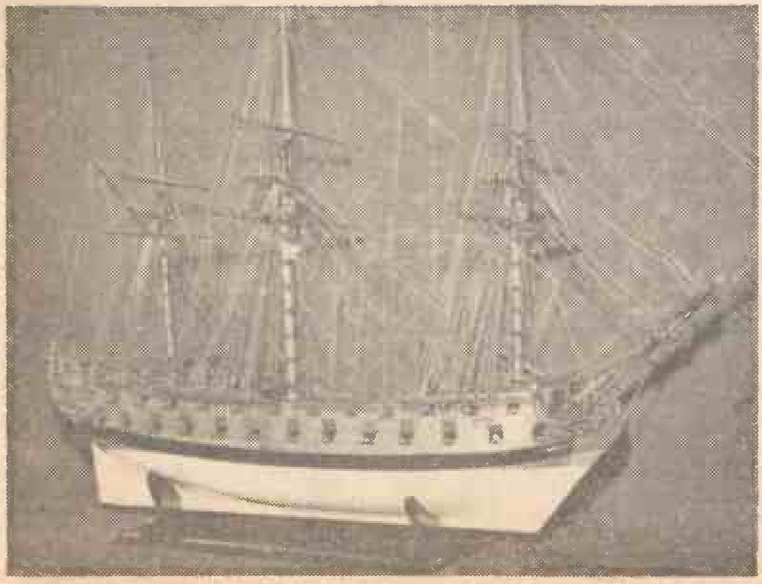
A second machine will have a daily capacity of 300 tons.

The plant has been completed in under two years, and harvesting of the reeds will start as soon as the Volga ice is thick enough to allow the use of tractor-drawn mowing machines.

The Time-keeper of the Sea

AN exhibition entitled "Four Steps to Longitude" is taking place at the National Maritime Museum at Greenwich, to commemorate the bi-centenary of the first successful sea trials of a marine time-keeper.

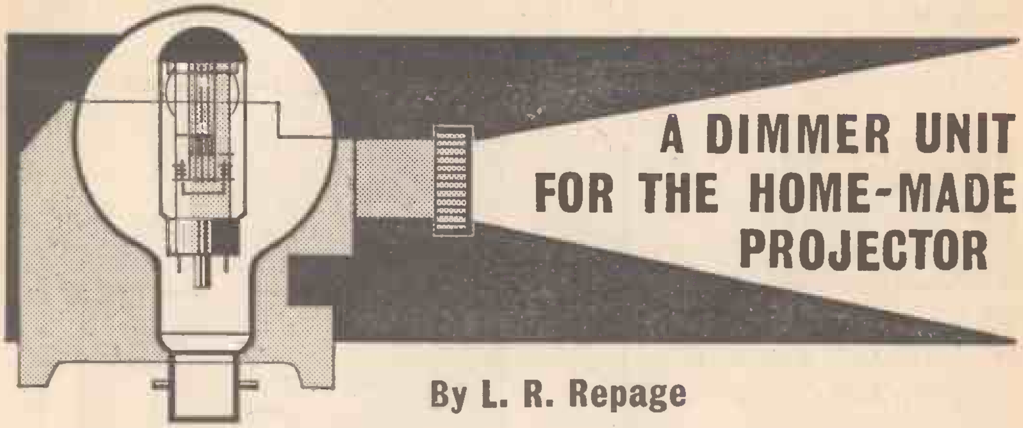
The photograph above shows John Harrison's first marine time-keeper dated 1735. This time-keeper won John Harrison a £20,000 award for successfully finding the longitude of a ship at sea.



The photograph on the left shows a scale model of the "Centurian" the ship that John Harrison's first time-keeper was tested on, in 1736.

The P.M. Geiger Counter

In the article on the geiger counter in our October, 1961 issue the tube recommended by the author was MX124. Messrs. Mullards Ltd. have suggested however that the MX123 would be more practicable for this circuit.



A DIMMER UNIT FOR THE HOME-MADE PROJECTOR

By L. R. Repage

AS will be appreciated the filament of a projector lamp, necessitating as it does a lamp of extremely high brilliance, is working at a much greater strain that that of the normal domestic lamp. Projector lamps usually have quite a substantial working life, barring accidents of course. However, there is always a surge current at the moment of switching on, and this added up can reduce the working life of the lamp. An arrangement therefore, which will reduce the first surge current, by allowing the filament of the lamp to heat up more gradually, will tend to extend the life of the lamp.

By putting another lamp rated at a similar wattage in series with the projector lamp the effect is just this. The effect is really that of adding another length of filament externally and reducing the pressure. There is one very important condition however, the extra lamp must be connected in series. This necessitates joining into one of the wires only, of the projector lamps circuit. If connected across the two wires the lamp will not only burn just as brightly, but on using the switch shown the mains supply would fuse.

Fig. 1 shows the unit with protecting cover partly cut away, and consists simply of a small raised platform, having a batten lamp holder at one end, and a lighting switch at the other. The protective covering was thought advisable in case the lamp was accidentally knocked. A photographic photoflood lamp was made use of as a similar wattage of 250W in household lamps would be rather large in size.

Fig. 2 shows the circuit pictorially and shows a three-pin plug. If using a lighting plug for connecting to a light socket, ony two connections will apply, as there will be no earth connection. One of the projecting lamps leads is cut at a convenient point, the two wires from the unit soldered to the ends, and then very carefully taped up with good insulating tape—very important this. If preferred the lamp may be installed in the lamp house as seen dotted at " B " and the switch on the projectors baseboard, as at " A "; thus dispensing with the separate unit, as shown in Fig. 1. The circuit however, must agree to that given in the circuit diagram

Fig. 1. — The unit with protective cover partly cut away.

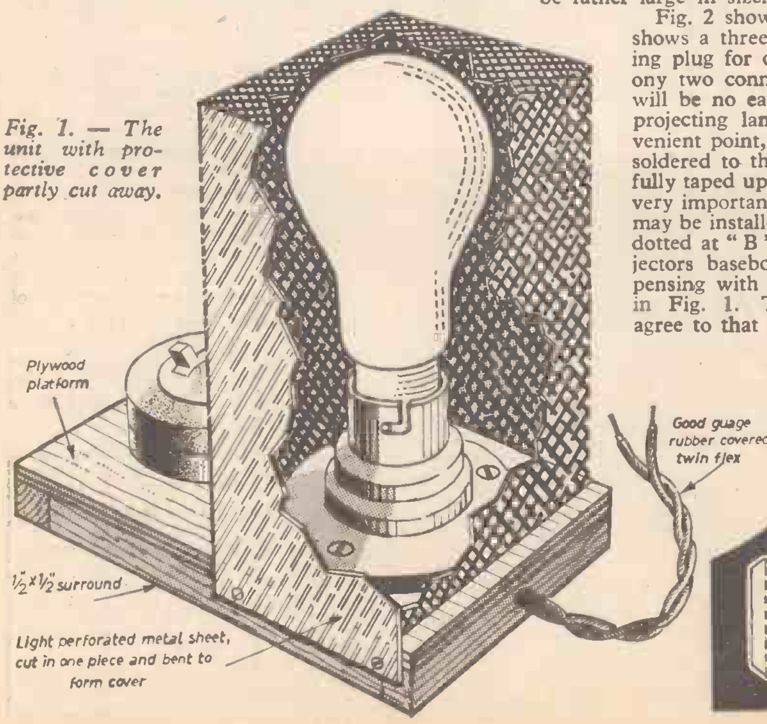
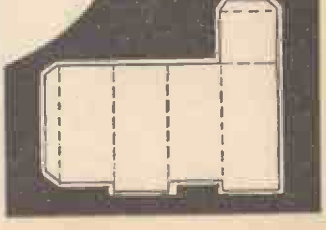


Fig. 4.—Lamp guard details.



