Practical MECHANICS

1'6

JULY–1962

GIANT WHEEL EXCAVATOR

LIFT FAN FLIGHT RESEARCH

A BLOWPIPE for BRAZING

Easily made ASTRONOMICAL TELESCOPE

Practical

MECHANICS

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FAIR COMMENT

Man or Machine

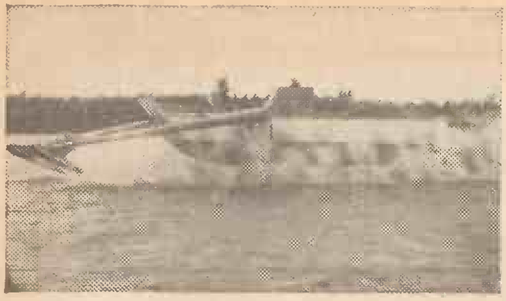
THERE is a good deal of talk these days about automation. Government, Trade Unions, Employers have all been busily discussing the problems it poses, social, economic and industrial, but we do not hear so much about the personal problem, which is the impact of automation upon the individual. It can be quite a sizeable problem. The time is fast approaching when the lingering remains of a man's work skill will no longer be required: whatever the future holds for him in industry it will not be in any kind of effectively creative capacity. It is, of course, only the logical development of every present trend, less drudgery, less dirt, less noise, more production and perhaps at the end of it cheaper goods and greater leisure. It only sharpens and intensifies the personal problems that already exist. This, for every man, is whether he is going to follow the line of least resistance and allow the machine to dominate his life, or whether he will use his leisure in creative activity.

The very opportunity of leisure is a gift in itself and one for which our generation should be thankful. We have to go back quite a long way in history for the age of the craftsman and the years between hold many grim and ugly pages. But unless we use this leisure to some purpose it can be a source of weakness rather than of any profit to us. For into our leisure the machine also enters as a temptation to beguile us from any form of creative living. We have machines to transport us from place to place or take us joy-riding through the countryside with the least amount of physical exertion; we have box-like machines within doors to entertain us with the least expenditure of mental effort; even into our gardens there comes a steadily increasing flow of mechanised tools and equipment to take the hard work out of gardening. All these things are good of their kind but are we going to become so machine minded as to accustom ourselves to a life without effort.

One's potentialities of gifts and character can only develop with use and if man is content to drift along on the tide, all that is best and truest in him will die in sheer lethargy. In medicine it is said that "movement is life" and one has only to encounter a person who, through the onset of disease, has lost wholly or in part the use of hand or arm and to see the courageous and most ingenious efforts they make to overcome the handicap even to the extent of producing really fine and skilful handicraft or embroidery, to realise how tremendously strong in us is the necessity to use our hands in creative work.

This is something that most mechanics will already have discovered for themselves. Yet we too will sometimes find ourselves being caught up by some less important venture and work hurriedly and impatiently to finish jobs we have undertaken as they tend to stand between ourselves and our legitimate pleasures. For work itself has fallen into disrepute. The word "drudgery" has been used so often to remind us of the benefits of machine aid, that it is easy to begin to look upon all work as tedious and frustrating. The satisfaction that can be derived from a handicraft is very real. In using and developing the skill of our hands we are responding to a deep seated instinct of man's nature but in order to give it expression we have to look upon it as something well worth doing.

The August, 1962, issue will be published on July 31st, 1962. Order it now!



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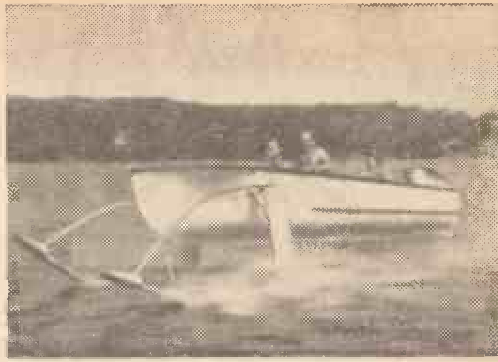


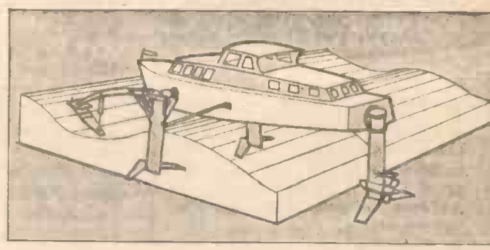
THE HYDROFIN Incidence

By Christopher Hook

I HAVE learned by experience that it is almost impossible to describe in words how a hydrofoil boat can get out of the water and "fly" over the wave tops and totally impossible to *convince* anybody except by the use of cine film. For this reason I don't even try any more and in this article I will not do any more than give your readers some food for thought:

The curved shapes on the sea which we call waves only really affect a region about 10 to 20 feet deep, below which we have almost undisturbed water from which steady lift can be taken, and above which we have air in which a vehicle can "fly" very comfortably. Furthermore the actual proportions of a 20ft wave are very different to those breakers that we see on a beach. As soon as we get out to sea beyond the breakers we find waves of a very different shape and in fact in Naval Architecture it is the custom to stress a hull in the most severe position in a wave, the proportions of the latter being taken as height =1/20th of the length. Now small waves it is true, will show more difficult proportions which simply means that if we can make a hydrofoil work in small size it will be a great deal easier when blown up.

Suppose for instance that we consider the 20ft wave and with long struts we lift our hull up 15ft leaving 5ft to be cleared by a heaving motion. If the distance between crests is 20 x 20 or 400ft we only have to rise $1\frac{1}{4}$ft per 100ft which is



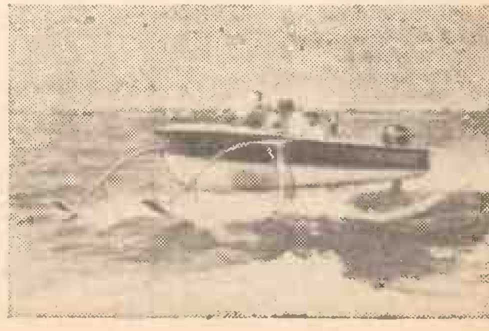
nothing spectacular and still provides perfectly comfortable sea travel (money back for all those who are sick!)

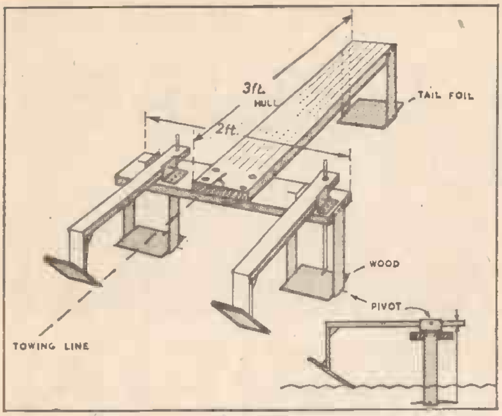
How long will such a ship be? Only about 130ft. Where now is the need for titanic proportions to cope with waves? Gone with the wind and the old method of displacement.

Hydrofoils have got a bad name simply because the need to lift up really high was not foreseen. It was thought that it would suffice to lift the

An example of Manual Control.

Conversion kit fitted to Dumphy moulded ply hull.

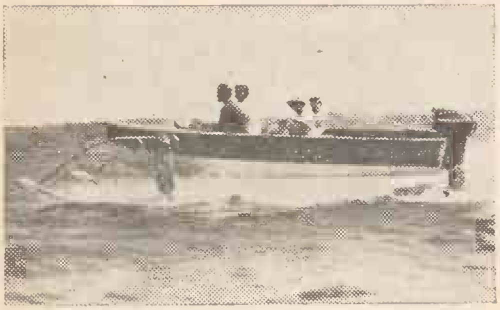




This highly simplified model can be built in a few hours and when towed at some 8-10 m.p.h. will demonstrate the remarkable stability and sea-worthiness of an incidence control system. It will negotiate waves of 5ft high with ease.

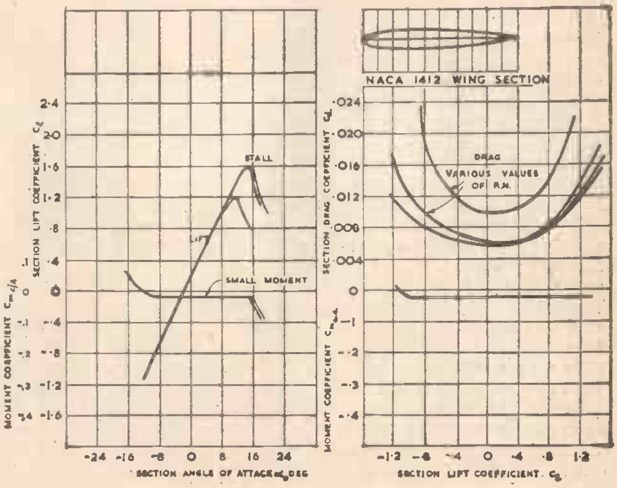
Feeler arm and skid should be made of balsa. The foil incidence rod must be made adjustable for length and the model is trimmed by this means. Tail incidence can be fixed after the first trial. Foils of different sizes may be fitted but a fair average size for a start will be about 5sq in. of total area per lb. The vertical struts must be fitted strictly parallel to avoid air entry. Efficiency will be low but the model is well worth building.

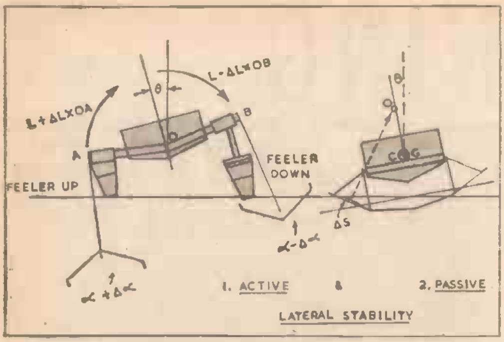
controlled hydrofoil boat



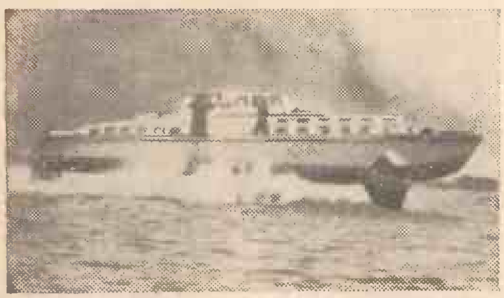
hull *just out* to go like smoke and this is true on a flat calm. But a boat that fails to work as soon as the wind gets up is just a joke, particularly in our climate, but wait: there was really rather more to it than that. That was only part of the story. Another thing that foxed the pioneers was air bleed, which they confused with cavitation which is something quite different. Possibly I was lucky in that I spotted air bleed on a heavily loaded model at Cowes and was able to re-design my strut and foil assembly in such a way as to eliminate this effect completely. Some years previously, in the same town, this trouble had caused the failure of a large full sized hydrofoil boat at great cost.

If you approach the back of a spoon to a running tap you will find that the camber causes the spoon to be drawn into the jet instead of being pushed out and this is, broadly speaking the





The high line of flight possible with incidence control is due to the powerful righting moments given by a combination of more positive lift on the lower side with negative lift on the upper. This has been called " active lateral stability " in contrast to " passive lateral stability " given by the fixed incidence system. This would of course tend to render banking impossible were it not for the addition of the pilot's correcting mechanism. The requirement for lateral stability with the "passive" type is that on heeling the new area brought into play Δs must produce a lifting force directed to a point 0 where 0 is above C.G.



An example of Vee Foil system.

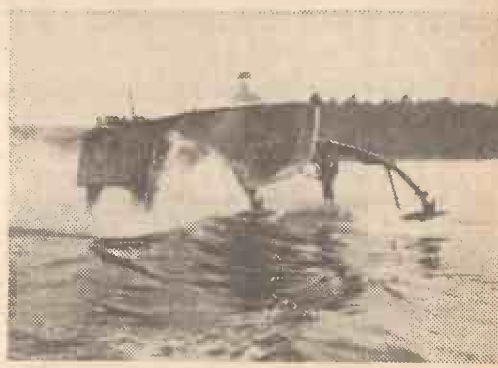
lifting effect of the top side of a hydrofoil. Strong negative pressures are generated, in fact a partial vacuum, into which air will run if it gets a chance. Of course the strut connecting the foil to the boat provides just the " conductor " that the air wants and, in the turbulent region behind this it will run down and " flood " the top side of the foil, effectively destroying the lift. If this happens on a front set of a tandem hydrofoil arrangement the resulting loss of lift causes the bow to drop and suddenly the lift from all the foils changes sign, slamming the hull with great force on to the water or into a wave front. This explains why the simple idea of fitting foils under a boat at the end of some stream lined legs cannot work. When the foils begin to lift they go on, right to the surface where, air running in to the top camber, lift is lost and the boat plunges. Here the air is lost and the cycle will re-commence. Thus control in altitude is the first requirement and for this *two different schemes* exist, the workings of which must be understood.

In the well-known formula for Lift

$$L=\frac{CL\cdot P\cdot V2\cdot S}{2}$$ (Units are lbs, ft, secs)

the second term is a density constant (almost unity in the case of water) and the third is the speed, which leaves us with the first or the last term to " adjust " to obtain our required control in altitude with respect to the surface.

Now for a calm surface where the interface is a well defined line the last term is the best to use. We build our hydrofoils in Vee shape so that, as speed increases, these will rise higher and higher on to the apex and thus a reefing effect is obtained which is good: the trouble is that, due to the V2 term, the area required at take off is about 4 times that required for normal flight and this, poised above the surface, coming into action at each wave, is a cause of trouble in a rough sea and severely limits the open sea performance of this method. Furthermore, as the foil lifts and the engaged portion contracts towards the center line, so the hull becomes less stable and this is a limiting factor on the wave clearance obtainable for this type.



The other scheme, known as incidence control, makes no attempt to reef but uses a fully submerged foil system and no emerged parts. (For reasons which would take too much space to explain here the efficiency of the two systems is the same.) The first term is a co-efficient of lift obtainable from aerofoil polar graphs and, with only slight differences, immediately adaptable to hydrofoils. Any aeromodeller knows that four and five times the flying CL value is readily obtainable by increasing the incidence so we require no emerged reserve area for take off and our lateral stability is so powerful that we can lift three times higher than the other system and thus really ignore small waves so long as we provide a suitable " signal " to the incidence change connecting rod.

First of all the control may be purely manual, using a joy-stick as in an aircraft and if the foil is mounted on a pivot located near its C.P. the force required to change the angle of attack is a very small one and easily handled by a control column in a small boat. The trouble is that the pilot will soon tire of the job of running the foil just beneath the surface even in calm water and in a rough sea it becomes altogether too difficult so that an automatic pilot is the next requirement.

(Concluded on page 469)

LEARNING TO FIGURE

BY SCHOOLMASTER

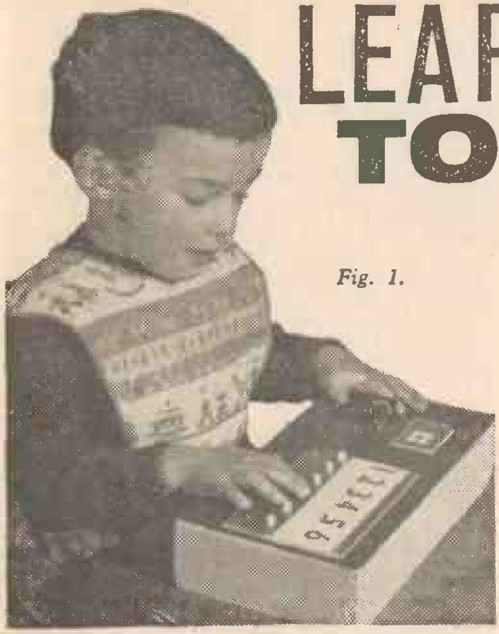


Fig. 1.

CHILDREN in the infant school—the five to seven year olds—have a difficult time in learning the basics in arithmetic. For example when we see the numeral 4 we know that it is four and associate it with four individual items. But to the child just beginning to count the symbol 4 is meaningless and hence the use of the box shown in Fig. 1.

The box shows the child a number of dots —domino style—and a row of numbers, one to six. By pressing the correct button linking up the number of dots with the appropriate symbol then a light comes on. In this case (Fig. 1) the child sees four dots in the Perspex covered window and has pressed the button under the symbol 4. This being the correct response the light above the Perspex window glows showing the youngster that it has made a correct choice. If the wrong button is pressed then of course no light is seen. The children enjoy this number-recognition game and at the same time remember and the first hurdle in " learning to figure " is overcome.

Children, by using the box, soon learn to associate number symbols with visual objects. The number card and the domino type disc, which is rotated by a knob on the box top, can be changed if desired to give further practice in the numbers 6 to 10.

The Electrical Circuit

The electrical circuit is as shown in Fig. 2. The switch is a six-way radio type rotating one with a fairly long spindle about 2½in. to 3in. The reason for this is that the rotating disc and control knob must be attached to the spindle, also a bracket to keep the switch in position.

The numbers shown on the switch are not consecutive but are the order of the number of dots shown in the window as the knob is rotated in either direction.

The circuit is easily understood. If the rotating switch is in position 1 (Fig. 2) then one dot is shown in the window. It can be seen that the circuit can only be completed if push button 1 is pressed, and of course the same thing applies to any other position of the rotating switch.

Rotating Disc

The rotating disc is the lid of a " National Dried Milk " tin. This gives a disc of a suitable diameter and the lid rim gives the rigidity required.

The disc is divided into six sections and the dots are marked on each section. In order to have the maximum window size work right up to the edge of the lid.

A ¼in. diameter hole is drilled through the centre of the disc and a ¼in. diameter radio coupling soldered into position on the underside of the lid. The coupling grub screw now holds the lid in position on the switch spindle.

If discs have to be changed then the control knob and disc can be removed from the spindle by simply slackening the grub screws.

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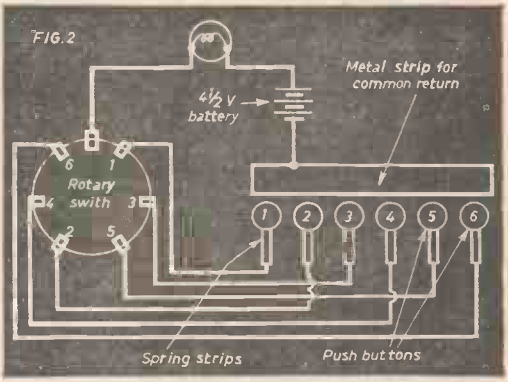
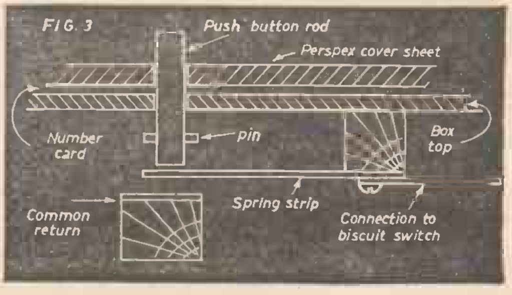


(Above).—The Electrical Circuit.
(Below).—Push Button Arrangement.



LIFT FAN FLIGHT RESEARCH

DESCRIBING AMERICA'S NEW VERTICAL TAKE-OFF AIRCRAFT NOW BEING DEVELOPED FOR MILITARY SERVICE

By Donald S Fraser

THE recent news, announced by Minister of Aviation Peter Thorneycroft, that further operations on the British-built, revolutionary Fairey Rotodyne were to be abandoned was most disappointing. Eleven million pounds had been spent on this—what had been hailed as a great British achievement—but production orders were strangely lacking. The craft, a 48-seater airliner, capable of rising or descending like a helicopter, was not considered, evidently, as a good commercial proposition.

Now comes the news, from America, of a Fan-in-Wing, VTOL Aircraft Research Programme which has similar characteristics to the Fairey Rotodyne project.

At one time a military version of the Rotodyne was planned, but the Government decided to forgo the operational advances offered in view of the cost involved.

Now the U.S. Army, however, feels that VTOL aircraft can make a major contribution to mobility; will ensure close co-ordination with the ground elements being supported, and will greatly reduce the Army's requirements for prepared landing fields and other fixed-base facilities in forward combat areas.

