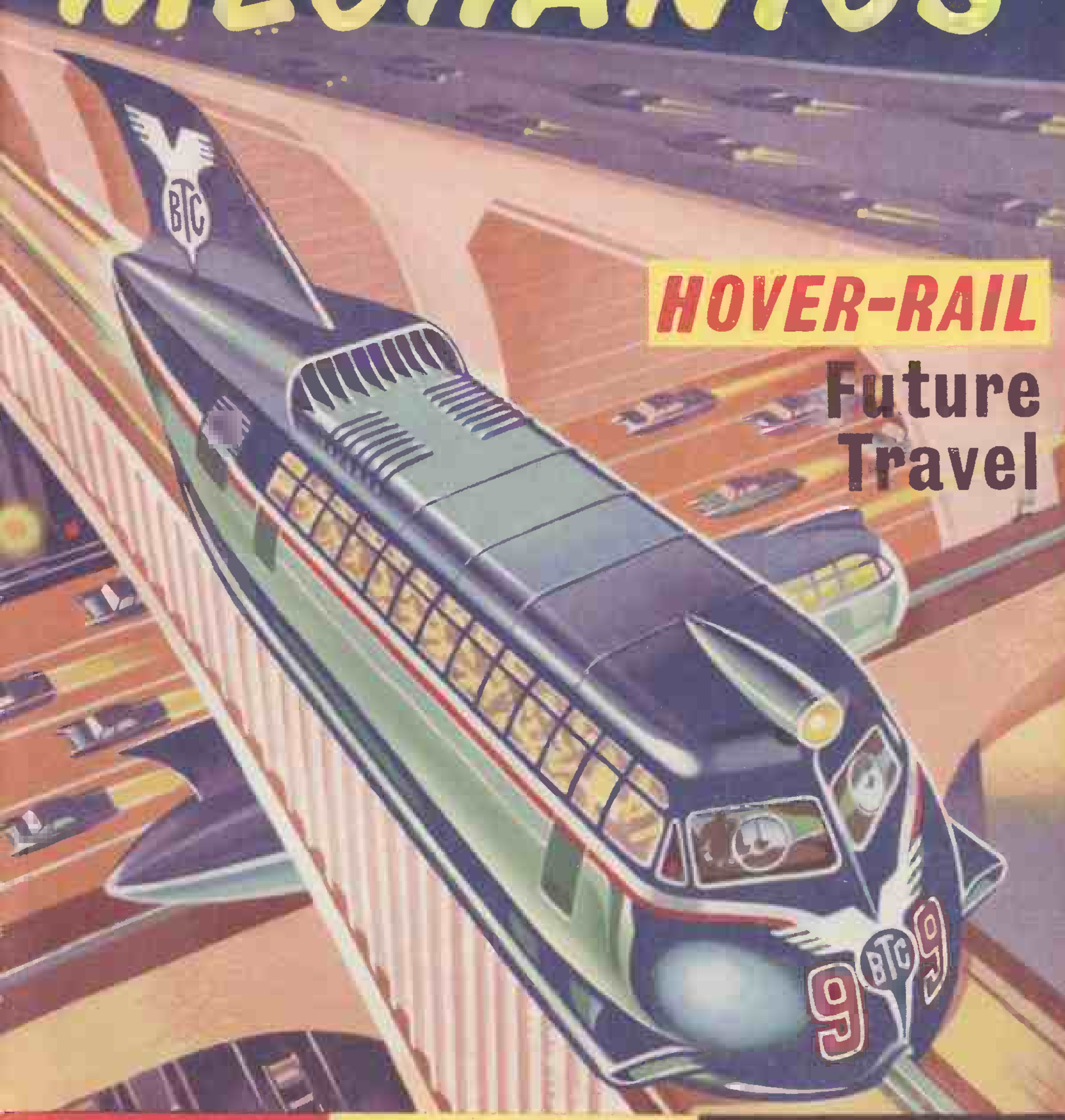
Practical MECHANICS

1'6

DEC–1961



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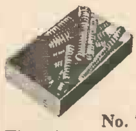

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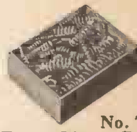

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Practical MECHANICS

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CONTENTS

CONTRIBUTIONS

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

FAIR COMMENT

OVER OR UNDER?

ONCE again the Channel project is in the news. This time the interest has been in favour of the tunnel and in addition it now has the backing of the British Transport Commission.

The Channel Tunnel Company under the chairmanship of Mr. Leo d'Erlanger recently demonstrated a 30 ft. working model, which was given full approval by officials of the B.T.C.

Although discussion has been going on for a long time, it appears a definite decision must soon be made and treated with some degree of urgency. Owing to the increase in cross-channel traffic the alternative would be to embark on big expenditure in extending present sea facilities. The bridge project has not been entirely discarded, but the main criticism is the possible menace to shipping. It could also be severely damaged by sudden freak weather conditions, and even normal bad weather would deter traffic from using it. In fact it could be correctly visualised as a "fine weather bridge." As an additional support in favour of the tunnel, it is estimated the cost would be £105 million, while the bridge would be exactly double that amount.

COSIER WORKSHOPS

With the approach of winter and the long chilly evenings, possibly more time is spent in workshops than at any other period of the year. There are many though who prefer the comfort of the fireside, usually accompanied by television, wishing perhaps they had a workshop somewhere indoors. From so many workshops the impression one gets is that of merely a shed in the garden, cold, badly lit—a cheerless affair.

As a further contribution in our "Readers Workshop" series, this month we have chosen one submitted by Mr. Macintosh. This proved so interesting it was decided to publish the whole text, which gives his well-tried ideas covering the construction, most suitable materials, heating, lighting and general layout of equipment. It must naturally be appreciated that this reader has only acquired the machinery and tools for his workshop over the years, but many of us less fortunate in this respect, can at least achieve a more cheerful interior in our "retreat" with very little expense. For a few shillings a tin of oil-bound distemper will brighten the inside considerably and light wall surfaces always give an impression of space. A small tin of some bright coloured enamel will go a long way for painting such items as a bench vice, tool handles, etc. If the floor is concrete cover it with hardboard or an old piece of carpet, it will at least prevent cold feet. In fact, go gay in your workshop. We all love colour and together with a little comfort this has a tremendous psychological effect on one.

JUST AN IDEA

The startling looking vehicle on our cover this month has a suggestion of being "a thing from outer space" a product of the imagination of a writer of science fiction. The Hover-rail is in fact, a reality, insofar as the design and method of propulsion have been proven.

From time to time we hear reports of The British Transport Commission's new programme for improving efficiency on the railways, and seemingly behind the scenes something is being done.

If the Commission were to ask PRACTICAL MECHANICS for their suggestions, we would simply say, "Scrap the lot and install a Hover-rail!"

The January 1962, issue will be published on Dec. 30th, 1961. Order it now!

HOVER-RAIL

FASTEST, SAFEST FORM OF TRAVEL

By R. N. Hadden

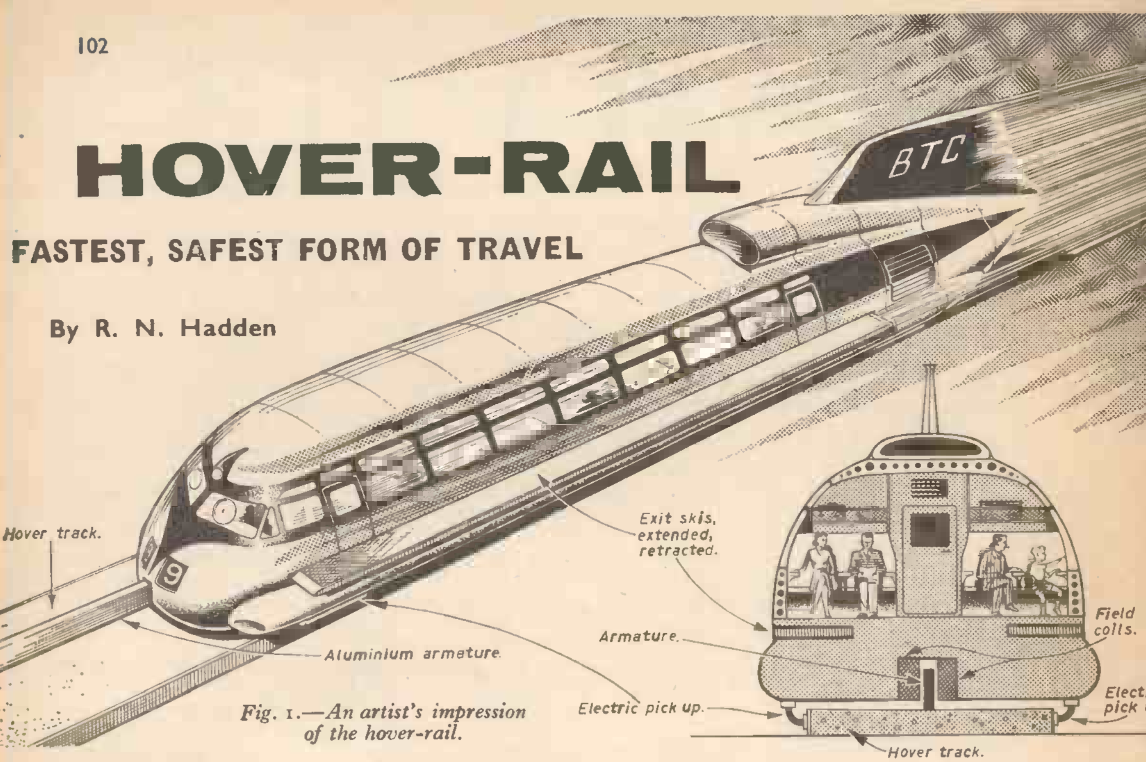


Fig. 1.—*An artist's impression of the hover-rail.*

A PROPOSAL for a revolutionary new transport system, known as the "Hover-rail," has recently been put forward. With this system it will be possible to travel at speeds in excess of 300 m.p.h., and as it can operate right into the centre of cities it will be faster for city centre to city centre journeys than air travel. Not only will this system be the fastest means of surface transport yet devised, up to distances of 1,000 miles, but it will also be the safest. Accidents will be impossible.

The Track

Fig. 1 shows an artist's impression of what the hover-rail will look like, from which the simplicity of the scheme can be seen. The track itself is similar to a road in that it is constructed of concrete, though it is neither so wide nor so heavily made, as the loadings are not so great. Down the centre of the track runs the "armature" which basically is an aluminium plate, about 1ft. high and 2in. thick. The armature is firmly fixed to the concrete track as not only is it used in the propulsion system, but also for guidance. On either side of the track run two electric conductors, which supply two phases of an A.C. supply. The third phase is carried on top of the armature.

The Vehicle

The hover-vehicle which runs on the track can also be seen clearly in Fig. 1. As the name implies this vehicle hovers above the track on an air cushion, the air being supplied from a centrifugal compressor. The height of hover is only about 1in. as there are no obstacles to be passed over on the track. Because the hover height is small the power required for the air compressor is also small. It should be pointed out here, that the hover principle is used in preference to wheels as it enables much higher speeds to be maintained.

When speeds in excess of 300 m.p.h. are considered, a very real danger exists of wheels flying to bits due to centrifugal force, as well as having the added complication of providing suitable bearings.

Propulsion

The means of propulsion is by means of a linear electric motor, which can be seen in Fig. 1. The field coils of the motor are housed in the vehicle and are positioned on either side of the armature. The small air gap between the field coils and the armature is maintained by feeding in compressed air through the coils so that they cushion the armature at the exact centre. This method not only prevents contact between the field coils and the armature, but also guides the vehicle as a whole. The field coils of the linear electric motor are fed with the three-phase supply.

Linear Electric Motors

While these are by no means new, they are not well known. Basically they are induction motors which have been opened out, so that instead of giving rotary motion, they produce linear motion. Fig. 3 shows a conventional motor. The field coils are fed with a three-phase electric supply, and the effect of this is to produce a rotating magnetic field. The armature is placed inside the field coils and the rotating magnetic field tends to drag it round with it. The armature itself is made up of soft iron laminations in which axial bars of copper or aluminium are inserted in the surface. These bars are short circuited at the ends by a circular ring. If the copper bars and short circuit rings are looked at by themselves they have the appearance of a cage, and it is for this reason that the motor is sometimes known as a squirrel cage motor. It must be emphasised that there is no direct electrical connection between the armature and the field coils, or the supply. The whole action takes place by electromagnetic induction.

In the induction motor the iron laminations in the armature are used solely to guide the rotary magnetic field, and to ensure that it acts on the copper or aluminium bars. It is important to appreciate this fact to see why a pure aluminium armature can be used in certain types of linear motor.

Fig. 4 shows a section of a linear motor which is simply a rotary induction motor opened out. It will be seen in this case that it has been necessary to retain the iron core to guide the magnetic lines of force. However there is no reason in the linear motor why a second set of field coils should not be placed above the armature as shown in Fig. 5. In this case the magnetic lines of force flow from one set of coils directly across to the other set, and there is no need to have iron in the armature. This means that the armature can then become a flat plate instead of a series of bars. It is this type of linear motor which is used in the hover-rail.

One of the characteristics of an induction motor, whether it be of the rotary or of the linear type is that it runs at a virtually constant speed. This is one of the key points of the system as it means all the vehicles on the hover-rail run at exactly the same speed, and so it is impossible to overtake or be overtaken. Because of this, travel on the hover-rail is very safe. The actual speed of running depends on the frequency of the electric supply and also on the construction of the motors, and these would be standardised throughout the hover-rail network.

Hover-rail Travel

So far only the construction on the hover-rail has been considered, but it is now appropriate to see how a journey would be made. A typical hover-rail station where a vehicle would be boarded is shown in Fig. 2. The vehicle itself would seat about 30 passengers as it would be economical to run a very frequent service of small capacity, rather than a less frequent service of very large vehicles. When the passengers were seated and the main track was clear, the vehicle would be lowered hydraulically on to the track. Once on the main track the vehicle would accelerate very rapidly and would be travelling at 300 m.p.h. in less than a minute. The rest of the journey would then be made at exactly constant speed. One of the features of the hover-rail would be its very silent operation, providing a very restful journey.

When the destination is being approached, the exit skis (see Fig. 1), would be extended, and these would engage with the inclined exit rails, which would lift the vehicle off the track, and up to the level of the station. While on the exit rails the vehicle speed would be reduced until it came to a halt at the station. The station would be at a sufficiently high level to enable the following vehicles on the track to pass underneath without obstruction. Once the vehicle had stopped, the passengers could alight,

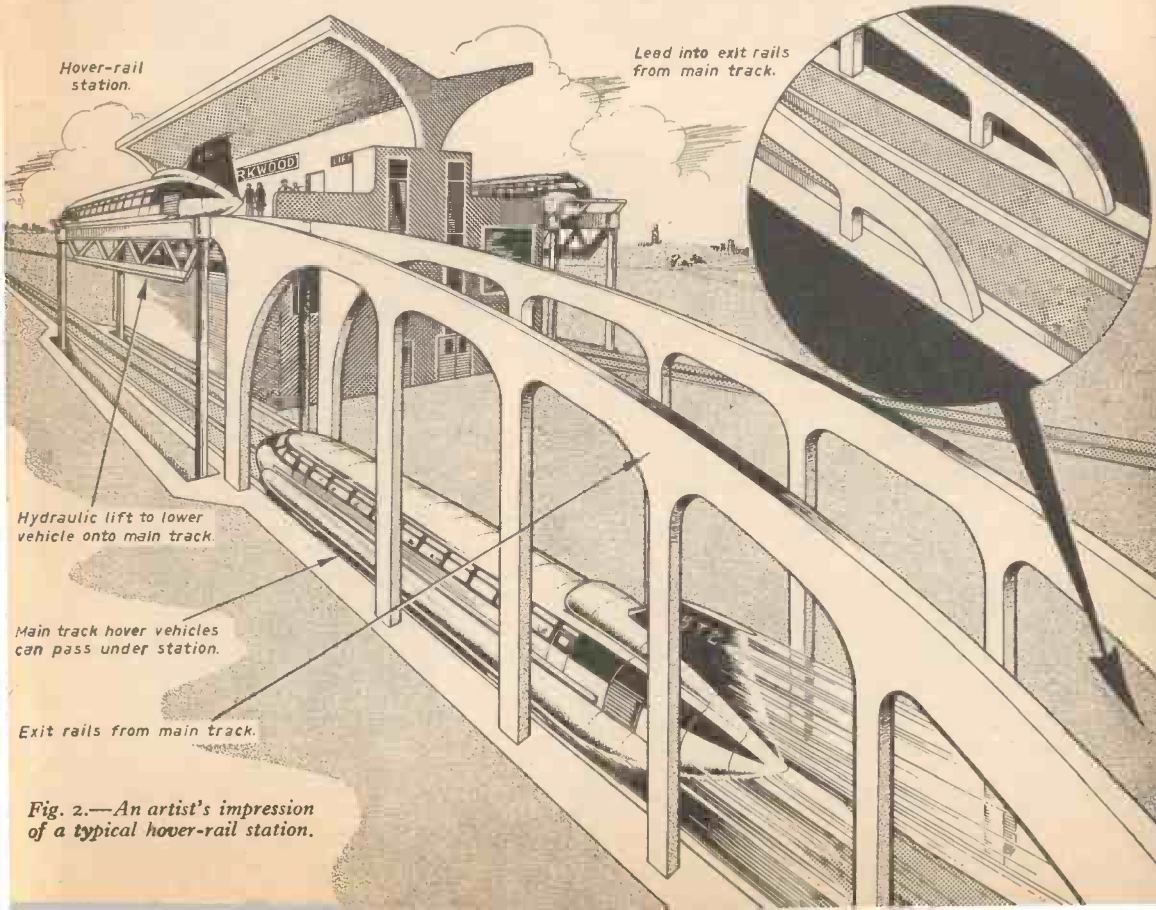


Fig. 2.—An artist's impression of a typical hover-rail station.

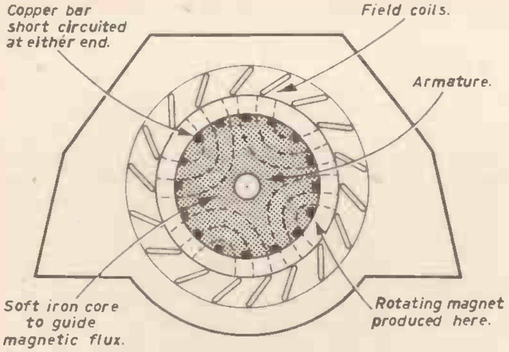


Fig. 3.—Conventional Induction motor showing armature, field coils, and method of rotation.

while others could take their place. The traffic using the hover-rail would be divided into express, and local vehicles. The express vehicles would only stop at the larger cities, while the local vehicles would stop every ten miles or so. However, even travelling on the local vehicles it would still be possible to cover more than 100 miles in the hour.

When it became necessary for a vehicle to change from one track to another this would be done at a station. The actual change over would be quite simple, as it would only be a matter of lowering the vehicle on to another track. This method would be superior to using points as it is not only simpler but also safer.

Fig. 4.—Single sided linear electric motor using iron in armature.

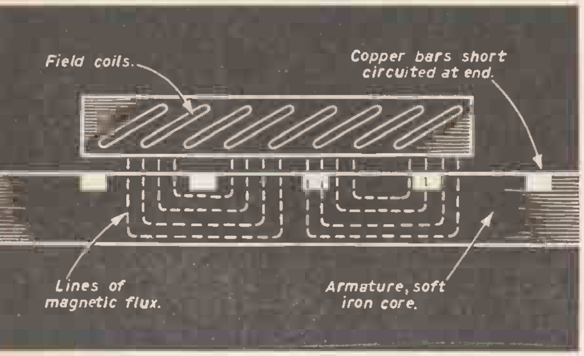
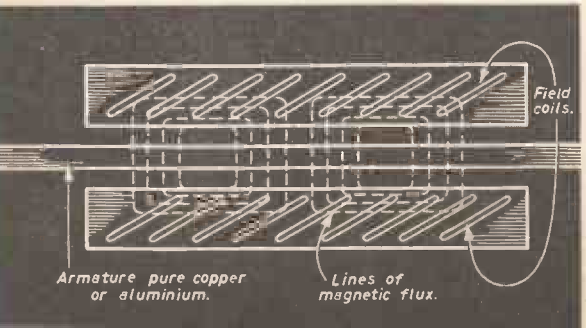


Fig. 5.—Double sided linear electric motor in which no iron is required in armature.



It may be argued that while very high speeds may be obtained on the hover-rail, it would not be accepted, because it does not have the same convenience of a private motor car, which can be driven anywhere there are roads. However this is not true, as there are two ways in which the convenience of a car can be combined with the speed of the hover-rail. The first way is to provide hover-vehicles which can carry cars, so that the hover-rail simply performs the function of a high speed car transporter. The second method could be adopted when there was a wide network of hover-rails, and that is to build cars and lorries with hover-rail attachments. This would be a most attractive solution especially for heavy transport. In either case it would be possible to drive a car out of a private garage in say London, and be in Glasgow an hour and a half later.