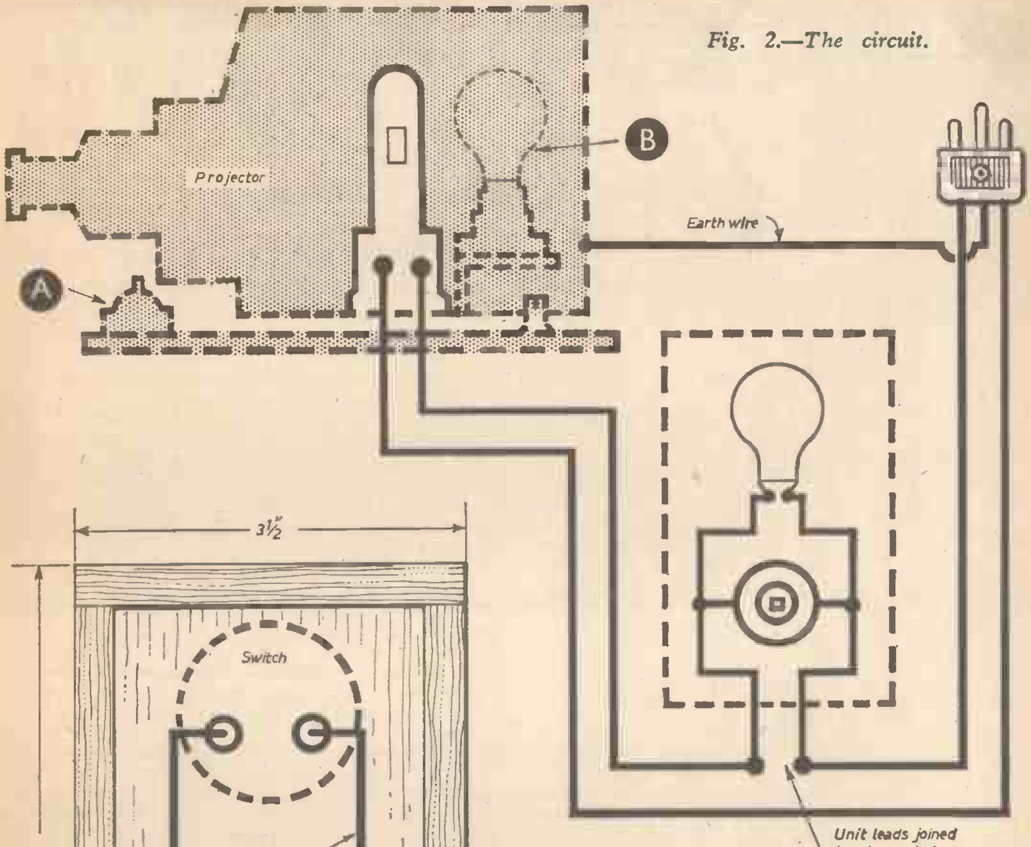


Fig. 2.—The circuit.

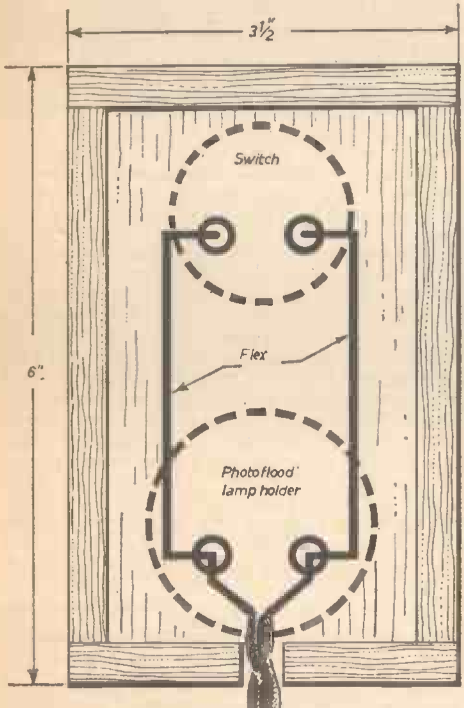


Fig. 3.—Underside view of the unit.

Fig. 3. This shows an underside view of the unit and the wiring to the lamp holder, and its switch.

When first switched on at the supply, the switch on the unit should be at the "off" position. This brings the photoflood lamp into circuit and a dimmer effect will be noticed, the projector lamp burning at about half brilliance.

On closing the switch, the photoflood lamp is shorted and the full current passes to the projector lamp. The unit switch does not switch off the main supply, but merely cuts the photoflood in or out of circuit as desired. The arrangement is not automatic and the dimming effect must be controlled as desired by this unit switch. As this switch passes the full mains voltage, it must be of mains type and the wiring of good gauge insulated flex.

Fig. 4 shows how the lamp guard can be cut out of one piece of light perforated metal. It should however, be of substantial enough gauge to form a quite rigid box type cover.

SPEED MAIL

An Interesting American Experiment

Told by A. E. BENSUSAN

IN reality, Speed Mail is not a single experiment, but a progressing and closely related development process. Although it has not yet been made available for use by the general public, neither is that likely to occur for some time to come, it has been successfully employed for the transmission of official correspondence between major governmental centres during the trial periods.

The object was to establish and test stations for the sending and reception of letters by wireless, extremely rapidly and with the maximum security. A letter could be typed, written or drawn on a special form similar in many respects to those used for the war-time American V-Mail and British Airgraph services. After folding and edge-sealing the form, the message is not seen again by anyone, Post Office employees included, until the addressee opens his fascimile copy on receipt.

The system has some points in common with commercial facsimile transmission systems but, additionally, it offers absolute security and speeds between one-hundred and four-hundred times as fast as those at which, for example, newspaper photograph transmitters operate. Since the process is entirely automatic, and reproduces the finest details of the message or drawing, no errors or omissions are possible.

