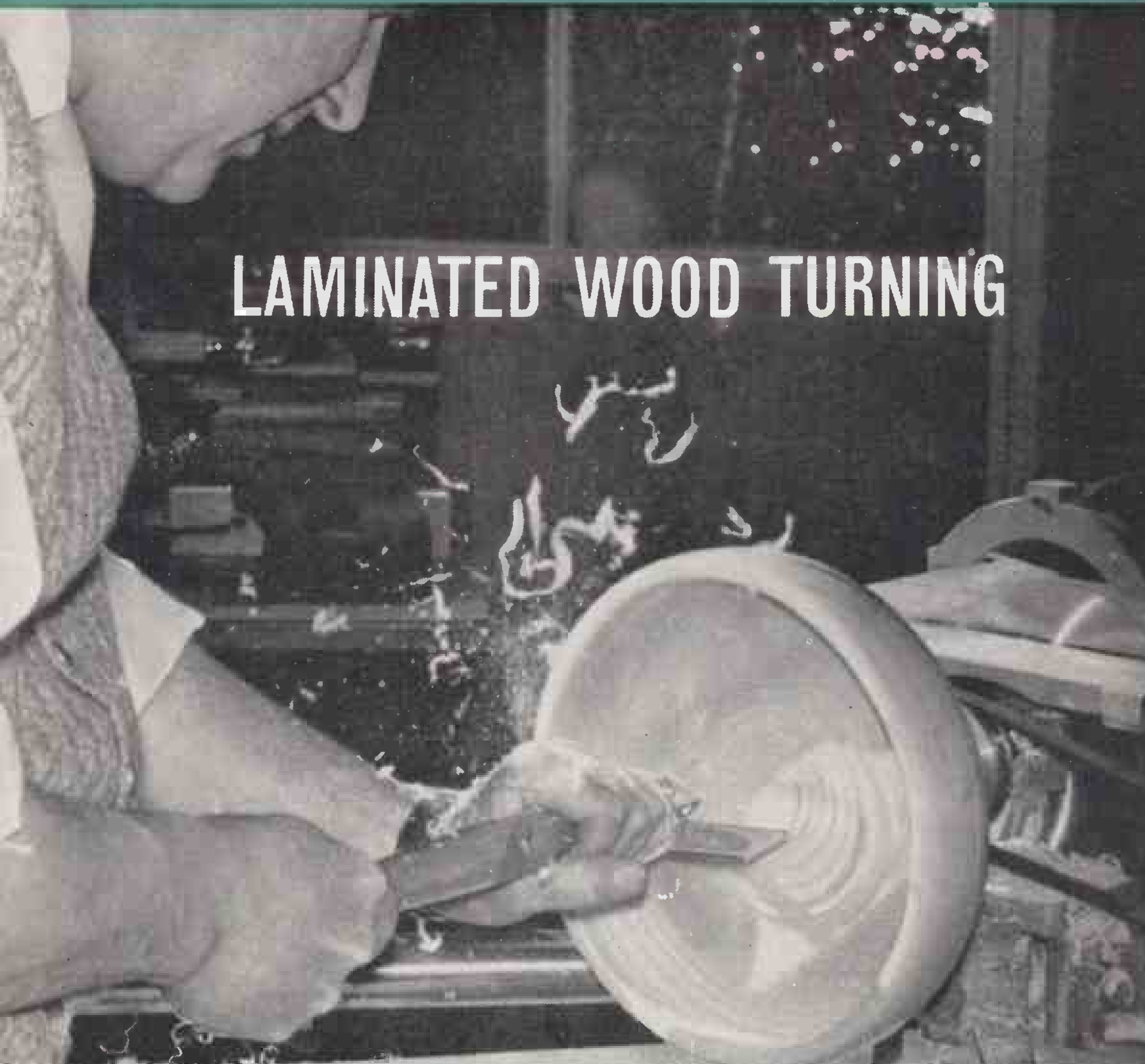
PRACTICAL MECHANICS AND SCIENCE

MAY 1963 **2/-**



BUILDING A CAMPING TRAILER

ELECTRICITY AND THE HUMAN BODY

HOME-MADE RAINFALL RECORDER

PRACTICAL MECHANICS AND SCIENCE

Vol. XXX May, 1963 No. 349

Editorial and Advertisement Offices
"PRACTICAL MECHANICS AND SCIENCE"
George Newnes Ltd., Tower House, Southampton Street, Strand, W.C.2.