Safety Factors

It has already been mentioned that the hover-rail is a very safe method of transport because of its constant speed characteristic. However, other features also contribute to its safety, the most noteworthy being its simplicity. This is due to there being no wearing parts except for the compressor, which itself can be made most reliable. Nevertheless, if some remote chance did cause a vehicle to stop on the track, or to slow down, then the whole electric supply would be tripped out bringing all vehicles to a standstill, until the fault could be rectified.

London Airport Link

While few people would dispute the desirability of such a high speed transport system, it may be asked where a start would be made. Probably the best route for the first hover-rail would be from London airport into the city centre. This would have several advantages in that not only would it fulfil a long felt need in transporting passengers quickly, but it would also be a tremendous prestige booster for this country. The merits of the system would then be so obvious that other tracks would quickly follow suit, and these could be built in place of existing main line railway tracks.

SCIENCE NOTES

Transporter for concrete in rubber bags.

Concrete in Rubber Bags

THE strange rubber container shown hanging upside down on the right is not a giant sized Rugby ball but the container used in a new concrete delivery service in California.

Inventors of the system, Rodeffer Industries of Pasadena, realised the difficulty of seeing that the correct proportions of sand, gravel, cement and water were put into the mixer. They solved the problem by delivering to the concrete user, not separate supplies of sand, gravel and cement, but all three complete with water and contained in a large rubber bag.

Because the container has two compartments, one for the cement and the other for the water, sand and gravel, the rubber container and its contents can be kept indefinitely until it is required. Then it is simply emptied into a concrete mixer and within a few minutes a batch of concrete is ready.

Made of strong thick rubber the container is returnable and can be used over and over again. It is hoped that soon a whole range of different kinds of concrete will be available at depots in California and the user will only have to use the telephone to have his complete concreting materials delivered.

Flyover Built in 30 hours

A REVOLUTIONARY new car bridge, a 797ft. long prefabricated steel flyover, was erected over one weekend at Camphill, Birmingham, to relieve congestion at one of the city's worst bottlenecks.

The construction work of the car bridge was completed in less than 30 hours; this was half the time available to the constructors, John Lysaght's Bristol Works Ltd. This impressive speed was achieved despite the fog, which was quite heavy at times, and which slowed down the delivery of the prefabricated sections brought by lorries and trailers from Birmingham Corporation's Depot, about one and a half miles from the site.

Picture below is the working model of the channel tunnel recently demonstrated to officials of the British Transport Commission at their London Headquarters.

L.B.S.C's 3½in. Gauge

EVENING STAR

Part 10. Cutting valves from the solid and guide bar details.

THE valves can be cut from the solid, using 1in. × ½in. drawn bronze bar. Chuck a piece in the four-jaw, and part off two 1 3/16in. lengths. Mill the steps to the given dimensions by the same process as described for the pony axleboxes, holding the blank in a machine-vice bolted to the vertical slide, or clamped under the slide-rest tool-holder, if you haven't a vertical slide. In the latter case, the easiest way to " dig out the hole in the middle " would be to make a deep centre-pop right in the middle of the face, put it face up in drilling-machine vice, and drill to ¼in. depth with a ½in. drill. The hole can then be squared up to the dimensions of the exhaust cavity by aid of a ½in. chisel. I did plenty that way in days gone by. If a vertical slide is available, bolt a small machine-vice to it, put the valve in that, gripping by the steps (Fig. 58) and go to work just as I described for cutting the ports.

Another trick I performed in 'ard-up-'n'-'appy' days was to make valves in two parts. In the present case, the bottom of the valve would be a piece of 1in. × 3/16in. bronze or gunmetal 1 3/16in. long, with a hole cut in it the size of the exhaust cavity. The upper part would need a piece 15/16in. × 11/16in., and 5/16in. thick. Brass would do for this. The smaller piece is silversoldered over the hole in the larger piece, taking care to keep it central, and no machining is required beyond cleaning off any superfluous silversolder, and trimming the width of the valve to given dimensions.

Packing and Jointing

The most satisfactory piston packing that I have so far found, is a ring of square braided graphited yarn, with the ends cut at an angle as shown in Fig. 52, like the joint in a metal piston-ring. This is easy to fit, completely fills the groove in the piston, remains steam-tight for an incredible time (provided that the piston is correctly fitted!) and protects the cylinder bore in the event of a temporary failure in the oil supply. The best mechanical lubricator in the world won't feed if the driver forgets to fill it, and none of us is perfect.

Put the ring of packing in the groove, enter the piston in the bore as far as it will go, then prod all around the packing with a narrow screwdriver, pressing on the piston at the same time. It will soon slide in! Another wangle which I usually work with larger pistons, is to make a clip from a piece of 1/16in. brass or steel a little wider than the piston. This is put over the packing, with the joint in the packing well away from the gap in the clip, and the bolt tightened until the packing is squeezed flush with the piston rim (Fig. 59). If a blob is sticking out at the gap in the clip, the bolt is loosened, and the clip turned around a bit so that the blob is squeezed in when the bolt is tightened again. The bolt is then slackened just enough to allow the piston to move in the clip, the latter is held against the end of the cylinder, and the piston pushed out of the clip into the bore. A drop of oil around the bore makes the transit easy.

The joints between covers and cylinders, and the rectangular joints between steam-chest, cover, and portface, can be made with any good commercial jointing such as 1/64in. Hallite, Klingerite, or other well-known brand. For the covers I just cut out a ring, which fits tightly over the register, avoiding any ridge or crease, put the cover in position, and poke a scriber down two of the screwholes to pierce the jointing. The screws are then put in, and the rest of the screwholes served in the same way. There is no need to punch the screwholes, and the screws fit steamtight. Rectangular joints are fitted in similar fashion. If commercial jointing isn't available, the old-fashioned way of making joints with thick brown paper, will

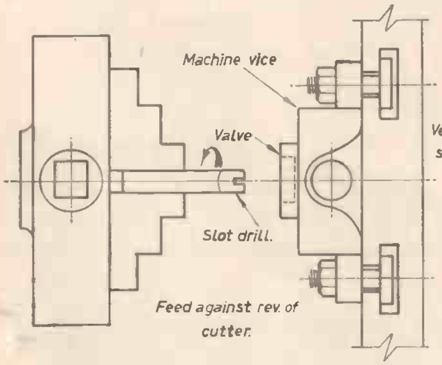


Fig. 58.—(Left) Slide-valve set up for cutting exhaust cavity.

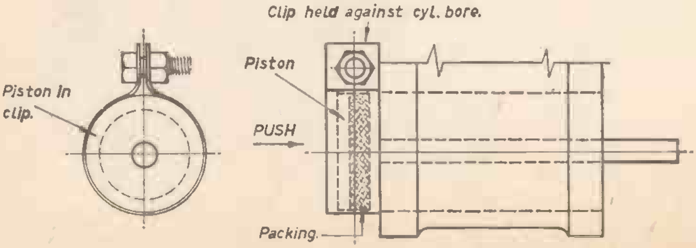


Fig. 59.—(Bottom left) Inserting packed piston into cylinder.

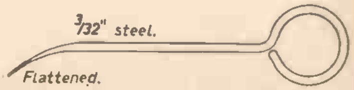


Fig. 60.—The packing pusher.

two narrow bottom bars being considerably less than that of the wide top bar. Tank engines are therefore usually provided with double guide bars and alligator crossheads, a type which I much prefer, and incidentally is easier to make and erect, especially as it simplifies the clearance problem. However, as the full-size *Evening Star* has Laird guide bars and crossheads, there would be a nice old shindy if I didn't specify them, so I schemed out the arrangement shown. As in full size, the bars are not attached to the cylinders, but are supported by brackets bolted to the frames. These brackets are recessed at the back, to allow clearance for the leading coupled wheels. There is just room for a top guide bar ⅜in. wide, if the leading coupling-rod bosses are slightly reduced in thickness to allow them to pass. The arrangement is shown in the assembly and erection drawings which will appear in the next instalment.

Guide Bars

The best material for the guide-bars is silver-steel, ⅜in × 5/32in. for the top bars, and ⅛in. × 3/16in. for the bottom bars. Both are commercial sizes readily obtainable. No machining is needed. Cut two wide lengths and four narrow lengths, allowing a little for trimming the ends, and file to the shape shown in Fig. 61. The spacers or distance pieces, are ⅜in. lengths of the same section steel as used for the bottom bars.

The screwholes in the bottom bars should be absolutely central with the bars, so mark out very carefully their position on the flat side of the bars. For accurate drilling, hold each in a machine-vice with the bar level with the tops of the jaws; and with the machine-vice on the table of the drilling-machine, or held against a drilling pad on the tailstock barrel of the lathe, drill them with No. 51 drill. Next, assemble the bars as shown in Fig. 61, taking great care to get them in exact alignment. Hold with a cramp at each end. To make sure that the bottom bars are the right distance apart, put a piece of the ⅛in. silver-steel between them, and hold it while the cramps are tightened. Then using the holes in the bottom bars as guides, drill through the distance pieces and the top bar.

Remove cramps, and mark the bars so that they can be replaced as when being drilled. Tap the holes in the bottom bars 8 BA, open out the holes in the top bar and distance-pieces with No. 43 drill, and slightly pindrill those in the top bar to form seatings for the bolt heads. Don't use ordinary commercial screws threaded right up to the head for holding the bars together; they are liable to break under stress. For jobs like this, I always use silver-steel of the requisite diameter, with a tight-fitting nut for the head. Bolts of this size can also easily be turned from 5/32in. steel, hexagon preferred. Use one of the distance-pieces to gauge the diameter; it should go on without shake. After assembling, trim off the ends square with the sides, and file the distance-pieces flush.

If silver-steel isn't available, mild steel can be used, but the underside of the top bar, and the upper surface of the bottom bars, should be rubbed on a piece of emerycloth laid on something flat and true, such as the lathe bed, to ensure a smooth sliding fit for the crossheads.

Guide Bar Brackets

Castings will be available for the guide-bar brackets. Very little machining is required but what there is, must be accurately carried out. The most important thing is to ensure that the part which is bolted to the frame, and that to which the guide bar is attached, must be at right angles, otherwise the crosshead will be all askew, and the connecting-rod won't fit on the main crankpin. Like all other jobs, it is dead easy when you know how! Bolt an angleplate to the faceplate of the lathe, and mount the bracket on it, sloping side down, holding with a clip at each end. Set the back of the bracket at right angles to lathe centres, and take a cut over it with a roundnose tool set crosswise in the slide-rest. Next, clip the faced part to the angleplate, and set the sloping part at right angles to lathe centres. Give that a dose of the same medicine, and the two machined faces will be at right angles. Drill the holes in the brackets as shown in Fig. 62.

Crossheads

The crossheads appear tricky to make, but can be built up from mild steel without difficulty, as a three-piece job; body, shoe, and arm. The body will need a piece of ⅜in. × ¾in. section, 1¼in. long. One end of this is slotted ¼in. wide, to a depth of ⅝in. full. The job can be done by any of the methods I have previously described for slotting. If a milling machine is available, grip the piece end-up in a machine-vice on the table, and run it under a ¼in. side-and-face cutter on the arbor. In the lathe, bolt the machine-vice to the saddle, put the cutter on an arbor between centres, and adjust the height of the steel in the vice, to get the correct depth of slot. Three or four cuts can be taken if necessary, at different heights. The machine-vice can also be bolted to an angleplate on the vertical slide, which gives height adjustment, allowing regulation of depth of cut. The method used for grooving axleboxes with an endmill or slot drill could also be tried, but several traverses would be needed to get the required depth.

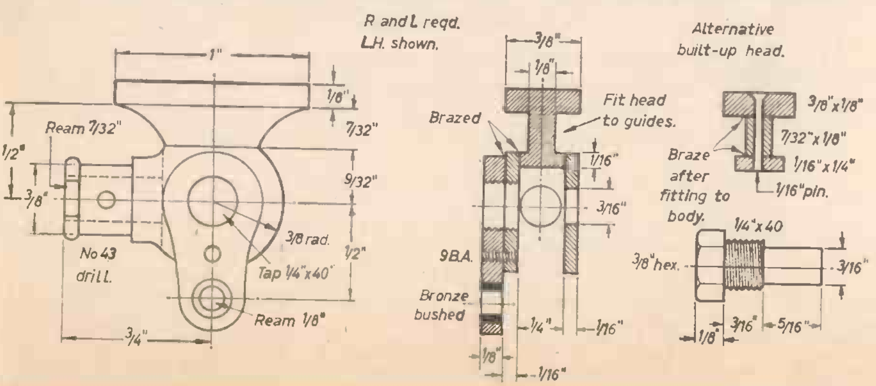


Fig. 63.—Crosshead and pin.

still do the job. After cutting them out, smear both sides with thick cylinder oil, and fit as above. The covers on the ends of the piston-valve liners need no jointing, as they only have to withstand the exhaust pressure. The metal-to-metal contact is perfectly sufficient, and even if they did blow, it wouldn't matter a bean.

Pack the glands with ordinary graphited yarn. This is made up from strands of yarn twisted into a string about $\frac{3}{16}$in. dia. and must be unravelled for use in the little glands. Pull out a strand, cut a couple of inches off it, wind a few turns tightly around the piston-rod or valve spindle, and prod them into the stuffing-box with a piece of stiff wire, bent at the end (Fig. 60). We used similar gadgets made from $\frac{3}{16}$in. round steel, with one end bent into a ring for giving a better hold, for packing the glands on full-size engines, and they were known as packing-shovers. The glands should only be screwed in tight enough to prevent steam leakage, not tight enough to cause unnecessary friction. If too tight, the rods may be damaged; on some of the old L.B. & S.C.R. engines, over-tight pump glands caused the pump rams to assume the appearance of the legs of a navvy's corduroy trousers. The more friction there is to overcome in the "works" of a locomotive, the less power available at the drawbar to pull the load. I have dilated somewhat on the cylinder construction job, for the benefit of beginners, because well-made cylinders are vital to the efficiency of the engine.

On any locomotive with coupled wheels close behind the cylinders, between guide bars and frames, there arises the problem of providing sufficient clearance between crossheads and coupling-rod bosses, without too much reduction in the bearing surfaces. This is quite bad enough on full-sized engines, but on little ones it is just—well, bluepencil, shall we say? We are up against this on the $3\frac{1}{2}$in. gauge *Evening Star*; and to complicate matters, she has the Laird type of guide bars and crossheads. I don't like this type at all. The big idea behind it is that the wide solid top bar, plus a crosshead having a bearing surface the full width of the bar, is better able to withstand both thrust and wear on a locomotive which does all its work when running chimney first, as tender engines usually do. For the benefit of the uninitiated, I might explain that the stress all comes on the top bar when running forward, and on the bottom bar when running backward. With the crank on bottom centre, and the piston pushing, the tendency is for the piston-rod and connecting-rod to double up like a pocket-knife on the crosshead pin, forcing the crosshead hard up against the top guide bar. With the crank on top centre and the piston pulling, the latter tries to pull piston-rod and connecting-rod into a straight line, again forcing the crosshead against the top bar. Going backward, the positions are reversed on both centres, and the bottom bar has to stand the racket.

It is obvious that the Laird arrangement is unsuitable for tank engines which have to run with a load in either direction, the bearing surfaces of the

(*Continued on page* 142)

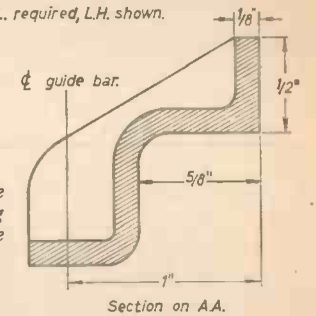
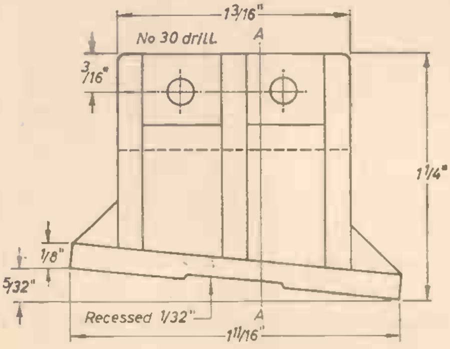
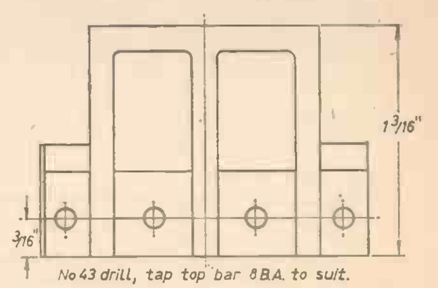


Fig. 62.—*Three drawings giving details of the guide bar brackets.*





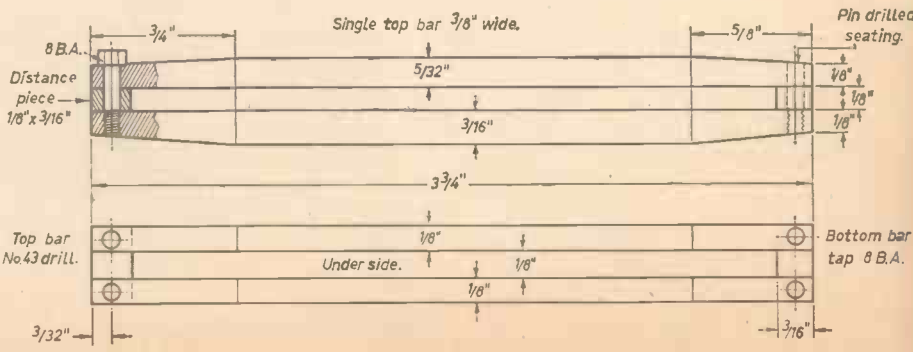
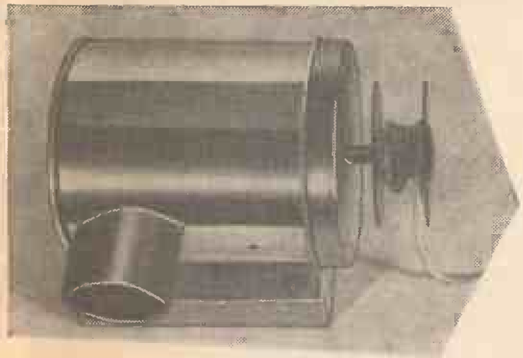


Fig. 61.—*Guide bar details and measurements.*



A FLASH SYNCHRONISATION TESTER

BY A. E. BENSUSAN

Fig. 2.—The completed tester.

AS may be seen from Fig. 1, an outer shell is made from a metal drum with a tight-fitting lid, such as a cigarette or cocoa tin. A hole of, say, ¼in. diameter in both bottom and lid takes a freely rotating spindle, which may be of wood since the device is used only infrequently. The shell has two $\frac{1}{16}$in. diameter holes in line along its axis, one with a card or metal hood to loosely accept the camera lens mount. The holes are located about ⅜in. from either end of an inner cylinder made from a second drum of slightly smaller diameter.

When mounted rigidly on the spindle and inserted in the shell there should be less than ⅛in. spacing between the two walls. A loose distance piece at each side stops end play and aids lightproofing. The end of the spindle protruding from the lid of the shell carries a pulley, which may be a cotton reel or a typewriter ribbon spool. When a length of light string, or stout thread, is wrapped around the pulley and jerked free, the inner cylinder should spin. A bracket or block attached to the shell permits it to be clamped or screwed to the bench. The complete tester is shown in Fig. 2.

Testing

The test procedure is as follows. The camera is bench or tripod mounted so that its lens enters the hood surrounding one hole in the shell end, with no film loaded, the back is opened or removed. The lens is opened to its maximum aperture and the shutter set to 1/25th or 1/30th of a second. The bulb loaded flash holder is plugged into the camera socket and located a short distance behind the camera, so that the light will shine through the lens and also spill round and enter the other hole in the shell. If the open camera back obscures the second hole, the lens and its hood must be transferred to this hole, leaving the other one unobscured.

With the room in darkness, or by the light of an orange safelight, wrap a sheet of bromide paper, emulsion side out, around the inner cylinder and secure it with a rubber band slipped over each end. The paper must be as wide as the cylinder is long, and long enough to cover the entire periphery with or without an overlap at the ends. Mark the paper to indicate the direction of rotation, reinsert the cylinder into the shell, clamp on the lid and wind the string or thread on the pulley. Jerk the string free to set the cylinder rotating quite quickly, but at no definite speed, and press the release to open the shutter and fire the bulb.

When the paper has been developed and fixed it will show two black lines. If synchronisation is accurate, the lines will be of the same length and start and end at the same points along the paper. Incorrect synchronisation will result in the line made through the shutter being shorter and nearer to one end of the other trace. The line relationships shown in Fig. 3 indicate the patterns which can be expected from the flashbulb firing too early and too late. The lines may cross the break in the paper, in which case the sheet should be cut across elsewhere and the two sections joined up with tape.