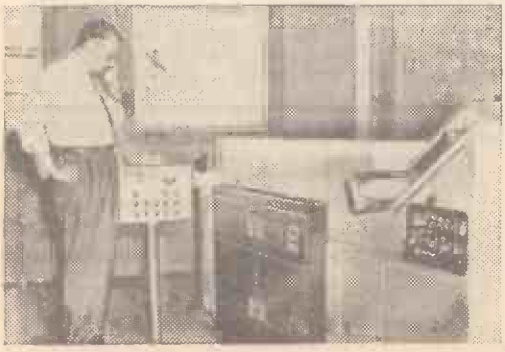
The sealed letter is posted in the conventional way and, on collection, sent to the Speed Mail unit established in the local Post Office. There it is fed into a machine, currently a converted postage meter, which stamps its face with a destination code, the date and time. The code enables an electronic switching machine to direct the message to the appropriate destination.

From that point onwards, the letters are handled mechanically and within locked guards. The first machine trims off the edge-sealing, without affecting the sender, addressee or message panels and feeds the letters into metal containers at the rate of one a second. Interlocks ensure that the machine cannot be operated until the container is firmly in place, neither can the container be removed until its cover is secure.

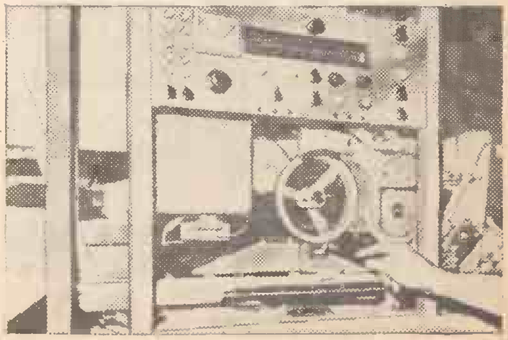
The transmitter has identical security locks. When it is started, it simultaneously switches on the receiver in the destination city and the message is scanned by a vidicon tube at the fine spacing of 120 lines per inch. The tube, of a similar type to those used in television cameras, and the use of micro-waves for transmission, show the relationship between this method and television broadcasting, although not in the same open manner. Should a fault cause three or more scanning lines to be missed, the machine stops and the entire message is repeated. The original letter forms are later destroyed under security conditions.

At the receiving station, the messages are separated and reconstituted into clear signals which are passed to the printing machine. Unlike the war-time processes mentioned earlier, the present system is non-photographic in the normal sense of that term. The impulses actuate a vidicon tube which imparts them to the sensitive surface of a selenium-coated cylinder. As it revolves, the cylinder picks up minute particles of dry ink and a toning substance only where it has been affected by the tube. Further rotation of the cylinder impresses the ink to paper, which is then heated to fuse the printing and make it permanent.

The new copy of the letter is cut to size, a signal from the transmitter indicating the end of each sheet, folded and edge-sealed before being passed to an enveloping machine. The envelope has double windows, and the method of folding and



The Speed Mail transmitting machine.



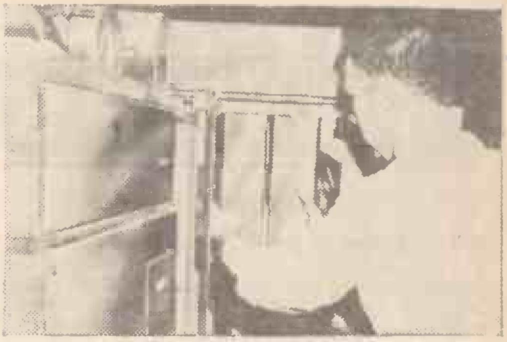
The Facsimile printing machine.

sealing the cut letter ensures that it is inserted so that only the names and addresses of the sender and addressee are visible. The letter is then ready for delivery, either through the normal postal channels or by special messenger.

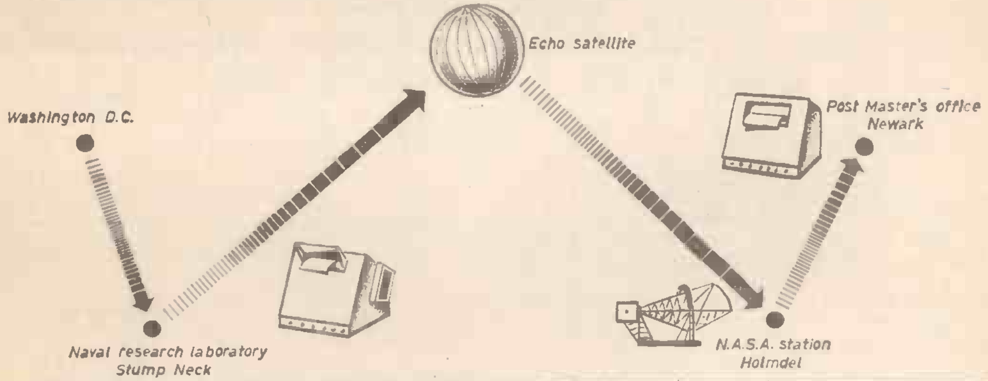
The transmission and receiving units can each handle one complete letter every four seconds. The installation of four pairs of units in the capital, Washington D.C., permits one message to be sent, and one received, every second. Three pairs of units are installed at Chicago, and one at Battle Creek, Michigan. The latter is located in the Federal Centre which accommodates the offices of Civil and Defence Mobilisation.

More recent experimental work has involved the sending of Speed Mail letters via an Echo satellite. The messages, which originated in the capital, were passed to the Naval Reserch Laboratory at Stump Neck, bounced off the satellite and received at Holmdel for onward transmission to the Post Office at Newark.

At present, the system is too expensive to operate commercially, although cost would hardly be a drawback if this rapid means of communication were needed at a time of national or international crisis. Additionally, there is always the prospect, and a realistic one at that, of future developments considerably reducing capital and particularly, transmission expenses. With that eventuality in mind, proposals for a nation-wide network of seventy-one Speed Mail stations have been made.



The security container on the Edge Trimmer unit.



A DOWELLING JIG *(Continued from page 253)*

dowels. Place the wood in the cramp with one end flush with the side block and set the drill guides so that the centre of the holes correspond with the centres marked on the wood. Tighten up, and drill the holes to the required depth: it is a good plan to improvise some form of 'stop' so that all holes can be bored to the correct depth. Once the apparatus has thus been set up, any number of like pieces of wood may be accurately drilled. Similarly, the corresponding members—rails or legs of a table, for example—may be bored merely by altering the position of the guide holder along the sides of the frame but *not altering the distance apart of the drill guides.* Note that due allowance should be made if the rails are to be let-in from the face of the legs as opposed to being flush with it.

If comparatively thin material is being worked, use a packing piece of wood to throw the face side away from the cramping plate as shown in the photograph depicting the edge of a rail being bored by hand. If, for the purpose of jointing two boards lengthwise, a large number of holes is required, bore the first two, slide the work along until the left-hand hole is over the right-hand drill guide, re-clamp and drill another left-hand hole, and so on.