Phone: Temple Bar 4363
Telegrams
Newnes, Rand, London

SUBSCRIPTION RATES
including postage for one year
Inland - - - £1 8s. per annum
Abroad - - £1 6s. 6d. per annum
Canada - - - £1 5s. per annum

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CONTRIBUTIONS
The Editor will be pleased to consider articles of a practical nature suitable for publication in "Practical Mechanics and Science". 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 and Science", George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

TALKING POINT

REGISTERED DESIGN

WE frequently receive requests from readers on the subject of registering a design for something they have made or plan to make. Many readers seem to confuse this with making an application for a patent. It is, of course, a different matter entirely.

The registration of designs for articles of manufacture is governed by the Registration Designs Act 1949, copies of which may be obtained from the Patent Office at 25 Southampton Buildings, Chancery Lane, W.C.2.

WHO MAY APPLY FOR REGISTRATION

Any person claiming to be the proprietor of a design may make application for the registration of the design in the United Kingdom in respect of an article or a set of articles.

The proprietor of a design is defined in Section 2 of the Act, which reads as follows:

Subject to the provisions of this section the author of a design shall be treated for the purposes of this Act as the proprietor of the design—

Provided that where the design is executed by the author for another person for good consideration that other person shall be treated for the purposes of this Act as the proprietor.

WHAT MAY BE REGISTERED

To be registerable a design must be new and consist of features of shape, configuration, pattern or ornament applied to an article of manufacture by an industrial process or means, the features being those which, in the finished article, appeal to and are judged solely by the eye.

A design applied to a part of an article of manufacture may be registerable if that part is made and sold separately.

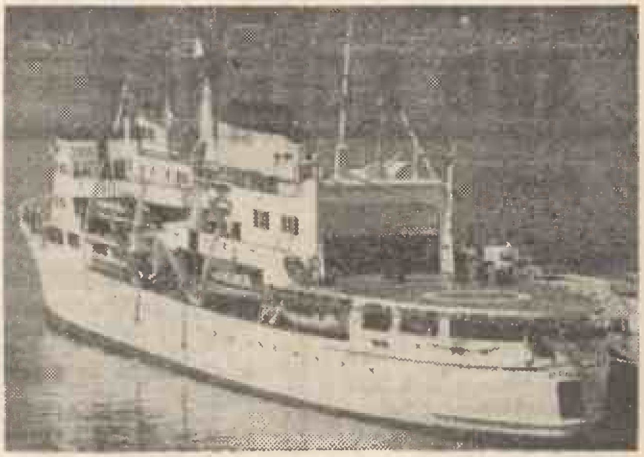
WHAT MAY NOT BE REGISTERED

A design which is not new, in particular a design which before the application is lodged at the Patent Office, has either been registered or published in the United Kingdom (*i.e.*, made available or disclosed to the public in any way whatsoever) in respect of the same or any other article or which differs from a registered or published design only in immaterial details or in features which are variants commonly used in the trade.

MAKING AN APPLICATION

Persons wishing to register a design should do so on Design Form No. 2, obtainable from the Patent Office. The application form must be impressed with the appropriate fee stamp £4 and must be accompanied by the prescribed number of representations of the design or specimens of the article bearing the design.. In case of a textile article, four identical representations must be furnished. Where it is desired to register a design in respect of more than one article simultaneously a separate application must be made in respect of each article.