Adjustments

These can then be made to the spring contact in the shutter until the two lines produced by subsequent tests are properly related. Knowing just which way to make the spring correction, and by how much, greatly facilitates the work.

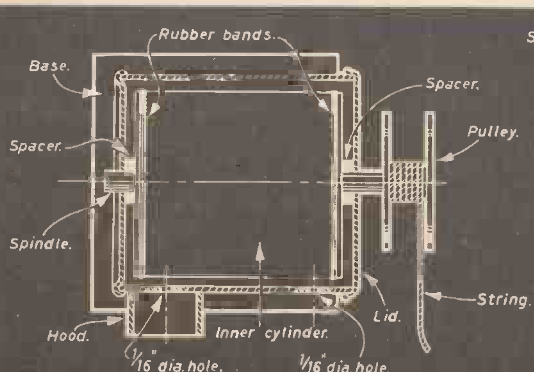


FIG. 1. SECTIONAL PLAN VIEW

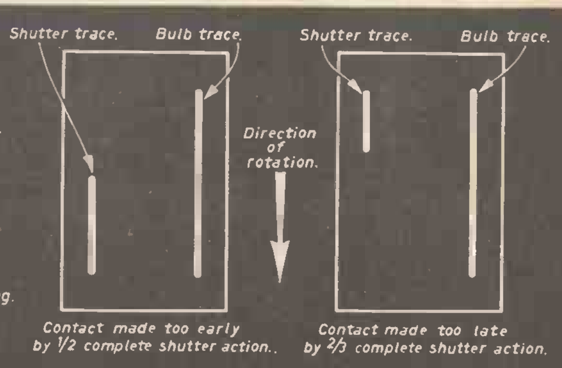
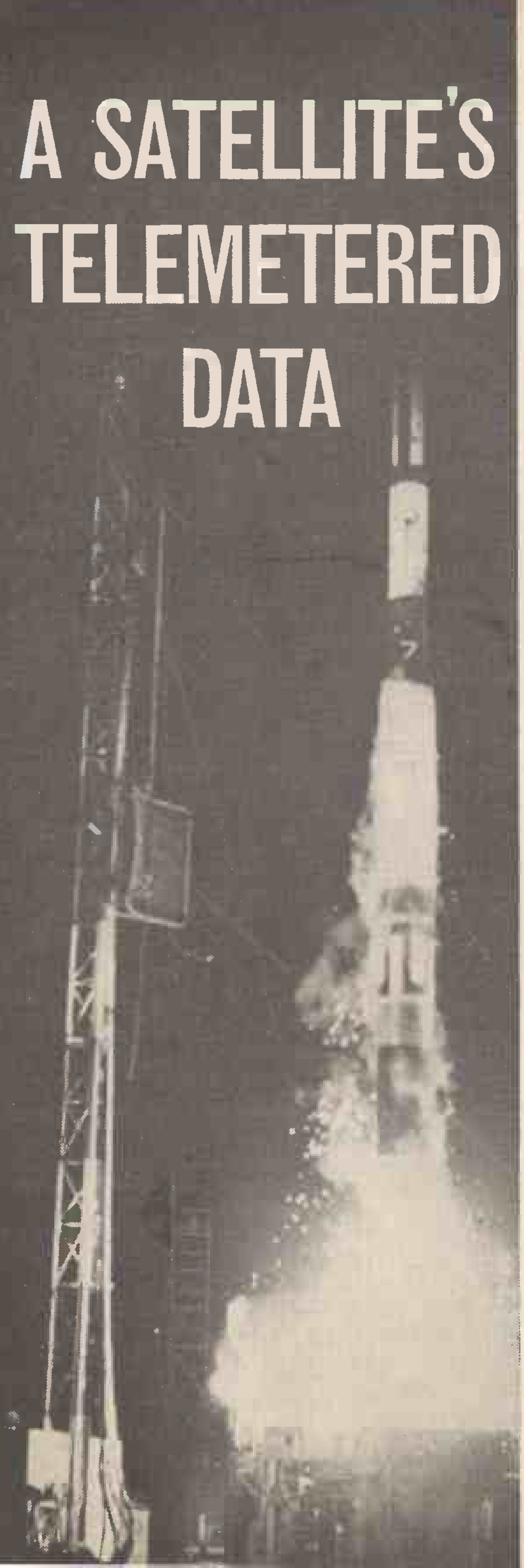


FIG. 3. LINES PRODUCED BY EARLY AND LATE FIRING.

A SATELLITE'S TELEMETERED DATA



Written by D. S. C. Fraser

DURING the past few years, we have heard a great deal about satellites being sent up, but we have heard very little about what the satellites send down. Naturally, there is a reason for everything, and every satellite sent aloft has some specific function to perform. The telemetered data from the Explorer VIII (1960 xi) satellite, which has just been released by the U.S. National Aeronautics and Space Administration is of interest both to scientist and layman.

Explorer VIII was launched by a Juno II rocket on November 3, 1960, into an orbit with a perigee of 275 miles and an apogee of 1,450 miles. The satellite weighed 90lb. and had a planned active life of two months. It was last heard from on December 27. The Goddard Space Flight Center Minitrack Network was responsible for acquiring and preparing the telemetered data.

Purpose of the Satellite

The satellite contained ten experiments. Five were designed to study the ionosphere, a region surrounding the earth which acts like a mirror to radio waves. Three experiments were used to determine the characteristics of an ionised cloud which forms around the satellite because of its interaction with the ionosphere. This cloud has been a matter of concern to satellite tracking specialists because of its effect on radar echoes. The last two experiments were designed to study the characteristics of inter-planetary dust particles.

Ionosphere Experiments

The five ionosphere experiments were entirely new and were conceived by Goddard scientists. Four of these five depended upon techniques involving orbiting sensors which function as vacuum tubes without glass envelopes. The main difference between the Explorer VIII type of vacuum tubes and those in a television set is that there was no need to provide a vacuum seal since the near vacuum of space provides this naturally. The fifth experiment involved the measurement of electrons by studying the amount of detuning they produce on an antenna. These experiments counted the number of electrons and positive ions in the ionosphere. This group of particles affect communications and should not be confused with the Van Allen zone particles. Data processed to date at Goddard Space Flight Center represents the most comprehensive study of the upper ionosphere through which Explorer VIII travelled.

The number of these particles have been counted as a function of time of day, and of latitude as far south as Johannesburg, South Africa, and north to the Canadian border. In general, it was found that the upper ionosphere is homogeneous, that is, it does not contain nearly as many disturbed regions as the lower ionosphere. Those in the lower ionosphere are responsible for disrupting communications.

Another type of ionosphere measurement involved determining the temperature of the electrons. Electron temperature was generally found to coincide with the temperature of the uncharged portion of the ionospheric gas. Temperatures of both electrons and uncharged gas are important to meteorologists. The ionosphere experiments also determined the chemical constituents of the charged gas. Data processed to date shows that oxygen is the pre-

A 72ft. Vanguard rocket blasts off from the launching pad at Cape Canaveral, with the earth's newest satellite.

dominant gas at altitudes up to 650 miles where hydrogen then gradually assumes the leading role.

Ionised Cloud Experiments

Another result from the Explorer VIII was the first experimental measurement of the shape and dimensions of an ionised cloud which forms around spacecraft. Data will permit theoreticians to determine the importance of electrical drag to the orbit lifetime of satellites. This ionised cloud formed mostly positive ions in the front of the satellite and negative electrons in its wake, extending back about one satellite radius. The effects which this could have on radar tracking and orbit lifetime are under study.

Cosmic Dust Experiments

On Explorer VIII these experiments are producing results of major significance. One of the two dust particle experiments are entirely new satellite instrumentation. The other was an expansion of the Vanguard III micrometeorite experiment. By comparing data from Vanguard III with information obtained from Explorer VIII, a definite picture of the numbers and size of these minute particles in solar orbit near the earth is emerging. Explorer VIII and Vanguard III data provide several thousand micrometeorite impact events, while the total number of impact events of all previous measurements, made by rockets and satellites, is considerably less than one thousand.

Dust Particle Discovery

Explorer VIII made a different measurement of a phenomenon first discovered by Vanguard III. On November 15–17, 1959, Vanguard III picked up a large number of micron-size dust particles. This has not been reported previously because the unravelling of data from the satellite has just been completed.

The indication from Vanguard III was that these particles could be associated with a major meteor stream. As many particles were detected during this 70-hour period in November 1959, as were found during the remainder of the 78-day period of the satellite. Explorer VIII, in November 1960, may have again seen this stream when one of its detectors sampled a different size range of particles than did Vanguard III. However, a complete picture is not available because of solar events during the same period. Data on the average number of micrometeorite

(*concluded on page* 134)

(*Right*) *Explorer VIII undergoing vibration tests.*
(*Below*) *Technicians conduct an electronic checkout of the instrumentation in Explorer VIII.*

Build these Natural Draught Convector Heaters

as described by V. G. KEVIN

A CONVECTOR heater works on the principle of hot air flowing upwards through the unit, or forced by an air blast. Generally speaking, they have no red glowing element or reflectors.

Two types are explained in detail, or modifications could be made to an old oil type convector from these instructions.

Making a 500W Convector

Fig. 1 shows how a 500W Goliath Edison screw type electric lamp is supported within a convecting chimney made from any metal container. The bottom is quite open to the air as the container is raised up at least 2½in. off the floor on rubber-covered legs.

Holes are drilled at the top to allow the warm air to escape and create an upward current of cold air. Lamps, generally, are not a good source of heat since they are "consumable," but while operating they are every bit as efficient in heat output as heater elements.

The Container

This is best blackened on the outside, but not necessarily on the inside. A small switch is mounted near the bottom on one side, use an insulated terminal type. A terminal block is fitted nearby to anchor the mains lead which passes through a rubber grommet in the side.

The Lampholder

A ceramic Goliath Edison screw holder mounted on an inverted batten type plate known as "Coughtree C 417" at electrical dealers. This plate is illustrated in Fig. 1. A ¾in. "nipple" is screwed into the C 417 batten plate *the wrong way up*. This may mean filing away a little metal to allow the threads to mate in the first instance. The nipple fits between the holder and the C 417. See Fig. 1. Two mild steel strips (½in. × ⅛in.) are cut to fit across the container. The lamp is supported on these strips with the C 417 *underneath*, and mounted as low as possible in the container.

The Legs and Wiring

The legs may be straight or curved, to the pattern shown. Do not cut down on the air gap, and for maximum stability keep them wide.

The wiring plan is given in Fig. 1. Note that the red mains lead is switched and that an earth is required. It will be found necessary to remove the lampholder supporting strips to insert a new bulb, wing nuts fitted inside the unit make this renewal easier.

The Glow Effect

If the lamp is given a coat of read heat resistant varnish it acts as an indicator that the heater is on and also gives the effect required. Never place clothes over a convector, a 500W. unit (even the lamp bulb type) could cause a fire under such conditions, as the air flow would be cut off. The unit may be operated by a thermostat of the "air type".

An Improved Three Heat Convector Heater

This unit is built for around £1 using an old serviceable oil drum. Heat is given off by two spiral elements arranged inside the drum as in Fig. 2. The hot air rises to the top of the drum and flows out of the air holes. This air flow is sufficient to keep the element at black (or almost black) heat. Thus radiation is kept to a minimum and element life is prolonged at such low temperatures.

Since the air is actually moving through the unit a room is evenly warmed in all directions, and such convection could also be controlled by an air thermostat.

It is ideal for general background heat and made to these instructions it is absolutely safe and foolproof. Three heats can be chosen at will.

Getting the Oil Drum Ready

Clean out with paraffin and chisel the top out with a sharp cold chisel and hammer. File the rough edges. The bottom of the drum is drilled with a centre hole. This now becomes the top of the heater.

Four rows of holes are then drilled around the sides of the drum (Fig. 2), they are ¼in. or more in diameter, and in each row they are 1in. or nearer to each other. The number of holes must not be reduced.

Small ⅛in or smaller holes are drilled round the bottom to take the safety wire net.

Holes have to be made in the side for the legs, and for the heater "frame," the switch and fuse, etc. However, deal with these as they are required.

The drum should be raised from the floor by at least 1½in. Make legs of strip metal as in Fig. 3 and bend to the angles suggested in a vice. Small rubber stops are fitted with small nuts and bolts and the legs are bolted to the drum evenly spaced. Three only are necessary each being fixed with large washers or a backing plate inside the drum. ¼in. Whitworth nuts and bolts will suit admirably, round heads making a neater job.

Making the Heater "Pyramid"

This is shown in Figs. 3a and 3b. The hexagonal base piece is cut to the directions of Fig. 3a, and bent to the shape shown by marking out a hexagon on a piece of paper first. Draw a circle the size of the drum with a compass making C the centre. Then put the compass point on any point on the circumference, i.e., S, and make a circle cutting the former circle at S and T. Now move the compass point to X and T and make two more circles cutting the first one at W and V. With compass point on W make one more cut on the original circle at V.

The strip is then bent, cold, in a vice to the shape shown and tested to make sure it will just fit inside the drum.

Three uprights are required as shown in Fig. 3b. Cut these to length first, drill the top and bottom holes, bend to shape and fit up as in Fig. 2. Test that the assembly will fit into the drum and can be fixed in place by the bolt which is fitted in the top of the drum.

Fixing the Insulating Split Bushes

The strip used is only ½in. wide to obviate shorts occurring and six $\frac{5}{16}$in. holes have to be drilled in each length as in Fig. 3b. Centrepop the holes carefully. Special ceramic insulating bushes are then fitted in every hole (Fig. 2). Cut off the bolts if they are too long. Test the assembly in the drum and verify that all bolts through the insulators are at least 1in. from any part of the drum.

Drill three holes in the drum to take the bolts holding the hexagon in position at the bottom. Cut some small pieces of piping, to use as spacers as shown in Fig. 2 to avoid spoiling the shape of the drum.

Positioning the Elements

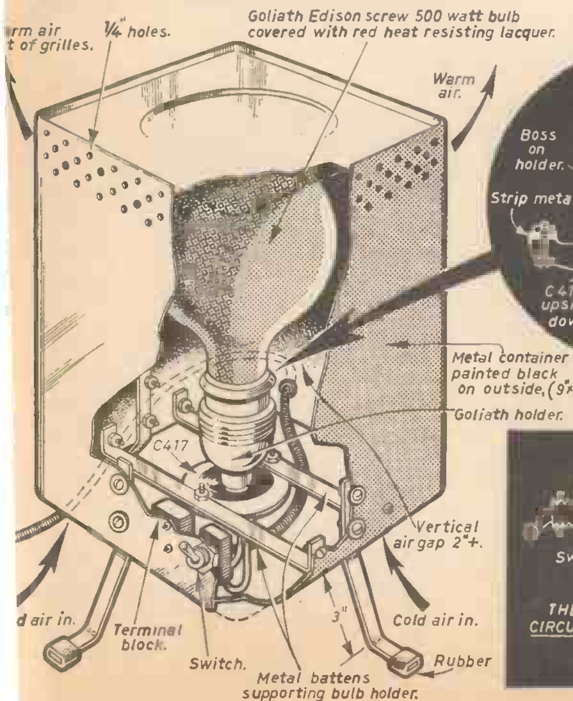
If the two elements to be fitted are 500W. each, then stretch the elements to a length of just under 3ft. 6in. each, by holding at the ends only. Starting at one bottom insulated bush, twist the wire round twice under the bolt head or nut and lead it gently round in a circle *inside* the metal supports fixing it twice round each insulated bolt head, the end of the wire being fixed round bolt head No. 7. The next element is also fixed round bolt No. 7 and continues in the same way to bolt No. 18. The elements must not be shortened, and if accidentally stretched must be "sprung" back into a spiral so that each spiral turn is equal distance from the next. If attention is not given to this the wire will glow red in places and the fire will not convect heat properly.

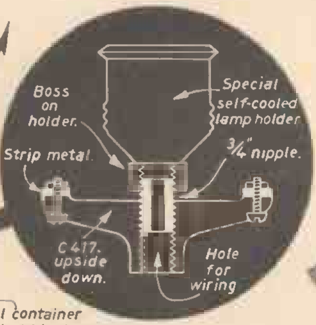
If, as in the prototype a higher wattage element is fitted at the bottom the point at which they join will be higher up the "pyramid" (Fig. 2). In the prototype the join was at No. 12. Thus the 600W. element was pulled out to a length of just under 5ft. and the 450W. element to a length of 2ft. 3in.

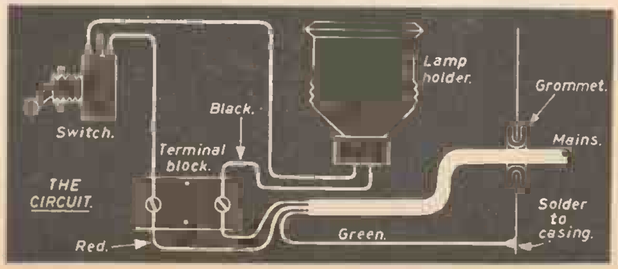
When complete tighten all the bolts, although no connections take place through the intermediate bolts, they hold the wire in the event of a breakage. Connect temporarily insulated wire to the two ends and the middle junction. Connect the middle to one side of the mains (for test purposes) and the two

500w CONVECTOR

Fig. 1 (Left).—Cutaway view showing how the unit operates. (Below) The lamp holder and circuit details, also photograph of the underneath of the unit.







outer ends to the other side. The elements should glow a dull red in subdued light. They will be duller when in the drum, due to the effect of the rising air.

Mounting the Controls

The thermostat may be fitted up in an open ended box, or the unit may be used without one, this depends on personal preference.

The switch requires a ⅜in. hole 4½in. from the drum bottom (i.e., in cool air draught), the switch is seen in Fig. 4a. And nearby a ⅜in. hole is fitted with a grommet for the mains lead, a two terminal is mounted inside the drum and the fuse holder mounted nearby in a ½in. hole (if F 155 is used the hole will be ¾in. dia.).

Wiring the Convector Heater

Attach good copper wires of at least 24g to the top, bottom and middle connecting bolts on the element, leave them quite long for the time being.

Bring in the mains lead and, following Fig. 2 solder the green lead very securely to the drum side. Give it a good pull to make sure it is well connected. Connect the red mains lead securely round one terminal of the block and take a lead on to the fuse holder. Connect the other tag of the fuse holder (do not use acid flux) to the other terminal of the block.

Take the black mains lead directly to terminal 2 (stamped on the back casing) of the switch, and take a wire also from terminal No. 2 to No. 1 on the switch. Loosen the screws on terminals 3 and 4.

Slip the element frame (tested) into place and bolt to top of container, and in the three places round the bottom. Take the thick copper wire going to the top of the element and slide over it interlocking ceramic beads so that the round (convex) part of one fits into the round (concave) part of the next until the wire is completely covered in the beads and can be connected to terminal No. 4 on the switch. Be careful not to stretch the element wires when doing this connection, and make sure the connecting wire is COMPLETELY covered.

In the same way the bottom end is connected to terminal No. 3 and the same precautions are taken. The middle lead is similarly insulated and taken to the terminal block screw already connected to the outlet from the fuse.

Testing the Wiring

Put the correct fuse in the holder. The lower value used the better, generally a 5A. should be used, but if a 3A. one will hold, use it. Heavy automobile fuses must never be used in this position.

Connect to the mains and observe that the elements get hot. Put the drum up the right way on its legs to avoid getting the elements overheated. The switch should give the following reactions:

Off—Both elements cool.
Low—The top element (450W. in prototype) only.
Medium—The bottom element (600W.) only.
High—Both elements together (1000W. plus).

The switch turns anti-clockwise from off for these reactions, but it may be turned either way directly, to the heater required.

The fuse should now be removed to make sure the instrument does not work without it.

THE PARTS REQUIRED (Second heater).

An oil drum. This is standard size, about 10¾in. dia. and 17¾in. high.
Mild steel strip, ½in. × ⅛in. 10ft. (Cost about 3d. per ft.)
Elements Prototype uses 1 600W. plus 1 450W. Two 500W. elements can be used.
Obtainable from walk round stores or Messrs. Technical Services Ltd., Shrubland Works, Banstead, Surrey.
Always buy nickel/chrome heaters for perfect safety. Cost is about 1s. 3d. each.
Insulating Bushes Buy these as " Ceramic Split Bushes." Good electrical repair shops should have these or order from Messrs. Technical Services Ltd. Cost about 3d. each.
Insulating Beads Any with an internal diameter of over $\frac{1}{10}$in. will suit. Source as per bushes.
Cable Good, well covered, three-core cable to carry 6A.
Thermostat External, No. CS 000 will suit. Messrs. Technical Services Ltd.
Switch Arcolectric C.S. 200 and Knob K 261. Obtainable from dealers. In case of difficulty write to the makers at Central Avenue, West Molesey, Surrey.
Fuse and Holder Fuse holder, Bulgin F 155 or F 55; fuse cartridge, Bulgin F 130 or F 35, see text. These are close tolerance quick action.
Terminal Block Any two terminal block will suit.
Grommets The local electrical dealer should have these.
Nuts and bolts and washers About 2 doz. ¼in. Whitworth nuts and bolts (1in. will suit).
1½ doz. ⅛in. Whitworth by 1in. nuts and bolts are required to hold the ceramic split bushes.
Other odds and ends Aluminium and gold paint. Solder. rubber feet, batten lamp holder and a 60W. mains lamp coloured or painted red. Fine wire netting (chicken wire) or see text.