In view of all this, two fan-in-wing aircraft will be designed and built to take off vertically and then enter a conventional flight pattern at speeds of 500 miles an hour or more. This dual capability of "straight-up" take-offs and great forward speed means that such aircraft will be capable of operating from small, widely dispersed areas where no airfields exist.

Lift Fan Unit.

The purpose of the U.S. Lift Fan Flight Research Programme is to evaluate the flight characteristics of the lift fan propulsion system in hover and transition and to demonstrate in flight that the fan-in-wing configuration is compatible with high subsonic-speed aircraft requirements. The U.S. Army flight research airplane will be designed to fly at 450 knots.

Phase 1 of this project covers 16 months and includes completion of the first airplane and propulsion and aircraft components for the second airplane. The Air Force is supplying the J85 engines and diverter valves for the programme.

The lift-fan propulsion system, which is being designed by General Electric's Flight Propulsion Laboratories, consists basically of a J85 engine and a tip turbine driven lift fan, 6ft. in diameter, which can be installed in either wings or fuselage. For vertical flight a diverter valve directs the jet exhaust to the tip turbine to drive the lift fan. The fan multiplies the available thrust of the basic engine which is sized for cruise conditions. For forward flight, the diverter valve closes the fan off. and allows operation as a conventional jet aircraft.

The U.S. Army flight research aircraft, which will be designed and built by the Ryan Aeronautical Company, will use the wing-mounted configuration. The exhaust from each engine is divided to drive both fans for engine-out safety. With one engine inoperative, both fans can still provide about 60% of their design lift.

General Electric and Ryan both have extensive backgrounds in V/STOL research and development. More than 160 hours of lift fan testing has been completed to date. Much of it has been carried out with lift fan hardware installed in a full scale aircraft wind tunnel model at the National Aeronautics and Space Administration's Ames Research Centre, Moffet Field, California.

Additional testing of two complete propulsion systems, in a new fan-in-wing model, is now under way at Ames. The U.S. Air Force has contributed substantially to the support of this programme.

Previous Ryan V/STOL aircraft are the X13, the world's first jet VTOL aircraft; the VZ-3RY, now being test-flown by NASA to demonstrate the deflected-slipstream principle; and the U.S. Army's first STOL airplane, the YO-51 Dragonfly, produced more than 20 years ago.

Technical data on the VTOL propulsion system is as follows:

SPECIFICATIONS

Lift thrust	7430 lb
SFC	0.34 lb/lb-hr
Horizontal thrust	2580 lb
SFC	0.98 lb/lb-hr
Fan pressure ratio	1.1
Fan tip diameter	62.5in.
Fan tip speed	720 ft/sec
Design speed	2640 rpm
Lift fan maximum thickness	14.4in.
Fan installed dimension distance between wing spars	76in.
Gas generator maximum diameter (less accessories)	17.75in.
Gas generator length (no afterburner)	80in.
Total system weight	1145 lb
Thrust-to-weight ratio	6.5 : 1 (lift and cruise combined)
Thrust-to-weight ratio	9.4 : 1 (lift only)
Exit louvre variation	Minus 15 deg. reverse thrust to plus 40 deg. forward thrust
Fan air flow	535 lb/sec

BASIC GAS GENERATOR

- GE J85-5 turbojet engine
- Engine used without afterburner
- Fixed conical nozzle mounted at rear of engine

DIVERTER VALVE

- Directs gas flow from turbojet engine to tip-mounted drive turbine

LIFT FAN UNIT

- **Scroll**—Hot gas flow enters circular scroll inlet and is split into two arms of the scroll where gas is directed at blades of the tip turbine.
- **Tip turbine**—Single stage impulse turbine mounted on rim of fan driven by jet exhaust gases to turn the lift fan.
- **Lift fan**—A single stage axial flow compressor. Below the fan are variable exit louvres to control direction of airflow for hover, transition from vertical to horizontal flight or vice-versa, and acceleration. Louvres close during normal cruise, presenting smooth wing surface.

DESIGN FEATURES

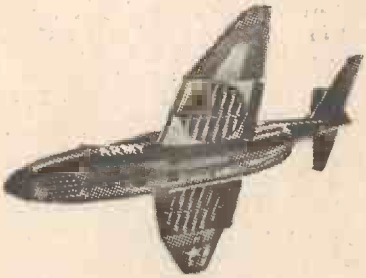
Flexibility of mounting configurations. Can be mounted in the wing or in a fuselage. Gas generator can be mounted in a variety of positions in relation to the fan.

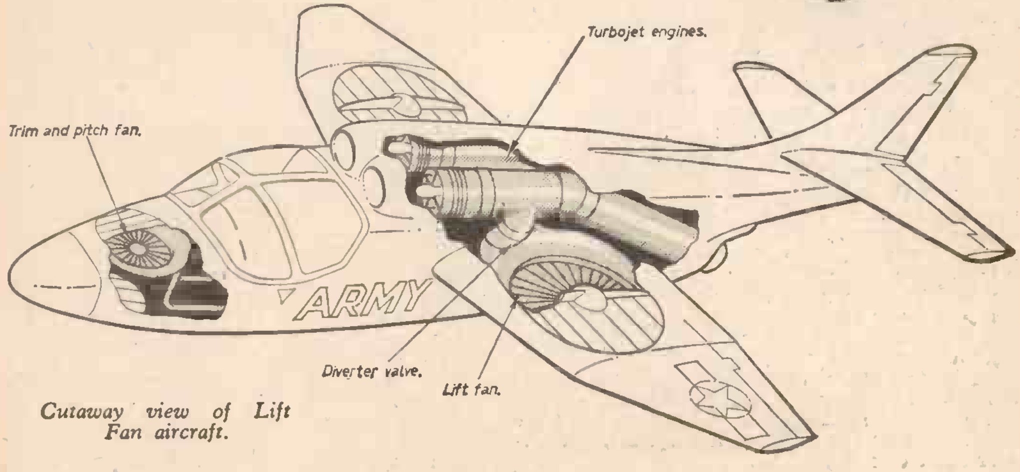
Can be used as pure lift engine by replacing diverter valve with elbow and removing exit louvres.

Fan can be used with several gas generators without compromising system simplicity or performance.

System is lightweight, compact, and provides high performance.

When successfully concluded, this new programme will represent a major step forward in the U.S. Army's search for a practical VTOL propulsion system.





Cutaway view of Lift Fan aircraft.

LATHE GADGETS

Part 7

PLANING ATTACHMENT

By L. C. MASON

SLOTS, keyways, and similar grooves required to be machined along shafts or in the bores of wheels and gears are very conveniently carried out by planing. While the lathe is chiefly concerned with producing round shapes, it can very well carry out light planing operations. The obvious way to do this is to mount the appropriate tool in the toolpost and rack the saddle back and forth along the bed with the hand wheel. While this works, it is not a very good idea, as it imposes a strain on the rack and pinion gear which it was not designed to withstand.

A much better arrangement is to utilise the tool movement of the lathe, but to provide the thrust in some other way. The accessory described does this, and at the same time makes it possible for the tool to move along a line at an angle to the normal lathe slide movements. In this way it is quite simple to plane keyways in taper wheel seatings on shafts or in taper-bored components.

If the saddle is racked along the bed for the tool movement, the tool point can only travel in a line parallel to the lathe bed. However, if the movement is provided by the topslide, this can be set over to any desired angle to the centre line along which it is desired to move the tool.

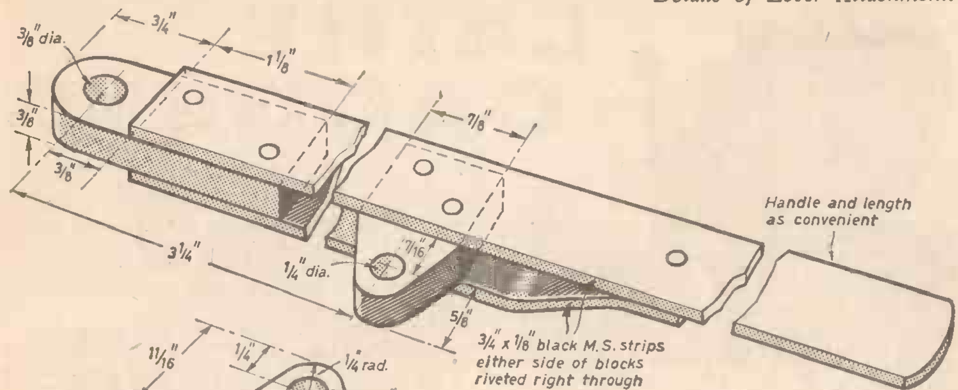
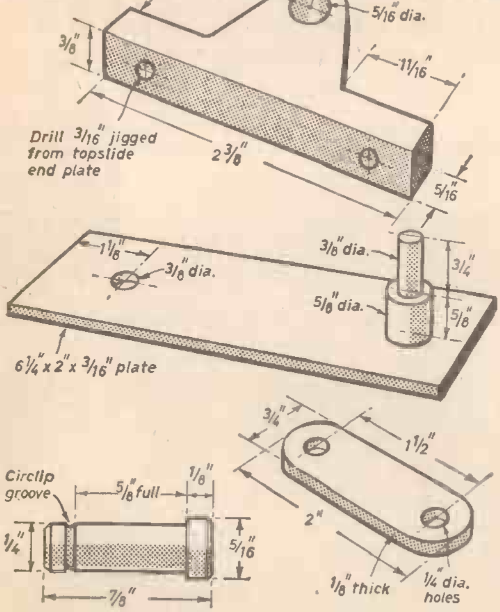
The normal tool holding arrangements are retained to mount the slotting tool, but the topslide feedscrew is not required. This is therefore removed complete with the topslide endplate. In place of the endplate is mounted a block, drilled to take a stout pin on which swivels one end of a pair of swing links. The links are attached by a similar pin at their outer ends to a hand lever, which provides the thrust for moving the topslide. The lever pivots on a short column riveted to a clamp plate bolted to the cross-slide behind the topslide. As the clamp plate for the fulcrum column is mounted on the cross slide by only one stud, it can be located in any position suitable to the lever to give straight line thrust to the topslide, at whatever angle that may be set.

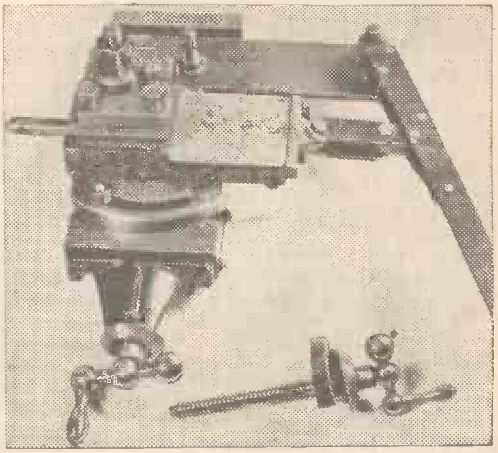
The dimensions for the topslide block are not at all critical, with the exception of the two bolt holes for attaching it to the topslide. So when the block is shaped up and the link pin hole drilled, use the topslide endplate as a template to get the hole spacing on the block exactly the same. In use, the block is attached to the topslide by the same pair of bolts as held the endplate.

The lever is a simple affair made up from a couple of lengths of $\frac{3}{4}$in. x $\frac{1}{8}$in. black mild steel strip. The two blocks carrying holes for the pins are riveted to the strips with iron rivets. With the lever cut to a convenient length, a simple wooden handle is added. Two strips of wood, one each side of the lever, are held in position by woodscrews which pass through clearance holes in the lever. The strips are roughly shaped rectangular bars when first screwed into position, being shaped up to a comfortable grip when fixed.

All the pieces are just drilling and filing jobs. The pins are silver steel because of the wearing qualities of that material. There is no special significance in the spring circlip method of retaining the pins except that it is neat, and keeps the length of the pins down to the minimum. Make the fulcrum pin and its base plate last. With the other components completed, you can bolt the topslide block in place, with the links and lever already attached. Lay the piece of plate which it is proposed to use for the clamp plate in position on the cross slide, then it is a simple matter to measure from the surface of the plate to the underside of the lever at the pivot end. This gives the length of the fulcrum column which supports the back end of the lever, so that the lever is level and the swing action quite free. Make the main part of the column appreciably bigger than the pin itself, not only to provide a generous supporting collar below the lever, but also to give as big a contact area as possible on the base plate. The bigger this area is, the stiffer will be the whole mounting. Turn a spigot on the bottom of the pin a close fit

Details of Lever Attachment.



for the hole in the base plate. Countersink the hole in the plate underneath and rivet the pin tightly in position, filing down flush after riveting.

To bring the attachment into use, remove the two screws securing the topslide endplate, and run the feedscrew back completely out. This will bring with it the proper endplate, which can be left on the screw as a unit ready for replacement. Fit the substitute block, using the same two screws, slip the fulcrum pin through the end of the lever from underneath, locate and clamp down the plate, and all is ready.

It might be mentioned that a keyway planing tool is much like a parting tool laid on its side, a small one shaped up on the end of a piece round tool steel and used in a toolpost boring bar being the most convenient form for planing keyways in bores. The toolpost and height gauge already described lend themselves very well to use with the planing attachment.

Learning to Figure

(Concluded from page 439)

Push Buttons

The push buttons are of the simplest design as shown in Fig. 3. When the Perspex rod is depressed to its limit this pushes the spring metal contact against the common return strip. The return strip, made from strip tin, is mounted on a wooden block for rigidity. This is necessary in view of the rough handling expected from children.

A metal pin through the base of the Perspex rod is all that is required to prevent the rod from being removed or lost.

Fig. 1.—The completed Mask and Guide.

The arm must be long enough to extend some distance beyond the front of the viewfinder, or the lines on the graticule will not be clearly visible but will tend to appear blurred. This extension will be 1 to 2in., depending on the viewfinder, and is best found by experiment in individual cases. A step cut in the top face of the stem gives accurate positioning of the arm.

The aperture in the frame need not be precisely cut, provided that it does not intrude on the field of view seen through the finder. When the frame has been assembled to the other metal parts, it should be blackened to prevent dazzle caused by light reflecting into the viewfinder window. The remainder of the mask unit may be blackened or finished in any other way desired.

The graticule is made by drawing regularly spaced lines, both vertically and horizontally, on a rectangle of thin transparent plastic or clear film. The spacing and number of lines are unimportant provided that the ruled area covers the entire view

(Concluded on page 455)

mask & guide

FOR MULTIPLE PHOTOGRAPHY

By A. E. Bensusan

HITHERTO, the making of several photographic images in planned juxtaposition on the same negative has been the prerogative of those owning cameras with rear focusing screens which could be drawn on with a grease crayon. The device described here enables the user of any camera having a direct vision viewfinder, whether of the optical or open-frame type, tc cope adequately with the matter.

Owing to the slight amount of parallax between the viewfinder and the lens, very close positioning of the different components on the one negative should be avoided at extremely short ranges. Even an automatically compensating viewfinder does not get over this difficulty owing to the difference in viewpoint. However, at ranges over six feet no allowances need be made.

The Mask

The mask shown in Fig. 2 was made to suit an Agfa Silette 35mm. camera which has its accessory shoe mounted on the top plate immediately over the viewfinder. Slight alteration may be necessary to fit other makes and models of camera. The basic parts are a foot to fit the shoe, a short stem to raise the arm above the top of the shoe, a connecting arm, a frame to locate in front of the camera viewfinder and a hand-drawn graticule. The metal parts may be made of brass or steel, with soldered or brazed joints, or aluminium alloy secured with rivets or one of the epoxy resins such as Araldite.

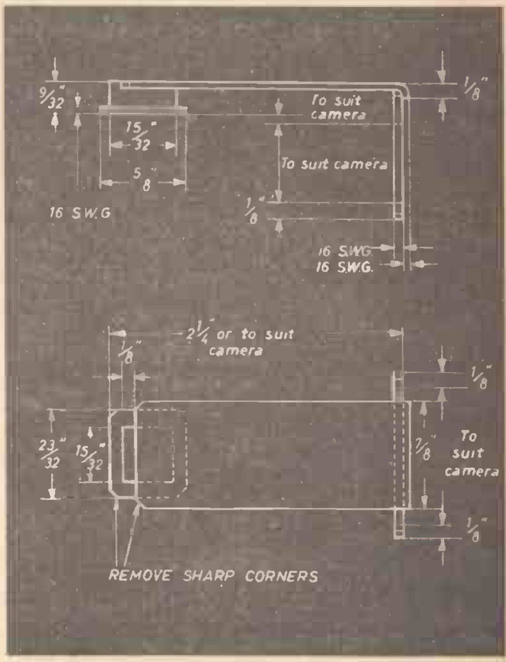
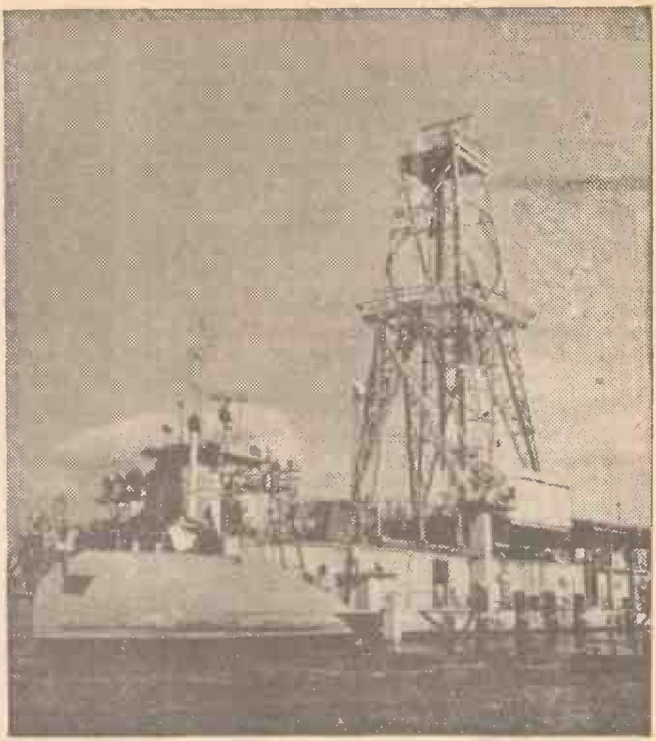


Fig. 2.—Viewfinder Mask.

INNER SPACE

U.S. Project Mohole is designed to reveal the secrets of our planet's interior

By "Our Science Reporter"



The U.S. navy vessel Cuss 1.

NOTHING succeeds like trying, even if the problem does look impossible. Scientists, whose work-a-day lives revolve around, seemingly, unanswerable queries, never give up, even after they do find the solution.

Having, during the past few years, progressed well on their way to finding out "How High Is Up", they are now interested in trying to learn "How Low Is Down". This information, when and if they are successful, will complement the extensive space programmes being carried out, and may prove to be one of the most dramatic, and valuable, scientific undertakings of the century. Research in this direction (it is known as Inner Space), could provide clues to the origin of the solar system; whether the magnetic poles have wandered throughout geologic history; if the planet is becoming hotter or cooler; fill in some gaps in man's knowledge about the origin and evolution of life, and answer many problems from the past which would be invaluable in the future. Geophysicists will be able to estimate the density of the earth's material all the way to the earth's centre from samples of rock taken deep in the crust. Then the age of the earth's crust and mantle will be no longer in doubt.

With all this in view, U.S. scientists are concerned in a large-scale, deep-sea drilling project—called Project Mohole—designed to reveal these secrets of the earth's interior. Russian scientists, too, are reported to be doing the same thing.

Apparently, the earth's crust—a layer of slag-like veneer of light granite rock—is relatively thinner at the bottom of an ocean than it is under land areas. Under shallow ocean basins it might be only five miles or so thick, against anything up to 30 miles under land. Consequently, all inner space research, with special equipment, is taking place at sea.

The top deck of the Cuss 1, showing some of the 8,500ft of drill pipe racked ready for use.

Underlying this crust is the earth's mantle—a dense plastic-like material—and the two are separated by a dividing line known as the Mohorovicic Discontinuity, or Moho, named after a Yugoslav scientist who identified it as the area where a sudden change occurs in the structure of the earth. It is this dividing line, the mysterious Moho, that engineers and scientists are now trying to penetrate, in order to reach the earth's 1,800 mile thick Mantle.