THE SEA AND SCIENCE

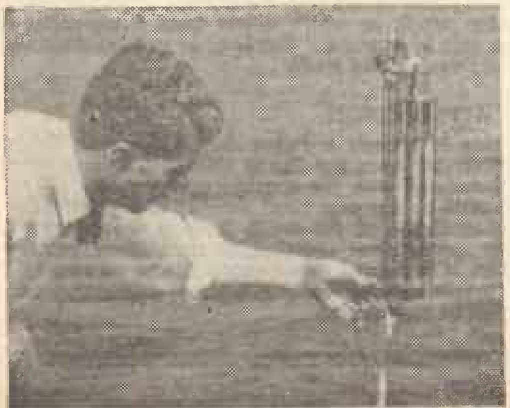


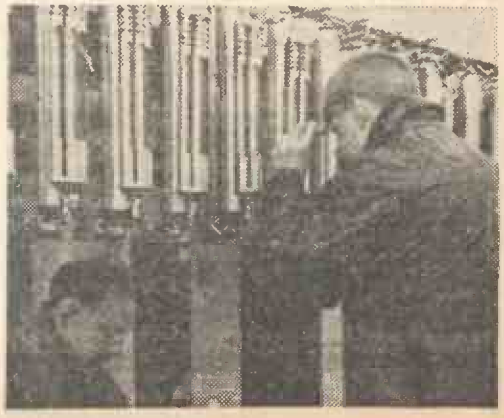
A FRESHENING breeze of scientific interest is blowing steadily along Canada's eastern, western and arctic seaboards. In other countries too, scientists are turning their attention to the sea. With the longest national coastline in the world however, bounded by three oceans and a myriad of large and small islands, Canada has a natural and urgent interest in oceanography—the scientific study of the mysterious sea and all its wonderful ways.

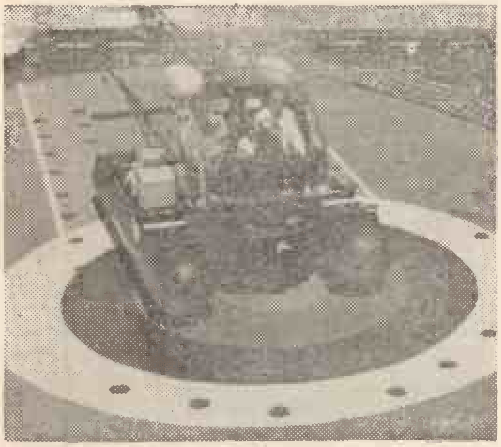
A neglected branch of scientific exploration but a few years ago, oceanography in Canada is now one of the newest, most exciting and vital fields of discovery. Spearheading Canada's concerted search for knowledge is a new Institute of Oceanography which has at work a solid nucleus of scientists, hydrographers, technicians and men of the sea. They will range Canada's blue, green and frozen white oceans, study their physical-chemical properties and investigate the life they contain and the riches they conceal. They will probe the sea's commercial use, its defensive strength and far-reaching effects on mankind and will provide Canada's scientific contribution to international studies of the world's seven seas.

Mankind's discovery, exploration, scientific observation and technological development of the earth's land surface is now being repeated across the vast oceans of the world. Deeper in parts than the mountains are high, stretched over two-thirds of the world's surface and totalling more than a quarter billion cubic miles the oceans are of vital importance to man's continued wellbeing and development. Discovered through the centuries, explored superficially, charted mostly within the last century, the sea has but recently come under scientific observation. Its food potential, mineral wealth, effects on man's environment and probable uses for the future are the reasons why scientists are now looking deep beneath the rolling waves and heaving swells of ocean waters and probing through ice-covered areas in polar regions. They are gaining their knowledge by studying samples of water, marine life, sea-bed rocks and silt as well as physical changes in the sea, its temperature and chemical characteristics.

Until recently, oceanography in Canada has been carried on in proportion to the country's needs by government and university, providing an invaluable core of basic knowledge. Now a concerted plan has been formed which will place Canada among the leaders in this field and will enable the nation to undertake its full share of responsibility in world







oceanography as well as provide for its own scientific, commercial and defence needs.

On the Atlantic coast near Halifax, Nova Scotia, the $4 million Bedford Institute of Oceanography referred to above has been built. The oceanographic vessel "Hudson", capable of operating anywhere in the world, is to be commissioned this year and three other research vessels are to follow. Another oceanographic institute and ship is planned for the Pacific coast.

Under the Canadian Committee on Oceanography, formed to co-ordinate and direct the national effort in oceanographic research, are combined the resources and facilities of five government departments, three universities and Canada's navy and air force. Physicists, biologists, hydrographers, geologists, meteorologists, chemists and other scientists and technicians will sail in warm waters and frozen seas, delve into the depths, scrutinise the ocean bed, observe the mechanics of water masses, study effects on the atmosphere and then, in the laboratories of the new Bedford Institute of Oceanography, study in detail the samples and information they collect.