Dowels should be about $\frac{1}{8}$in. shorter than the combined depth of both holes, and the ends should be rounded. Make a light sawcut lengthways along the dowel to accommodate surplus glue when the work is cramped up.

L.B.S.C's 3½in. Gauge EVENING STAR

PART 13
CONTINUATION OF INSTRUCTIONS FOR THE EXPANSION LINK BRACKETS

ERECTING LINKS

IF both bushes are removed from the lugs, it will be found quite easy to put the links between the lugs, as the ⅜in. holes give ample clearance to manipulate them. After inserting, replace the bushes with the holes in them going over the link trunnions, and put in the screws. When these are tightened up, the link should swing quite freely, but without a vestige of shake.

Alternative Cast Brackets

Castings for the link brackets will be the same as the built-up kind, and will require bushing for

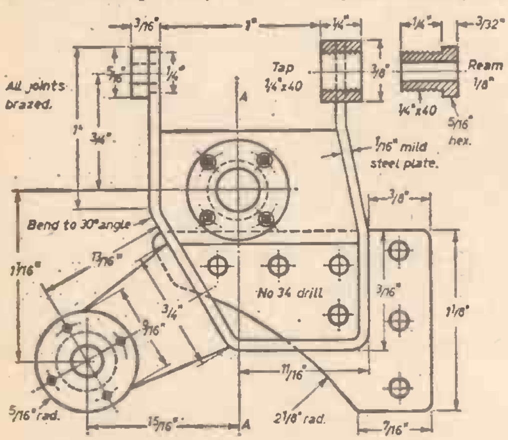


Fig. 78.—L.H. Expansion Link Bracket.

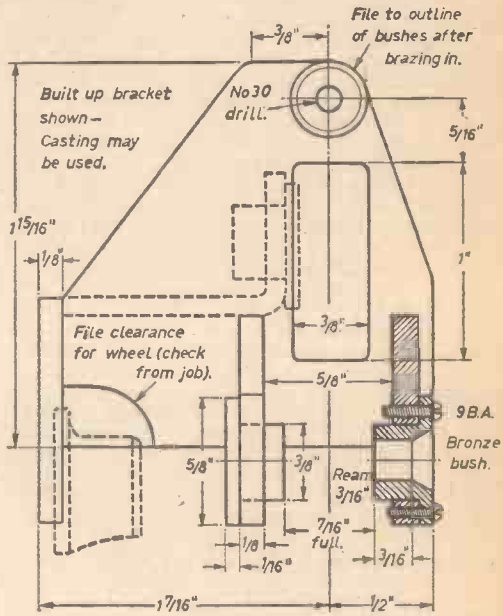


Fig. 79.—Front view of L.H. Bracket.

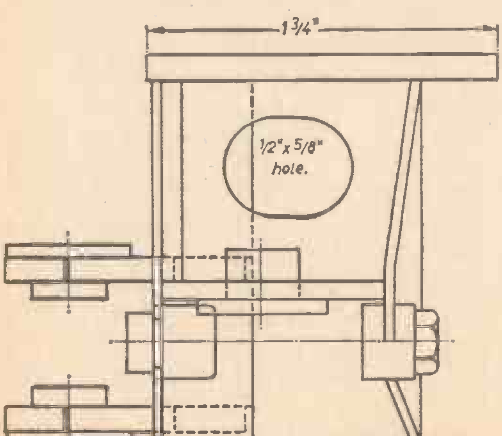


Fig. 81.—Plan of L.H. Bracket.

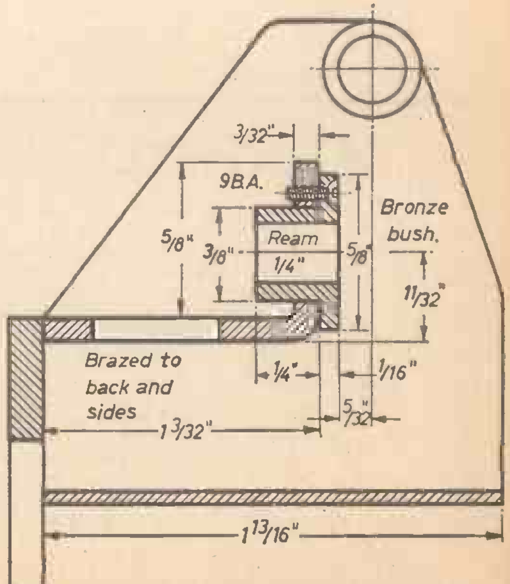


Fig. 80.—Section AA L.H. Bracket.

the link trunnions and reversing-shaft. Not only would it be a very difficult job to cast the bearings integral, needing intricate patterns and cores but the only way to erect the links would be to make one of the lugs removable, entailing extra work. The castings as specified, will need little attention. The side plate which butts against the engine frame, only needs smoothing off with a file. The easiest way to do it, is to lay a big flat second-cut file on the bench, and rub the side of the casting on it, taking care to avoid tilting it. The "text-book" way is, of course, to grip the casting in the bench vice, hold the file horizontally, take steady strokes, and so on; but many good folk wouldn't get a flat face in a month of Sundays by that method, whereas by doing the job as I recommend, they get one at first shot, and in a fraction of the time. Anybody who has a milling-machine can set the casting in a machine-vice on the table, and take a cut over the contact side with a small slabbing cutter; but be mighty careful to avoid distorting the casting when gripping it.

Locating and Drilling Screw Holes

The holes for the screws which attach the bracket to the engine frames should be marked off on the opposite side, centrepopped, and drilled with the contact side resting on a flat piece of wood on the drilling-machine table. Tip: parquet flooring blocks are champion to drill on, being hard wood, and true on both sides. The holes for the link trunnion bushes can be set out on the lugs, as shown in the side views, Figs. 78 and 82. Drill them $\frac{3}{16}$in. at first, and test with a piece of $\frac{3}{16}$in. rod to see that they line up and are square with the bracket. If not, correct with a round file, redrill $\frac{1}{4}$in. and test with $\frac{1}{4}$in. rod. When O.K. open out with $\frac{23}{64}$in. drill, and ream $\frac{3}{8}$in. putting both drill and reamer through both holes at one go.

Next, set out the holes for the reversing-shaft, locating them from the centres of the link trunnion holes. Drill a $\frac{3}{16}$in. pilot hole first, check to see it hasn't wandered away from the centrepop (drills frequently suffer from wanderlust, especially when the flutes are shallow and the penetrating points wide) then open out and ream as above. Both link trunnion bushes and reversing-shaft bushes are made and fitted exactly as described for the built-up brackets.