The hole that is being drilled is the deepest ever attempted. It is taking place beneath the wind-swept surface of the Pacific, off the coast of Mexico. Eventually, it may be necessary to drill through water 3·4 miles deep into a thickness of some 15,000ft of rock, making a total of 32,000ft (six miles). The deepest hole ever drilled on land is just over 25,000 ft (4·7 miles). Engineering difficulties involved in this project are tremendous, and involve bringing to the surface—through special pipelines connected to a sort of floating platform—samples of the ocean's bottom sediment, and cores removed from beneath the ocean floor in the primordial crust, Moho and Mantle of the earth.

Being used for Project Mohole is the U.S. Navy vessel Cuss 1. She is unmoored, but held in position by means of four diesel steering motors. Her position is maintained by four or five buoys anchored to the bottom. These buoys are equipped with sonar transponders, or "pingers", which respond to sound waves from the ship. Electronic equipment on the vessel translates the signals received into distance, whereby the pilot can determine the ships position over the hole.

The Cuss 1 has many special features, including a derrick specially designed to withstand ship motions; horizontal drill pipe racking; a steel floor foundation unit that can support the wellhead and casing strings; an automatic all-weather drill pipe handling system; an unusually strong and flexible anchor system and a flexible and removable connection between the wellhead and the ship.

The drilling method being used is the standard rotary method used on land by the petroleum industry. A main objective of the operation is to confirm the engineering computations of the forces and stresses acting on the ship and the drill pipe, the determination of optimum rotation speed and the necessary amount of weight on the bit.

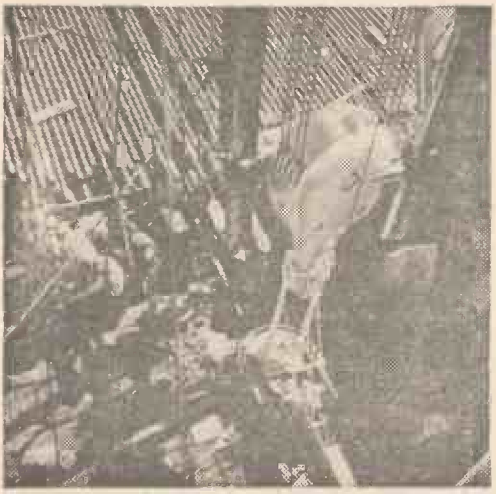
All holes are uncased. In other words, the only connection between the ship and the sea floor will be the drill pipe itself. This means that once a bit has been withdrawn from a hole, that hole cannot be re-entered. All sampling and measuring operations, therefore, must be conducted by lowering tools and instruments through the drill pipe on the cable, or wire line. A core barrel has been specially designed which can be retrieved through the drill pipe in an attempt to obtain continuous cores of the entire soft sediment section. Diamond drills are being used in all holes as both very hard, and very soft, rocks are being encountered.

How Low Is Down? Well, figuring on the earth's diameter being 8,000 miles, the distance to the earth's innermost core would be 4,000 miles, which is a long way to go—with a drill. The present ultimate goal, however, is to reach the earth's mantle and bring to the surface samples of what are lying there. These core samples may reveal an uninterrupted record of the earth's development for two billion years, as somewhere, buried under tons of sediment, is the earth's original face, dotted by a layer of ancient meteorites that fell from the heavens eons ago.

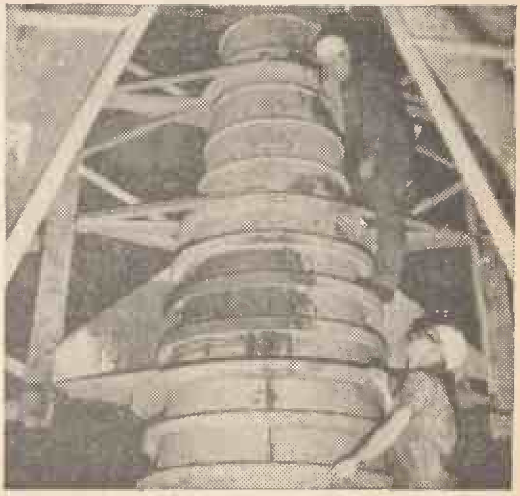
Project Mohole is a significant operation. It will probe into new, and totally unknown, regions of the earth. All that is known now is by indirect evidence. Seismic waves have told scientists a great deal, but much of this theory could now be corroborated by actual samples.

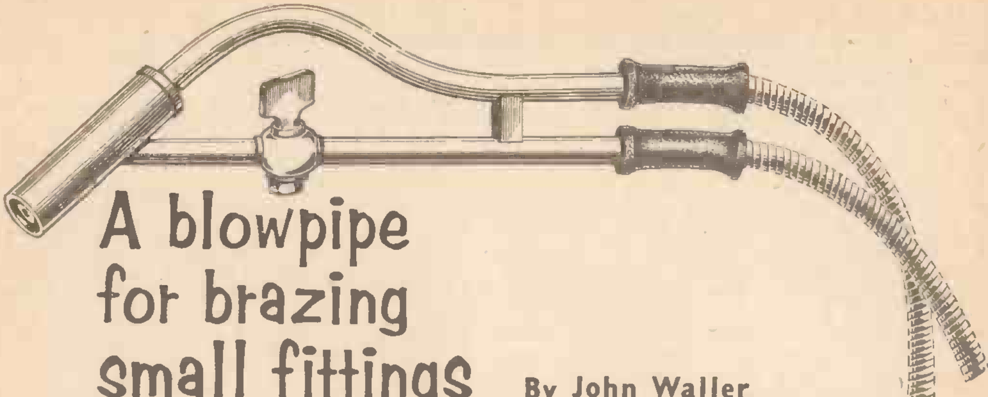
The Mohole idea, originally conceived by scientists of Princeton University and the University of California, is being carried out by the U.S. National Academy of Sciences with grants from the National Science Foundation. The cost of the project will run into many millions of dollars.

The drilling platform of the Cuss 1.



Drilling pipe guide shoe, beneath the hull of Cuss 1, being checked by workmen.





A blowpipe for brazing small fittings

By John Waller

A PROBLEM which frequently confronts the owner of a small workshop arises when he wishes to obtain a tiny hot flame having a high enough temperature to allow him to braze or silver-solder small details, but this is not difficult to overcome if an air supply is available to use in conjunction with the usual domestic gas from the mains, and the solution is seen in Fig. 1 which shows a simple piece of equipment easily made from scrap ends of material and a standard gas cock.

The use of a vacuum cleaner as a source of air supply is feasible but a small compressor and tank is obviously much better, and both gas and air are introduced from their respective sources with the aid of the armoured tube normally used for gas fires and pokers. Rubber connectors are readily available from gas company showrooms and a similar type of nipple is provided on both the gas and air inlet tubes on this torch as those used for the orthodox gas fire.

Brass tube is best suited for these details because it bends easily and does not rust if the torch is out of commission for several months, so use a piece of $\frac{5}{16}$in. or $\frac{3}{8}$in. diameter and bend the air inlet as will then enable the constructor to scribe a line shown in Fig. 1. The bend is necessary to allow the tube to clear the gas cock and an easy bend ensures this clearance and at the same time preserving the good looks of the torch. Fill the tube with fine sand, gently damp this down a little at a time—you must obviously plug the other end temporarily during the bending operation—with the aid of a small stick which can pass through the tube, until a solid detail is secured. Tube of this size can be bent by hand and to obtain the required bend, mark out the curvature on a piece of paper and use this as a template. When the desired shape is accomplished, remove the plugs and allow the sand to drop out, but do take care not to kink the tube as this looks unsightly and gives the impression of poor workmanship. If the tube is hard and proves difficult to bend, heat it in the domestic fire and then plunge it in water.

The brass mixing tube is attached to the air supply by providing it with a shouldered plug and brazing this to the air tube, but before attaching this member the opposite end of the air tube is fitted with a nipple which is drilled $\frac{1}{16}$in. for the passage of the air. Again this item is brazed

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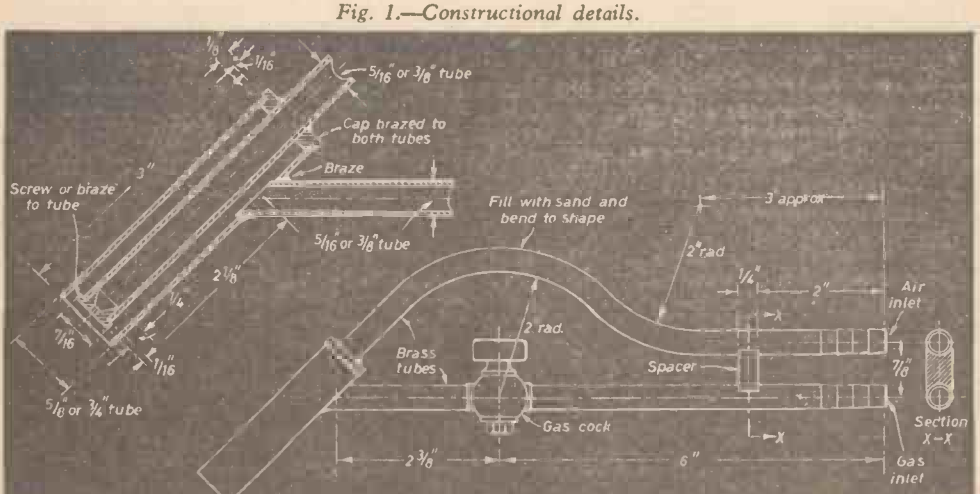
Fig. 1.—Constructional details.



A 12 volt stabilised POWER SUPPLY

By D. Watkins

IT will be remembered that the Transistorised Exposure Timer recently described in the May issue was designed to run off a 12V battery or stabilised supply.

The circuit diagram for a suitable power supply is shown in Fig. 1. The circuit is a straightforward full wave voltage doubler followed by a smoothing filter and a Zener diode stabiliser. The mains transformer used is a standard 6·3V heater transformer, the current required being quite small—something in the order of 40mA. Diodes D1 and D2 and capacitors C1 and C2 form the voltage doubling circuit.

During the first half cycle of the incoming mains voltage, point A is positive and point B is negative and current will flow through diode D2, charging capacitor C2 to the supply voltage (6·3V). During the next half cycle, point B will be positive and point A negative. Therefore capacitor C1 will be charged and, as both capacitors are now charged, the final voltage across the load will be twice that of the supply. This applies only if the load is drawing no current, and, in a practical case, current drain will prevent the capacitors from reaching their full charge, and the voltage will never be quite double that of the supply. This means that we might not quite manage to obtain 12V from the voltage doubler. However, if we connect a capacitor input smoothing filter, formed by C3, R1, and C4, across the output, assuming that the capacitor C3 is reasonably large, the voltage developed across this capacitor will be the peak value of the output (1·414 times the R.M.S. value) in other words, about 17V. This is now dropped to 12V by resistor R1, and any ripple smoothed out by C4. Diodes D3 and D4 are Zener diodes which have the property of maintaining the voltage across them at a steady rate when the input to them is at a higher voltage, i.e. if, in this case, the input voltage to the diodes is anything above 12V, the diodes will keep the output at 12V irrespective of the current being drawn by the load.

Construction

The unit is constructed upon a five-way tag-board as shown in Fig. 2.

Connect together tags 5, 7 and 10.

Connect capacitor C2 between tags 1 and 6 with the positive end on tag 6: connect capacitor C1 between tags 3 and 6 with the positive end on tag 3: connect diode D2 between tags 1 and 2 with the cathode (red) end on tag 2: connect diode D1 between tags 2 and 3 with the cathode on tag 3: connect resistor R1 between tags 3 and 8:

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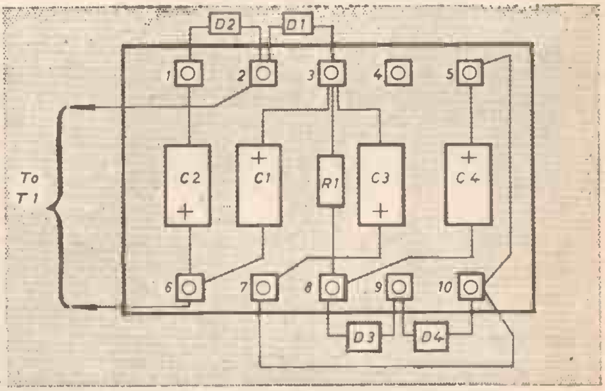
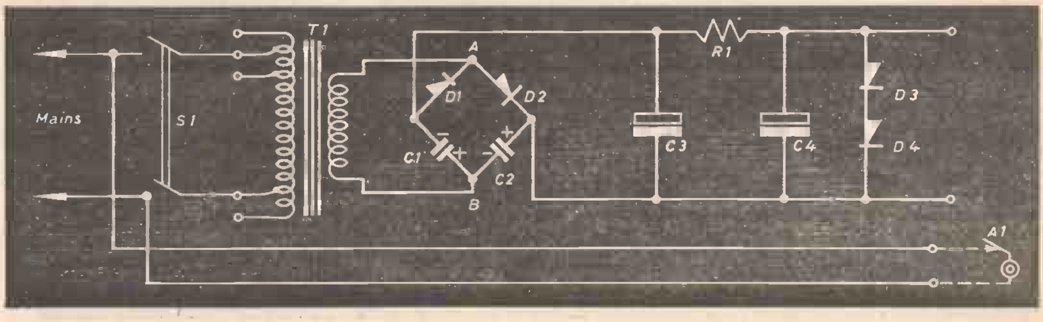
Fig. 2.—Tag-board layout.



LIST OF COMPONENTS

T1 6·3V heater transformer.
D1, D2, G.E.C. SX641 or similar.
D3 G.E.C. SX56 or other 5·6V Zener diode.
D4 G.E.C. SX63 or other 6·3V Zener diode.
C1 100mfd. 12V electrolytic.
C2 100mfd. 12V electrolytic.
C3 50mfd. 25V electrolytic.
C4 100mfd. 12V electrolytic.
R1 510Ω 5% 1W.
S1 single pole single throw (S3 in timer).

Fig. 1.—Circuit diagram of Power Supply.



SCIENCE NOTES

Man from Mars?

WHAT does the average well-dressed scientist look like? Not always the dignified, scholarly-appearing gentleman we assume in our mind's eye.

For instance, the deep-sea-diver-looking-character, in the illustration, is a scientist. He deals not only with theoretical calculations, but with their practical applications. This particular scientist is working on the development of new fuel cell compounds to contain the furious new propellants for space rockets and missiles.

Garbed in this protective suit, the scientist is preparing to transfer acid from a storage container to an experimental tank filled with rocket fuel.

The tank is then subjected to a continuous expulsion cycle to determine its durability, compatibility and diffusion. The "Martian-type" suit protects him from fumes that may be discharged during tests.

Tail section showing pusher prop.

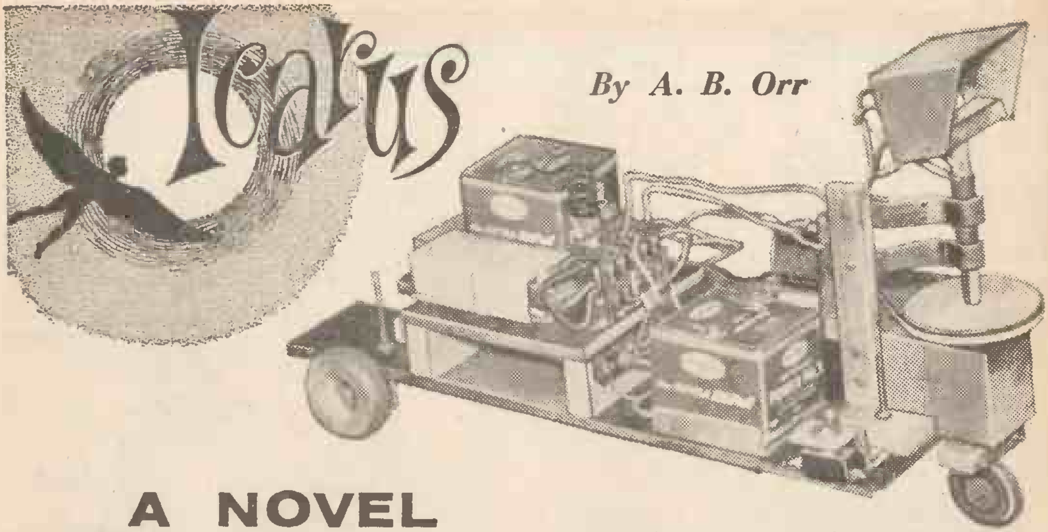
Man Powered Aircraft at Hatfield

A CONFERENCE on Man Powered Aircraft took place at Hatfield Aerodrome on Saturday, May 19th. The Royal Aeronautical Society Man Powered Aircraft Groups "Puffin" was on show.

Photograph (Left) shows:—Pilot J. C. Wimpenny, at the controls of "Puffin"—he flew this aircraft for 993 yards—with him is J. H. Phillips, who did the flight trials in the aircraft.

Icarus

By A. B. Orr



A NOVEL LIGHT CONTROLLED VEHICLE

THIS little "toy" is most interesting in operation and is not very difficult to make. The "heart" of the vehicle is adapted from the "Liton" photo-electric parking switch which is supplied by St. John's Radio of 156 St. John's Hill, London S.W.11. This unit may be bought ready made or may be obtained in kit form. The writer is extremely grateful for the kind help and co-operation he received from this firm during the construction.

In the original unit a secondary relay is used to switch the side-lights of a parked car on at dusk and off at dawn. In Icarus this relay is used to switch on and off a small electric motor.

The vehicle comprises a scanning unit mounted on the same axis as the front steering wheel, a simple transistor amplifier, two relays and the necessary batteries. A small electric motor (Mighty Midget or similar) is used as a scanning motor and drives the scanner, and the steering wheel, through 360 deg. A second motor drives the rear wheels through a worm reduction gear.

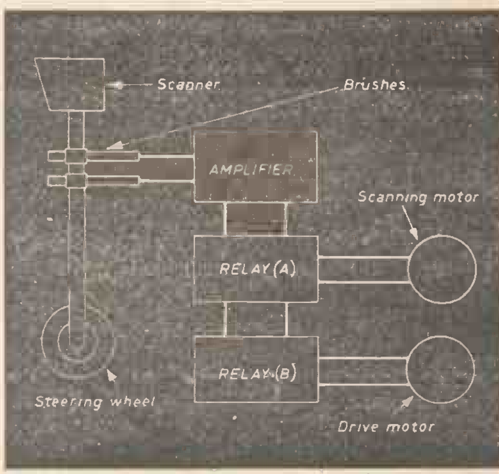
This is how the machine operates. When switched on the vehicle remains stationary and the front wheel with its scanner unit revolves slowly, looking for a light to home on. The photo-cells are fitted with a cowl that makes them directional by cutting out incidental light. A light-source, such as a powerful hand torch, is then switched on and focused on the revolving scanner. On picking up the light beam the photo-cells click the relay (A) and the scanner motor circuit is opened, causing the scanner head to fix on the light-source. At the same time relay (B) is clicked and switches on the drive motor to the rear wheels, causing the vehicle to move forward in whichever direction the scanner, and therefore the front wheel, is facing. It continues to move forward until it moves out of the light beam and the sequence is reversed. The scanner, on losing the light-source, starts scanning again and the drive motor circuit is opened causing the vehicle to stop moving forward. On the next revolution of the scanner the light is once more picked up and the sequence is repeated. This sequence of operation is continued until the scanner fixes on the light source dead ahead. When this happens the vehicle will move directly towards it.

Fig. 1 shows the circuit in schematic form. The unit, as supplied, is complete with full details of construction and adjusting. Icarus does not alter the original apparatus, it merely drives motors instead of lighting lights.

Construction

Before starting work, bear in mind that the essentials of the vehicle are a sturdy chassis, a small electric motor driving the rear wheels through a

Fig. 1.—Circuit details.



worm reduction, a scanning unit and the Liton unit. Dimensions given are purely for guidance. The main thing to go for is a freely revolving steering head and really good contact between the brushes and the copper rings, so that no "power" is lost between the photo-cells and the amplifier.

Make a start on the chassis. This is made from a 14in. x 6in. x ¼in. sheet of Paxolin, Bakelite or wood. This provides a sturdy base for the components and is easily drilled. The rear drive motor is mounted on a wooden block and drives the rear axle through a worm gear (see Fig. 3). Nylon gearing can be obtained in most model shops.