Mounting the Decorative Red Reflection Lamp

A 60W. red electric lamp is mounted within the element pyramid and is fixed by making a suitable bracket to the dimensions given in Fig. 3c.

Rubber covered leads are taken underneath to the terminal block and terminal No. 2 on the switch, as shown in Fig. 2.

When plugged in to the mains whether the heater switch be at off, low, medium or high the red light will give visible warning that electricity is on, and will give the carpet an attractive red glow.

The Safety Netting

The likelihood of an element falling down after breaking and causing damage is very remote, but it is possible for a young child to put its hand up inside the heater. To prevent this, small wire mesh is fixed over the bottom secured by small holes in the drum.

The convector works well and reflected heat on to the floor is very little, the floor never getting above 110deg. F. The heater is very stable and the top reaches a temperature of about 130deg. F. this is hot to the touch, but not dangerous.

Warning

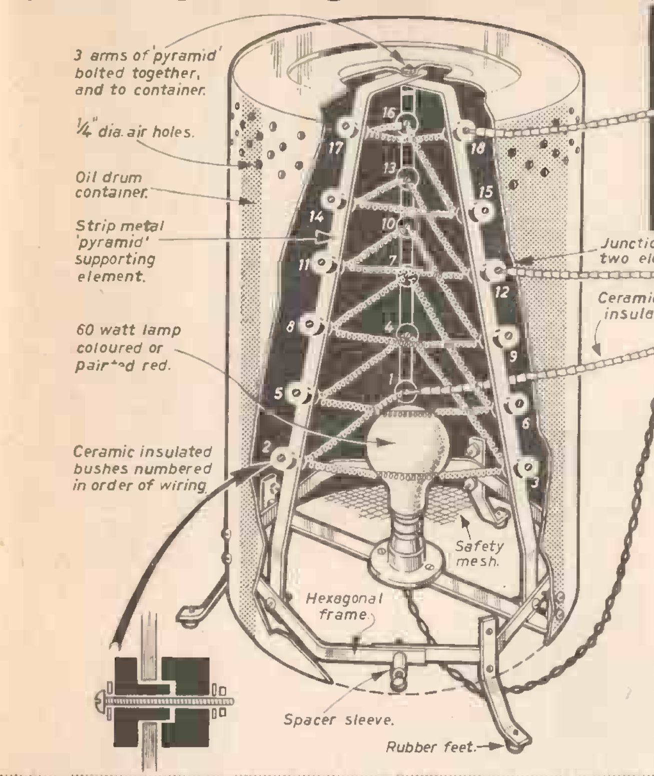
Clothes etc., must never be placed over any convector or it will overheat. In this model it is most likely that element breakage would cut the current off due to the fuse blowing. The above warning is still operative even if an air thermostat is being used.

Switches for Three Heat Settings

For the switching of two or three heating elements in any combination of series/parallel wiring, on this or any electric fire or heater, special heavy duty multi-contact switches are available.

One of these is used in the convector heater described. Most types can only be used on A.C. as (*Concluded on page* 134).

3 heat CONVECTOR



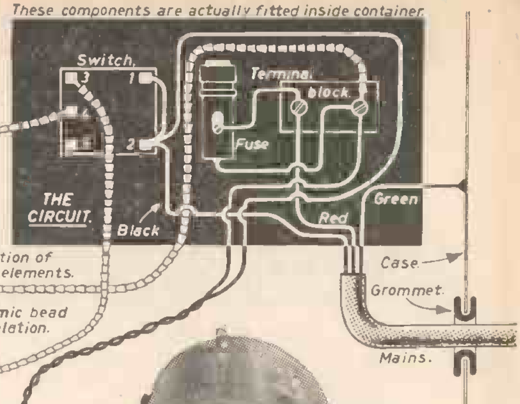


Fig. 2 (Left).—Constructional details and wiring. (Above) Bottom view showing how the element tripod is fixed and also positions of controls.

Fig. 3 (Below).—Dimensions of parts made of strip metal.

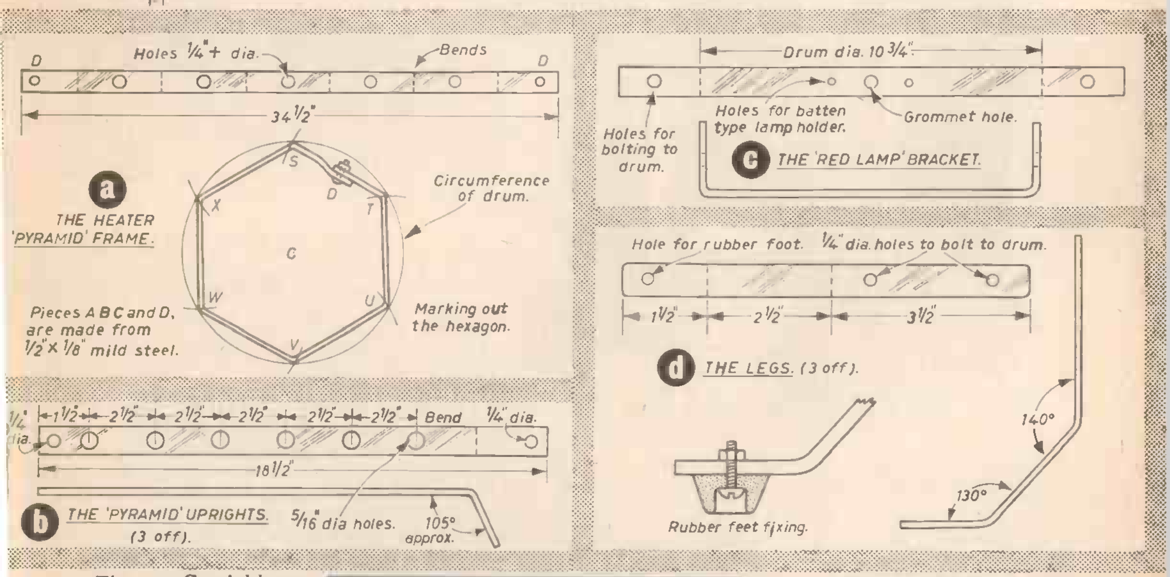


Fig. 4.—Special heavy duty multi-heat switch.

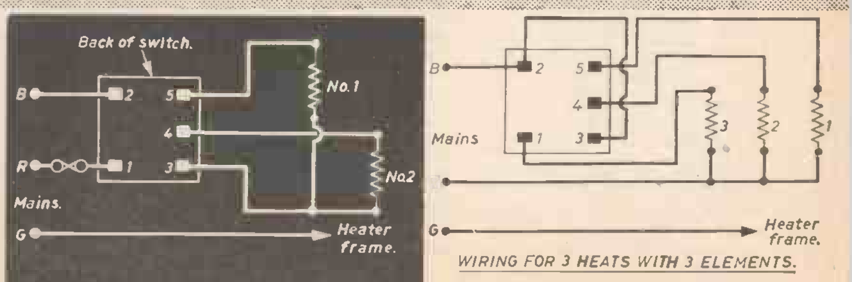


Fig. 5.—Two circuit diagrams for element switching.

BUILD YOUR OWN FOUNDRY

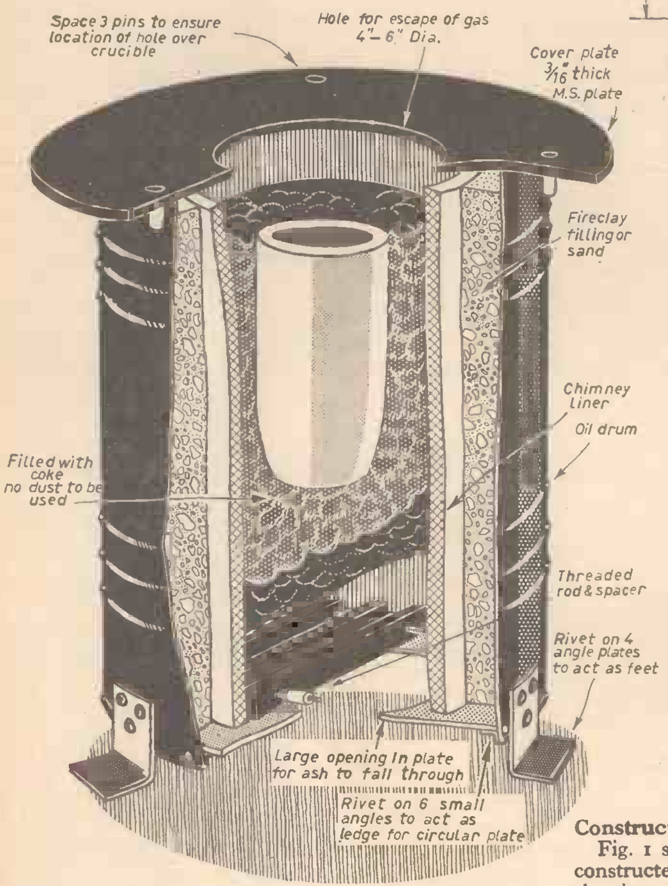


Fig. 1.—This cross section view shows how a lining is made and the method adopted for holding the lower fire bar plate.

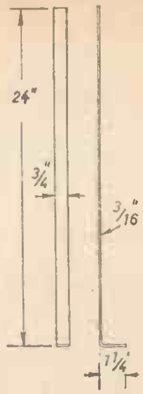


Fig. 3 (Above).—Rod used for skimming dross.

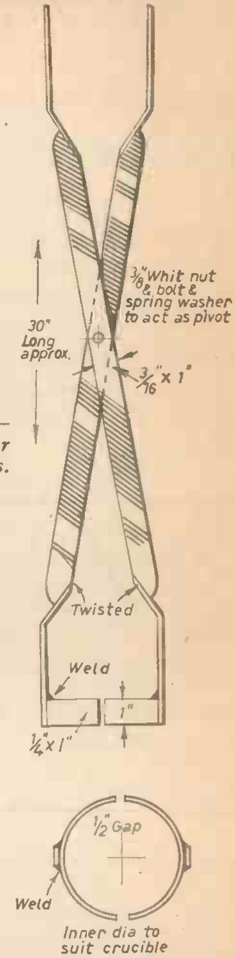


Fig. 4.—Tongs for lifting the crucible from the furnace.

By John Waller
Part 1.

A FOUNDRY in the back garden is not the ambition of every reader but there are occasions when the ability to produce a casting or so, can tremendously increase the scope of both model making and the production of various household ornaments and gadgets. The casting of all the common metals with the exception of steel is possible, and if reasonable care is taken, the work is easy and often profitable. While a reasonable degree of care is essential—burns from molten metal can often be serious—generally the danger connected with such work is exaggerated though it is preferably not performed when children are present.

Construction

Fig. 1 shows a cutaway view of the furnace. It is constructed from a 5 gallon oil or paint drum. After cleaning, a hole is cut in the bottom, about 2in. less in diameter than the drum to make a shelf against which a thicker circular piece of steel can rest. If this latter detail is cut from ⅛in. thick plate, it has a reasonable life when subjected to the heat of the furnace and is less likely to disintegrate than the thin floor of the drum.

The top of the drum is cut off. This operation and cutting the bottom are both easily accomplished if you use a chisel to make a hole—and then clip the remainder away with a pair of snips. Alternatively, sever each piece completely, using the chisel as the cutting tool.

Cut four pieces of steel and bend them to a right angle as shown in Fig. 1 to form feet and to lift the drum from the ground. Sufficient clearance is necessary to allow a vacuum cleaner pipe to pass underneath.

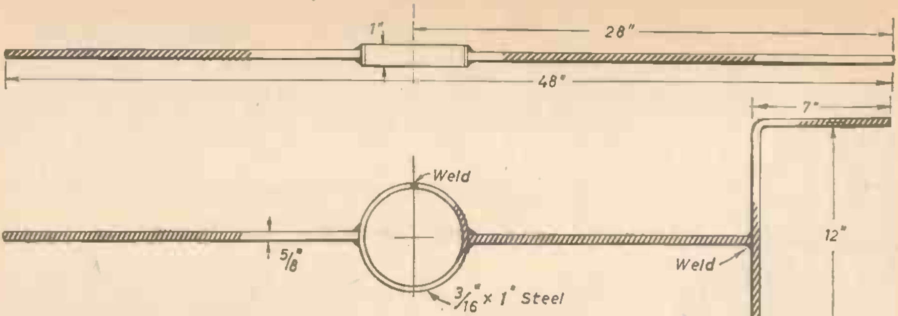
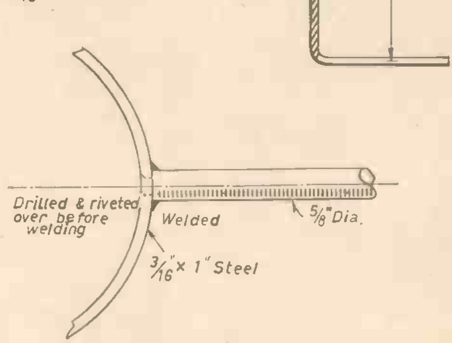


Fig. 2.—Details of the dual handle ladle.



The Lid

This is made from a $\frac{3}{16}$in. piece of M.S. plate; a circular detail looks better but as you purchase the metal as a square, there is really no point in trimming it circular. A hole approximately 4in. dia. is made in the centre to allow fumes to escape but the lid still retains much of the heat from the fire. Rivet three or four pins to this lid to allow you to centralise it with the drum. Though not really necessary, as lifting the lid with the aid of a pair of tongs is simple, a pair of handles might find favour with some readers. See that the top face of the drum is flat to allow the lid to seat correctly without any wide gap.

Liner and Fireclay

At the local builder's yard, buy a chimney liner and stand this in the centre of the drum. Fill the surrounding opening with fireclay—pack this down a little each time using a long rod for the job—and then there are no weak spots which can break down and afterwards cause trouble. Carry on the filling until the top is reached and level this off with a trowel.

You could actually dispense with the liner and attempt to trowel the fireclay into place but this takes time especially as a 2in. thickness is required. Though the liner may eventually crack and fall away due to the high temperature, the initial establishment of the thick layer of clay is much more quickly accomplished and repair work is not a difficult task.

You can, as an economy measure, use old firebrick mixed with new fireclay in the ratio of 1 to 1 for the lining, but finish off the interior, if you do not intend using a liner, with a layer of new material to a depth of $\frac{1}{2}$in.

Allow this lining to harden slowly. Covering with old sacks and allowing to stand for about a week in the garage is the best way to perform this drying operation. When the surface is dry, bring it once more into the garden and light a small fire—and the emphasis is on the word small—in the furnace and keep this going with chips about 3in. long for two or three hours. Do not make the blaze too fierce: a slow drying action is all you need.

Firebars

The final constructional details are the firebars and though you can purchase heat resisting material, ordinary mild steel will last a fair time before it requires renewing. Cut these items to span the hole in the lower disc, allow about $\frac{3}{4}$in. between them and you can, if you wish, bolt these together with a spacing washer between them.

Remember that the future handling of this furnace requires care. Do not drop it or knock it over at any time and so damage the fireclay lining. When the latter shows signs of disintegrating, gently break away the old material and replace it with fresh clay, allowing it to dry, of course, before putting the furnace to use again.

A unit of this type requires a generous air blast in order to accomplish the necessary degree of heat and an old vacuum cleaner is necessary. One of the barrel type is ideal.

The fire is lit using pieces of wood well soaked in paraffin and after packing the coke round the crucible as shown in Fig. 1, turn on the fan and keep it going until the metal has reached a molten condition. Some cinders will fall through the bars and could contact the pipe so bend a piece of steel to act as a shield.

Brass, aluminium and iron are the three most popular metals you will use for casting, and though the latter requires a higher temperature than the other two, there are numerous occasions when an iron casting could be useful.

The manipulation of a pot of molten metal is not difficult if the correct tools are available, and as these are easily made in the home workshop from black bar material the final cost is negligible.

Tongs

Lifting the pot from the furnace requires a substantial pair of tongs and the type shown in Fig. 4 are a smaller version of the design used in an engineering foundry. Before attempting the construction the diameter of a pot must be known and the reader is advised to use only one make and size. This means, of course, only a single pair of tongs is necessary. The rim which locates and grips the pot is welded to the handles—a job for the local garage who are generally prepared to carry out this work. The twists which appear at the top and bottom of each handle are made by first heating the bars to a bright red. Then quickly gripping them in the vice with the jaws close to the point of twist, a spanner is applied for turning the bar at right angles. Readers will find that, whereas an attempt at bending with the bar in the cold state is difficult and requires heavy pressure, a properly heated bar will twist without any trouble. Leave it to cool naturally, say overnight, as this is preferable to plunging the material into water.

(*Continued on page* 142).

'BEHEADED'

This fascinating illusion can be carried out by using the simple apparatus described here by E. Hawksworth

"BEHEADED" is an original "sawing-a-woman-in-half" illusion using an ordinary-looking carpenter's saw for the apparent decapitation. The saw can be examined both before and after the trick to prove absence of deception and any lady from the audience may be invited to participate in the illusion. The complete outfit packs flat for easy carrying and construction is of hardboard, ply and thin aluminium sheet costing about 15s. in all.

Making the Saws

Two saws are used in the trick—a plain saw that can be examined and a "U" frame saw that remains partly concealed during the performance. Fig. 1. Both saws are made of thin aluminium—16 gauge is ideal but the thinner 20 gauge will do when cost has to be considered. The handles are cut from 3/16in. plywood.

The plain saw blade is 23½in. long tapering from 4in. at the handle end to a 2in. width at the nose. Teeth of the saw are cut to a ¾in. pitch and are ½in. deep and the upper nose end of the blade is slightly rounded. Mark out the handle on a piece of plywood 6in. × 4in. after drawing a grid of 1in. squares as copy reference and fret out the shape. Use this finished handle to mark out a duplicate component for the "U" frame saw.

The second saw is cut from a piece of aluminium measuring 10in. × 15½in. Mark out the "U" frame to the dimensions given and shear or saw out the frame centre. Front and rear portion of the actual saw blade can be cut from removed centre portion of the sheet. The handle end measures 5in. × 4in. and the nose end 7in. × 2½in. After cutting the teeth, the blade ends can be riveted as shown to the legs of the "U" frame.

Handle grips are well sanded and the leading edges given a chamfer before fixing to the blades with ⅛in. dia. rivets. Hammer the rivet heads flat and clean up with a fine file. Copper dome-head rivets are best as countersunk rivets would not have enough head in the thin ply and metal sheet after peening over. Two ⅛in. holes are drilled in the blades of the "U" frame saw for the elastic rasp attachment.

Saw Pocket Boards

The boards for the saw frame are cut from thin hardboard although ⅛in. plywood could be used for a lighter job. Face board measures 28in. × 19in. and is marked out to the dimensions of Fig. 2. First find the centre of the sheet using diagonals from each corner and mark the 9in. dia. centre hole. Round off the ends of the board with 14in. radius curves taken from the centre then saw out the shape. Use this first piece to mark out two more boards. This second pair has cut-away sections in the top curved edge for speedy location of the saw handles during operation of the illusion.

Packing pieces of 3/16in. thick plywood are sandwiched between this second pair of saw pocket boards in the positions indicated. First, a packing ring is sawn to go inside the 9in. dia. head hole—this may be cut as a complete ring ⅜in. thick or may be built up of segments of a circle—and then suitable strips of the plywood are tacked round the edges of the bottom sheet as shown. The packing ring can also be tacked to the bottom sheet at this stage.

The face board has 3/16in. strips tacked to its back to form the saw housing for the plain saw. Notice how these wood strips on the back of the face board are cut away level with the head hole so that the plain saw can be passed through at one stage of the performing routine.