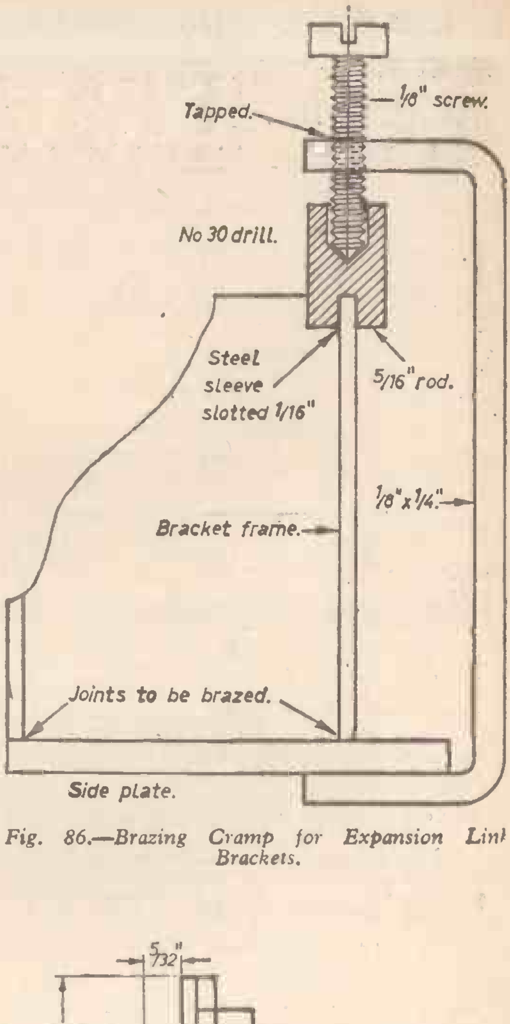


Fig. 86.—Brazing Cramp for Expansion Link Brackets.

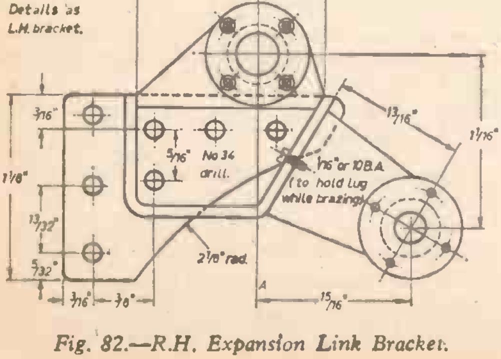


Fig. 82.—R.H. Expansion Link Bracket.

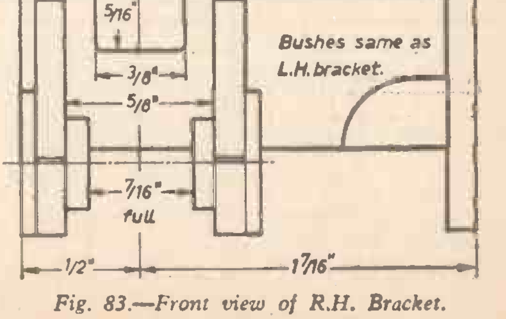


Fig. 83.—Front view of R.H. Bracket.

The bearings for the reversing-screw will be cast integral with the left-hand bracket. Drill both No. 30; if in correct alignment, the drill, or piece of $\frac{1}{8}$in. round rod (silver-steel is usually perfectly straight, and fine for testing) can be put through both holes, and twisted with your fingers. Open out the back one with $\frac{7}{32}$in. drill, and tap $\frac{1}{4}$in. x 40. The screwed bush which fits into this, and keeps the reversing-screw in place, is made in exactly the same way as the piston-glands in the cylinders. Use $\frac{5}{16}$in. hexagon bronze, and drill the centre hole No. 30. The bush for the built-up bracket is the same.

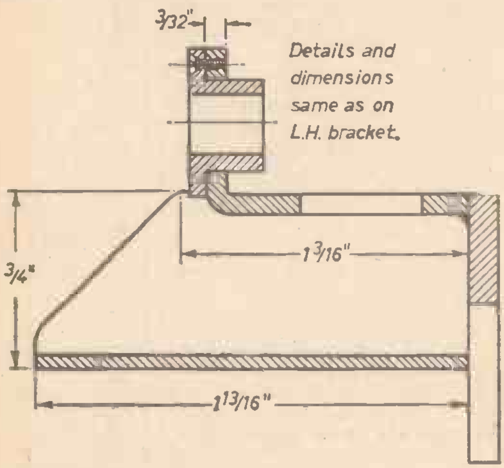


Fig. 84.—Section AA R.H. Bracket.

Erection of Brackets

The exact position of the brackets on the engine frame is shown in the plan and elevation drawings, Fig. 68 Jan. instalment, and as the correct valve setting is dependent on this—watch your step! The location of the expansion link is the vital factor, so set up the L.H. bracket on the frame, with the centre of the link trunnion bushes in the position shown. Note—a clearance for the intermediate coupled wheel must be filed in the front of the bracket, as shown in the front views, Figs. 79 and 83. The curved lower edge of the side plate allows clearance for the wheel flange, but a piece must be taken out of the bracket frame to allow the wheel tread, shown by the dotted lines, to clear. If the bracket is held temporarily against the wheel, you can see at a glance exactly what is required.

Check Bracket Position Carefully

When the bracket is correctly located, clamp it in place with a toolmakers' cramp, check up to make quite sure that the centre of link bearing is the correct amount ahead of the driving axle (cramps *do* shift sometimes when being tightened!) then drill the engine frame for the bolt holes, using those in the bracket to guide the drill. Don't put all the bolts in yet, as the bracket has to be removed to allow the die-block and radius rod to be attached to the expansion link; just put in a couple of 6B.A. bolts to hold it for the time being.

The right-hand bracket can then be erected in similar fashion, the link bearing being exactly the same distance ahead of, and above, the centre of the driving axle. After correctly locating the bracket and clamping it temporarily in place for drilling the bolt holes in the engine frame, make an additional check by putting a long straight piece of $\frac{1}{8}$in. round rod (commercial silver-steel should be straight enough) through the bushes in the two angle plates. This should slide in easily, and should be easy enough to turn with your fingers. If it turns stiffly, or won't go in at all, either one of the brackets is not correctly located, or else the distance between the centres of the bushes for the link trunnion and reversing-shaft isn't the same on both brackets. The remedy for either fault is obvious, and should be put right before proceeding further. Any fault in the valve gear will ruin the efficiency of the engine.

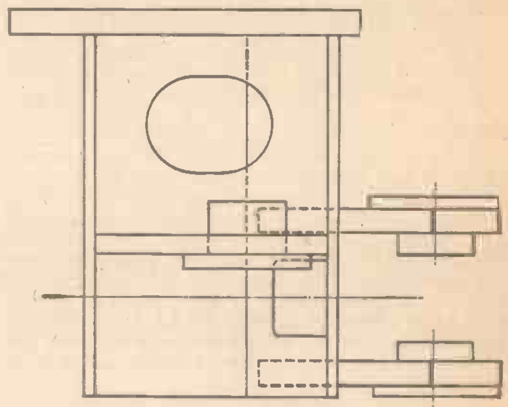


Fig. 85.—Plan of R.H. Bracket.