The front block is shaped as shown in Fig. 2 and is made from hardwood. A hole of suitable diameter to make the ball bearing cages a force fit is drilled in the projection as shown. The brush supporting arm is screwed to the right hand side of the front block with wood screws and the brushes themselves are screwed to this support. The brushes may be made of thin copper or brass strip, those in the original being made from draught excluder.

The block is bolted to the chassis through the lugs at each side.

Steering Head

This is quite simple and consists of a 6in. length of $\frac{5}{16}$in. dowel with two ⅝in. lengths of copper tubing forced on near the top. A shallow channel will have to be cut under the top one to allow the lead from the scanner to get to the lower one.

The pulley on the steering head should be roughly 2½in. in diameter and can quite simply be cut from plywood using a fret saw and then filing a Vee round the edge. This is pushed on the shaft before forcing it into the bearings.

At the top end of the steering head is the scanner itself. This consists of a 2¼in. x ¾in. x ¼in. piece of wood with a 1¼in. back pinned to it. The photo-cells are glued to the back and the two leads taken to the copper rings. Note that, while one cell is frequently sufficient, the original had two in parallel. The cowl over the cells is made from tin pinned to the scanner. After fitting the shaft into the bearings the front wheel may be mounted. Fig. 2 shows how this is done. The front wheel, like the two rear wheels, should have soft rubber tyres to protect the relays from road shocks.

Scanning Drive Unit

The diagrams show how this is made. Note that the unit is mounted on a sub assembly, the completed unit being bolted to the main chassis with long ⅛in. bolts. This enables the two pulleys to be accurately lined up. Once again, the drive is taken through a worm reduction gear to allow the scanner to revolve at a reasonably slow speed.

Amplifier

In the original this was made from scratch and was assembled on a sub chassis mounted on small wooden blocks which were finally bolted to the main unit. It would, however, be much simpler to use the completed unit as supplied and this may be bolted direct to the chassis.

As already mentioned, the Liton unit is supplied complete with instructions about wiring up and this is very simple. The only difference lies in the relay which, instead of lighting car parking lights or

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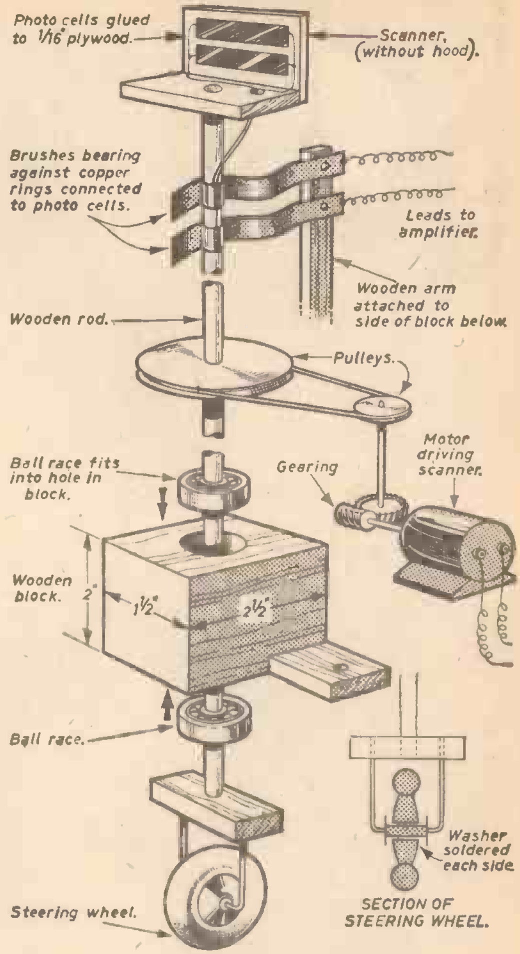
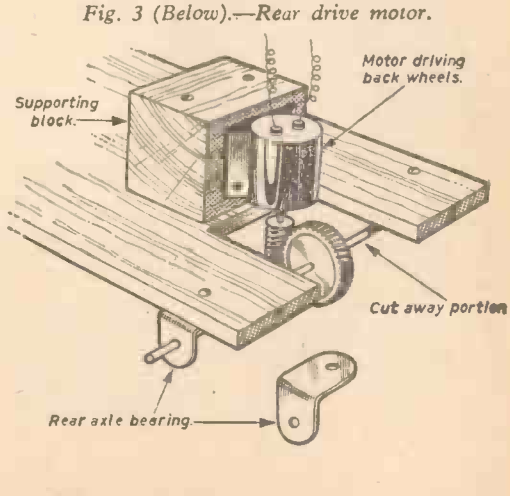


Fig. 2.—Front block details.

Fig. 3 (Below).—Rear drive motor.



An easily made ASTRONOMICAL TELESCOPE

B.C. Macdonald

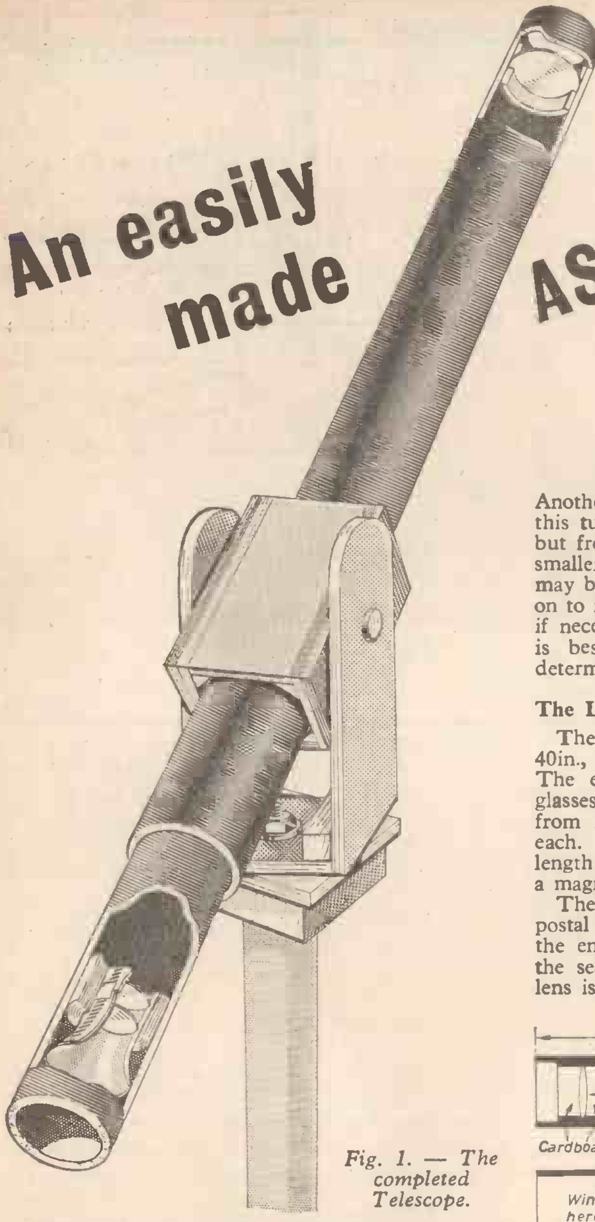


Fig. 1. — The completed Telescope.

THIS telescope will easily show some of the nine moons of the planet Jupiter, the craters of the moon, as well as other interesting celestial phenomena.

To make the telescope you will require a spectacle lens, obtainable from any optician, and two jewellers' eyeglasses. For the rest of the telescope cardboard tubes are used, postal tubes are ideal. The main tube carries the spectacle lens, or object glass, and is 36in. long, the diameter depending upon the width of the lens used. Another smaller tube is required about 15in. long, this tube carries the eyepiece and must be a firm but free sliding fit in the larger tube. Should the smaller tube be too slack to fit in the larger one it may be built up to fit by pasting a sheet of paper on to it. Several sheets of paper may be pasted on if necessary, so long as they are quite smooth. It is best to obtain the lenses first, since these determine the diameter of the tube required.

The Lenses

The spectacle lens should have a focal length of 40in., and be of as large a diameter as possible. The eyepiece is made from two jewellers' eyeglasses, and these are obtainable in focal lengths from 2 to 4in. Obtain two of 2in. focal length each. When combined in one eyepiece, the focal length will be about 1in. This gives the telescope a magnification of 40.

The spectacle lens should be a close fit in the postal tube. A strip of thin card is glued inside the end of the tube to form a seat for the lens, the seat must be carefully positioned so that the lens is held square with the tube. A second strip

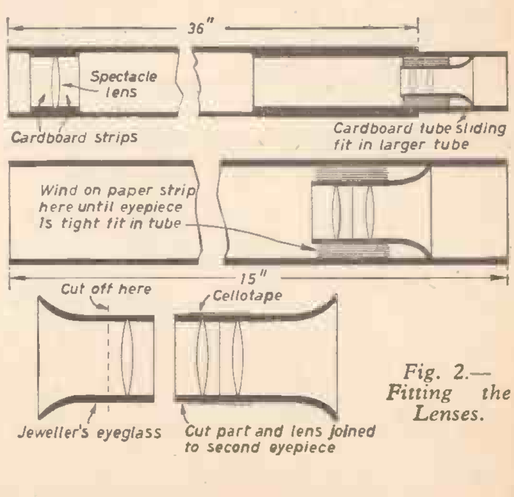


Fig. 2.— Fitting the Lenses.

of card, glued to form a circle and to be a tight push fit in the tube, is pressed in after the lens to hold the latter in position and to allow it to be removed for cleaning. (See Fig. 2.)

The Eyepiece

Cut the bell-shaped end off one of the eyepieces, as shown in Fig. 2, then reverse it so as to bring two true surfaces together. The lenses must be carefully cleaned and taped together with Cellotape. Build up the small diameter of the eyepiece by winding strips of paper on to it until the whole is a nice tight fit in the end of the smaller tube. In order to obtain a full field of view the eye has to be held a little distance from the eyepiece, and best results are obtained when the eyepiece is pushed some way into the tube so as to provide for this. Find the amount by trial, but it will be 1 to 1½in.

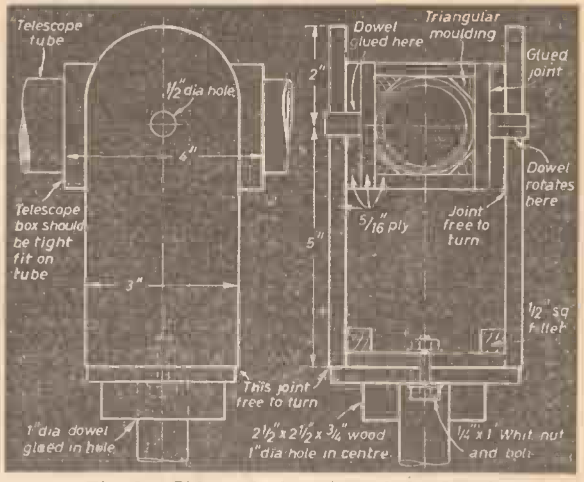


Fig. 3.—Side and plan view of the Stand.

Using the Telescope

Focus the telescope by moving the sliding tube in or out as required until a clear image is obtained. The telescope may be used for terrestrial purposes but, in common with all astronomical telescopes, the image is upside down. The image is almost entirely free from acromatism, or colour. Due to the high magnification, the telescope must be supported when used, and this is easily done, a simple wood swivel stand has been devised, as shown in Fig. 3.

The Optical System

There is no hard and fast rule about the lenses used. The focal lengths may be varied if desired, but if the focal length of the spectacle lens is increased the length of the main postal tube must be proportionately increased. The greater the focal length of the spectacle lens and the shorter the focal length of the eyepiece, the greater will be the magnification obtained. The actual magnification may be found by dividing the focal length of the spectacle lens by that of the eyepiece. However, the maximum useful magnification is limited by the diameter, or light admitting power of the spectacle lens. The higher the magnification the darker the image.

The reader may be able to obtain a suitable lens from a pair of old spectacles. The lens must be a positive one or it will not form an image. The lenses in spectacles used by short-sighted persons are not suitable. You may check a lens for this and focal length by using it to project the image of an electric lamp on the wall of the room or on to a piece of paper. Any positive lens will do this if the distance between the lens and the projection surface is correct. If this experiment is performed with some distant object, such as the sun, the distance between the projected image and the lens is the focal length. Opticians measure the "strength" of a lens in units called dioptres rather than in focal lengths. Here are a few focal lengths in inches converted to dioptre equivalents,

20=2D; 30=1·3D; 40=1D; 50=·79D; 60=·66D.

The Swivel Stand

The construction of the stand is easily followed from the illustrations. A 3in. long box made of $\frac{5}{16}$in. plywood is used to hold the telescope and the diameter of this is not shown because it depends upon the diameter of the postal tube used. For the same reason the width of the base to which the upright supports are fixed is also not shown, this being fixed by the width of the box. Note that the box must be assembled in position before the second upright is fixed, it cannot be put in afterwards. The top of the 1in. dowel is recessed to accommodate the Whitworth bolt head. The head of the bolt should be a tight fit in the recess to prevent its turning. The bottom end of the dowel may be fixed to any firm base board, using the same method of attachment as that used at the top end.

Finally a warning, the telescope must not be used to look at the sun; to do this would seriously damage the eyes. Sunspots may be seen by allowing the telescope to project an image of the sun on a piece of white card held at a suitable distance from the eyepiece.

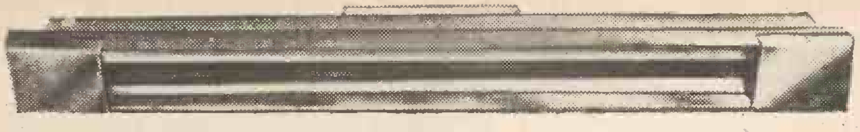
ICARUS—A LIGHT CONTROLLED VEHICLE

(Concluded from page 451)

side lights, opens one circuit (the scanning circuit) and closes another (the drive to the rear motor).

There are many relays that will do this and St. John's Radio can supply a suitable one. Those in the original were taken from ex-W.D. equipment.

It should be emphasised that no great knowledge of electronics is necessary to construct this novel and entertaining vehicle. Paxolin or Bakelite sheets, cut to any size can be obtained from Messrs. B. C. & W. (Plastics) Ltd., Irwell Street, Radcliffe, Lancs., and photo-cells, amplifier, relays etc., from St. John's Radio, 156 St. John's Hill, London S.W.11.



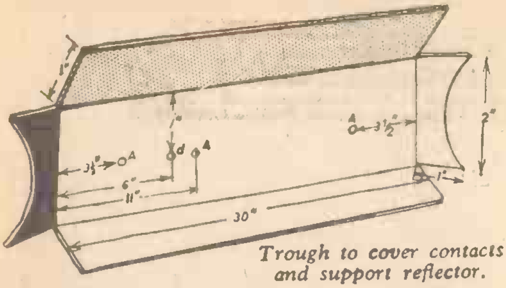
The heater in use

An easily constructed "INFRA RED HEATER"

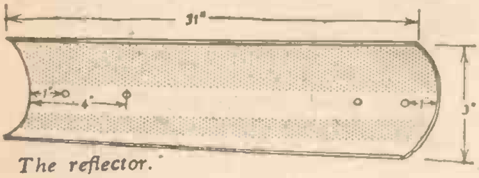
Designed by K. D. RENDALL

THERE must be many readers who have seen and admired the latest type of heaters to appear in the shops. The long slim " Infra red heaters " in which the heating element is enclosed in a quartz rod, which are generally fixed to the wall. They also have the advantage that they are out of the way of children and pets. It is not generally realised that these can quite easily be made by the average " Practical Mechanic " for as little as 30s.

The basis of the heater to be described is one of the elements sold by the makers of various types of these heaters as replacement elements. These cost about 17s. for one that is rated at 680W. 230V. The length of the one used by the author is 30in. The reflector is made from a piece of aluminium drain pipe—the diameter of this pipe is 3in. and the length 32in. The pipe only has to be sawn lengthwise. This will, in actual fact, produce two reflectors so that the second one will be even cheaper than the first (if you need two heaters). The reason that drain pipe was used is that it already has a radius that is suitable for the reflector, and once it has been cut there only remains the job of polishing and drilling. This is best done by rubbing the tube with emery paper then steel wool, and finally polishing it off with metal polish. When this has been finished to the satisfaction of yourself then it can be drilled to suit the insulators that are of the feed-through type that most radio shops stock at around 1s. a pair. The method of clamping them in place will be apparent by reference to illustrations, actual height of the brackets has been left to the individual constructor. The reason for this is that there seems to be a matter of opinion what type of beam is is desired, and for those people who want to vary the focus of their heater, all one needs is a bulb and battery and a darkened room. The bulb is placed in the reflector a small distance from the centre of the radius. This will produce a beam that can be focussed across the room until you get the beam that you desire. One can actually do this so that you have a very narrow beam that you can direct across the average room to the spot where you sit when watching the " square-eyed monster " or where you work. The support brackets are then made so that the element is mounted in this position. The trough to cover the back of the heater and carry the bracket is made to the dimensions shown. This is best made out of alloy 18 gauge. The holes for mounting the trough to the reflector are drilled—also a hole to feed the cable through. This must have a grommet in order that the mains cord is not cut into by the warm metal. The brackets can be either mild steel or alloy. The author used alloy as this was to hand. If anyone else decides to use alloy this is best heated before bending as this thickness of metal is very prone to crack. The two halves of the bracket are fitted together by OBA bolts and wing nuts. This allows one to set the angle of the heater. The end plates are retained with 4BA self tapping screws. When the whole heater has been assembled and an earth lead connected to the metal, you must then check that there are no short circuits, with a meter, or failing that, a torch bulb and battery. When all is well, the heater should be screwed to the wall. This is best done by separating the two halves of the bracket as the reflector will get in the way otherwise. This bracket is best fitted to the wall with Rawlplugs or some such thing. If you decide to paint it, then a word of advice—this is not to be recommended as the author has discovered that even so-called heat resistant paints have only a limited resistance and the reflector gets quite hot. A better idea is to dip the parts in a strong solution of caustic soda. This produces a fine matt finish that can be easily cleaned and does not show finger marks, etc. If this method is decided on then the reflector must be covered with a thin film of grease. This can be removed afterwards and will stop the caustic attacking the polished surface.

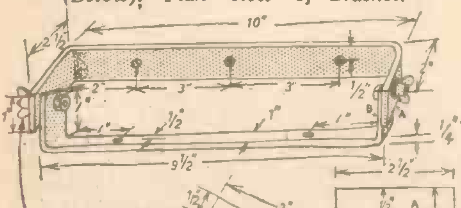


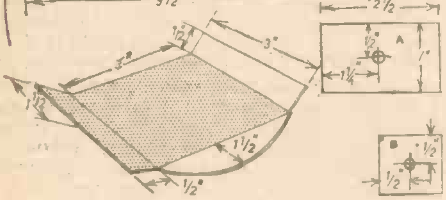
Trough to cover contacts and support reflector.



The reflector.

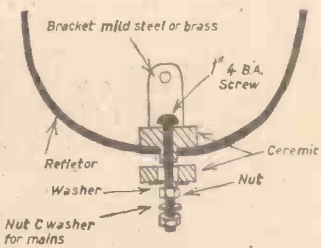
(Below).—Plan view of Bracket.





End plate details.

Method of mounting brackets for element.



List of Components

1 length of alloy drain pipe 31in.
1 piece of alloy, gauge 18, 9in. x 4in.
1 piece of alloy, gauge 18, 30in. x 4in.
1 ½ grommet.
1 quartz element 30in. long.
Length of mains cable.
1 pair of insulators.
2 ½in. 4B.A. steel nuts and bolts.
2 1¼in. 4B.A. countersunk nuts and bolts.
2 1in. 2B.A. nuts and wing nuts also 4 washers.
4 4B.A. self tapping screws.

Mask and Guide for Multiple Photography

(Concluded from page 444)

seen through the finder. For ease in identification, vertical lines may be numbered and horizontal ones lettered. The lines and identification can be drawn in with waterproof Indian ink. If there is any trouble in getting the ink to take, it can be solved by adding a trace of gum. Cement the graticule to the inner face of the frame so that the numbers and letters are seen the correct way round from the camera side.

The additional arm length enables the mask unit to be dropped in place on top of the camera and then slid forward so that the foot engages in the shoe. The complete mask is shown in Fig. 1 and, alongside it, the guide which is used in association.