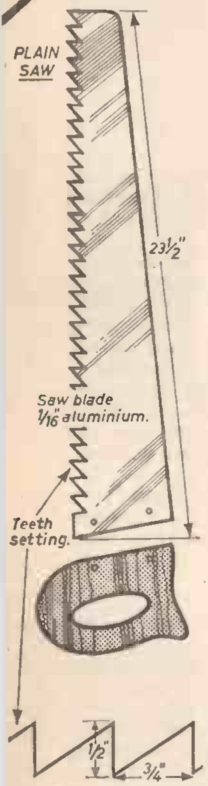
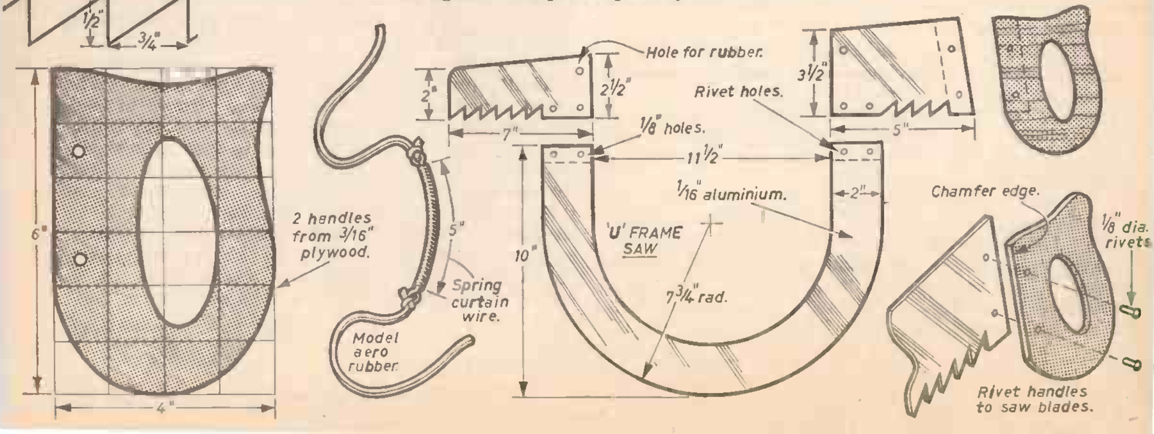


Fig. 1.—Component parts of both saws.



Assembling the Components

Fig. 3 shows the complete assembly with the two saws in position. Before the "U" frame saw can be located round the packing ring the elastic rasp attachment must be made and added. The rasp serves a dual role in keeping the "U" frame between the lower boards and producing a sawing noise when the short length of spring curtain wire is drawn back and forth over an inset metal knife-edge in the packing ring. Pieces of aero elastic are tied to the screw eyes of the curtain spring and the holes in the "U" frame blades. Tension of the elastic must be sufficient to keep the lower part of the "U" frame in contact with the internal packing ring but still allow the saw to be rotated easily about the ring.

The three boards with intermediate packing strips can be finally assembled with panel pins and the face board painted. Use one colour—green or red—for the board then line the head hole and the edge of the board with yellow. These contrasting bands have the effect of making the board look smaller than it actually is.

Rear view of the board—Fig. 4—shows the position of both saws in their respective saw pockets and also shows how the plain saw can be pushed sideways through the board—blade going between the packing strips as already explained. The plain saw must slide easily into and out of the top saw pocket and the handle must be easily accessible for the fingers in the cut-away sections of the boards.

During the routine, the "U" frame saw is rotated from the position shown and moved down the board with a sawing action. Stroke of the saw is about 2in. and the sound of the rasp spring gives a vivid illusion of a real saw in action. Of course, the assistant's head fills the hole and hides the fact of the saw having no centre. As the saw is moved down past the head hole the elastic stretches under the pressure of your hand. When the trick is completed, the "U" frame saw is allowed to return with the tension of the elastic cord. The saw is then rotated to its pocketed position and the plain saw withdrawn from its housing for inspection.

Presenting the Trick

At the start of the illusion, the plain saw is lying on a table and the board is resting against one of the front table legs—face board to the audience and flat edge to the floor. A lady is invited to assist in the trick and she is seated and given the saw to inspect.

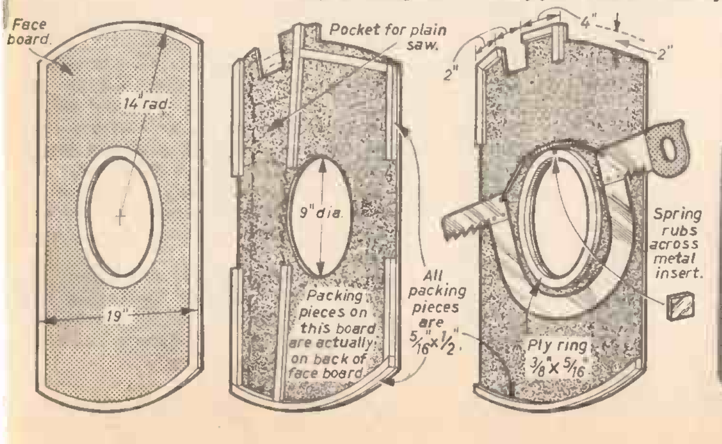
The performer takes up the board with the handle's end uppermost and pushes the plain saw horizontally through the side slots of the front saw pocket. Stage 1 of Fig. 4. Then, the board is held by the lady on her lap and she is asked to push her head through the hole. The board is turned to an angle of about 45 degrees—Stage 2—and the plain saw is inserted into the saw pocket. As soon as the handle is out of sight, the performer's hand catches and rotates the handle of the "U" frame saw into view. Explaining that the audience will see better if the board is upright, he tilts the board to a vertical position—Stage 3.

The saw is stroked back and forth bringing the rasp into action and the blade moved down the cut. Take the blade down as far as it will go and then let it return to its upper position.

Complete the trick by turning the board to Stage 2 position, pushing the "U" frame saw back into its pocket and smoothly withdrawing the plain saw. Put the board on the table and pass the saw to the audience for inspection.

Fig. 4. (Above)—(Stage 1). Plain saw is pushed through slide slots. (Stage 2). Plain saw is pushed into saw pocket. (Stage 3). "U" frame saw is rotated from rear saw pocket to complete the illusion of "sawing off" head.

Fig. 2.—Exploded view of face board assembly.



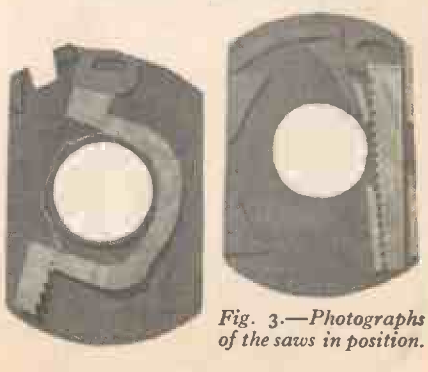
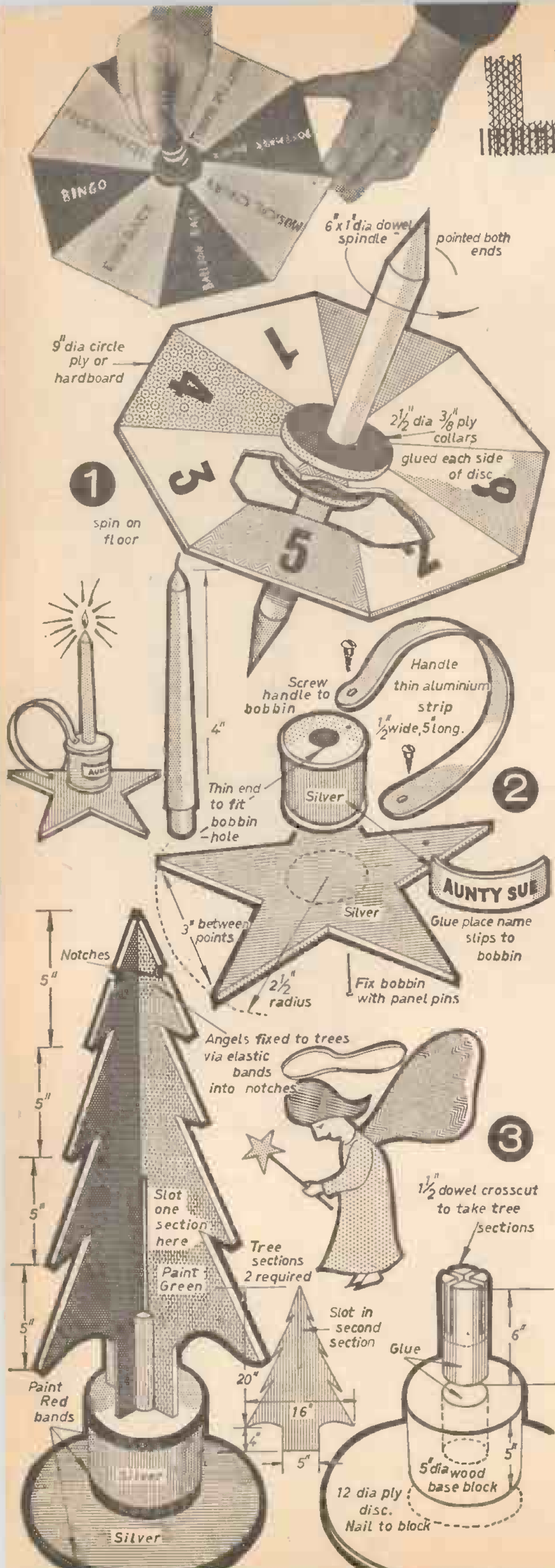


Fig. 3.—Photographs of the saws in position.

LET'S make

Add brightness and safet… making the novelties desc…



MAKE this pair of robust fir trees for your front porch. Two sheets of hardboard or thin plywood measuring 16in. × 24in. are required for each tree (Fig. 3). Pencil a centre line down each sheet and mark out the branch lines on one piece. After cutting out, this first shape can be used to pencil the outline of the other tree halves.

Tree sections fit together by means of two slots cut midway on the centrelines. One section has its slot cut from the base upwards to the middle of the tree and the other sheet is slotted from the top downwards. The slots should be as wide as the hardboard or ply is thick to ensure a good sliding fit.

A base for the tree is built up as shown using a 5in. dia. wood block—a square base would do equally well—and a 12in. dia. disc of ply screwed to the bottom to steady the tree. Actual tree halves are secured to the base by setting them into cross-cut slots in a piece of 1½in. dia. dowel that is recessed into the base block. Thus, each tree can be dismantled and packed away flat when the decorations are taken down. Paint the tree halves green and the base silver and red. Saw out small notches near the tip of each tree to hold green elastic bands for securing the little angels.

Illuminated Greeting Box

A BOX for the sign is built of ⅜in. thick plywood and measures 4in. × 4in. × 18¾in. long. The box is open fronted—Fig. 4—and has several ½in. ventilation holes drilled in top and base. Screw a mains type bulb holder into the box to take a small, 240V., 40W. light bulb and thread the twin flex through a hole in the top of the case.

Recess bead strips are tacked into each end of the box to hold the strip of hammered or fluted glass and fretted greetings sign. Mark out the sign letters 2in. high, neatly spaced along the ply strip, and cut out with fret saw. Tack two retaining strips across the sign board to keep board and glass in place. Pieces of coloured Cellophane could be glued across the back of the fretted out letters to produce a multi-coloured greeting.

Hang the box with two screw hooks and chain in a suitable location over the front door. Run the flex—this must be mains voltage type—up the chain and into the hall lamp by means of a double connector.

Star Candle Holder

MARK out the stars on ¼in. plywood by pencilling a 5in. dia. circle and stepping off at 3in. stations round the circumference the star points (Fig. 2), use a ruler to join up the dots to make the five-pointed star. After sawing, tack an empty cotton spool to the star's centre and make a handle out of a strip of thin aluminium. Household aluminium cooking foil could be used if a piece were cut and folded several times. Fix to the candle holder with small screws or tacks.

Paint the star and bobbin silver, and colour the edges red. Fit 4in. high coloured Christmas tree candles by thinning the bottoms to fit the bobbin holes. Neatly print your guests' names on white paper slips and glue to the candlesticks.

Fig. 1.—The wheel of fortune. Fig. 2.—Christmas candles. Fig. 3.—Trees for the porch.

...T a PARTY

...ty to your Christmas by
...cribed here by E. H. Brook

Safety Tub for the Christmas Tree

EVERY season brings its crop of accidents through insecure Christmas trees. Construction of a safety tub with a row of ballast bricks and fold-over locking lids does away with make-shift arrangements and provides stability.

Make the tub of planed 1in. thick boards to the widths given in Fig. 6. Use 1½in. × 1½in. planed wood in the corners to join the boards and make a strong job of assembling with woodscrews. The tub is 17in. square at the base and 19in. round the top. Overall height is 16in. including the 3in. × 2in. battens underneath and the 1in. thick locking lids.

The lids are 19in. long by 9½in. wide and have a half circle hole cut in each. After a tree is loaded into the tub, the lids can be folded down to grip the trunk or wedges can be fitted if the tree is on the small side. Hinge the lids with flat mounted butts.

Rope handles are knotted into drilled holes and a decorative plywood or hardboard star is cut and tacked to the front of the tub. Paint the tub red and the star yellow and pack a row of clean bricks into the base.

Wheel of Fortune

THE party game and forfeits selector disc is an eight-sided wheel with a list of suitable games written on one side and numbers 1 to 8 on the other. Draw a 9in. dia. circle on plywood or hardboard and mark off the flats at 3½in. spacings. Saw out and drill a 1in. hole through the centre (Fig. 1).

The spindle is a 6in. length of 1in. dia. dowel pointed at each end for easy spinning. It is fixed into the wheel by means of two ⅜in. plywood collars, 2½in. dia. which are glued each side the disc. Paint the numbers with an artist's brush but the game names can be printed on paper slips and stuck on the reverse side of the wheel of fortune.

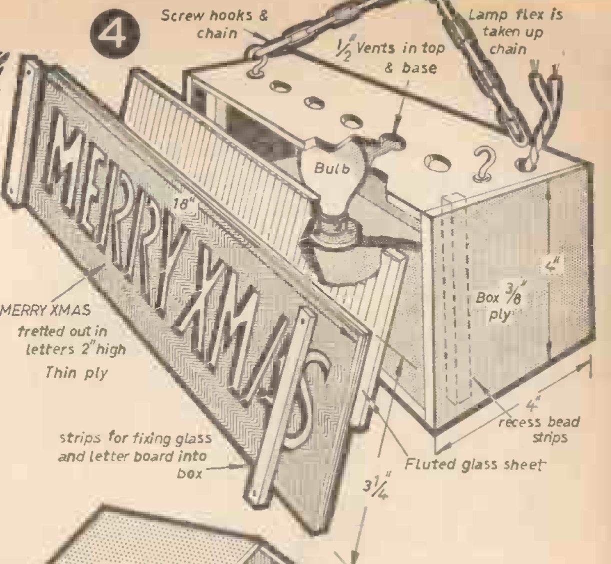
Lucky-Dip Wishing Well

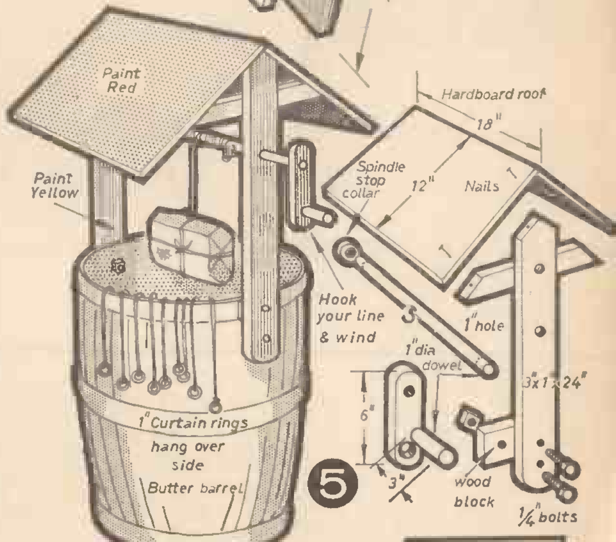
Party prizes or presents are wound out of the wishing well after selecting a cord and hooking its ring on the winding spindle. Fig. 5. Supports for the canopy are 24in. lengths of 3in. × 1in. rounded at the base and pointed at the top. Holes are drilled to take the mounting bolts and the 1in. dia. spindle in the positions indicated.

The canopy roof comprises two sheets of hardboard 18in. × 12in. which are nailed to the supports and cross arms. The spindle should rotate easily in the holes. The handle unit and spindle stop collar are glued and pinned at each end. Fix a screw hook into the spindle for hooking the parcels.

A butter barrel from the grocers makes an ideal well base although a square hardboard tub could easily be constructed on a light frame. Bolt the supports to the barrel, using packing blocks where necessary, and the wishing well is ready for painting. The barrel can be brown, supports yellow and the top red.

Tie cords on to the wrapped gift parcels and fix the cord ends to 1in. curtain rings. Load the parcels into the well and let the cords hang over the barrel side ready for party time.





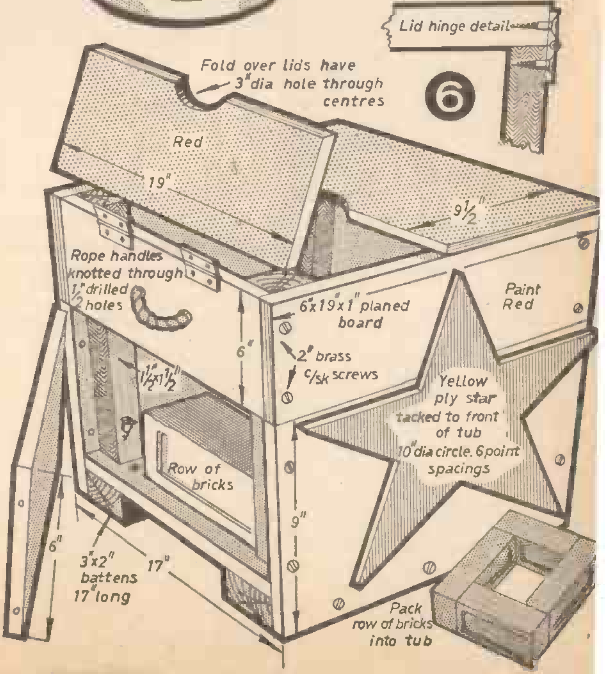


Fig. 4.—Greeting box.
Fig. 5.—The lucky-dip wishing well.
Fig. 6.—Safety tub for the Christmas tree.

C. C. Somerville

PUPPET WITH that

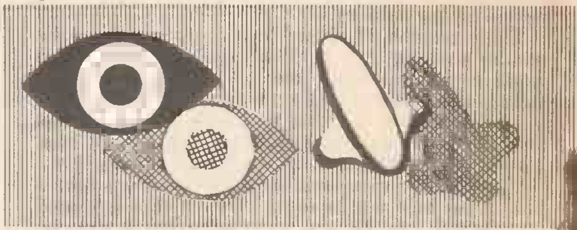


Fig. 1.—The eyes and nose are moulded on separately.

Fig. 3.—The rough position of nose, mouth and eyes are marked.

Fig. 4.—The character of the face begins to emerge.

Fig. 5.—The mouth and ears are added.

ONE of the latest developments in puppetry is to give the characters flexible faces which can smile, wink, grimace or contort their features at the will of the operator. Flexible features were first used on puppets in a commercial film where they were controlled by hidden electro-magnets beneath a "latex skin." The puppet described in this article is hand operated but does utilise the same latex construction.

Modelling the Head

The head is first formed in modelling clay from which a two-piece plaster mould is made. Liquid latex is poured into this mould and dries as a strong flexible duplicate of the original model. A gallon tin of latex (soft toy mix) is available from Macadam, Ltd., 5 Lloyds Avenue, London E.C.3 and the plaster of Paris, which should be " Dental " quality can be obtained from Boots Chemist.

Fig. 9.—Plaster is poured round one side of the head.

describes how to make

PETS FACES *move*

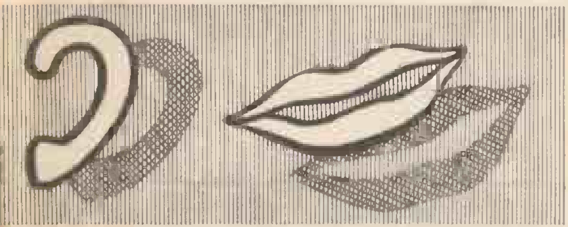


Fig. 2.—The mouth and ears are also added separately.

Fig. 6.—The character of the face is now complete.

Fig. 7.—Position of operator's fingers.

Fig. 8.—Cardboard wall built around head.

The head is first modelled on a stand similar to that shown in the photographs. This consists of a piece of broom handle set into a solid baseboard. The head is first given a very rough oval shape with a very thick neck as in Fig. 3. On to this the rough position of the eyes, nose and mouth are indicated with a modelling tool. The next stage is to add blobs of clay in these positions (Fig. 4). The eyes start as mere buttons while the nose and lips begin as sausage shapes. Figs. 1 and 2 show in some detail the formation of the various features. These are next smoothed into the head, carefully turning it so that it looks well full face and in profile (Figs. 4 and 5). The character of the face is, of course, a matter of personal choice, but make the modelling very bold (Fig. 6) for this will greatly assist in manipulation of the face. For instance, if a puppet is to wink, then it should be given large eyes and very prominent brows. A further point to watch in this initial modelling is to ensure

Fig. 10.—When one half of the mould has set, the cardboard wall can be removed.