The next item is the reversing screw, and this is made from a $1\frac{7}{8}$in. length of $\frac{3}{16}$in. round silver-steel. Chuck it in the three-jaw with $\frac{3}{4}$in. projecting, face the end, and turn down $\frac{5}{8}$in. length to $\frac{1}{8}$in. dia. Use the screwed bush from the top of the left-hand expansion-link bracket for a gauge; the turned part should be a nice running fit in the bush, without any slackness. Any slackness in the reverse-screw bearings will cause the whole gear to chatter and dither all the time the engine is at work. Turn the rod end-for-end in the chuck, face the other end, and turn down a full $\frac{3}{16}$in. length to $\frac{1}{8}$in. dia. leaving 1in. between the shoulders. Grip the longer turned end in the chuck tightly, and screw the unturned part with a $\frac{3}{16}$in. Whitworth left-hand die in the tailstock holder. If a left-hand die isn't available, a right-hand die can be used; but this makes it awkward for the driver.

The reversing wheel on the 2-10-0 engines is mounted parallel with the side of the cab, driving the reversing screw through a bevel gear connected to a revolving shaft with universal joints at each end. With a left-hand screw, to go ahead, the wheel is turned in the same direction that the good lady used to turn the wheel of the domestic wringer, when putting the washing through it, in the days before washing-machines came into general use. This "comes natural", in a manner of speaking. If a right-hand screw is used, the driver has to turn the wheel backwards to go forward (says Pat). This doesn't matter much when the usual type of wheel and screw is fitted, with the whole doings in the cab, and the wheel mounted directly on the end of the screw, at right angles to the cab

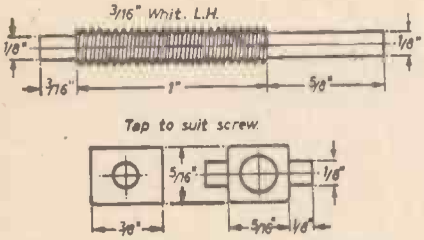


Fig. 87.—Reversing Screw and Nut.

side. The Stroudley engines on the L.B. and S.C.R. had right-hand screws, which we turned clockwise to notch up, or go into reverse gear; it's just what one gets used to!

To make the nut, chuck a piece of 5/16in. x 3/8in. bronze rod truly in the four-jaw. Face the end, turn 1/8in. length to 1/8in. dia. and part off at 7/16in. from the shoulder. Grip the 1/8in. pip in the three-jaw, and turn down the other end for 1/8in. length to 1/8in. dia likewise, leaving 5/16in. between the shoulders. Rechuck in the four-jaw with the square end running truly, the pips being at each side. Centre, drill through with 9/64in. or No. 27 drill, and tap to suit the screw, guiding the tap with the tail-stock chuck. The nut should be an exact fit on the thread of the screw, for reasons previously mentioned.

Hold the nut between the lugs on top of the left-hand link bracket, insert the screw through the bush hole, screw it through the nut until the end of the screw enters the front bearing, and screw the bush in place. When the bush is right home, the screw should turn freely, but without any endplay. If tight, take a shade off the front end of the bush, where it bears against the shoulder.

Lifting and reversing arms (left-hand side)

Cut two pieces of 16-gauge (1/16in.) soft mild steel sheet 2in. long and 1 3/8in. wide; see that they are quite flat, then solder them together. On one side, mark the outline shown in Fig. 88, drill the holes No. 32, and drill another one at 3/4in. above the location of the bush hole. Saw and file to outline, and cut the slot at the top of the vertical arm by sawing down to the hole—I use a jeweller's thin brass-back saw for jobs like this—and trimming to exact width with a thin flat file. Ream the hole in the small boss with a 1/8in. parallel reamer. Open the hole in the big boss with 3/8in. drill. Heat the pieces until they fall apart, and wipe off any solder that may stick to them.

Chuck a piece of 1/2in. round mild steel rod, face the end, centre, drill to 3/8in. depth with letter C or 15/64in. drill, turn 1/16in. length to 3/8in. dia. (a tight fit in the 3/8in. hole in the arm) part off at 5/16in. from the end, reverse in chuck, and turn the other end in like manner. Put a 1/4in. parallel reamer in the hole, just far enough to leave the hole a very tight fit on a piece of 1/4in. rod. Squeeze the arms on to the ends of the bush, lining them up exactly by putting a piece of 1/8in. silver-steel through the holes in the small boss, and a piece of 1/8in. flat stuff in the slots at the top of the vertical part. Then braze or silversolder the arms to the bush in the manner previously described for other small parts. Quench in cold water, and clean up; then very carefully, bend the vertical arms outwards until a piece of 5/16in. square rod will slide nicely between them. The easiest way to get both sides exactly the same, and to the right width, is to file the end of a bit of 5/16in. square steel rod to the contour shown in the section. First bend the arms outwards at the lower bend, with a pair of flat-nosed pliers; then put the filed end of the 5/16in. square rod between them, put the lot between the jaws of the bench vice, and tighten the screw. This will squeeze the arms in close contact with the rod without marking them, and as soft mild steel doesn't spring, they will stay put when the vice jaws are released.

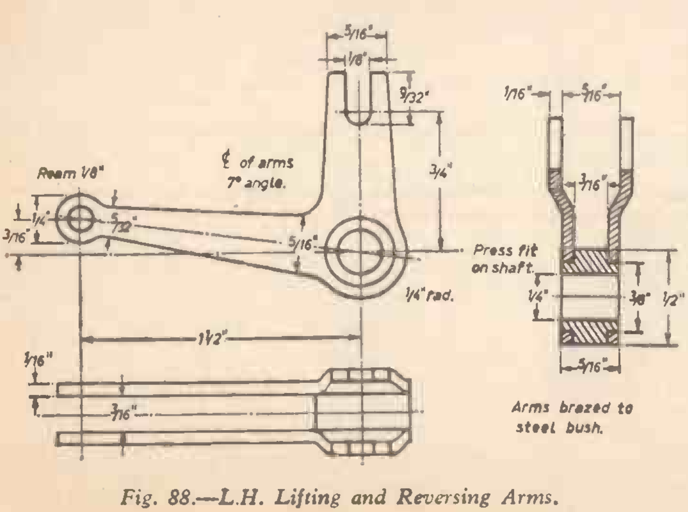


Fig. 88.—L.H. Lifting and Reversing Arms.

Mainly owing to a change in our printing arrangements, there was an unfortunate and quite inadvertent mix-up in the February instalment of L.B.S.C.'s "Evening Star" construction serial. Instead of part of the illustration showing the expansion link brackets being presented with the appropriate instructions, all the latter were printed, and the illustrations omitted. The figure numbers in the text were also incorrect.