The guide is ruled on a sheet of paper so that it, too, has regularly spaced vertical and horizontal lines. The scale may be larger than that of the graticule, although it must be in proportion and lettered and numbered in agreement. Pre-ruled graph paper may be bought if time must be saved, but, since the arrangement will be used comparatively infrequently, the saving is very slight.

Setting-Up

The camera is set up on a tripod and the subject correctly framed in the viewfinder. With the mask in place, the vertical and horizontal ordinates of the outline of the subject are marked on the squared paper. The first exposure is then made. By joining up the points which have been transferred to the paper, a reasonably good outline can be drawn in. The camera is sited for the second exposure and the subject arranged so that it is correctly positioned in relation to the first image. Checking with the

Fig. 3.—Quadruple exposure of the same subject.

outline drawn on the guide paper provides an accurate assessment. If there are to be subsequent exposures, the outline of each should be recorded on the paper.

Black backgrounds permit any number of exposures to be recorded on the same negative. Alternatively, carefully controlled lighting may be used to the same effect. Since most modern cameras have their shutters interlocked with the film wind, exposures will probably have to be made by means of a lens cap, the shutter being held open throughout on the "Time" setting. A quadruple exposure of the same subject is shown in Fig. 3.

KOLBE WHEEL EXCAVATOR

2,100 tons of muscle

P.M. REPORTS ON AN EARTH EATING MONSTER DESIGNED TO SPEED-UP STRIP MINING IN THE U.S.

DESCRIBED as a huge, steel "octopus" with an appetite for coal wallowed in a mine bed recently, lunching on boulders and topsoil—in truck-load bites.

This "monster" is a marvel in mechanical engineering designed to step up the efficiency of strip mining and at the same time pare the costs involved in heavy earth-moving operations.

It's called the Kolbe wheel excavator, the invention of Frank F. Kolbe, president of the United Electric Coal Companies of Chicago, one of America's top strip mining firms.

The Kolbe wheel was put through its paces in a special performance for some 250 Mid-West industrialists at United's Cuba mine.

With all the flavour of a coal field "spectacular" the 2,100 ton steel giant bit into the earth and boulders, chewing away the "wrapper" on the underlaying coal vein. What makes it spectacular is this: The Kolbe wheel can strip away the upper layers of soil—up to 100ft of it above the coal bed—convey it in a steady stream at 3,500 cubic yards an hour to a dump pile 420ft away. All this in continuous motion.

How it Works

On one end of a long, armlike steel boom is a series of ten buckets, mounted in ferris wheel fashion on a heavy digging wheel which gnaws into the countryside like a whirling burr. The earth, rocks and sub-surface matter are passed from the wheel to an endless conveying belt system, which shoots the diggings at 1,225ft per minute over another boom to the dump pile.

More simply, make a short, squatty man out of steel. Stretch his arms out in both directions. Let him pick up a rock with his right hand, roll it across one arm over his back to the other arm and into his left hand. Then let him drop the rock. That is how the Kolbe excavator operates.

The wheel did not "just happen". Some 16 years ago, United's Kolbe came up with the idea of strip mining with a wheel excavator. Then came 15 years of trial and error as the company experimented with wheel diggers—three of them, each bigger and better than its forerunner.

Out-stepping the old shovel-dragline team operation was no easy conquest. United's engineers found rocks and heavy chunks of earth freezing to conveyor belts in the winter. Huge boulders shook the steel frames of the first excavators until the operator's teeth rattled. The engineers sweated on.

Today, the Kolbe wheel takes on all obstacles, whips them and busies itself with producing coal. the result is a speedup in the coal fields, more production at less cost.

The Cuba mine—testing ground for the workout of the Kolbe wheel — is the company's oldest operating mine, dating back to 1923. Today it is one of the most modern mining units in America

and is pouring out some 800,000 tons of coal per year.

United's Fidelity mine, farther down in Southern Illinois, until recently was the World's largest strip mining operation, producing more than a million tons of coal a year—each year—since it opened in 1929.

New Progress

In developing these fields, United has spent equal time in developing new strip mining techniques, such as the Kolbe wheel. Included in these new mining innovations drilling with compressed air instead of water.

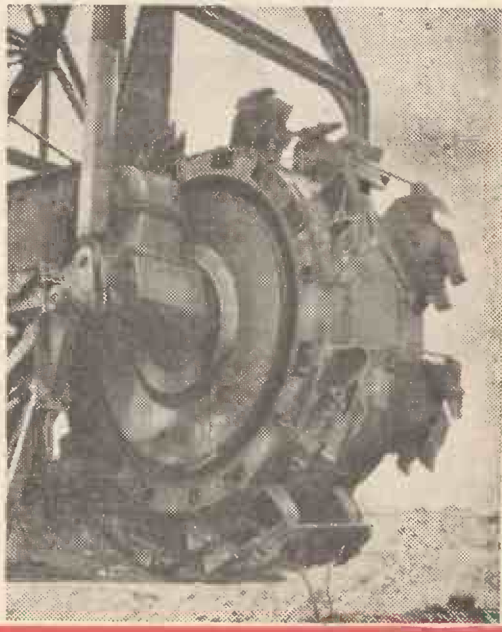
Add to that a new economical explosive, put to work in the mine pits only four years ago. There are many more, each pioneered by United.

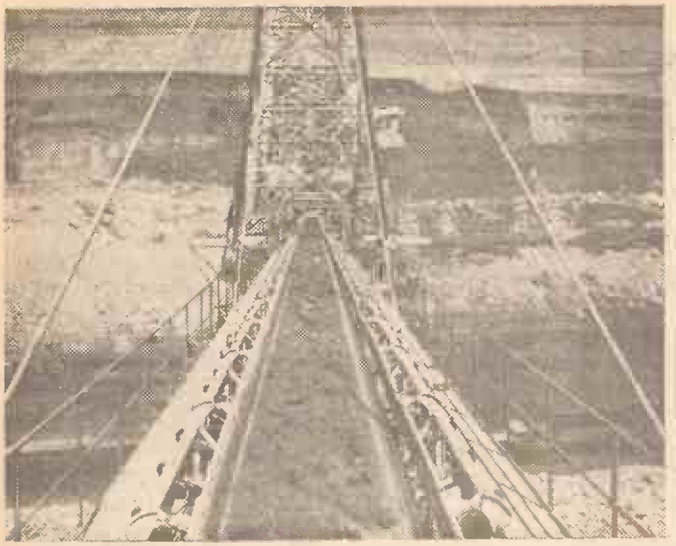
Reclamation

Inevitably this produces miniature mountains of useless soil heaped upon the countryside from the excavations. United, like most major mining concerns is tackling the problem of putting the dirt back in place, making it useful again. Positive proof that mined-over-land can be restored to practical use was proved by the existence of Slug Run Ranch, a 2,500 acre mining tract now converted to grazing land for some 400 head of cattle. Wherever possible, the mighty mounds of dumped soil are being levelled and planted in pasture crops. Slowly, the scars left by the mightly Kolbe wheel and its sister stripping machines are being erased from the countryside. Meanwhile, coal output is on the upswing, and the St. Lawrence Seaway, the Mid-West's new byway to the world may pep-up the industry still more.

View along Conveyor.

"The Business End", the Wheel.





Giant Wheel Excavator

View of Conveyor looking towards the Wheel. Along this belt Top-soil is moved at the rate of 3,500 cubic yards per hour.

Side view looking down on Machine gives some idea of its colossal size.

L.B.S.C's $3\frac{1}{2}$in. Gauge

EVENING STAR

PART 17

DETAILS OF STEAM BRAKE GEAR

Brake Cylinder

The brake cylinder will probably be cast solid, as it isn't worth while coring such a little hole. Chuck the casting in the four-jaw with one end running truly; two of the jaws should grip on the side bosses, and the other two holding the flange. Face off the projecting flange, and turn it to $\frac{3}{4}$in. dia. Centre, drill right through with $\frac{23}{64}$in. drill, and ream $\frac{3}{8}$in. To get a clean true bore without any scratches in it, hold the reamer in the tailstock chuck, enter the slightly-tapered end of the reamer in the drilled hole, then grip the tailstock tightly and slide it bodily along the lathe bed, pushing the reamer clean through the casting steadily but non-stop, right to the end of the flutes. Pull it steadily out again, also non-stop, and if the cutting edges of the reamer are O.K. the bore should be as smooth as glass. Beginners' tip: run your finger-nail along the cutting edges of the reamer before operating, and if you feel the slightest roughness, rub it off with the end of your oilstone. The other flange of the casting is turned and faced with the cylinder on a stub mandrel, same as the engine cylinders.

If the casting is now chucked crosswise in the four-jaw with one of the side bosses running truly, same can be faced off to length—it should stand out $\frac{1}{32}$in. beyond the flanges—then centred, drilled No. 40 for $\frac{1}{8}$in. depth, and tapped $\frac{1}{8}$in. or 5B.A. If a beginner overshoots in the drilling, and pierces the bore, he needn't fret about it, as the trunnion pin will prevent any leakage of steam. Reverse in chuck, and repeat operations; but before rechucking, ascertain if the two bosses are in line. If they aren't, which is very unlikely, make a centre-pop on the unturned one, right opposite the tapped hole in the turned one, and chuck with the pop mark running truly.

If castings are supplied for the covers, turn and fit them in the same way as described for the covers of the engine cylinders. No gland is needed in the bottom cover. Just centre it, and put a No. 30 drill through. As the cylinder is single-acting, the space below the piston must be open to the atmosphere, so drill a No. 53 vent hole through the bottom cover, as shown in Fig. 108. Castings are not really necessary for these weeny covers, I turn mine from brass rod. Chuck a piece of $\frac{3}{4}$in. dia., face off, turn $\frac{1}{32}$in. to a push fit in the bore, and part off at $\frac{3}{32}$in. from the shoulder. Repeat operation for the bottom cover, but before parting off, centre and drill No. 30 for about $\frac{5}{16}$in. depth, then part off at $\frac{7}{32}$in. from the shoulder. To turn the boss, rechuck in a little stepped bush, made as described for the larger one used for holding the covers of the engine cylinders. Drill two No. 32 holes in the top cover, as shown in the plan view (see Fig. 108) for the pipes connecting with the driver's brake valve, which will be fitted when we get to the cab details.

Making and fitting the piston and rod, is another job done in precisely the same day as those in the engine cylinders. Turn the piston from drawn rod; brass will do if nothing better is available. Rustless steel or bronze, $\frac{1}{8}$in. dia. will do for the piston-rod. The fork, or clevis as it is sometimes known, is made in exactly the same way as the valve-spindle crossheads on the big cylinders, so there is no need to go through the ritual again. Just work to the dimensions shown in Fig. 108.

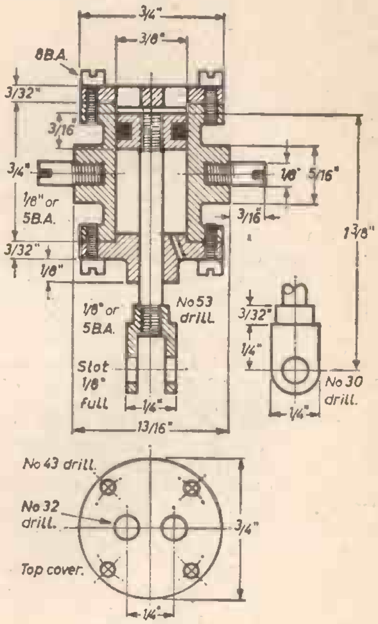


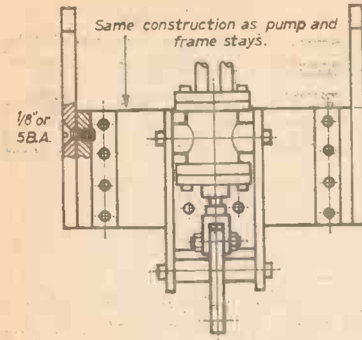
Fig. 108

BRAKE CYLINDER.

Stay and Bracket

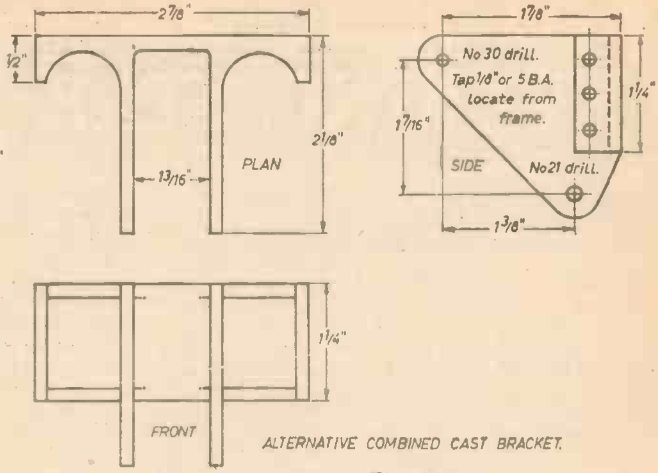
The cross-stay and cylinder bracket can be combined in a single casting which requires little machining, and I prefer this type if available; but for those builders who prefer "fabricating", details of the built-up type are also shown. The cross-stay is made exactly as described for the pump and frame stays, and may either have bent-over flanges, or flanges made from angle, riveted on, as shown in the drawings of the brake gear erected, Figs. 109 and 117. Full details of construction were given in the April 1961 instalment.

A piece of 13-gauge ($\frac{3}{32}$in.) mild steel will be needed for the cylinder bracket, 5in. long and 2in. wide. Mark off the outline of the bracket at one end, as shown in Fig. 111, and at $1\frac{3}{16}$in. from the back end, mark off a similar outline, but the other way around. Cut away the surplus metal along the diagonal lines, and bend along the vertical lines so that the result is channel-shape, as shown in the plan view. Mark off the holes from the



STEAM BRAKE CYLINDER ASSEMBLY

Fig. 109



ALTERNATIVE COMBINED CAST BRACKET.

Fig. 110

back end of the bracket after bending, so that both sides line up. Attach the completed bracket to the stay by six $\frac{1}{16}$in. iron rivets, as shown in the two arrangement drawings, Fig. 117.

If the combined casting is used, the sides should be machined off as described for cast frame and pump stays, so that they fit nicely between the engine frames The insides of the projecting parts which carry the cylinder and brake shaft should be smoothed off with a fine file. Take care that the holes on each side, for the cylinder and shaft bearings, are exactly level. I usually mark off one side, then centrepop the marks, set the casting on something level, like a surface plate or the lathe bed, set the needle of a scribing-block to the centrepops, and use it to mark off the other side. No bushes are needed, either in the built-up or cast bracket. Pins through the plain drilled holes are quite satisfactory, as the wear is infinitesimal.

At $1\frac{1}{8}$in. from the back end of the frame, on each side, drill three No. 30 holes, the first at $\frac{1}{4}$in. from the bottom, the others at $\frac{3}{8}$in. spacing, and countersink them. Smooth off any burring, then set the bracket in place with the bottom of the stay level with bottom of frame, and the back flush with the cut-away, see Fig. 117. Run the No. 30 drill through the holes in the frame, making countersinks on the bracket flanges; follow through with No. 40 drill, and tap $\frac{1}{8}$in. or 5B.A., but don't put any screws in yet.

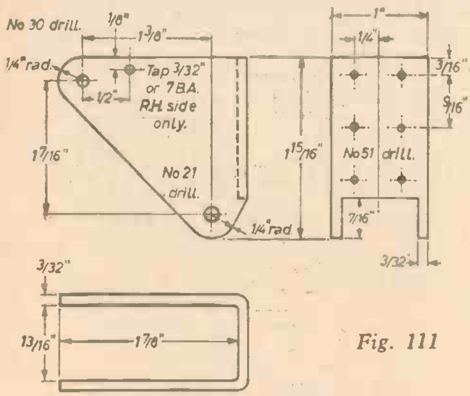


Fig. 111

CYLINDER AND SHAFT BRACKET.

Brake Shaft

Chuck a piece of $\frac{1}{4}$in. round mild steel, face the end, centre, drill No. 30 for about $\frac{1}{4}$in. depth, and tap $\frac{5}{32}$in. x 40. Part off at a bare $1\frac{3}{16}$in. from the end, reverse in chuck, and repeat drilling and tapping. Saw and file the bell-crank lever from $\frac{1}{8}$in. steel; an offcut from the frame will do, I save all my offcuts for jobs like this. Drill the hole for the brake shaft with letter C or $\frac{15}{64}$in. drill, and ream it just enough to fit tightly on the shaft. Set it nicely in the middle, and braze it, as described previously for similar small jobs. Quench in water, and clean up.

The pivots are made from $\frac{3}{8}$in. pieces of $\frac{5}{32}$in. silver-steel, one end screwed $\frac{5}{32}$in. x 40 for $\frac{3}{16}$in. length, and the other end slotted with a fine hacksaw, to take a screwdriver. To erect, just put the shaft in place between the sides of the bracket, and screw the pivots into it through the holes at each side.

The cylinder can also be erected. Pack the piston with a few strands of graphited yarn, put on the bottom cover (no gasket is needed) and screw on the fork tightly. Don't fix the top cover permanently, as it has to come off for attachment of pipes later on. Put the cylinder in place, with the fork over the end of the long arm of the brake lever, and secure it by screwing in the trunnion pins through the holes in the bracket. The trunnions are merely $\frac{5}{16}$in. lengths of $\frac{1}{8}$in. silver-steel, with $\frac{1}{8}$in. of thread to match the tapped holes in the bosses, at one end, and a screwdriver slot at the other. Pin the fork to the brake lever by a pin made from $\frac{1}{8}$in. silver-steel, turned down at each end, and screwed and nutted as shown for the forks on the brake rods. The bracket, with shaft and cylinder attached, can now be erected in the engine frame "for keeps", using $\frac{1}{8}$in. x $\frac{3}{8}$in. countersunk steel screws.

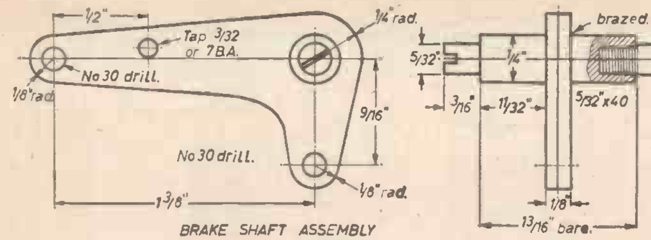


Fig. 112

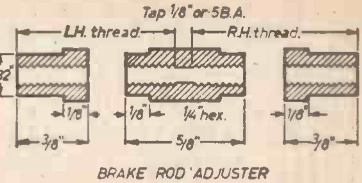


Fig. 113

Pull-rods

The pull-rods are made from $\frac{1}{8}$in. round steel; either mild or silver-steel will do, or straight lengths of $\frac{1}{8}$in. iron wire would be quite satisfactory. The pull-rods working the brakes on one of my own engines were made from straight bits of tinned iron wire from a broken lamp shade. Ten forks will be needed for connecting up; these are made from $\frac{1}{4}$in. square mild steel, to the dimensions shown in Fig. 116 by the same process described for making the valve-spindle crosshead forks. Ten silver-steel pins are also required, as shown in the same figure.

Put the forks in place on the brake beams, and put a pin temporarily in each. Next, with the chassis upside-down on the bench, measure carefully the distance between the forks, with the brake-blocks pressed against the wheel treads. Allow for about $\frac{6}{32}$in. entering the boss of each fork. Cut the rods to the measured lengths, and screw each end of them for about $\frac{3}{16}$in. length, to fit the bosses. Fit the forks to the first four pull-rods, and adjust them so that when the pins are in, and nutted up, all the brake-blocks touch the wheel treads at the same time, when the rear beam is pulled toward the back of the engine.

The fifth beam is connected to the short arm of the brake lever by a pull-rod with an adjuster on it, Fig. 113. This requires a $\frac{1}{8}$in. or 5B.A. left-hand tap and die; but anybody who hasn't these, need not worry. Just fit a plain pull-rod, same as the others. Those who have, proceed as follows. Chuck a piece of $\frac{1}{4}$in. hexagon rod in the three-jaw, face, centre, drill to $\frac{3}{4}$in. depth with No. 40 drill, and tap to a full $\frac{1}{4}$in. depth with $\frac{1}{8}$in. or 5B.A. right-hand tap. Turn $\frac{1}{8}$in. length to $\frac{7}{32}$in. dia. and part off at $\frac{5}{8}$in. from the end. Reverse in chuck, turn down the other end likewise, and tap the remains of the hole with a $\frac{1}{8}$in. or 5B.A. left-hand tap. Mark on the outside, which is which!