Fig. 11.—*Separate mould and remove original modelling clay model.*

that the neck is wide enough to take the operator's three fingers, for, unlike the usual sleeve puppet, this requires manipulation inside the head.

The Plaster Mould

A cardboard wall must be built around the head in line with the puppet's ears (Fig. 8) and should be about 1½in. wide. A quantity of the plaster is then mixed to a smooth, creamy constituency and poured around one side of the head, Fig. 9 and left for an hour to dry.

Most text-books say that the plaster should be added to the water but I favour the exact opposite. Put three cupsful of plaster in an enamel bowl, add a little liquid detergent to prevent lumps and air bubbles, and then begin adding water gradually, stirring all the time until the required constituency is gained. The procedure is very much the same as for mixing cement. Use a spoon to pile the wet plaster around the model, patting gently to ensure that every crevice is filled. When an overall thickness of at least 1in. has been attained the outside surface of the mould can be roughly smoothed and left to dry.

When thoroughly dry the cardboard wall should be peeled away and the exposed wall of the mould greased with cooking fat. The second half of the mould can now be poured (Fig. 10). When both halves of the mould are dry they are separated and the original clay model removed (Fig. 11). The insides of the two moulds should be thoroughly cleaned from bits of clay and grease and then fitted together and securely tied as shown in Fig. 12.

The Rubber Head

Pour the rubber mixture through the neck-hole into the mould, a little at a time, and carefully so as not to catch air bubbles in the nose or chin. Hold the mould to one side and fill the face first, then fill up the mould completely. Leave for about three-quarters of an hour, then pour off the excess latex. A deposit will be left clinging to the walls of the mould. This skin should be left to dry overnight. The head can now be completely removed from the mould when it is left a little longer to dry. Then it must be cleaned by scrubbing with an old tooth brush and plain water.

Painting and Dress

The head is painted either with the flexible rubber paint available from Macadam Ltd., or else with coloured waterproof inks mixed with some of the latex liquid. When dry the whole head, inside and out, should be dusted with french chalk, zinc stearate or talcum powder.

The dressing of the puppet follows the standard method for glove puppets. A basic garment is cut from strong material to the size of the operator's hand (Fig. 13). This can either be black or flesh coloured. The costume of the puppet is then built on to this basic gown in the style of doll's clothes. The way the gown is worn on the hand is illustrated in Fig. 7. The hands of the puppet can either be felt mittens or else made in modelling clay and cast in the same way as the head. If this plan is followed, the hands should be modelled flat. You can afford to make the hands large as they add to the expressiveness of the puppet.

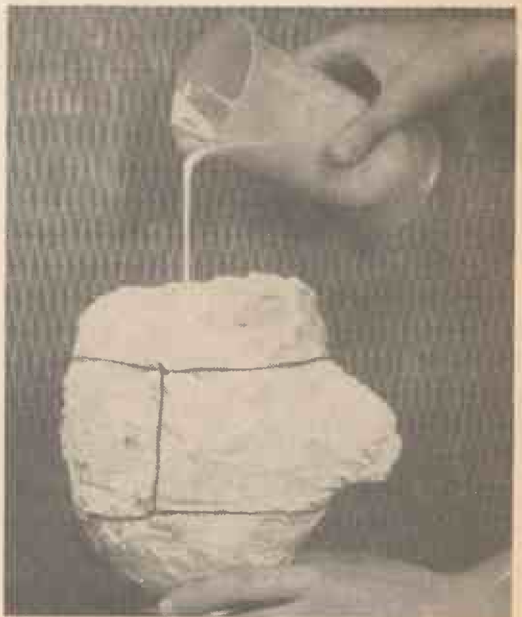


Fig. 12.—*Tie the moulds together and pour latex through the neck hole.*

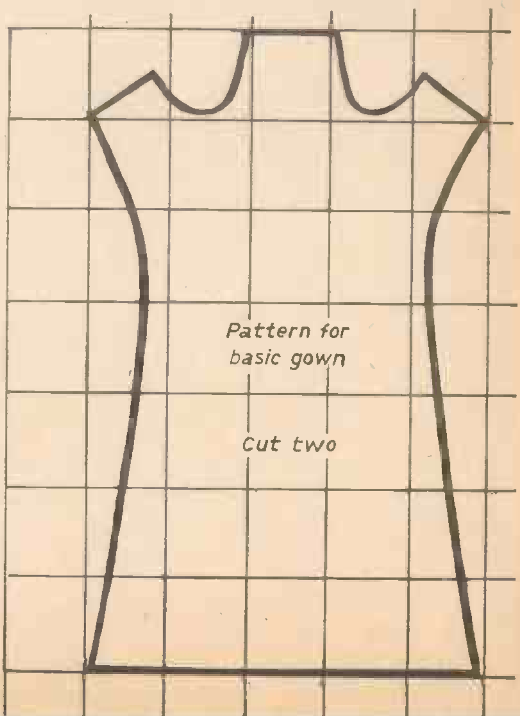


Fig. 13.—*Pattern showing method of cutting the costume.*

an easy to make SAW BENCH

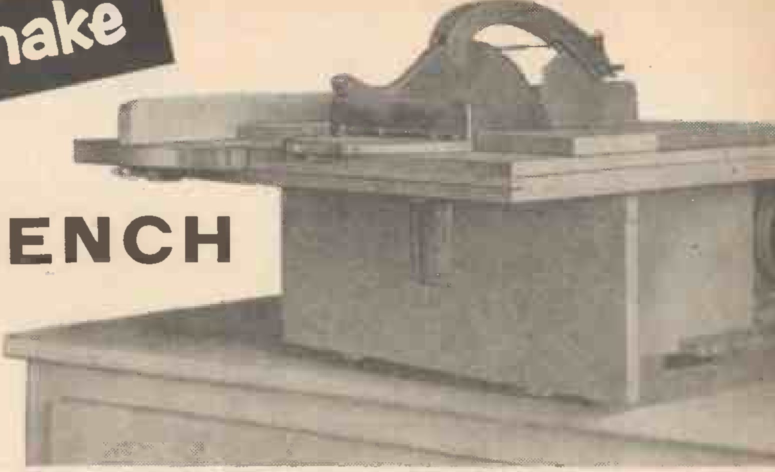


Fig. 1.—*The completed saw bench ready for use.*

described by Jameson Errol

As will be seen from Fig. 1, this compact bench follows a box-like construction with a hinged lid which acts as the saw table. It is intended to rest on a baseboard carrying the motor which is positioned outside the box. The author has made a number of machines, all of which rest on the motor baseboard and thus enable one motor to be used.

For this reason sizes are optional and will depend entirely upon the type and size of motor employed and the board on which it is mounted. It can, of course, be made up for use with its own motor, in which case the latter can well be contained within the box carrying the saw unit. If this is done, it is advisable to fit a hardboard partition between the unit and the motor to confine the sawdust.

The Unit and Table

The size of the table is liberal—26in. × 20in.—and is made from ½in. plywood strengthened all round with 1in. × 1in. edging glued and screwed from the underside. Fig. 3 is a cutaway view of the complete assembly and shows that the box is much smaller than the table. It comfortably contains the saw unit which is mounted on the bottom of the box.

This is an "Empire" unit manufactured by Messrs. S. & G. Sergent of Costessey, Norwich, Norfolk, and costs £3 6s. It is sturdy yet compact and will take up to 12in. dia. saw. High speed ball-bearings are fitted and a standard type 2½in. vee pulley of "A" section for ½in. belt. Since, however, there are accepted speeds at which varying sized saws will work most efficiently, the author asked for a 2in. pulley to be fitted. This is run direct from the 5in. pulley on the motor which makes 1,425 r.p.m., thus giving to the saw a spherical speed of about 5,600 f.p.m., which is reasonable with a 7in. saw. As saws get larger, a spherical speed in the region of 10,000 f.p.m. is aimed at. If the constructor's motor runs at 3,000 r.p.m.—as many do—the 2½in. vee pulley can be used running off a 3in. pulley on the motor for a 6in. saw or off a 2½in. pulley for a 7in. saw. Work out the size of the pulley you will need and, when ordering the unit, ask the makers to supply that size.

Fig. 2.—Table completely raised for saw changing. Note enlarged hole for wobble saw and indent for belt clearance.

Box and Frame

There is no need to go into minute details of the box construction as its size and, possibly, its shape will vary so much, but from Fig. 3 it will be seen that the table is carried by a halved framework of 2in. × 1in. and 1in. × 1 in. where it falls outside the walls of the box. The table itself being perfectly rigid, this frame support is quite adequate and, it will be noted, the front of the box is extended to nearly the full width of the table and furnishes strong support near the saw blade—where it is most needed. Note the groove cut in the face of the front edging piece to accommodate the mild steel guide fixed to the ripping fence head (A in Fig. 3). The back edge of the table is hinged to the back of the frame with a pair of strong 3in. brass hinges which must be of good quality and free from any "play." Do not attempt to cut the hole for the saw nor the grooves for the mitre fence at this stage.

The Saw Slits

Fix the unit, with saw attached, to the base of the box allowing the blade to clear the front by about 1in.

Connect up with the motor, raise the table (already resting on the saw) and switch on. Now gently lower the table and let the saw gradually cut through it. The top should then be removed and the inset for wobble saw cut. C in Fig. 3 shows this detail. An inset of ⅛in. hardboard is cut 1¾in. wide and 7in long, and two C/S holes made to carry No. 4 wood screws. A recess ⅛in. deep is cut into the top of the table to accommodate this, placing it so that the saw cut will be in a central position. Equally each side, the saw cut is enlarged to a width of ¾in.; this will allow entry for a wobble saw blade which usually does not cut to a greater width than ⅝in. Now screw on the piece of hardboard, fix the table to the frame, raise slightly and switch on the motor. Gently lower the table and let the ordinary saw (not a wobble saw) cut its own slot in the hardboard. Raise the table and clean up the edges of the cut with a small file so that they just clear the saw at all points.

The grooves for the mitre fence may now be cut after removing the table from the frame. If a mitre gauge as shown at D is to be used, the inside edges of the grooves should be cut approximately 3¾in. from the nearside edge of the saw blade. The grooves are ¾in. wide and $\frac{3}{16}$in. deep.

If it has been found that the top of the vee belt tends to drag on the underside of the table, a slight grooved indent should be cut to give belt clearance. The drag could be eliminated by increasing the height of the frame but this is not advisable since it would reduce the depth of cut and, as a 6in. saw gives only approximately 1¾in. depth of cut, diminution is to be avoided.

Rise-and-Fall Mechanism

This can be seen in Fig. 2, and E, Fig. 3 gives details of the method employed and its construction. Two brackets fit on the underside of the table and have, between their flanges, a pin carrying a length of ⅜in. Whitworth rodding (or a bolt with the head removed will do). Two similar brackets are fixed on the front of the box at right-angles to the other two, and these are placed so that their flanges are $\frac{9}{16}$in. apart as shown. The gap between them carries a knurled wheel threaded centrally ⅜in. Whitworth; the holes in the flanges are bored to clear ⅜in. Thus, rotation of the knurled wheel increases or decreases the distance between the two pairs of brackets and causes the table to rise or fall. Only ½in. No. 6 wood screws can be used to fix the top brackets to the underside or the table—since the latter is only ½in. thick—but ¾in. screws may be employed to fix the bottom brackets to the box face.

The size of the knurled wheel is quite elastic

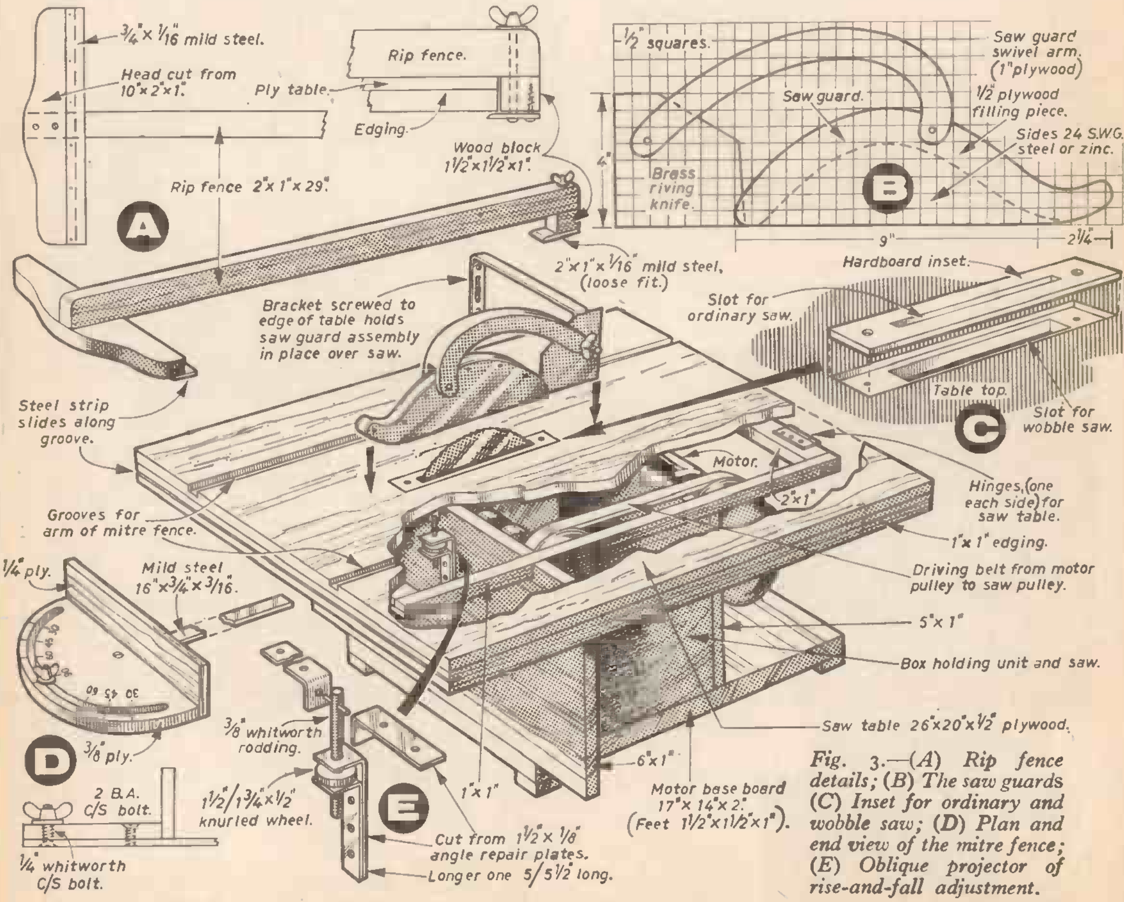


Fig. 3.—(A) Rip fence details; (B) The saw guards (C) Inset for ordinary and wobble saw; (D) Plan and end view of the mitre fence; (E) Oblique projector of rise-and-fall adjustment.

Fig. 4.—Table raised for groove cutting with rip fence fixed for multiple spacing and saw guard raised to clear wobble saw.

within reason, but it must be remembered that the position of the two ⅜in. clearance holes in the brackets must allow the back of the wheel to clear the face of the rear bracket. Fig. 4 shows the mechanism in use, the saw blade projecting only ¼in., and Fig. 2 shows it completely unthreaded in order to " get at the works " for changing saws and clearing sawdust.

The Ripping Fence

This is of sturdy construction and generous depth, is easily moved yet locks immovably, and is not difficult to make. Details are given at A, Fig. 3 and these call for little comment. Be sure that the wood chosen for the blade is perfectly straight and square, and take care that the head is set at an accurate right-angle. The toe-locking device incorporates a loose mild steel plate as shown; this is brought close up to the underside of the table edging by means of a ¼in. bolt furnished with a wingnut. The plate is prevented from turning by the addition of an ordinary R/H wood screw which, however, is *not* screwed home, *i.e.*, the plate is allowed to lie about 1/16in. away from the wood block—to permit ease of movement—but grips tightly when the wingnut is brought into action.

A somewhat similar fitting was added at the head of the fence—it can be seen in Figs. 1 and 4—but it was found that the fence locks adequately without it.

The Mitre Fence

This is an extremely useful accessory to any saw bench—it may almost be called a " must "—and the type shown at D is not too difficult to make if care be taken when cutting the semi-circular slot in which the clamping-bolt rides. Its total width is 7in. and the ¼in. wide slot is cut ⅜in. from the edge. The front of the fence, against which the work will rest, must be perfectly flat and at right-angles to the table when in use. The degrees can be marked with a protractor and, of course, a fuller scale than that shown may be inscribed if desired. The 2 B.A. bolt on which the fence swivels is a thread-fit into the mild steel bar; it should be screwed home as tightly as possible consistent with reasonably easy movement of the fence.

One method of cutting the semi-circular hole—apart from use of a fret saw—is to drill a number of 3/16in. holes as closely together as practicable, and then finish with a coarse file or thin rasp.

Saw Guard and Riving Knife

B in Fig. 3 shows a scaled layout of this accessory. This design is in almost universal use now and possesses many advantages over the earlier types. The joints are loose fits and the guard and its swivel self-adjusting. The wood being sawn lifts the nose of the guard as it is pushed forward and the work passes smoothly along without undue friction. As the cut nears completion the nose begins to fall and the guard eventually comes to rest in direct contact with the table. Thus, at no time is any part of the revolving saw unguarded when work is being done.

The function of the riving knife is to prevent the cut ends of timber tending to close together and thus bind on the saw; this would certainly happen when long timber is being cut. The knife, therefore, should be a shade less thick than the saw-cut is wide; 16 s.w.g. brass will be found a suitable thickness to use. When the wobble saw is in use, as for groove cutting, both guard and knife must be removed, but since only a small portion of the saw is above the table level and the wood being grooved covers it as it passes along, no accident will happen if liberties are not taken.

The swivel arm is of 1in. plywood hollowed out at the ends as necessary to allow it to swing over the riving knife at the back and to permit the guard to swing freely at the front end. The guard is composed of two pieces of 22 or 24 s.w.g. sheet zinc separated by a suitably curved piece of ¼in. plywood the inner edge of which rides about ¼in. above the saw when at its full height. It is much better to use zinc than sheet iron since it is so much softer than the saw and will not cause damage should it be pushed into contact while the saw is running. Note that the design is for a 6in. saw; if a larger one is used, the inside curve must be altered accordingly.

Using the Saw

It is not proposed to go into details regarding the general use of a circular saw since it is assumed the constructor will already be conversant with its operation. A few hints, however, may not be out of place.

It is essential to ensure that the saw unit is set in the box in such a way that the blade is exactly parallel with the mitre fence grooves, and that the rip fence is aligned with the saw. If attention is not paid to these points accurate cutting cannot be accomplished.

Always use the saw guard when operating the machine with the one exception that, when grooving, it and the riving knife must be removed.

Use the ripping fence and the mitre fence when requiring to cut a number of pieces of exactly similar length.

Never use a blunt saw and do not attempt to push the work forward faster than the saw will cut it. And, when nearing the end of a cut, use a stick of wood to push the work through the final few inches.

Ripping can be carried out from either side of the saw; with the fence on the right a wider board may be sawn as there is more table-room available. Hold the work tightly against the fence with one hand and push it forward with the other.

A Reader's Workshop

R. J. Mackintosh describes his own workshop and gives his views on construction and planning

HAVING had to put up with a lot of makeshift workshops in my time (my first one was in a cellar), this one contains all the ideas and details that I have found from experience to be most suitable for working. It is situated in the garden at the back of the house and it measures 16ft. 2in. long × 8ft. 6in. The back is 7ft. 6in. high and the front 6ft. 6in. A home workshop requires careful consideration and planning, with a view to comfort and cost, as mistakes can rarely be rectified.

I used the following method in the construction of my workshop: First of all make a scale drawing of the shed, say ½in. to the foot. Consult your local Borough Surveyor to ensure that you do not infringe any of the local bye-laws. Make provision for machines, even if none are contemplated at the time building is commenced, i.e., provide electrical supply, also take into consideration the positioning of windows and doors, etc.

Shed Construction

This will naturally depend upon the skill and the facilities the builder has for wood, or metal working. I would recommend corrugated asbestos sheeting on a wooden or metal framework, the framework being supported upon a 3ft. brick or concrete wall laid on concrete footings.