All this has now been put right in the instalment appearing in this issue, and we assure all readers who are building the locomotive, that we shall take every precaution to avoid any further trouble. Builders who have been making inquiries about full-size blueprints, will be glad to hear that these are in hand, and it is hoped to issue them at an early date.

TRADE NOTES

A REVIEW OF NEW TOOLS, EQUIPMENT, ETC.

New Spray Gun

ALFRED BULLOWS and Sons Ltd., Long Street, Walsall, announce the introduction of their new L920 Spray Gun.

This is a lightweight high performance gun designed for spraying small, mass produced components. It is, however, equally suitable for colouring and shading in, for example, the furniture and pottery trades. Its small size and light weight combine to give a well balanced, easy to handle gun particularly suitable for use by female operatives.

Suitable for pressure or syphon feed, the L920 is recommended for medium or light production finishing and gives a full, well defined spray pattern. Fluid and air connections are ¼in. B.S.P. and 2, 5 or 8fl oz cups are available when the gun is used for syphon feed.

The body is an aluminium alloy forging with all wearing threads in brass inserts. A range of hardened stainless steel fluid nozzles are available from ·020in. (5mm) to ·060in. (1·5mm) together with suitable air nozzles.

The L920 Spray Gun costs £8.

Tin-A-Lum

IT appears that some readers who were interested in our editorial mention of Tin-A-Lum aluminium solder in our December, 1961 issue, have had difficulty in getting in touch with this company. We have now learned that they recently moved their business from London and the new address is now:

Tin-A-Lum Ltd.,
Drift Road, Fareham, Hants.

RIVETING from one side of the work only and in inaccessible places is possible with the KLIK system of riveting which utilises Monel or Aluminium tubular rivets mounted on expendable steel mandrels. The process employs either of two riveting devices, the RS-3 lazy tongs or the RSL-2 riveter-pliers. It is said to be both quick and efficient, requiring only one operator.

Two kits are available for general repair and maintenance work. One is the KLIKIT 3, containing the RS-3 lazy tongs riveter, the other, the KLIKIT 2, embodies the RSL-2 plier-riveter. Riveters and rivets can be supplied separately. Rivets are available for any combination of material thicknesses from 0·08in. to 0·6in. Standard rivet diameters are $\frac{3}{32}$in., $\frac{1}{8}$in., $\frac{5}{32}$in., $\frac{3}{16}$in. and ¼in.

The KLIKIT 3 kit, including the RS-3 riveter and various nozzles, costs £8 15s. and the KLIKIT 2 with RSL-2 riveter and nozzles costs £5. Separately, the RSL-2 and RS-3 are priced at £2 13s. and £5 18s. respectively.

The manufacturers are Riveting Systems Ltd., Under Lane, Chadderton, Oldham, England.

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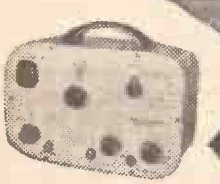

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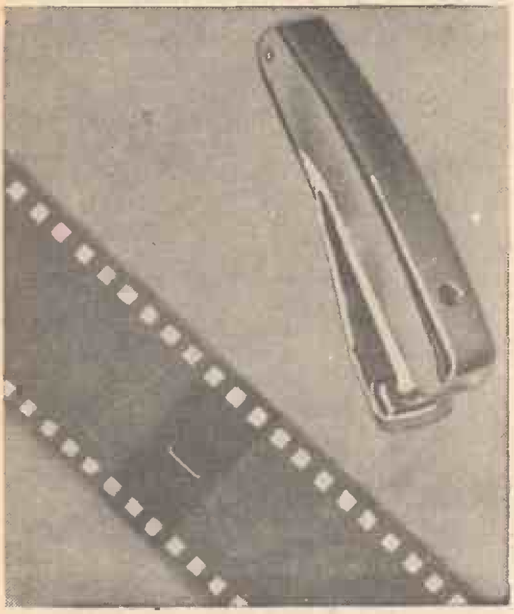
HANDY PHOTO TIPS

By Photographer



Showing two film lengths stapled together.

How to lengthen the tripod.

Developing film lengths together

ANYONE who uses short lengths of film, perhaps the offcut ends of full-length strips, will appreciate this method of loading several pieces into the developing tank so that they can all be processed together. The system works well with either miniature or roll films of any thickness, and there is no possibility of one end riding over another while in the tank, so causing uneven development through solution starvation.

In the darkroom, changing bag or whatever place you employ to load the tank, draw just a little film out of each of two cassettes or off two spools, and cut away any trimmed leaders. This reduces the risk of damage due to handling. Then allowing the width of your finger in overlap, clinch a chromium or nickel plated staple through the join. Roll films of 120 or 620 size need two staples, one fairly near to each side of the film width, or their curl will cause them to jam while feeding into the tank spiral. Never use unplated or brassed staples.

Having joined the two ends together, the remainder of the films can be taken from the cassettes or spools and the other ends freed from their clips or gummed strips. Further lengths can be added until the capacity of the tank spiral is reached.

Extra-high tripod

Now and again the need for a really high camera support makes itself felt. Normal tripods rarely extend to eye-level or above, but most lighting stands go up to 8 or 9ft. So, remove the upper sliding section of the lighting unit and replace it with a $\frac{1}{4}$in. Whit. bolt from which the head has been cut, or a length of steel or brass studding of the same thread size.

If a flat is filed part of the way up the shank of the threaded portion, pressure applied through the knurled locking screw will enable it to be rigidly secured without fear of turning. It can then be removed after use and replaced at will. Leave just sufficient of the shank protruding to give good engagement in the camera tripod socket, or the tapped hole in the ball and socket head, without bottoming.

This camera support may not be quite so rigid as your normal tripod, although that depends on the constructional stability of the lighting stand, but a pause of a few seconds will allow any vibration to die out before the shutter is fired with a cable release.

YOUR Queries ANSWERED

IS it true that when a watch is wound it weighs more than when unwound? If so by how much and can you offer an explanation?—A. Whittaker (Lancs).

THERE is not an increase in weight that can be measured by means now at our disposal. Weight is a measure of the effect of the earth's gravity on substances (mass). This gravity is inversely proportional to the square of the distance from the earth's centre of gravity, which we assume is the centre of the earth.

When a body is taken up a mountain it weighs less. If a watch is taken up, it too, will weigh less. If taken down a coal mine it will weigh more. Its mass remains the same. If the watch is wound up its mass is unaltered, and its weight will remain unaltered to all intents and purposes.

However, if the spring takes up a position that either raises or lowers the centre of gravity of the watch there will be a microscopically small alteration in weight. This is due to the different distance to the earth's centre. If the C.G. is lowered the watch will weigh more, but if it is higher then the weight will be less. The orientation of the watch will thus be important.

The theory of relativity in which mass and energy are equated is of no consequence in a problem involving so little energy as this.