Chuck the hexagon rod again, centre, drill No. 40 to $\frac{1}{2}$in. depth, tap $\frac{1}{8}$in. or 5B.A. right-hand thread, turn $\frac{1}{4}$in. length to $\frac{7}{32}$in. dia. and part off at $\frac{3}{8}$in. from the end. Ditto repeat, but this time use a left-hand tap. That completes the adjuster. Cut a 1in. length of $\frac{1}{8}$in. rod, screw one end $\frac{1}{8}$in. or 5B.A. for $\frac{1}{8}$in. length, and the other for $\frac{5}{8}$in. length. Screw the short end into a fork, and pin it to the short arm of the brake lever. Put on the long adjuster nut tapped R.H. and screw on the R.H. end of the middle section of the adjuster.

Finally, hold the adjuster horizontally, and measure from it to the fork on the rear brake beam. Cut a piece of $\frac{1}{8}$in. rod to $\frac{5}{16}$in. longer than this measurement. Screw one end for $\frac{1}{8}$in. length, right-hand thread, and the other end $\frac{5}{8}$in. length, left-hand thread. Put the left-hand adjuster nut on this end, and screw the rod into the L.H. end of the middle part of the adjuster. Remove the fork from the brake beam, screw it on to the pull rod, and replace, putting in the pin. Adjustment is made by running the long adjusting nuts right back as far as they will go, and turning the centre part to right or left as required. With the piston at the top of its stroke, the brake-blocks should be quite clear of the wheel treads. When the correct adjustment is obtained, run the long adjuster nuts up to the centre section and tighten them, but not enough to risk stripping the threads.

When the driver's brake valve (to be described later) is operated, steam is admitted to the cylinder, forces down the piston, and the long arm of the brake lever, and "plonks 'em on" as the drivers say. When steam is released from the cylinder by shifting the driver's valve to the "off" position, a spring pulls up the brake lever, and releases the blocks from contact with the wheel treads. The spring is wound up from 19-gauge tinned steel wire. One end is attached to the brake arm by a $\frac{3}{32}$in. or 7B.A. screw, and the other end to the cylinder bracket near the top in similar fashion, as shown in the drawing of the whole bag of tricks erected Fig. 117.

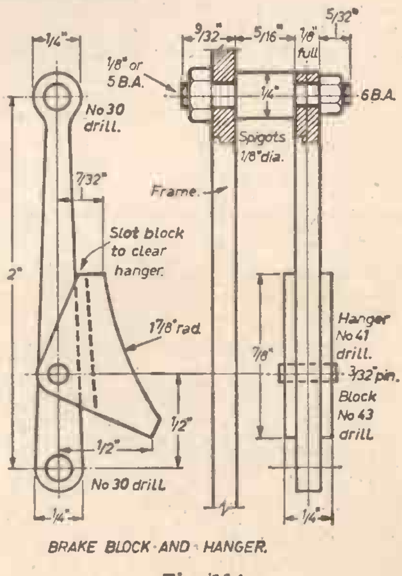
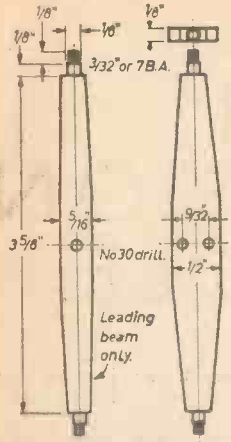
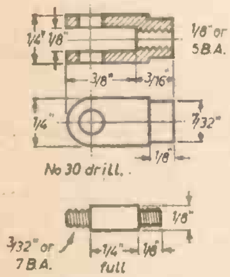


Fig. 114



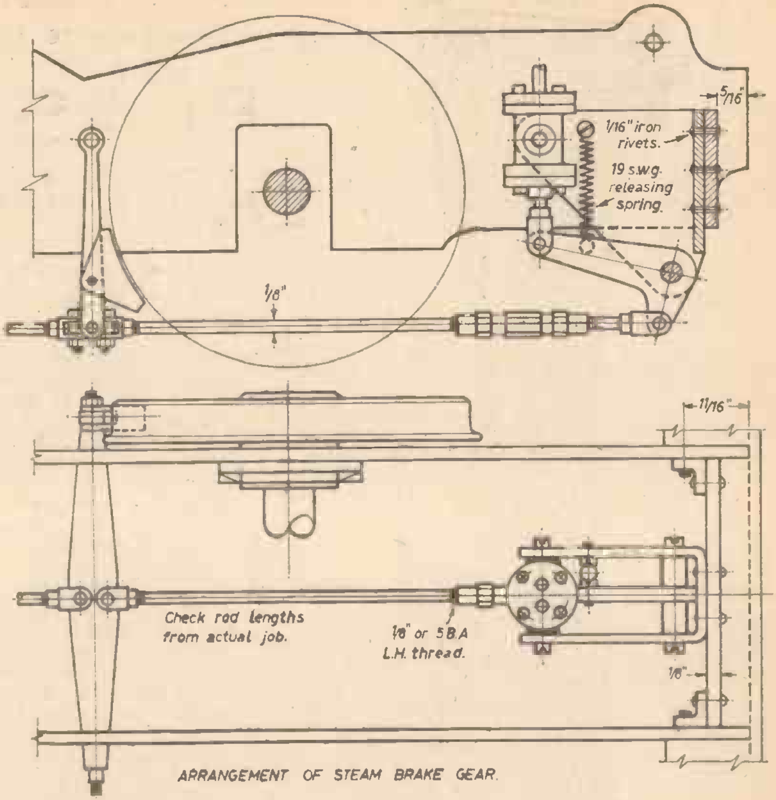
BRAKE BEAMS.

Fig. 115



BRAKE ROD FORK AND PIN.

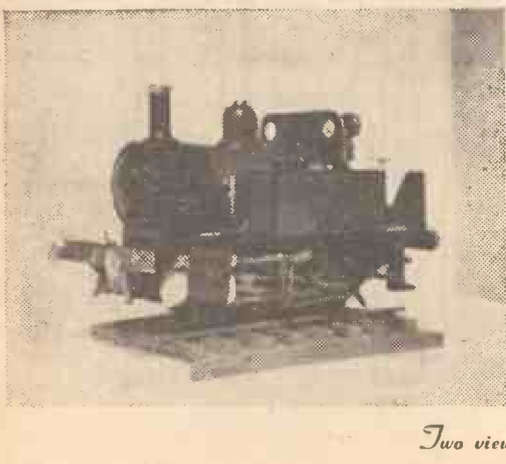
Fig. 116

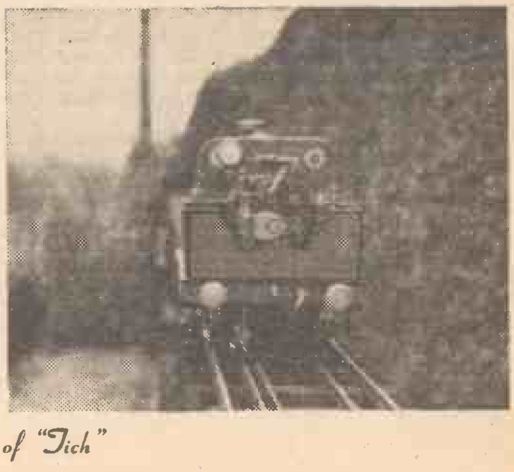


ARRANGEMENT OF STEAM BRAKE GEAR.

Fig. 117

C. R. Young sent us these photographs of L.B.S.C's. "Tich" which he has built and describes on page 478





Two views of "Tich"

A. E. Bensusan
tells how to make a —

FLASH EXTENSION HANDLE

Fig. 1.—The completed unit.

THIS is a multiple-purpose photographic accessory. It provides a good grip when the flashgun is held remote from the camera, particularly if modern equipment of streamlined, moulded plastic design which affords no handhold is used. A press button permits the flash to be fired independently of the camera and without any connecting leads, which is a valuable facility when a bulb is employed to light up a dense shadow area during a lengthy time exposure. By fitting a test lamp in place of the flashbulb, and pressing the same button, the electrical circuit of the gun may be checked.

The provision of a socket and a plug of standard 3mm. miniature coaxial size permits the lead from the flashgun to be plugged into the socket and an extension lead from the camera to be fitted on to the plug. Thus, there is no pull on the flashgun wiring when the unit is employed, in the hand, at the full length of the extension cable. The finished unit is shown in Fig. 1.

The basis of the design is the housing: a ring of brass or steel, which may be an offcut of tubing about $\frac{3}{4}$in. long. The diameter is not important and anything in the region of $\frac{3}{4}$ to 1in. will be adequate. The wall thickness should be approximately 16s.w.g. (·064in.) to 14s.w.g. (·080in.). Three positions are marked out roughly equally around the periphery of the housing and centrally between the ends as shown in Fig. 2.

One position is drilled to give a good sliding fit on the press button stem, which may be either metal or plastic. An $\frac{1}{8}$in. diameter snap-head steel rivet serves well as the button head and stem. With the stem in position through the hole a $\frac{3}{16}$in. diameter disc is soldered or bonded to the inside end to act as a pad and to trap the button.

At the second position a hole is drilled to suit a 3mm. socket. A range of patterns is available from The Metropolitan Instrument Repair Co., 5 Friern Barnet Road, London, N.11, of which the most suitable for this purpose are the types FFC or CRS at 6s. 6d. and 2s. 10d. respectively.

The FFC has a threaded body and locking ring and is assembled to the housing from the outside through a $\frac{7}{32}$in. diameter hole. The slotted and flanged head seats outside the housing, a soft packing ring is placed on the body from the inside and the ring locked down. If the gauge of the tube employed for the housing is so thick as to prevent the ring engaging it may be thinned locally on the outside by spotfacing or filing a flat.

Socket type CRS is assembled by carefully cutting away the skirt, which is actually a form of tubular rivet, passing it through a $\frac{1}{8}$in. diameter hole in the housing from the inside until the flange prevents further movement and soldering it there. An illustrated list of these fittings is available free from the suppliers.

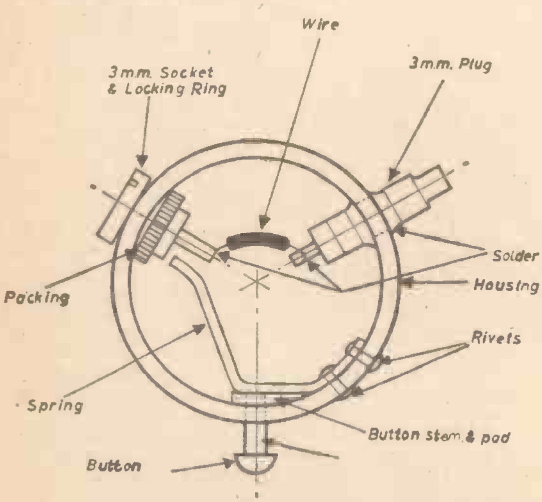
The 3mm. plug may be the solderless connection type C/P at 6s. 6d. from the same manufacturer. However, cheaper types can be had, assembled to insulated leads, from most camera shops. Take care to obtain a plated brass plug, as some are aluminium and cannot be soldered by normal methods. The lead from the outside contact of the plug is not needed, so it may be cut away, but a short lead from the centre contact should be retained. The plug body is soldered into a suitably sized hole in the housing and the short lead soldered to the centre pin of the socket.

A flat spring of about ⅛in. width is formed into a profile approximately as shown in Fig. 2. Two $\frac{1}{16}$in. diameter rivets are used to attach it to the housing. When the lead from the flashgun is plugged into the socket, and the button pressed to fire a flashbulb without a connection to the camera, or to test the wiring, the circuit will be through the outside of the socket, round the housing, through the spring and to the socket centre pin. The spring causes the button to return after firing. For remote synchronous firing from the camera one side of the circuit will be through the outside of the plug, round the housing to the outside of the socket, while the other side will be through the centre pin of the plug and the single internal wire to the centre of the socket.

A disc of metal is cut to fit inside the end of the housing and drilled clearance for 8B.A. screws in two or three places. The disc is then bonded into the lower end of the housing. It is advisable to use epoxy resin for this, as the heat necessary for soldering could damage the previously made joints. A shaped handle of plastic has its end face drilled and tapped 8B.A. to match the hole positions in the disc. The housing is attached to the handle with ¼in. long screws at this stage.

The shoe to accept the flashgun can be made from brass with the base cut large enough to cover the top of the housing and bonded in place. If a commercially produced shoe is used it will be found to be too small to cover the aperture and will need to be mounted on a second disc fitted and bonded into the upper end of the housing. These shoes are supplied pre-drilled and complete with three fixing screws.

Fig. 2.—Assembly of housing.



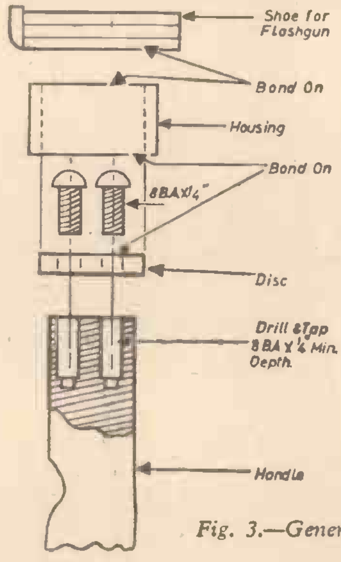


Fig. 3.—General assembly.

PUZZLE CORNER

Whisky Galore

TWO identical 4oz tumblers are three quarters filled, one with whisky and one with soda water. An ounce measure is filled with neat whisky from the first tumbler which is then emptied into the soda water tumbler. The resultant mixture is thoroughly stirred and then the measure is used to transfer 1oz of the mixture into the whisky tumbler. After completing these operations will there be more whisky in the soda water tumbler or more soda water in the whisky tumbler?

Answer—

The amounts are equal. The whisky removed from the first tumbler is replaced by an equal quantity of soda water and vice-versa.

This can best be shown by setting out the quantities in each tumbler at each stage in a table as follows:

	Soda Water Glass	*Whisky Glass*	*Total*
Initial	3 oz Soda Water (S.W.)	3 oz Whisky (W.)	6 oz
Stage 1.	3 oz S.W. + 1 oz W.	2 oz W.	6 oz
Stage 2.	¾ (3 oz S.W. + 1 oz W.)	2 oz W. + ¼ (3 oz S.W. + 1 oz W.)	6 oz
	= 2¼ S.W. + ¾ W.	= 2¼ W. + ¾ S.W.	6 oz

If your solution gives more whisky in the soda water tumbler then you have found a way to turn water into whisky!

An identification outline chart of the moon.

WATER on the MOON?

By V. A. FIRSOFF, M.A., F.R.A.S.

IT has long been a cliché, a "received opinion", that the Moon is waterless and airless. There were, of course, good reasons why such an opinion has been formed in the first place. The question is only whether this cliché tells the full story. Indeed, the conditions on, or below, the surface of our old-fashioned natural satellite still remain baffling in many respects and lately there has been some movement in ideas about them.

Liquid water cannot exist on the Moon because at pressures below 4·58mm of mercury it sublimes; ice changes to steam without melting. There can be no doubt that usual barometric pressures on the lunar surface are very much below this figure, so that water would "boil" there below freezing point. This, however, does not preclude the existence of ice or hoarfrost.

In the opening decades of the century Professor W. H. Pickering, of Harvard, was convinced that he could see snow on the Moon, that, in fact, the white haloes surrounding many lunar craters were hoarfrost condensed from the vapours issuing from volcanic vents and cracks. He recorded an observation of a "snowstorm" on Pico B in Mare Imbrium and invoked the agency of ice erosion to explain the destruction of central peaks in ring mountains.

That Pickering's ideas are far-fetched is beyond dispute. Yet the observations behind them are still unexplained. Some of those haloes do vary in size with temperature. More particularly micrometric measurements by Barnard, Haas and others have confirmed that the diameter of the bright halo surrounding the small crater Linné in Mare Serenitatis increases during a lunar eclipse.

Many other bright features show a clear dependence on insolation, but the reality of this relationship is difficult to establish because the Moon knows no seasons other than the time of its day, so that any seasonal changes on its surface would be difficult to disentangle from the mere movement of light and shade. Lunar eclipses provide an independent test, but the cliché of changeless Moon weighs so heavily on astronomical thought that this test is not usually recurred to in this connection.

Yet in systematically observing the Moon it is difficult to escape the impression that wherever the surface has been disturbed by craters, faults or fractures, some light and occasionally dark material oozes from below under the influence of sunshine. Is this impression an illusion? We have no right to say so without good evidence. It is a pity that the very people who should be custodians of scientific caution so often jump to conclusions on the slender basis of a single experiment or, worse, an unproven hypothesis.

Kozyrev's observation of 18th November, 1958, in which he secured a spectrographic record of the emission of a great volume of gas within the ring of Alphonsus, may not be enough to prove that the ring is volcanic, but it shows that gas exhalation from the lunar interior is taking place at the present time. This makes us take a second look at the numerous reports of local obscurations or "mists" on the Moon, notably in such bright, rayed craters as Tycho or Aristarchus.

It has recently been found that the bowls of these rings do not keep pace with the general drop in temperature during a lunar eclipse and stay 40-50° C warmer than their surroundings. This has been explained by there being "less dust" inside them. Perhaps, but the very existence of dust on the Moon has not been established. And a local pool of gas could produce the same effect. Why, then, is this alternative explanation so out of favour?

The reason is that various sensitive methods have been employed to detect a lunar atmosphere and have either failed or produced contradictory results. The latest determination of the ground density of lunar air is 10^{-13} of the terrestrial figure. This is a very good approach to perfect vacuum. The estimate is based on the electronic refraction of radio signals from the Crab Nebula observed by the English radio-astronomers, Costain, Elsmore and Whitfield on 12th September, 1956, at Cambridge.

But is their argument foolproof?

Let us consider a local cloud of gas close to the surface on the dark side of the Moon. It will not be appreciably ionized until it emerges into full sunlight. An ionization ensues a large number of free electrons will be formed alongside of positive ions. These free electrons will constitute a very light gas, having a particle weight $\frac{1}{1840}$ of a hydrogen atom. This gas will be lost to space almost instantly and its dissipation will continue until a sufficient positive electrostatic charge has been built up to restrain the electrons. The critical electrostatic force required to equalize the escape of positive ions and electrons will depend on the gas. For argon it is of the order of the surface gravity of Jupiter!

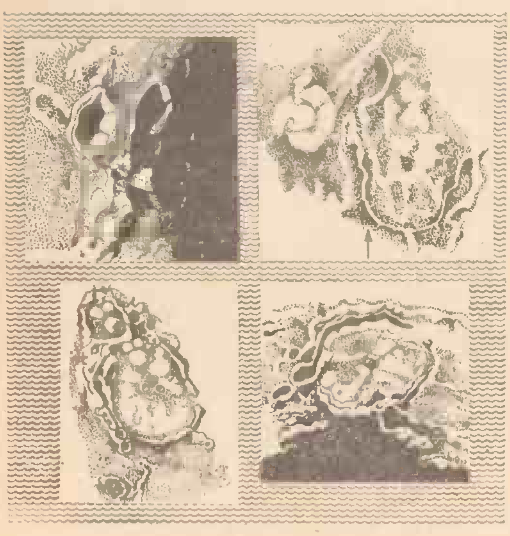
Thus not only will the high atmosphere of the Moon be deficient in electrons, but the residual positive charge in the ionized gas will induce a negative electrification in the subjacent layer or ground, to which it will thus become electrostatically bound. This should prevent any ground atmosphere formed by exhalation, desorption or similar processes from expanding upwards and allow a daytime atmospheric " skin " of considerable density to exist close to the surface.

Other reasons for suspecting such an atmospheric " skin " are the precipitation of many common substances, such as CO_2, in the cold of the night and the highly absorbent nature of the surface. Jan van Diggelen's investigation of lunar reflection curves indicates that the structure of the surface is filamentary, such as could be produced, for instance, by the efflorescence of salts. The pumice-like texture of the surface rocks is generally admitted and the existence of dust is suspected, or inferred. All such materials absorb gases as a sponge soaks water. In the heat of the sun some of the gases held by sorption will be liberated, but they will be very cold and subject to further chilling by adiabatic expansion, which may be sufficient to cause precipitation.