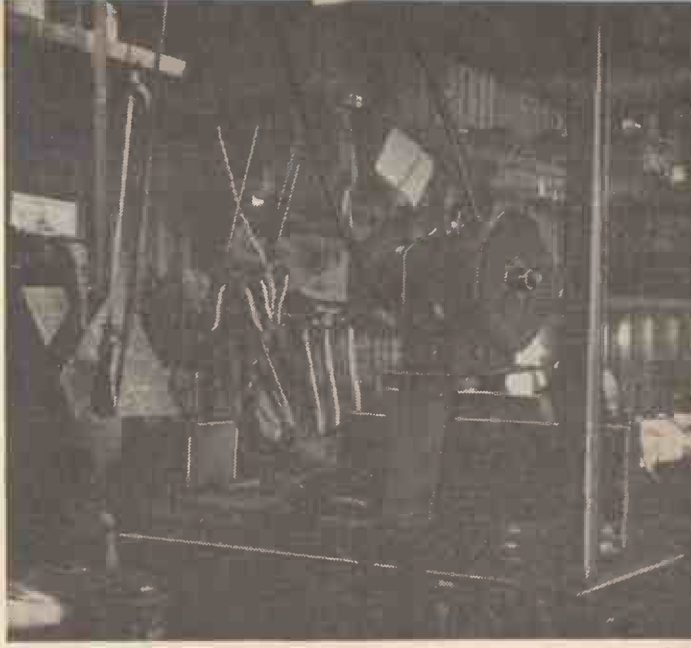
Fitting and Woodworking Benches

These have different characteristics, the bench for fitting in my shed is such that the height, floor to top of vice jaws is 3ft. 8in. This would of course vary according to the height of the person using the vice. The width of the bench, which is of heavy timber, is 2ft. A backboard is provided and has plenty of Terry's clips for holding a good assortment of tools. The vice should be secured over one of the bench top supports, which will be attached to a leg, and this should give good rigidity. An important point to note is that the inner vice jaw should project beyond the front edge of the bench by about ½in., so that any long pieces of material may be properly gripped in the vice in an upright position if so required. The positions of the benches should be decided, and the floor can then be considered, so that if it is to be concreted, plugs can be put in position before the concrete is laid, so as to leave holes for bench-legs. The same applies to brick or concrete walls, recesses can be left for bench top supports. My woodworking bench, although portable, is of rugged and heavy construction, it is 6ft. 6in. long × 3ft. wide × 2ft. 8in. high. Even if a fixed woodworking bench is decided upon, the 2ft. 8in. height would be suitable.

Windows

These should be positioned with regard to benches (vice position) and machines, enabling you to make full use of daylight. The drilling machine should also be near a window to enable a long bar or plank to be passed out of the window, for drilling or working on same.

Lathe positioned where maximum daylight is obtained from window.



This is a view of a grinder showing drive from overhead countershaft.

Lighting and Power

The wiring should meet the requirements of the local electricity board's safety measures. Cable is run out from the house to the shed in buried conduit, to two fused switch boxes in the shed, one for lights and one for power. Wiring for lights and power and also earth wire (seven strand copper aerial wire) is run right around the shed. All the joints are soldered. Two sockets are provided, one each side of the shed, for plugging in portable electric tools and lights. Swinging and extendable lights are fixed over the two benches and the lathe drilling machine. The electric furnace has its own plug on a board with switch and simmerstat. For heating I use a 10-24 V. 1A heater element wired in series. The elements are ex-R.A.F. and they just take the chill off sufficiently on a cold day. I have four each side and one each end of the shed. They will be wired in parallel, when the windmill I am at present constructing to provide power, is working. Oilstoves are unsuitable, however clean they are kept, as they cause condensation. When the conduit was put across to the shed for the electrical supply, a gas pipe was laid in the same trench and I coupled this with rubber tubing to the gas stove in the kitchen and have my supply of gas in the shed for operating gas blow pipes for brazing and silver soldering, etc. Also in the shed I have an electric muffle furnace, fixed on brackets so that the peep hole in the door is at eye level. This was made from the constructional details given in the April, 1960 issue of PRACTICAL MECHANICS.

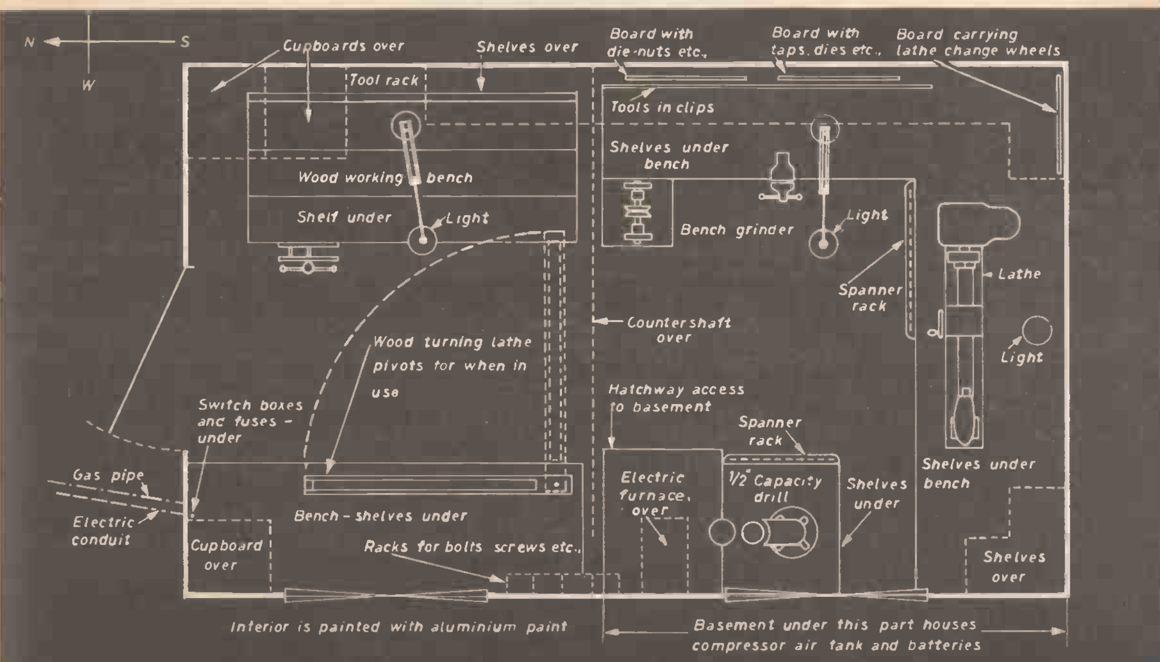
Doors

These should be positioned with regard to passing long bars or planks to drill, or for use on other machines. Also for passing long planks or pieces of material for storage overhead (on the bottom member of roof spans in my case). A sloping doorstep, inside and outside should be provided, to prevent flooding from rain. The slopes should be grooved to give foot grip. On the outside a hole should be provided through the doorstep, for water to run away.

Storage

I have three cupboards secured to walls well above

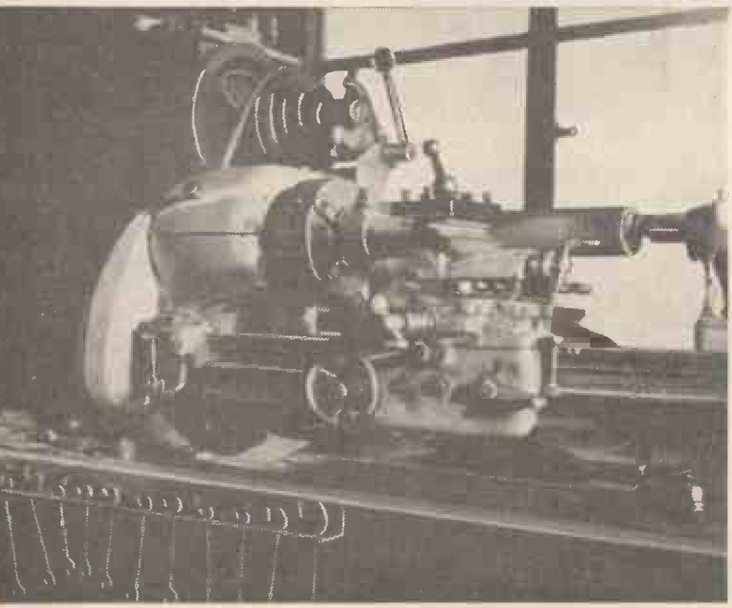
General plan of workshop layout.



General work bench with vice and tool racks.

the benches and items of one kind are kept together: one for woodworking tools and gear, including screws, nails and glue, etc.; one for electrical gear, wire, fittings, etc., and one for paint, builder's gear, etc. I have one set of racks for bolts, nuts, screws, etc. There are racks and clips at the back of the benches. Lathe change wheels are mounted on a board adjacent to the lathe. Boards with die nuts, stocks and dies, tap wrenches, are at the back of the fitting bench. I put shelves nearly all round the shed, both above and below the benches. I arranged shelving

Close-up of lathe head-stock.

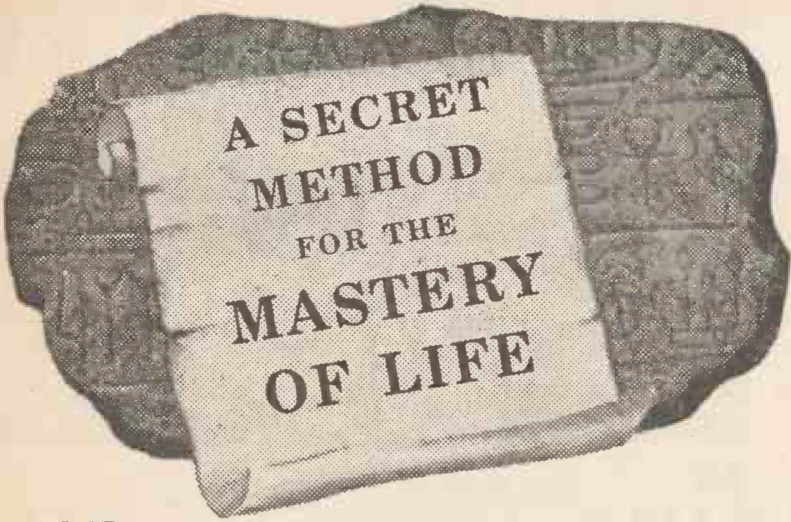


12in. wide, so that I can use 12in. standard lengths of timber which can be cut from odd pieces. It is handy when brushing down the shelves, as the small lengths are only laid loosely on angle bars. Having a spare ⅓ h.p. electric motor, I put a countershaft across the shed and this drives a bench grinder and a wood turning lathe, both of which I have recently made. It will soon drive a 6in. circular saw which is nearly completed. The wood turning lathe is pivoted and when in use is swung across the workshop and secured to a bracket by clamps.

Additional Machine Tools in Workshop

Over a number of years I have collected the following additional machine tools: 5in. Halifax S.S.S.C. lathe bench model, 24in. between centres. Lathe centres are 4ft. 1¼in. above floor level. Chucks, steadies, lathe tools, ¼in. portable electric drill; Watchmaker's lathe, treadle driven. In the hand tool range I have a 0-½in. eight speed drilling machine, bench model. The drill table is 3ft. 11in. from floor level. A supply of drills, milling cutters, etc., some home-made, has gradually been built up. Tool post grinder (home-made). A hydraulic test pump, also home-made, will test to 5,000 lb. cu. in. Toolmakers and other clamps, some home-made. One cannot have too many clamps of various sizes. Rules, callipers, jennies, squares, dividers, micrometers, vernier callipers, depth micrometer, spanners, wrenches, chisels, pin punches, etc. Spanner racks are fitted in handy positions, made from angle iron. Owing to the sloping nature of my garden, I have a space under the shed itself and accommodated there are: an air compressor and tank (for air storage), batteries (N.I.F.E.) for use when the windmill is completed.

As far as possible I make all my own tools, within the limits of the machines. I also make all patterns and core boxes for any jobs requiring castings.



KNOWLEDGE THAT HAS ENDURED WITH THE PYRAMIDS

WHENCE came the knowledge that built the Pyramids and the mighty Temples of the Pharaohs? Civilization began in the Nile Valley centuries ago. Where did its first builders acquire their astounding wisdom that started man on his upward climb? Beginning with naught they overcame nature's forces and gave the world its first sciences and arts. Did their knowledge come from a race now submerged beneath the sea, or were they touched with Infinite inspiration? From what concealed source came the wisdom that produced such characters as Amenhotep IV, Leonardo da Vinci, Isaac Newton, and a host of others?

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Bead Threading

SOME of the finest professional bead-threaders are men and it is said that, as in cooking men make the best chefs, most men that turn their hand to this form of jewellery-making become expert very quickly. There seems to be no particular reason for this but it might give male readers the incentive to try to prove the theory, right or wrong!

The masses of instruction may seem bewildering at first, but you will, in fact, find the procedure far simpler than it can be made to seem on paper. After the first attempt you can dispense with over half of it, commonsense will automatically take its place. At a later stage it will only take a little ingenuity to think up all manner of things you can do quite easily.

Where clasps are essential, particularly if these form part of the effect and are not merely a reason for joining two ends, it is important to choose with care. A good bead deserves a good clasp both for reasons of appearance and safety.

Beads are usually gauged by the metric system, the smallest size in common use being 3 mm. The most usual graduation in a single row pearl necklet being from 3 to 8 mm. Length depends on individual taste and requirements, though the average accepted is 16in.

Three Row Necklet

For guidance in producing a three row necklet the following chart is of great importance. It is advisable that the first three row necklet is made accordingly and thereafter depending on knowledge gained.

Size of Pearl	*1st Row*	*2nd Row*	*3rd Row*	
7 mm.	10	11	12	beads required
5 „	20	22	24	„ „
4 „	24	26	28	„ „
3 „	36	40	44	„ „

Threading Materials

Basically, there are three types of threading materials from which to choose:

Silk on wire (silk fibres twisted into a double coil wire).

Nylon thread (nylon fibres twisted to form a thread).

Nylon threader (solid nylon pulled into a thread firm enough to go through beads without a needle).

These are, of course, in addition to the traditional pure silk thread which is generally used for pearl necklets only. Other basic materials required are Gimp (fine wire coiled to form a flexible tube cover for necklet ends, which prevents thread wearing at the clasp). Cut off ⅜in. for each " end."

Beeswax is a handy item. Rubbing the end of thread along this will make for easier needle threading.

Silk on wire thread can be used without needle or gimp, but lends itself rather better to heavier types of beads. However, if a needle is used it is preferable to use a finer type (i.e. No. 10 is rather heavy, better for " chunky " type beads). Before you commence, be sure that the needle will pass through the beads as well as wire ends (gimp).

For each single row, cut off about 48in. thread.

Thread the single row and pass beads to centre of thread.

Now pass needle through a wire end and push this close up to end bead.

Handle the wire ends very carefully as if they become kinked they are useless.

Take needle through hole of shank in clasp and through first bead.

Pull up tightly. The clasp should now be secure in a looped wire-end.

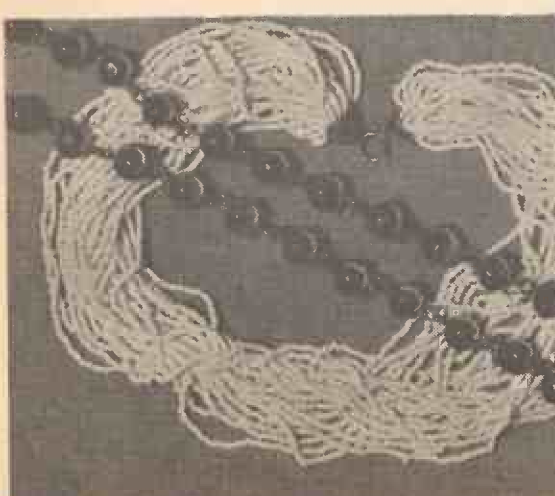
Knot thread behind first bead, ensuring that bead and clasp are tightly together.

Guide needle through second bead and knot as before. Repeat through third and fourth beads and cut off surplus thread.

Repeat process at opposite end of necklet, making sure that all beads are quite close together. Failure to do this will result in gaps between beads.

It is advisable after knotting behind the fourth beads on each side of the necklet, to take the thread through several more beads before cutting off surplus. This is known as " losing the end."

Necklaces such as these can be threaded quite easily.



Pearls

A good colour, depth of tone, a silky appearance, an impression of weight and opulance, these are all the attributes of a good pearl.

There is no reason why beads cannot be turned into bracelets and, particularly, into matching ear-rings. The latter are generally more easily produced in the drop-style, either on wires or screws, or on clips with a matching bouton.

" Cascade " types of necklets hang better if joined to a bar type of end which is supplied with almost any number of holes for joining rows to. Single rings on the other side of the bars allow chain, or a small length of strung beads, to form a tail-end. To one of these a hook is attached. This simple form of fastening is adjustable and quite secure.

Additional accessories are various sizes and designs of metal filigree caps which serve as a " cup " for beads, when making more ambitious projects.

Tastefully used, this filigree can really " make " a necklet. Even more so, they are certainly effective in the designing of ear-rings.

Rolled Gold

One last suggestion, which still comes under the heading of " beading," though without the traditional use of thread. This is replaced by wire, in the case of Rolled Gold which is preferable, the thickness should be approximately equal to 15 amp. fuse wire. If softer wire is used a slightly thicker gauge is recommended. Plated wire is an acceptable alternative, and avoid using anything unplated.

A pair of small, preferably round-nosed pliers will easily enable you to make rings in the wire.

It is now merely a question of cut and bend, allowing just sufficient wire to make a small, neat ring. Before closing up each time, insert the previously completed ring. A ring—a bead—a ring—with a gap, insert the next complete ring and close the gap.

That is all there is to it—simple, but very effective. Keep going as long as you wish—making a lightweight, decorative chain. At any time you may have a spare clasp and/or ear-ring fittings, you can easily make additional use of the chain simply by opening a ring here and there and hooking up into ropes or necklets with any number of rows; chandelier ear-rings can also be made from such a chain.

The Vanguard satellite is installed atop the satellite launching Vehicle 7 at Cape Canaveral.

A Satellite's Telemetered Data

(*Concluded from page* 111).

particles which can be expected near the earth should provide information of great benefit to spacecraft designers, who will have to determine how much protection will be necessary for instrumentation and man.

In addition to the geophysical data, Explorer VIII provided many advances in spacecraft technology. These are important to the design of future spacecraft. A mechanism designed by Marshall Space Flight Center slowed the satellite's spin from 450 r.p.m. (a value dictated by the Juno II booster) down to 30 r.p.m. The temperature of the satellite was controlled to within ±10 deg. C.

Most important, the Explorer VIII research programme brought an unexpected dividend for future spacecraft application: a means of orienting a spacecraft without the use of optics. Several "traps" for ions and electrons were orbited. Any charged particles present entered these traps with the current flowing into a circuit attached to the collector. The current can be measured and thereby provides a signal from which the satellite orientation in space may be determined.

Explorer VIII provided 500 separate pieces of information for every second of its active life. It is estimated that it will take another six months to completely process this volume of data. Goddard scientists are making the scientific data available to the domestic and international scientific community as readily as possible.

Natural Draught Convector Heaters

(*Concluded from page* 114).

they are really micro-gap circuit interrupters. Fig. 4 shows one such switch (Arcoelectric C.S. 200), it will carry a total current of 15A. and will withstand a temperature of over boiling point and is thus suited for use in most heaters.

Three Heat Settings with two Elements

Fig. 5 shows the wiring for the switch (C.S. 200) when used for a series parallel arrangement. With the setting at Off (nil heat) to start with, 90 deg. turn clockwise will put both elements in series. If each has a rated wattage of 500W. then they will give a combined total wattage of only 250W., but on turning the switch through another 90 deg. anti-clockwise, one heater only (No. 1) is in circuit giving a total wattage of 500W. Another 90 deg. turn will give both heaters in parallel with a total wattage of 1000W. In the circuit shown, extra safety is given because when off, both neutral and live mains wires are interrupted.

Three Heat Settings with Three Elements

A very slightly wider range of heat output switching can be obtained with three elements. The last heater described can be wired with three elements. Take the case of a heater with elements of 350W., 500W., and 750W. By wiring as in Fig. 5 it is possible to obtain wattages of 350W. in the first position, 850W. in the second and 1200W. in the third.

Any of these positions can be automatically controlled by a thermostat (air type) fitted in the main red mains lead to the power plug.

Switching Sequence

For the more technically minded reader who might wish to devise his own circuits the following information about the four switch positions, going anti-clockwise from off, is given:

odeg.—All contacts isolated from each other.

90deg.—(anti-clockwise) 1 and 4 are joined; 2 and 5 are joined.

180deg.—Contacts 1 and 3 are joined; 2 and 5 are joined. 270deg.—Contacts 1 and 3 are joined; contacts 2, 4 and 5 are all joined together.

LETTERS TO *The Editor*

The Editor does not necessarily agree with the opinions expressed by correspondents

Calling all Hobbies Clubs

SIR,—We have many members who are extremely interested in forming a hobbies club and we are therefore desirous in ascertaining how such clubs are run in the U.K. We would be very pleased to hear from small hobbies clubs having activities in carpentry, electronic gadgetry, elementary automobile engineering, aero modelling and similar subjects. We should be pleased to have details of how these clubs are run, a synopsis of their activities and programme. —D. A. Tellis, Secretary of Electronic Engineers, High Grounds, Bungalore, 1, India.

Editor: Perhaps secretaries of hobbies clubs would care to contact Mr. Tellis direct.