If your question was prompted by the fact that when a watch is wound it contains potential energy, i.e., so many units of energy, foot pounds, centimetre grams etc., then you may care to note the following:

If water is pumped up a hill or tower it gains in ability to do work, i.e., it contains Potential Energy. Thus the water is pumped up and GAINS ENERGY but at the same time it LOSES weight due to the greater distance from the earth's centre!

While the watch will gain in foot-pounds when wound up, there is no increase in mass, and if the C.G. is not altered there will be the same attraction by gravity and its weight will be the same.

RULES

Our Panel of Experts will answer your query only if you comply with the rules given below

A stamped addressed envelope, a sixpenny crossed postal order, and the query coupon from the current issue which appears at the foot of this page, 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.

"Practical Mechanics" Advice Bureau. COUPON.
This coupon is available until March 31st, 1962, and must be attached to all letters containing queries, together with 6d. Postal Order. *A stamped addressed envelope must also be enclosed.*
Practical Mechanics. March, 1962

Cleaning Used Plates and Film

I HAVE a number of old exposed X-ray plates which I wish to clean. Most of the emulsion can be washed off with hot water but the very black section round the edge always remains. Do you know of any solution which will be suitable? —J. E. Allen (Co. Durham).

MOST film and plate emulsions can be stripped from their supports by soaking in a solution of sodium hydroxide (caustic soda) in hot water.

The strength of the solution and the period of immersion depend upon the age of the film or plate. The gelatine coating of an old film or plate becomes progressively more tough and requires a strong bath and prolonged immersion if the soda is to penetrate sufficiently. As you have probably already found, exposure to light before development also has a "tanning" effect and hardens the emulsion where the exposure has been considerable. Chemical hardening of the film after development also slows down the stripping process, but X-ray films are rarely hardened chemically to any great degree.

The sodium hydroxide can be obtained in the form of sticks or pellets, but great care is needed in handling this highly corrosive chemical. Either in solid or solution, it should be handled with forceps or rubber gloves and, particularly, kept clear of the eyes and mouth. If you do happen to get any on your hands, wash off immediately and apply a little vinegar. The acetic acid in the vinegar will neutralise the soda.

Should you wish to remove the image on the negative, without damaging the gelatine emulsion itself, you can use Farmer's Reducer or any other similar photographic reducing agent to completely bleach out the image. All these preparations can be bought ready mixed from photo shops.

Blueing Steel

COULD you please tell me of a process for blueing steel?—K. K. Paterson (Notts).

A WELL established method of forming a sound gun-metal blue is to use a molten salt bath comprising:

Sodium nitrate 49 parts
Potassium nitrate 49 parts
Manganese dioxide 2 parts

Watch Cleaning Fluid

COULD you please give a formula for a watch cleaning fluid that is non-rusting?—W. Jackson (Yorks).

THE following is a good formula for making a watch cleaning fluid:

Solution 1: Boil 1oz. of oleic acid in 1 quart of water. Solution 2: Add 6oz. of ammonia to 1 quart of water, then add 2oz. of acetone. Bring this liquid to the boil for a moment and then add it slowly to the hot Solution 1. Stir the mixed solution until it is homogeneous.

A still simpler solution for watch cleaning can be made by dissolving ½lb. of ammonium carbonate and ½lb. of soft soap in ½ gallon of water. Both these solutions have good cleaning proporties, but they do not prevent rusting of steel. Hence, the parts so cleaned should be immersed in methylated spirit or iso-propyl alcohol in order to remove the surplus water.

Information Sought

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

Appinco Paint Sprayers

COULD you please tell me the manufacturers of the paint spray with the trade name of Appinco?—A. Wray (Oxford).

Battery Clocks

DO you know of a firm who supply battery operated clock movements?—R. T. Jones (Holyhead).

A SURF BOARD

(Continued from page 272)

board to the hand hold to be made by simply cutting off a length of rope and re-tying the knot.

Whether a reader considers the two half-round strips as required as additional stiffening members will depend on the type of board used and, of course, the thickness, so if there is a suspicion the board tends to bend slightly, the fixing of these details adds considerably to the final strength of this unit. Each piece "B" is attached by a series of thin screws after the under sides have been treated with marine glue.

A surf board requires a firm foothold and though there are various ways of providing these, the easiest and cheapest idea is to attach two lengths of fairly coarse glass paper which is used for rubbing down paintwork with the aid of water. Both strips are held by the marine glue, and as they become worn replacement is effected overnight simply by scraping off the old sheets with a paintscraper or similar tool. Attaching strips of wood is not favoured as these tend to make the feet sore after a time, and they do not provide the same degree of adhesion—the complete foot is always in contact with a rough surface—as those depicted here.

Little finishing is necessary other than the usual coats of paint, but as these articles come within the fun and games category the temptation to run riot with various colours should be encouraged as they appear much better for a few splashes of vivid paint. Again a brightly coloured board is easier to observe in the water should it break adrift, so add some blue and red strips to a yellow background—on both sides as the board can naturally float either side up if it does become detached—and you have a piece of equipment of both distinctive quality and design.

So far nothing has been said regarding the method of installing the tow and the position of the rope in relation to the hand rope. In this case the use of the two front holes where the hand rope is knotted is used—at least as an initial temporary measure until after the first run—and then any further drilling is performed to ensure a correctly balanced board. Again the provision of a strong rope is essential as a towing medium and the same knot tying feature is undoubtedly the best and easiest way of securing it to the board.

Finally the painting of the owner's name and address or some other distinctive sign is advisable, and this is best carried out at the front end between the knotted ropes as there is less chance of any rubbing action removing it. If it is proposed to carry a board of this design on the roof rack of a car—it is too large to go inside the boot and certainly not easy to stow inside the car—a thin board is made a little larger than this member which can be held with strap to the rack, and if two or three thin brass strips made to pass over the surf board and which will hold this detail, then there is no need to drill unnecessary holes. When not in use and the board is perhaps stored in the garage or loft space, the presence of the additional board helps to protect and keep it from warping which it might do if stored for long periods in a damp atmosphere.

SALES AND WANTS

The pre-paid charge for small advertisements is 9d. per word, with box number 1/6 extra (minimum order 9/-). Advertisements, together with remittance, should be sent to the Advertisement Director, PRACTICAL MECHANICS, Tower House, Southampton Street, London, W.C.2.

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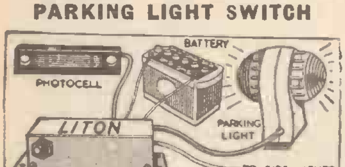

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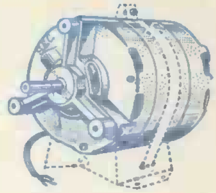

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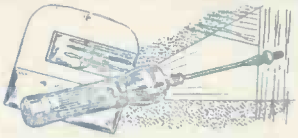

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