Thus reinforced, we may return to the attack on crater haloes.

Many common salts, such as the chlorides of ammonium (a frequent volcanic exudate), tin, or aluminium, would vaporize appreciably in lunar conditions and could produce the requisite white frosting, distributed preferentially at the bottom of small hollows. This suggestion of mine has met with some favour and I understand from Dr. John Strong that it is to be investigated at the Laboratory of Astrophysics and Physical Meteorology, at The Johns Hopkins University.

Observational drawing of Lunar craters which appear to develop bright features in sunlight. Aristarchus (top two), Posidonius (bottom left), Gassendi (bottom right).



But could the frosting be at least partly hoarfrost?

After all, water is a very common substance. Professor J. J. Gilvarry has recently re-examined the problem of molecular dissipation of water from the Moon. Assuming an initial content of water in lunar magmas equal to the terrestrial, he calculates that the Moon should have possessed a hydrosphere filling the maria to an average depth of 2km—say, 1¼ miles, and that the lifetime of this hydrosphere would be of the order of 1,000 million years. In fact, according to his graph some of it should still be there!

He even goes on to suggest that the dark colouring of the maria may be due to carbonaceous matter of organic provenance.

Frankly, I doubt it, not because I distrust his mathematics, but because I suspect that, having consolidated under a greatly reduced gravitational stress and a barometric pressure which will always have been low, the surface rocks will have a very loose texture and be specifically lighter than water. Consequently, this would accumulate not on, but below the surface, where it would remain locked by the permafrost seal.

This idea was first mooted in my *Strange World of the Moon*, but Professor T. Gold has arrived independently at a comparable conclusion. Indeed, microwave data indicate that at a depth of a few feet the underground temperature is constant at between 25 and 30°C below freezing point.

Incidentally, any liquid water on the Moon will be technically superheated and flash instantly into vapour if exposed to the sub-vacuum of the surface. It would thus act as a high explosive and produce a phreatic eruption, as superheated water does in terrestrial geysers and volcanoes. Some vapour, however, could seep through peaceably.

On the Moon there is virtually no transfer of heat by convection; the surface materials are almost perfect insulators. In these conditions a pocket of hoarfrost could maintain itself in a small hollow in

(Concluded on page 469)

Lick photograph of gibbous waning moon, showing the bright features well developed.

How to make your own prisms to correct parallax and at the same time bring the range-finder down to close distances

A PRISM placed in front of the viewfinder causes an apparent change in position of object viewed. The word apparent must be noted because, whilst camera angle is slightly changed and lens pointing at object, there are still two points of view, for example, a cube dead in front of the lens is a square, but from the viewfinder the top and one side could be seen. This must be borne in mind when using prisms for correcting parallax as must the fact that a prism corrects one angle of deviation and one only, therefore, an object nearer or farther from the lens is off centre, this is scarcely noticeable. When calculating these prisms, it was decided to take the angle of deviation from an object at the closest distance of the supplementary in use, leaving farthest distance to take care of itself.

The prisms to be described must have a holder which keeps them in position in front of their respective finders, therefore construction depends upon camera design and calls for some ingenuity. Make sure that the view seen through the finders is not cut off by thickness of perspex or edges of holder.

Only elementary trigonometry is required to calculate angles from the given formula. Figs. 2 and 3 show how to find angle a, each being different. Endeavour to work within an angle of ten minutes or the thickness of a needle scratch. Gauges, of the correct angle, into which the prisms slip as the work progresses, can be cut from thin card using a razor blade. Save the cut out pieces of card.

From an offcut of about $\frac{3}{8}$in. thick transparent perspex cut, with a hacksaw, a square larger than the diagonal of aperture into which it will be fitted. Square all edges. Carefully protect one polished face by sticking gummed paper thereon, making sure it stays on. Mark angle on opposite edges using the angles cut from out of the card so that prism tapers to a knife edge, join lines where base will be, use a needle for this and refrain from more than one scratch.

With perspex held (not crushed) in the vice, cut roughly to angle leaving markings well clear, then file down as near as possible. The file should be fine cut, nearly new and constantly cleared. Very fine glass paper is used to come into the line with constant checking for flatness and angle—a rub on plate glass shows up high spots. The glass paper should be glued to a piece of really flat wood and perspex held by fingertips. With the angle now as accurate as possible, transfer to " Flour " paper and aim for a fine matt surface with grain running one way, then, with a little metal polish spread over another flat piece of wood rub against this grain, not forgetting to keep checking angle. Final strokes should be like those of a barber who wants a super keen razor. A final polish with cloth and finger tip using a touch of rouge leaves a transparent prism. Now remove protective paper and see the result.

Choose the flattest part of each prism, mark a vertical axis just enough to be seen and fix uncut, temporarily over its appropriate aperture on the holder, as Fig. 4. With the rangefinder prism dead upright, images should coincide at infinity, if not, then rotate the viewfinder prism until they do. With this accomplished, bring the rangefinder to its nearest distance and with an object centred at the nearest measured distance of supplementary, rotate rangefinder prism until images coincide.

If the rangefinder is coupled, no more need be done except marking the prisms from the back as they stand, then cutting and fitting. Make sure that rear surface of prism is parallel to the face of camera.

Should the lens not be coupled, distances marked on the rangefinder must be related to those on the lens by means of tables usually supplied with a supplementary. A few trial exposures are advised. Emphasis must be put on the flatness of surface therefore, without making too much work, the the larger the prism the greater the area from which to choose the best. It should be remembered that perspex is soft and must be protected from scratches.

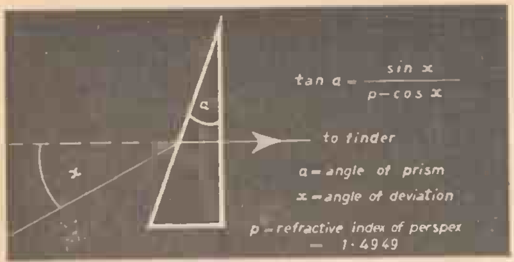


Fig. 1.

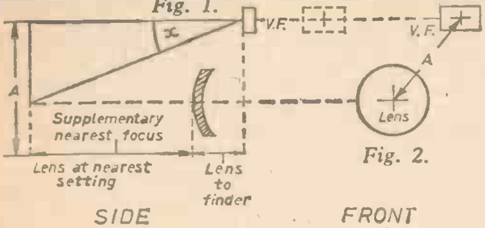


Fig. 2.

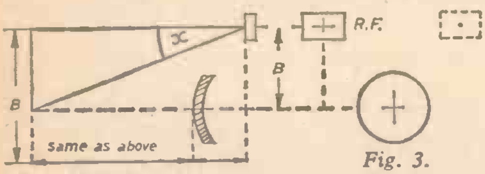


Fig. 3.

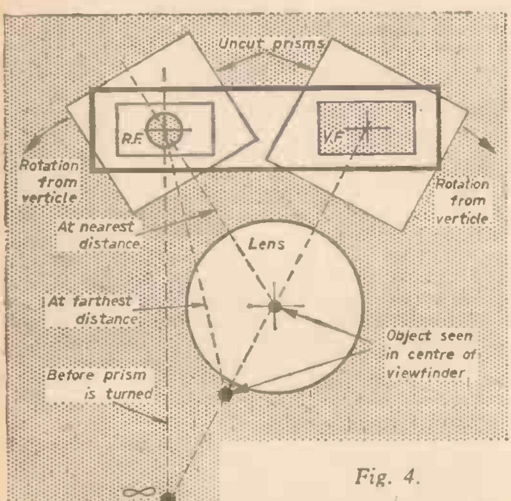
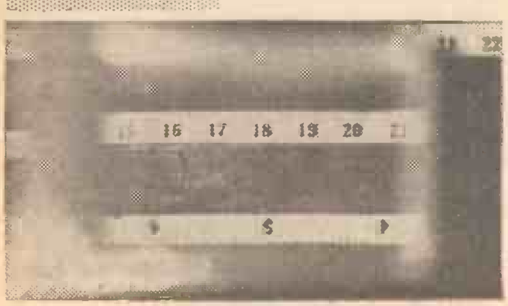


Fig. 4.



A 12V. STABILISED POWER SUPPLY

(Concluded from page 448)

connect capacitor C3 between tags 3 and 7 with the positive end on tag 7: connect capacitor C4 between tags 5 and 8 with the positive end on tag 5: connect diode D3 between tags 8 and 9 with the cathode on tag 9: connect diode D4 between tags 9 and 10 with the cathode on tag 10: connect tags 2 and 6 to the 6·3 volts winding of the mains transformer.

Remove the red and black wires from tags 1 and 21 on switch S3 in the timer and connect the red wire to tag 5 on the tag-board and the black wire to tag 8 on the tag-board. Remove the red and black battery leads from tags 2 and 22 of switch S3 in the timer and discard these. On the mains side of the mains transformer connect two wires from the tappings which correspond to the mains supply in your area to tags 1 and 21 on switch S3 in the timer. Finally, connect a lead from tag 2 on switch S3 to the lower of the two tags on the relay in the timer and a lead from tag 22 on switch S3 to tag 17 on the tag-board in the timer. The completed power unit can be conveniently mounted in the same case as the timer, alongside the relay.

MAKING A GUITAR STRUNG LUTE

(Concluded from page 472)

The head should now be glued in place, see that it is accurately positioned.

The finger-board is screwed to the neck with two brass screws as shown. These should be countersunk, the holes being covered with small discs of plastic or mother of pearl.

When gluing the bridge to the sound-board, ensure that the distance from the edge of the nut to the fret on the bridge is exactly 24½in. As the strings exert considerable pressure on the bridge it is essential that a really good joint is made.

The sound-hole rose is made from the same material as the sound-board. Transfer the design (Fig. 7) to a suitable piece, using carbon-paper and carefully cut it with a fret-saw. Do not glue in place until the instrument is finally sanded and polished.

Now for the final stage. First fill the grain with a good grain-filler and lightly sand before applying the polish. The rose should be polished before gluing in place.

Fit the machine head and the instrument is ready for stringing, tuning and playing. Nylon strings are to be recommended. The instrument is tuned in exactly the same way as an ordinary guitar and no difficulty should be encountered.

To make the lute you will need body 9ft x 1ft x ¾in. walnut.
Sound-board: one piece 18in. x 12in. x $\frac{3}{16}$in. hardwood, or one piece 18in. x 12in. x ⅛in. plywood.
Batten: one piece 10¼in. x 1in. x $\frac{3}{16}$in. hardwood.
Neck: one piece 15in. x 3in. x 1½in. walnut.
Bridge: one piece 8in. x ¾in. x ¼in. hardwood.
Head: this is made from waste removed from laminations.
Finger-board: one piece 15¼in. x 3in. x $\frac{3}{16}$in., hard-wood to match Sound-board.
3½ft of fret wire, machine head, strings (preferably nylon), grain, filler, polish, etc.

THE HYDROFIN

(Continued from page 438)

All kinds of devices have been tried from sonar beams (which tend to cost more than two new boats) to sets of small holes or electrical contacts on the strut itself. One very interesting idea was used on a large craft and consisted in carefully balancing the foil about its aerodynamic centre so that it could *itself* detect the orbital wave motions to which it had to respond. This worked in small waves and for a stable platform but went out of control when the whole ship started to pitch and heave in the large waves.

Generally speaking the problem is this:

If the signal is located at the strut itself the craft will respond to a wave as rapidly as the Vee foil only if the time lag in the transmission is zero. Even the Vee foil's response however tends to be too late and this type will crash from phase lag effect under certain conditions. Furthermore, to have a transmission of zero time lag would mean a terribly "hard" system and would defeat the whole object of foils which is to smooth out waves by a hull response that is far *softer than the wave contours* that are passing beneath the hull.

Just as a railway engineer who is building viaducts and cutting tunnels through a difficult countryside must survey *ahead* of his work, so must a signal in our case come from a position in advance of the boat. It so happens that it is not too difficult to incorporate into the signal device those elements such as springs and shock absorbers which in the automobile we are accustomed to place between the vehicle and the ground. We can also split up the predictor unit into two parts and make it a wave height measuring instrument, letting through all waves that are small enough to be accommodated, 'twixt hull and water and calling for incidence increase for all waves of greater height. As the waves get really big this sorting out of waves merges into a purely coasting action with the sorting out still operating however in respect to the smaller harmonic waves which ride on the backs of the large ones.

If we remember that a bicycle with hard wheels would be hopelessly uncomfortable at even 10 m.p.h., but provided with 1in. of pneumatic cushion permits 40 m.p.h. with comfort, we have some measure of how easy it becomes to increase speeds over the sea when we have thus built in an air cushion *several feet* deep.

The reader will begin to see how complex and involved this all is and will possibly be wanting to come up for air by now so I am going to propose the construction of a super simple contraption which I will not dignify by the name of "model". I well remember how uncertain I was myself that this could work on the sea until I had built a similar contraption and tried it out. There are no refinements here: just something that the reader can knock together in three or four hours from scraps but the hardest part is going to be to find a boat which can operate in the 5ft waves which this model will clear with ease.

A Blowpipe for Brazing Small Fittings

(Continued from page 447)

to the tube. Despite the 2¼in. dimension shown on the drawing, it is best to offer the gas tube to the partial assembly to see that it assumes a horizontal position and the small tube is bevelled to match the sloping outer diameter of the larger detail. This round the small tube and so secure the correct position for the hole: As this aperture is set angularly, drilling is impossible and the easiest way to make this hole is to file across the tube until a hole appears; enlarging this with a round file until the small tube fits tightly (takes only a few minutes) and then brazing or hard soldering it in the same manner as practiced for the air tube.

A pair of tubes spaced in this way will tend to bend when gripped too hard so a spacer is introduced between them. This is depicted at Section X-X and consists of a brass block with two half-circles to match the tubes, and this detail is afterwards soldered in place approximately where shown on the drawing.

Little need be said about the gas cock other than to stress that it requires an easy movement when operated, and though these fittings are notorious for sticking at the wrong moment, some degree of smoothness is possible if the cock is dismantled and the taper smeared with a trace of metal polish. The taper is then rotated back and forth for a time until both members match correctly and then they are washed in petrol to rid them of all traces of the liquid. Most of the difficulties with these details is experienced because a slight—in fact one might say an infinitesimal amount—of discrepency exists between the two tapers causing the item which is supposed to turn, to lock immediately the nut is tightened.

Finally if a larger amount of air is required after the usual tryout with this torch, gently holding the large tube in a vice—taking care, of course, not to distort it—and enlarging the $\frac{1}{16}$in. diameter hole with the aid of a hand brace, will overcome this problem. It is suggested that the hole is only opened out in stages to a maximum of $\frac{3}{32}$in. as this gives all the air necessary for small items likely to be brazed with this equipment. On lighting the torch a flame about 9 to 10in. long is obtained—with the air blast — and when the gas flow is reduced a shorter flame is produced which has an intense heat sufficient to melt soft brass unless precautions are taken.

WATER ON THE MOON

(Concluded from page 466)

the face of prolonged insolation during the lunar day. The threat to its existence would come from photo-dissociation, but if the hydrogen liberated in it were prevented from escaping by electrostatic forces a state of equilibrium could be reached between the dissociated and undissociated phases, the dissociated phase disappearing at night. Thus, with a further aid from sorption, this hoarfrost might be able to survive.

MAKING A GUITAR STRUNG LUTE

By "Musician"

INTRODUCED into Europe by the Saracens, the lute (from the Persian Al'ud, meaning "the wood") is probably one of the most beautiful of all stringed instruments.

The instrument to be described is a guitar-strung lute which is tuned and played in exactly the same way as a guitar. While the original method of construction requires considerable skill and experience, the method to be described is quite simple and produces an instrument of first rate appearance and tone.

Construction

Body (Part one)

This consists of six laminations of $\frac{3}{4}$in. walnut. When buying the timber, select wood that is well seasoned and get it planed both sides to finish $\frac{3}{4}$in.

Start by enlarging the profile drawings (Fig. 1) on stout cardboard and then cut out with scissors. Now lay the plank of walnut on the workshop floor and, laying the profile template alongside it, mark the shape of the template on the edge of the plank. Now saw across the plank $\frac{1}{4}$in. from this mark. Lay the remainder of the plank on top of the first piece and mark off the continuation of the template shape on the second lamination. Saw across the plank just clear of the mark. Repeat this sequence until the full profile is marked out on the edge of the laminations. The marked block is shown in Fig 2. Ensure that the grain in all laminations runs the same way.

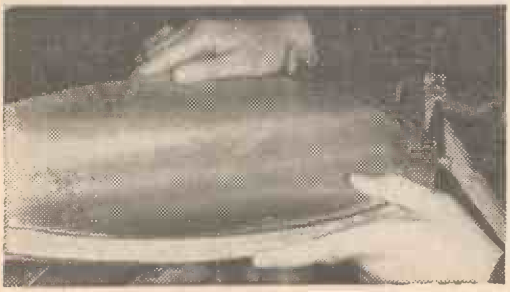
After marking the centre line on both sides of each lamination, use the plan template to mark the plan profile on each lamination. This done, the laminations may be cut to plan shape using a coping saw.

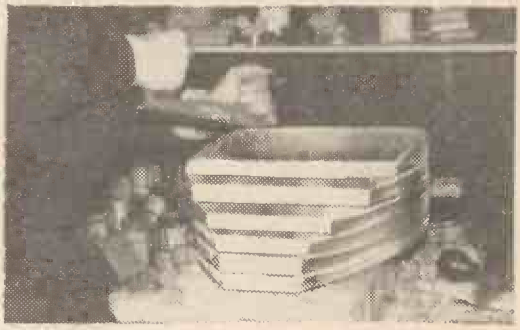
The laminations are now screwed together, using two screws in each. Start by screwing the second smallest lamination to the smallest. In this way no unsightly holes will be made in the body shell. When screwing together, keep the screws near the centre so that they will not be exposed by subsequent shaping.

The actual shaping may now be started. The work will be greatly simplified if two small pieces of wood are screwed to the bench to grip the block while it is being carved.

(Above).—Using cardboard template to mark out block.

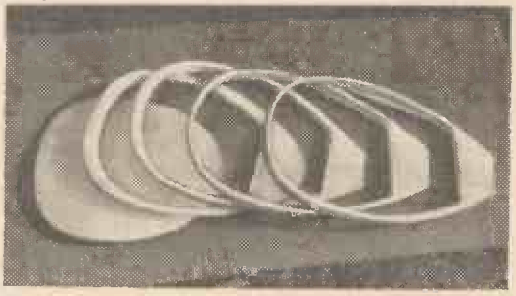
(Below).—A power tool makes light of this stage of work.





(Above).—The first stage of shaping.

(Below).—Laminations laid out prior to glueing up.



Start the shaping with a ½in. or ¾in. gouge. Finish with a plane, spokeshave or Surform. Work on the body as a whole and let the shape grow gradually all over.

During the final shaping a piece of broken glass will be useful as a scraper. Finish off with medium sandpaper.

The carved elaboration may now be added. Mark the shape from Fig. 1 on to the body, using a paper template. Using an ⅛-Acto knife, or similar sharp knife, cut about one tenth of an inch into the body along this line. Now carefully cut up to this line from below until the elaboration stands out evenly all over. A word about this carving. If it is felt that this part is too tricky, it may be omitted altogether without affecting the tone.

The tail end of the body should not be finally finished until after the neck has been made and fitted.

At this stage, before separating the laminations for hollowing, it is wise to mark a number of pencil lines down the body to assist in lining up the laminations later.

Neck

Fig. 3 gives the dimensions. This part is made from a suitable block of ¾in. walnut. A Surform will greatly simplify shaping. Use various grades of sandpaper until a silky smooth finish is obtained.

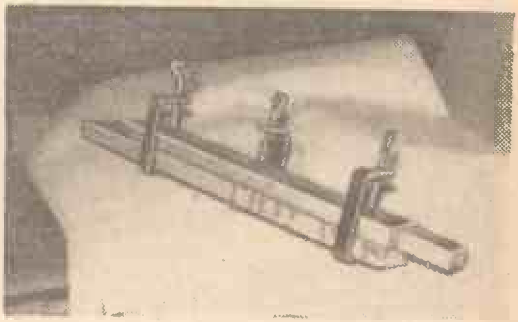
When the neck is finished, the socket may be cut in the top lamination of the body. Lay the neck projection on the top lamination and carefully mark round it. Cut out this area with a saw and fit the neck to ensure that it locates accurately.