BY OUR SCIENCE CORRESPONDENT

Top row, left. Research flagship *Baffin* alongside the Institute's wharf. Next year she will be joined by *Hudson* and later by replacements for three older vessels.

Centre. A helicopter leaving the flight deck of *Baffin* during trials prior to the 1962 voyage to the high arctic.

Right. A paddle-wheel current metering buoy is lowered into the water from a research vessel.

Bottom row, far left. An oceanographer adjusts the trigger device of a water sampling bottle before lowering it into the sea.

Centre left. Taking the readings of deep-sea thermometers after retrieving them from the sea.

Centre right. Examining sea water samples from various depths, for salt content.

Right. Assembling a special device which can record ocean-bed temperatures for periods up to 60 days.

laminated wood turning

Fig. 2.—Pieces are then sawn into 3-inch widths. The rip fence is used to give uniform sizes.

THIS type of turning is usually known in workshop "jargon" as the "bread and butter method", and articles turned in this way can look very attractive particularly when different combinations of wood are used.

Our bowl was made from laminations of beech, which was formed by using a plank measuring 3ft 6in. x 9in. x 1in. This was cut on the saw into pieces 10½in. x 3in. x 1in. as shown in Figs. 1 and 2.

Before gluing-up, the faces of the wood should be scratched with a scriber. This is to give additional keying for the glue Fig. 3.

Set the pieces up and press together making sure all faces of the wood are perfectly flat. Use a powerful glue such as Aerolite 306, which is also waterproof and will not affect the finished bowl in contact with water.

For cramping the job use sash cramps if possible with additional strips of hardwood held either side of the work, this is illustrated in Fig 4. Leave in cramps for a minimum of 48 hours to allow the glue to set and harden.

The next stage is sawing to rough shape and how this is done will depend on the machinery available. We were fortunate in having at our disposal a Coronette wood turning lathe with bandsaw attachment which was used for this work.

For the first stage of the turning the wood should be held on a faceplate with 4 wood screws.

Fig. 3.—Scratch all faces of the pieces to give stronger glue joint.

Fig. 1.—Cross-cutting the plank into 10½-inch lengths. Apply even pressure to avoid pinching saw.

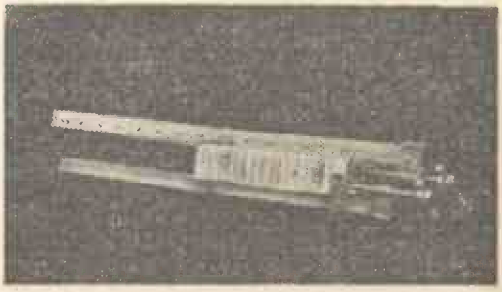


Fig. 4.—Work is held in sash cramps and left in minimum temperature of 60°F to set.

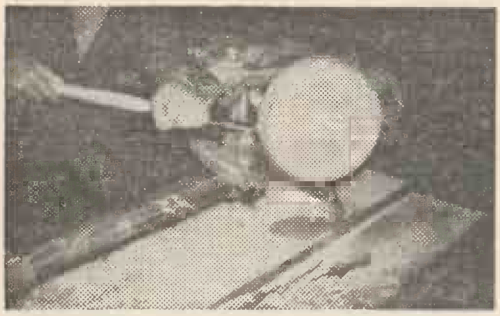


Fig. 5.—Start turning by working chisel on outside edge until all rough "corners" are removed.

Fig. 6.—Final smoothing is done first with coarse grade sandpaper, finishing with fine. Use moderate pressure.

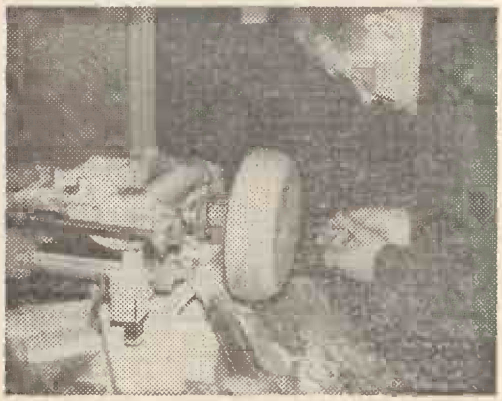


Fig. 7.—Locating centre while work is still turning, slight pressure will bore hole for screw.