Sealing Polythene—Correction

SIR,—I should like to point out an error which appeared in your September, 1961 issue on " Your Queries Answered " page. When welding plastic, such as P.V.C. or polythene, it is essential to interpose a sheet of Celophane between the hot roller and the work. This is the whole secret of this type of work. Without the barrier the roller will simply burn through the job.

Perhaps your readers would also be interested to know that very simple joins can be made in polythene by clamping the two edges to be joined between two metal bars and running a flame down the exposed raw edge. This will burn back to a neat beading, giving an excellent joint.—D. W. Godwin (Cheshire).

Demineralised Water—Correction

SIR,—As a regular reader of PRACTICAL MECHANICS for the last 20 years and a water treatment technician for even longer, I cannot allow your reply to A. O'Neill (October, 1961, Your Queries Answered) to pass without comment.

If Mr. O'Neill, as you suggest, puts the water through a base exchange material such as zeolite for a thousand times he will never get demineralised water. A base exchange material will only substitute sodium for calcium and magnesium so that the effluent from such a plant will contain sodium salts in place of the original calcium and magnesium salts. Most domestic water softening plants operate in this way.

A demineralisation process must remove the acid radicles, e.g. sulphates nitrates, bicarbonates, chlorides, etc., as well as the metals calcium, magnesium, sodium, iron, etc. Therefore a base exchange plant must be replaced by a hydrogen ion exchange unit which will convert the various salts into the corresponding acids, e.g. sodium chloride into sulphuric acid. The acidic effluent so produced must then be passed through a bed of a special synthetic resin which will remove the acids without putting anything in their place. Carbonic acid, however, is not affected by this process and must be removed in a degassing unit. The first unit is regenerated with a dilute acid (usually sulphuric) and the second by an alkali, e.g. soda ash.—A. F. Gowling (Kent).

Enprinter Article Criticism

SIR,—It was with surprise and some resentment that I read the opening paragraph of your article " Make This Enprinter " in your October issue, in which it was stated that the standard of commercially produced enprints is not very high. Photograph machine manufacturers are now producing very intricate and costly printers and processors for the production of enprints, which are now, contrary to your author's remarks, of a very high standard indeed and for 6d. per print is extremely good value.

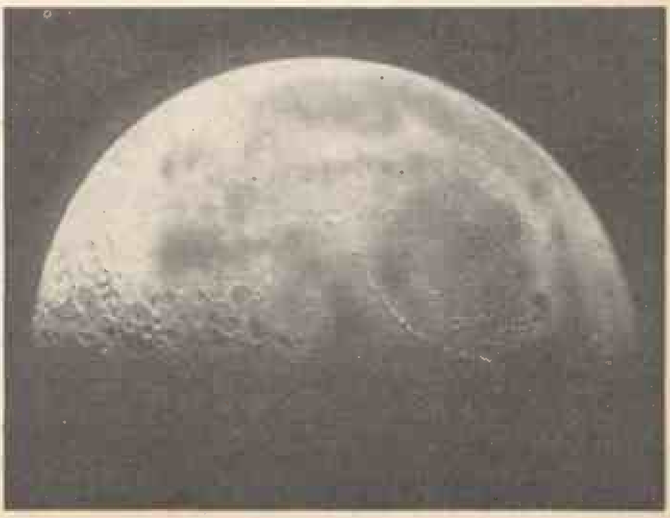
Perhaps your author has been unfortunate in his experience and if this is so, it is suggested that in future, he obtain his service from a dealer who is using a reliable photofinisher.—K. Slaney, University Photo Works Ltd. (Cambs.).

Photographing the Moon

SIR,—Since having built the 6in. Reflecting Astronomical Telescope as described in your May and June, 1959 issues, I have had many an interesting evening studying the Moon. Being an amateur photographer I have been experimenting with " fittings," etc., on the telescope to hold a camera. I enclose an example of my first attempt at astronomical photography (below). It was taken at 4.30 a.m. on Sunday, October 1st., 1961. The camera is a Periflex, but I removed the lens and focused with the Erfle Ocular. This is a 6 lens orthoscopic eyepiece, focal length $\frac{3}{4}$in.

I can recommend this telescope making as a hobby. I enjoyed making it almost as much as the wonderful surprise I got when I looked through it for the first time.—F. M. Easton (Birmingham).

Mr. Easton's first attempt at astronomical photography

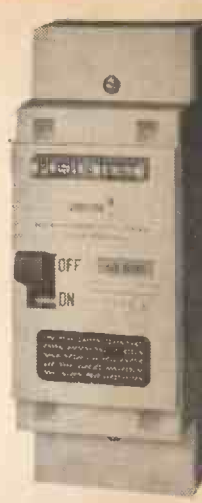


TRADE NOTES

A REVIEW OF NEW TOOLS, EQUIPMENT, ETC.

Earth Leakage Unit

A NEW earth-leakage protection unit of advanced design has been introduced and marketed by Chilton Electric Products Limited, of Hungerford, Berkshire. This unit automatically protects the rural and remotely-situated consumer from electric shock due to unsuspected breakdown in the electric wiring system of house, workshop or factory. Known as the Type " C " earth leakage circuit breaker, it represents a new advance in design in earth leakage protection. Available in ratings up to 100 A. It can be wired for mains incoming and outgoing from top or bottom terminals. The unit is marketed at £2 6s. 9d.



(Right), Earth leakage circuit breaker.

(Below) The " Rutland " tool kit.

New Tool Kit

STANLEY have recently placed on the market a new tool kit called the " Rutland." It consists of a smoothing plane, joiner's hacksaw, hand drill, set of twist drills, mallet, panel saw, tenon saw, marking gauge, rule, pliers, bradawl, hammer, two chisels, two screwdrivers, pin punch, trimming knife and square. The kit is contained in a stout cardboard box and costs £7 15s. 6d. The manufacturers are Stanley Works (G.B) Ltd., Rutland Road, Sheffield 3.

New 50 c.c. B.S.A. Power Unit

THIS unit is the latest addition to the range of four-stroke petrol engines and weighs only 14 lb. The engine is a departure from normal B.S.A. practice in that it is basically a die-cast aluminium alloy unit with a cast-in iron cylinder liner.

Good looks have been foremost in the designers' minds and the unit has clean lines, uncluttered with petrol pipes, or tank straps and bolts. The petrol tank is mounted as part of the cowl structure.

The unit is particularly suitable for use in lawn mowers and allied equipment. Price £15 15s., from B.S.A. Power Unit Division, Redditch.

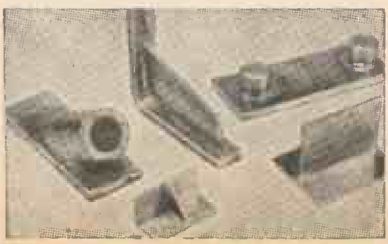
Aluminium Solder

TIN-A-LUM—a fluxless aluminium and universal solder has been marketed only after extensive development and test work. Its main characteristics are as follows:

1. It tins, without rubbing on, all surfaces easily and thoroughly and forms a complete bond with the materials on which it is applied. Its bonding strength increases by about 30 per cent. within 12 hours.
2. It melts at 180 deg. C. (356 deg. F.) and has a range up to 350 deg. C. for specific requirements. The melting point rises substantially after soldering.
3. It is extremely malleable and can be drawn, moulded and machined to any shape and size.
4. It has no flux built in and works without any flux on aluminium, duralumin, alloys, pewter, magnesium, tin-plate, zinc die casts, beryllium, cobalt, ceramic, etc. It is capable of lifting the oxide skin of aluminium and penetrating right underneath it.
5. It can join any two metals and there is no danger of an electrolytic action whatsoever.

The makers are Industrial Synthetics (Overseas) Ltd., Bishop House, 106 Bishopsgate, London, E.C.2.

The latest B.S.A. Power Unit.



Tin-A-Lum has been used on these joints and joins.

SALES AND WANTS

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

MISCELLANEOUS

AQUALUNG and Compressor Equipment, Ballraces and Miscellaneous items. Lists 3d.—Pryce, 157 Malden Road, Cheam, Surrey.

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FOR SALE

CATALOGUE No. 41. Over 4,000 items, electrical, mechanical, material etc. 9" × 3" S.A.E. please.—K. R. Whiston (Dept. P.M.S.), New Mills, Stockport.

ALUMINIUM LADDERS/STEPS. Gigantic offer, 400 models.—Sanco Ltd., 17 (PM) Boundary Road, Hove.

Brand new ex M.O.S. electric gramophone units in heavy gauge metal cases fitted carrying handles and locks, finished black crackle. Heavyweight 200-250 volts A.C. motor pick up, 78 r.p.m. only, cost £20 each, case alone worth more than my price, 35/- plus 5/- carriage. Ditto used 20/-.

Brand new Dallmeyer 4in. projection lenses especially designed for 35 mm. transparency projectors, but will cover up to 2¼in. square, original price £7, only £3, post 1/6.

2in. Bi-Convex Glass Condensers 2/6 each, post 6d. Epidiascopes from £20 each.

Brand new Avominor moving coil Multirange A.C./D.C. Test Meters (ex M.O.S.) solid hide case with shoulder strap, leads and test prods, in original tropical packing list over £11, price £5, post 2/6.

Brand new Kodak (ex Admiralty) 7 × 50 Prismatic Telescopes, focusing, in fitted wooden case with binocular eyepiece, fitted filters, cost over £50, due to another huge purchase, lower than ever price, £4 10 each, carriage 5/-.

Brand new (ex A.M.) 12 volt 25 amp batteries. These are R.A.F. general purpose lead acid accumulators, and are similar in construction to normal car battery. Very suitable for cars and vans, will start any vehicle. Never been filled and in original tropical packing. First charge instructions included, cost about £10, only £2 10 each, carriage 5/-.

Ex Admiralty brand new **Pocket Stopwatches** by Waltham and Smiths. Fully jewelled movements, ⅕th second, 60 seconds per rec., 30 minute recorder dial, winding button start, stop and re-set, value £8, 45/-, post 2/-. Ditto, tarnished cases, but brand new 37/6, plus 2/- post.

Ex Admiralty brand new Pocket Stopwatches, Waltham, 6 seconds per rev., no recorder dial, security greater than 1/10th second, jewelled movement, in original box, winding button start, stop and re-set, cost over £12, 19/6, post 2/-.

Ex R.A.F. Aerial Film 9½in. × 300ft. Pan, £3. 160ft. 35/-, 5½in. × 47ft. 8/-, 24ft. 5/-. Ideal for cutting to smaller sizes. Perfect condition. Post 1/6.

Ex A.M. G.45 Gun Cameras 24 volt, 2in. fixed focus lens, 50ft. magazine loading, complete with magazine, new £2 15, ditto used £2. Both post 2/6.

Ex A.M. GGS Mark 3 Recorder Camera. 16 m.m., made by Specto. Latest model with three shutter speeds, 2 or 16 f.p.s., bloomed 1½in. lens F.1.9 with iris to F.16, 24 volt, 50ft. magazine loading, complete with magazine in original tropical packing, absolutely brand new, only £5, post 2/6. Ditto used £3 10, post 2/6.

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FOR SALE *continued*

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PHOTOGRAPHY

BELLOWS, Camera, Enlarger, Process, Industrial Collapsible Machine Guards.—Beers, 4 St. Cuthbert's Road, Derby. (Tel. 41263).

PROJECTORS. Home Assembly Kits all types and sizes and Stereo from £6 2s. 6d. Fan Base Kit £3 7s. 6d. Opticals: Screens. S.a.e. Marshall Smith Ltd., 64 Norwich Avenue, Bournemouth.

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PATENTING SERVICES. — Advice, Qualified agent.—C. L. Browne, 114 Greenhayes Ave., Banstead, Surrey.

TOOLS

WATCHMAKERS

WATCH PARTS

RADIO

EDUCATIONAL

EDUCATIONAL *continued*

ELECTRICAL

Continued on page 143

YOUR *Queries* ANSWERED

Worm-proofing Wood

I AM building a timber garage which is to be coated with a tar and creosote mixture on the outside and painted inside. How can I make it proof against woodworm.—R. E. Smith (Scotland).

IF the timber which you are going to use for your garage is well saturated with creosote, it is unlikely that it will be attacked by wood boring insects since these will not exist on preserved timber. However, the inside of the garage which is not treated with tar may be given a coat of green Cuprinol or any one of the insecticidal treatments prior to oil painting, but you should assure yourself that the material purchased is suitable for subsequent decoration.

Busbars

WHAT exactly are busbars and how did they get their name? Also why are generators said to be " lifted on " to the busbars when being switched on or connected and why " tripped off " when switched off or disconnected.—J. Mason (Leicester).

A BUSBAR is simply an electrical conductor which constitutes a common connection between any number of separately-connected receiving and delivery circuits. The name is an old one and we do not know its origin. We would suggest that the name may be due to " loads " being " taken on " or off the busbars in a somewhat similar manner to passengers on a bus.

Generators may be said to be lifted on to the busbars because, after starting up, the voltage of a generator has to be raised or adjusted to a similar voltage to that of the busbars before being connected to the busbars. A generator is connected to the busbars through a circuit-breaker which is usually held closed by a catch. To switch off the generator the circuit-breaker is " opened " by tripping the catch and allowing the contacts to open under the action of springs.

Treating Pewter

I WISH to remove paint from an old pewter vessel. Turpentine seems ineffective. Could you tell me how to do this and also let me know the best method of cleaning pewter?—R. Fidler (Stockport).

TRICHLORETHYLENE should be quite suitable for removing paint from old pewter. To clean, use methylated spirit on a pad of cotton wool.

Wind Power Generator

I HAVE a 6V. 5A. hand generator, handle speed 100 r.p.m. Could you tell me how to connect it up for wind power to charge a battery. —J. Coles (Hunts).

WE presume that the dynamo has a permanent magnet field system. For the propeller you could use a 6ft. length of well-seasoned straight-grained pine or cedar, tapering from about 6in. wide at the boss to about 4in. at the tips, with blades at about 35 deg. to the plane of rotation. The boss should be strengthened by means of a steel piece clamped or keyed to the shaft. The normal speed of such a propeller in an average wind may be about 300 r.p.m. so the propeller shaft could drive the dynamo through a 1 to 3 reduction vee belt or gearing.

A lever should be fitted to enable the propeller to be turned out of the wind in high winds, and the dynamo should be connected to the battery by substantial cables in order to minimise volt drop. An automatic cut-out and a fuse rated at about 5A. should be connected between the dynamo and the battery.

Soapless Shampoo

COULD you please let me have the formula for liquid soapless shampoo with the pearl-like look.—W. Trent (Staffs).

A SUITABLE formula would be:

Whites of	2 eggs
Water	5 fluid ozs.
Ammonia water	3 fluid ozs.
Cologne water	⅓ fluid oz.
Alcohol	4 fluid ozs.

Beat up the eggs thoroughly (white only) and add above ingredients in order given. Mix thoroughly.

Improving Atmosphere

I WISH to place something in my room that will give off an amount of oxygen, so as to be beneficial in the atmosphere.—F. Dalton (Beds).

YOUR best plan is to install a small oxone generator. This is easily made by transforming up the mains voltage of 230V. A.C. to 7,000V., and obtain a corona discharge by wrapping a hollow glass or silica tube with aluminium foil and inserting inside the tube a cylinder of aluminium foil. Electrical connection is made between the inner and outer sheaths of foil via the transformer circuit. Ozone results from the corona discharge thus set up.

Soap Bubbles

CAN you give me the right ingredients for making soap bubbles. I have tried without success to make a mixture for my children.—

TAKE some soft soap (a potash soap as opposed to a soda soap) and mix with a little glycerin. This should make an effective soap bubble mixture. Alternatively you could use Teepol and again add a little glycerin.

L.B.S.C'S 3½in. Gauge Evening Star

(*Continued from page* 108)

To turn and drill the boss, the slotted blank has to be chucked truly in the four-jaw with the solid end outwards. This may cause some beginners to puzzle their heads, but the solution is simple. What I do, is just to jam a bit of ¼in. × ¾in. steel or brass in the slot, parallel with the solid end, and solder it. The slotted end can then be gripped in the four-jaw, and the jaws adjusted until the tip of a pointed tool in the slide-rest just touches all four corners of the projecting blank end when the mandrel is turned by hand. Tighten the chuck jaws, turn the boss to the shape shown in Fig. 63, face the end, centre, and drill No. 4 until the drill starts to penetrate the bit of metal soldered into the slot. Put a 7/32in. parallel reamer in as far as it will go.

Remove from chuck, scribe a line along the middle of one side, and centrepop it at ¾in. from the end of the boss. From the centrepop, strike a circle with the divider points ⅜in. apart. Drill a 5/32in. hole from the centrepop, right across the slotted end, making sure it goes through square with the sides; then melt out the bit of packing, and round off the end to the scribed circle. Finally, file a flat at the top of the rounded part, 9/32in. above the centre of the hole, and clean off all traces of solder.

The Shoe

This can be made from a 1in. length of ½in. × ⅜in. steel. On the wide side, at ⅛in. from one end, mill a groove 7/32in. wide and ⅛in. deep. Turn it over and repeat operation on the other side, leaving a ⅛in. web between the grooves. Then mill away the bottom to ¼in. wide and 1/16in. thick, see section in Fig. 63. Alternatively the shoe could be built up, the top being a 1in. length of ⅜in. × ⅛in. steel, the web 7/32in. × ⅛in. and the bottom 1/16in. × ¼in. Assemble the three pieces in the form of a T as shown (Fig. 63) holding them tightly together with a cramp at each end. Drill a couple of 1/16in. holes through the middle of the assembly, countersink them, and put in pieces of 1/16in. iron wire, riveting over both ends.

The crosshead arm, or drop arm as enginemen usually call it, is filed up from a bit of ⅛in. steel. I save my frame offcuts for jobs of this sort. Drill the holes 5/32in. for the start, then attach the arm to the side of the crosshead body by a 9 BA screw, lining it up with a piece of 5/32in. rod put through the holes in crosshead arm and body. Set the shoe in the slot as shown in Fig. 63, making sure that it is parallel with the boss. Remove the lining-up rod, and braze the joints at one heat. Just coat them with wet flux (Boron compo mixed to a paste with water is as good as anything) heat to bright red, touch each joint with a bit of thin brass wire, about 16 or 18 gauge, and a little bit will melt off and penetrate each joint. Be sparing with it. If the built-up shoe is used, the joints in that should be done as well. Sifbronze can be used instead of brass wire, if preferred; so can coarse-grade silversolder. When the redness has died away, quench the crossheads in clean cold water, clean them up, and carefully file away any traces of brass from the grooves, and from the inside of the recess.

Build your own Foundry

(*Concluded from page* 117)

A Cradle

When the pot is lifted by a pair of tongs from the furnace it is placed in a cradle. Fig. 2 shows how this too can be made up from black strip, welded where shown. The crucibles (or pots as the foundry worker calls them) are tapered slightly and the circular band should fit the pot about one third of the length from the top, making it impossible to drop from the cradle.

Skimming Rod

A dross forms on the top of all molten metals and a skimming rod made from a piece of 3/16in. × ¾in. section steel with 2in. of the lower end bent at right angles as shown in Fig. 3 is required for skimming this slag. Always heat this rod before attempting the operation otherwise a cold rod will cause the metal to splutter. Though a pre-skimming is performed prior to pouring, it is a safeguard to watch as the metal is poured to see that no further slag can enter the mould by pushing it away with the aid of this rod.

Part 2 will describe how to make the necessary mould from a pattern. Any elaborately shaped article will make a suitable pattern and steps are taken when making the mould to see that it withdraws easily. Typical examples in this category are brass ornaments, candlesticks and door knockers.

ELECTRICAL *continued*

ALL TYPES OF ELECTRICAL GOODS at extremely competitive prices, e.g., 5 amp. Twin Cable, 35s. 100 yards; Lampholders, 7s. doz.; 5ft. Battens, 49s.; quality and immediate dispatch guaranteed. Request list.—Jaylow Supplies, 93 Fairholt Road, London, N.16. (Telephone: Stamford Hill 4384).

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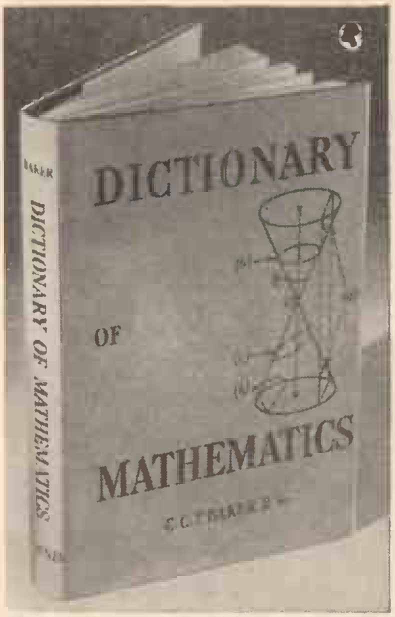

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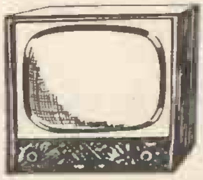

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