Laminations are clamped and glued together in pairs.

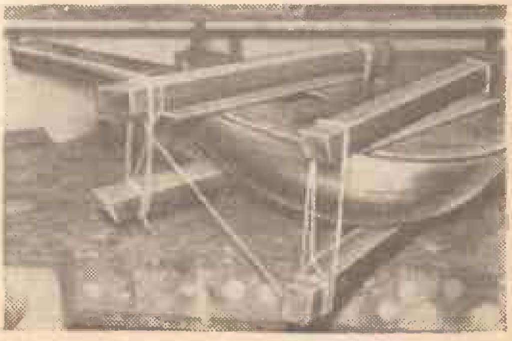
A flexible sanding pad being used to sand inside of body.

(Above). — A spokeshave being used for final shaping.

(Below).—Fitting the neck into its socket.



(Above). — A neck made from two laminations. Clamps are used to ensure good joint. (Below).—Gluing soundboard in place.



Body (Part two)

Mark a line $\frac{1}{4}$in. in from the side all round the bottom side of each lamination, except the bottom one which is scooped out to the required wall thickness with a gouge. Note, however, that the top two laminations are left solid where the neck is joined to the body.

The centre of each lamination may be removed using either a coping saw, bow saw or hower saw.

Once the centres are cut out, the laminations should be glued together in pairs. When the glue is dry, trim the inside of each pair, removing all the ledges. The inside shape should exactly follow the outside shape. Carefully reduce the wall thickness to about $\frac{1}{8}$in. Now glue the pairs together and allow the glue to dry thoroughly before trimming the inside finally.

The outside of the body may now be given its final sanding. Locate the neck temporarily in position and finish the tail-end of the body so that it meets the neck gracefully.

Sound-board

This may be made either $\frac{3}{16}$in. solid wood or $\frac{1}{8}$in. plywood. Select a piece with attractive grain.

Lay the body upside down on the sheet of wood and carefully mark round the edge. Saw around this line, leaving about $\frac{1}{16}$in. clear. The sound-board should be sanded absolutely smooth, the finger-board when fitted should stand about $\frac{1}{16}$in. proud of the sound-board.

Now cut out the sound-hole and slightly bevel the underside edge.

Next glue the batten to the underside of the sound-board in the position shown in Fig. 1.

Finger-board

In the original this was made from the same wood as the sound-board. See Fig. 5. Get a really good finish on this part, it should be sanded finally before sawing the slots for the frets.

Lay the finger-board on the sound-board in the correct position and mark round the end with a pencil. Using a fine fret saw, carefully cut round this line. Check for a snug fit.

Head

Fig. 4 gives the dimensions. Once again walnut is used. No dimensions are given for the location of the holes to take the machine head. The spacing and diameter of these will depend on the particular machine head used.

Bridge

This is shown in Fig. 6. A short length of fret wire is located in a saw cut. Take care to drill the holes to take the strings dead straight.

Assembly

First of all the neck is glued in place to the body. Check carefully that it is accurately located. Any adjustment may be carried out by packing the joint with small slivers of wood.

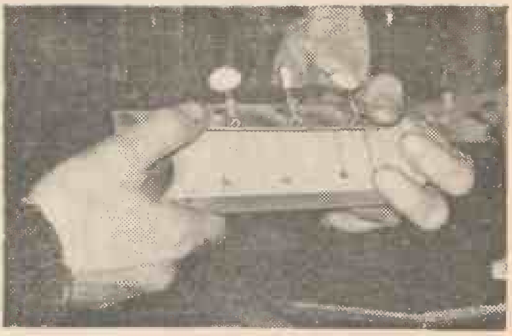
Now for the sound-board. Apply glue liberally to the edge of the body and carefully seat the sound-board in place. The body may be bound round with cord or, better still, elastic, to ensure an even pressure all round as the glue dries.

The constructional drawings are shown on the next page.

(Concluded on page 468)

(Above).—Fitting rose in sound hole.

(Below).—Fitting the machine head.



(Above).—Marking out the head to take the machine head. (Below).—The neck and head.

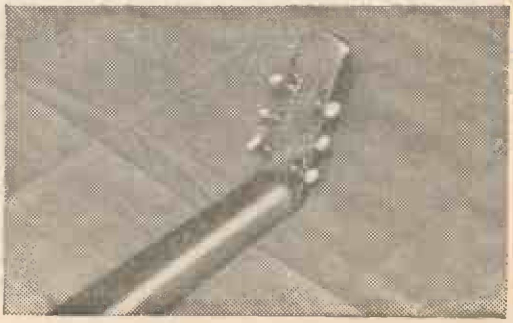


Fig. 2.—Marked out block.

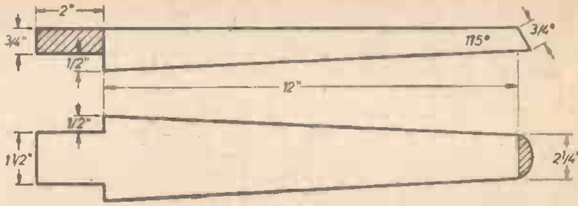
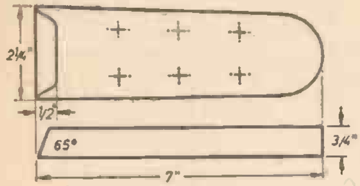


Fig. 3.—Neck measurements.



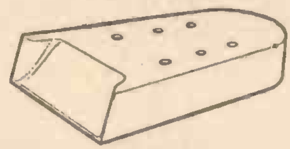
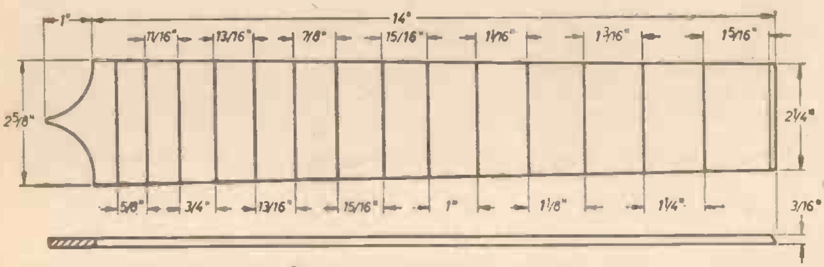


Fig. 4.—Details of the head.



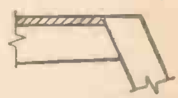
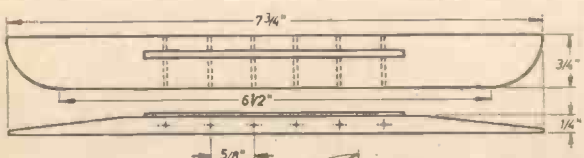


Fig. 5.—Finger-board and fret measurements.



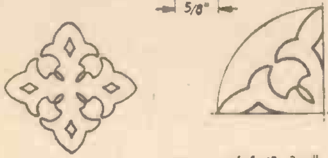


Fig. 6 (Above).—Details of the bridge.

Fig. 7 (Left).—The rose pattern.

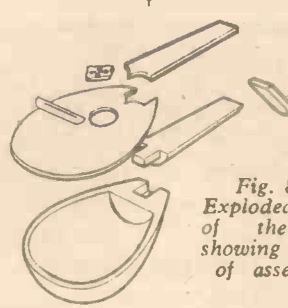


Fig. 8.—Exploded view of the lute showing method of assembly.

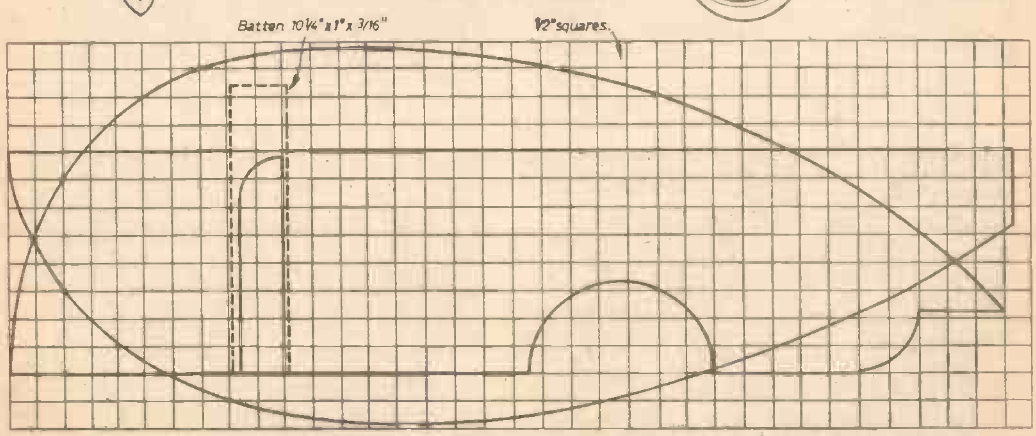


Fig. 1.—Body shape.

TRADE NOTES

A REVIEW OF NEW TOOLS, EQUIPMENT, ETC.

A New Rodene Timer

THE Rodene Electrical Company have just announced a new timer, the "Chronoset", which will be the main feature of our show on Stand No. D165 at the I.E.A. Exhibition.

As will be seen from the illustration, it has the appearance and ease of reading of the modern "square" voltmeter which it has been designed to match, and also complies with the fixing details recommended for these meters in Appendix E of B.S.89.

"Chronoset" timers can be connected to run from the momentary closure of a control switch and then reset automatically at the end of the timed period, or to stay in the timed out condition until a reset contact is momentarily opened.

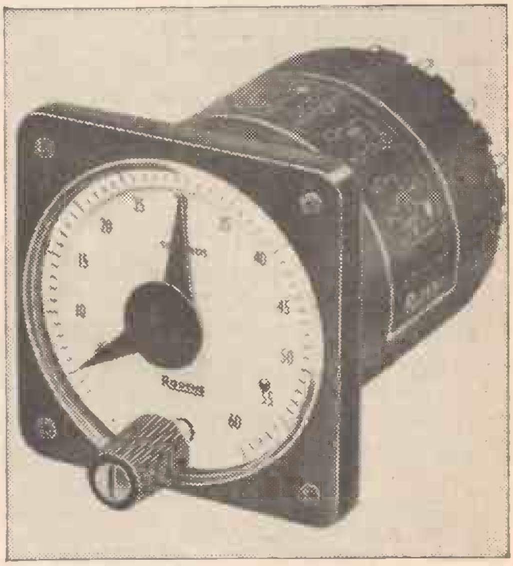
They are also available with a built-in relay so connected that the timer will re-cycle automatically, i.e. run for the timed period, reset, pause for about a second, and the re-start. This timer can also give a very short pulse of about one second duration even when the time range is measured in hours.

A removable key can be supplied in place of the time setting knob to prevent unauthorised adjustment. An important point is that no damage is caused if the time setting is altered during timing.

The dial has two pointers, a black one which, during timing, travels towards zero indicating the unelapsed time, and a red one which stays to indicate the set time. On resetting, the black pointer returns instantly and without bounce to cover the red one.

These timers are made as standard for 105/120V, 195/220V, and 230/250V at 40, 50 and 60 cps. The clutches can also be supplied for D.C. operation. The repetitive accuracy is within ½% of full scale; life tests have exceeded 2,000,000 operations; the contacts are rated at 5 amps at 250V or 3 amps at 440V, and insulation is tested at 2kV.

Full details are available from D. Robinson & Co. Ltd., 5-7 Church Road, Richmond, Surrey. Telephone No.: Richmond 7181/4.



New Metal Filler with "100% Adhesion"

A COMPLETELY new body filler which has taken three years to develop, has been introduced for the motor trade by Plastics and Resins Limited, Wolverhampton. It is supplied in a pre-mixed paste form that sets in thirty minutes, and yet remains soft enough to cut and work up to 24 hours. It is also tack-free and it is claimed that cleaning tools, such as files and "Surform" tools, will not clog up nor will they become blunt.

The new material, known as Metolux "Easyfill", is a sister product to "Metolux Aluminium", already in wide use.

Claimed to have remarkable bonding qualities—a 100% adhesion is guaranteed—the pre-mixed filler spreads easily and can be applied in any thickness, but hardens quickly leaving a non-porous surface.

Sold in 8lbs and 16lbs packs, Metolux "Easyfill" is priced at 52s. (8lbs pack) and 98s. (16lbs pack).

Full details and a leaflet are available from Plastics and Resins Limited, The Airport, Wolverhampton.

Protocoat: Protects-Seals-Insulates

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It instantly protects, seals and insulates and, by means of the simple spray method, can be evenly applied with ease over the least accessible surfaces of equipment. It is quick-drying and equally suitable for the smallest electronic and radio equipment and for the largest switchgear. Having a working temperature in the range of −50°C to +200°C, it is both oxidation resistant and non-volatile and also shows extreme resistance to tracking and the effects of corona discharge.

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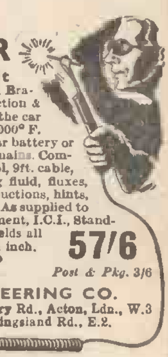

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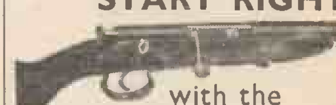

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Hand-operated Railway Trolleys

CAN you give me any information regarding a hand-operated railway trolley as I wish to construct a working model.—T. A. McGraith (Aberdeen).

HAND-OPERATED railway trolleys, or hand-cars, as they are usually known, are practically out of date, and are only now used in remote places where the use of a motor-driven car would not be economical. Before the advent of the small internal-combustion engine, hand-cars were widely used in the U.S.A. and Canada, and on Colonial railways, by permanent-way section gangs. The type most favoured consisted of an A-shaped frame mounted on a wooden platform, about 4½ft wide and 6ft long. The platform was mounted on four wheels, with axleboxes and springs similar to a coal wagon, but the wheels were outside the axle-boxes. A beam was pivoted at its centre, to the top of the A-frame, and this beam had cross-handles at each end. A gear-wheel carried in bearings, and provided with a crank, was mounted underneath the platform and meshed with a small pinion on one of the car axles. The crank was driven from the beam by a connecting-rod attached near the centre, and passing through a slot in the platform.

The ratio of the gear-wheel and pinion was usually about 3 to 1, for a normally graded line, but if the grades were steep, a lower gear, 2 to 1 or more, was used. With a man of average strength at each end of the beam, operating it in see-saw fashion, a quite respectable speed could be attained on a level road.

A small version of this could be built without drawings, for 3½in. or 5in. gauge, and if the platform is made long enough for a couple of children to sit on, they could thoroughly enjoy themselves, "pumping" the car along a small railway.

On the Isle of Wight railway, in pre-nationalisation days, a small hand-car was used to shunt wagons, one at a time, in one of the goods yards. The platform was very low, being mounted on 15in. diameter wheels, which were coupled like those of a locomotive. A shaft with a crank handle at each end was arranged at a convenient height above the platform, and on this was a chain sprocket, driving a similar sprocket on one of the axles. With a man turning each crank, wagon-shunting was quite easily done.

Caring for Films

COULD you please give me some tips on how to handle 35mm. film to avoid getting dust, fingerprints and scratches, etc., on its surface?—W. O'Brien (Eire).

CARE is needed when handling and processing 35mm. film as dust actually embedded in the emulsion cannot be removed without causing clear spots. Cassettes should be brushed out, particularly along the velvet trapped lips, or dust will transfer to the film or scratch it. The camera should also be cleaned and any film guide rollers highly polished. A clean developing tank and filtered solutions avoid trouble at that stage, while drying in a dust-free enclosed space completes the sequence. Fingermarks on the negatives may be prevented by handling only by the clear rebates along the edges.

Should, however, the negatives get scratched, Kodak and Johnsons produce a preparation for filling scratches on the backs only of negatives. These firms also manufacture film cleaning preparations. Both of these products are obtainable from your local photographic supplies shop.

Model Speed Record

I HAVE for some time been considering building a model rocket powered machine, to run on model railway tracks. I have no problems as regard the power plant, as I have been flying and sailing rocket powered models for many years. What I do wish to know is, what is the model land speed record on rails?—D. Gardner (Essex).

THERE is no known record for high speed on the tracks used by miniature railway locomotives, electric motor-coaches or similar vehicles for the simple reason that they can, if properly constructed, travel at a far higher speed than that at which derailment would occur.

Some years ago the owner of a 2½in.-gauge 4-6-2 steam locomotive originally designed and built by "L.B.S.C." tried to see how fast it would go "all out". He had a long, continuous track with a straight stretch running parallel with a fence of the wooden featherboard type about 3ft. away. On this the locomotive accelerated to a shade below 17 miles per hour, at which speed it jumped the track and went clean through the fence, damaging the front buffer-beam, one corner of the frame and the smokebox and chimney. The driver's arm and shoulder were injured badly enough to need hospital treatment.

Another locomotive, tested on a stand with the driving wheels resting on friction wheels connected to a speedometer, turned its wheels at a speed equal to an actual 86 m.p.h.

In the nineteen-thirties "L.B.S.C." carried out some speed experiments in connection with water pick-up apparatus for small locomotive tenders. It was found that a 1¼in.-gauge engine was unsafe at over 5 m.p.h. and a 1¾in.-gauge between 9 and 10 m.p.h.. The safe speed of a 3½in-gauge engine could not be ascertained as the straight part of the line was not long enough, but it went fast enough to pick up water through the tender scoop.

It would appear that a rocket-powered locomotive would need careful adjustment of the jet, as even a slight downward thrust would lift the engine off the line. "L.B.S.C." suggests that the most suitable type of rail vehicle on which to try rocket propulsion would be a car running on a single rail with an overhead guide rail and pulleys on the car roof engaging with it. This arrangement could not derail at any speed.

Waterproofing an Inspection Pit

I HAVE recently completed a car inspection pit but find that water seeps through, can you suggest a method to avoid this?—R. E. Lee (Glasgow).

WE feel this would be difficult to overcome permanently but would suggest that you treat the surface with one of the silicone treatments now on the market for use on brickwork and rendered surfaces such as "Brella". Waterproofing solutions such as this would hold the damp back for a time, but a more permanent modification to the pit would be to render over the existing cement, using cement mix with a waterproof solution such as Publo.

This type of fault usually develops with an inspection pit where the ground immediately surrounding it is higher, which causes water to drain through it. Another solution, providing the location was suitable, would be to dig a larger hole in close proximity to the pit and fill this with suitable brick rubble and material to act as a separate soakaway. Alternatively a soakaway could be formed in the bottom of the pit by knocking a length of tubing about 2ft. into the ground.

C. R. Young describes "Tich"

THE photographs on page 462 show my model of L.B.S.C.'s "Tich", a ¾in. scale, 3½in. gauge contractors type 0-4-0 locomotive.

Construction of the frames, wheels and cylinders followed the normal practice. It can be seen that the valve gear is a version of outside Stephenson's Link motion. This is both unusual for British practice, and highly successful, as the engine will run one notch out of mid-gear quite well.

Again the bodywork and boiler follow L.B.S.C.'s well tried practice, but I cut a piece out of the banker to make easier firing, and driving.

The weather board is copied from the Metropolitan Railway. This is made from 20s.w.g. brass, the beading is $\frac{1}{16}$in. diameter brass rod, slit down the centre to form a channel section and sweated into position. For the window (or cab light frames as the locomotive men call them) frames, a piece of brass bar was turned over the top to the correct diameter, and then drilled and bored to leave a full $\frac{1}{16}$in. wall. A $\frac{1}{64}$in. register was machined on and the frame parted off $\frac{1}{32}$in. wide. Four of these were made and riveted into position with $\frac{1}{32}$in. brass rivets. The glasses are commercial microscope slides!

I cut the drag hooks from stainless steel, as were the buffer heads, and this has resulted in both serviceable and easy to clean components.

The locomotive is painted in Great Eastern blue, with black edging and a fine red dividing line.

"Tich" has performed very well, and has run half-a-mile with two up. I think this is a tribute to the scheming of L.B.S.C. and my friends in Ashford for their help and encouragement.

This is my second steam locomotive, the first was an "0" gauge London, Chatham and Dover Railway Goods engine.

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