Fig. 8.—Providing chisels are kept sharpened the inside can be worked fairly rapidly, move the tool-rest closer as cutting proceeds.

The outside of the bowl should be shaped first, starting by truing up the edge and face to eliminate vibration and get the work turning smoothly Fig 5. Keep your chisels as sharp as possible; if they are allowed to become dull they will tear, rather than cut end grain in the turning work. A small motorised grindstone near at hand will serve for this purpose adequately. When the external shape has been finished, smooth the work down with glasspaper. Apply moderate pressure so as not to cause burning Fig 6.

Before the bowl is reversed for turning the inside it must be realised that the exact centre has to be located otherwise it will not run true. An accurate method of doing this is shown in Fig. 7. While the work is still revolving use a scriber or sharp pointed tool, locate the centre and apply slight pressure, making a hole about ½in. deep. The bowl should then be removed from the faceplate and assembled on a woodscrew chuck. This is usually sufficient to hold it although additional securing screws can be used if desired. Turning the inside requires a little more care. Keep the tool rest as close to the work as possible Fig 8, hold the chisels firmly, and sharpen them frequently. Commence on the outside and work towards the centre. Try and finish the inside surface as smoothly as possible with the chisel, don't rely too much on the final glasspapering for sanding away ugly ridges, etc.

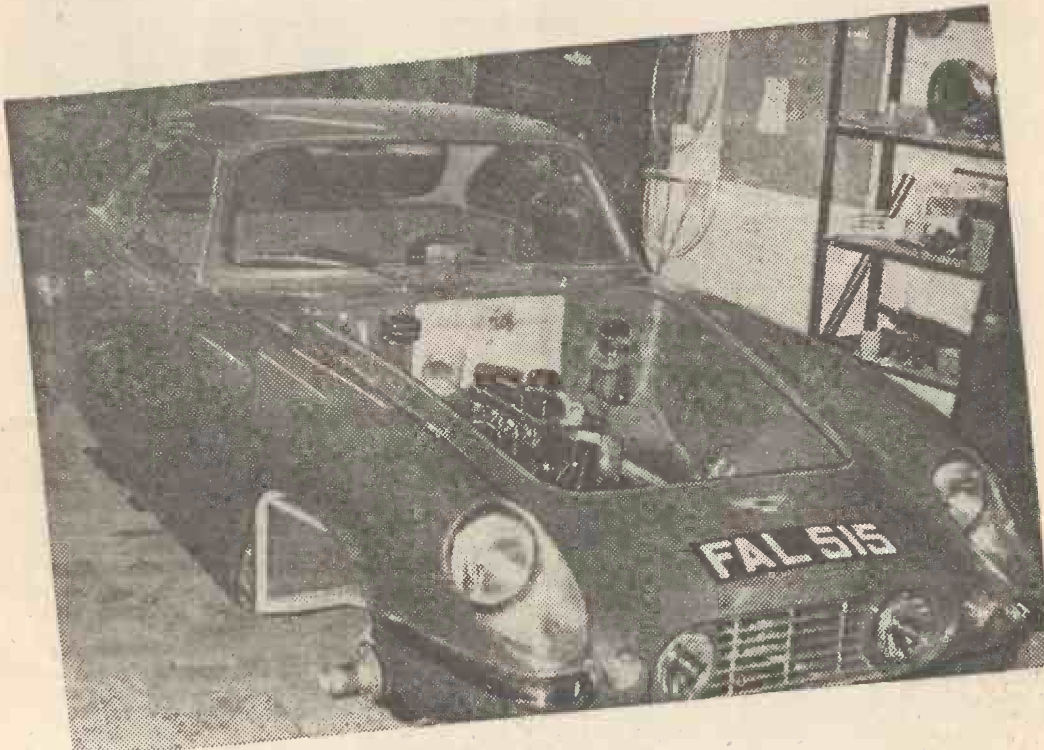
Finishing

This will depend, of course, on what the bowl is to be used for. If for salads or fruit, the recommended finish is olive oil. Apply with a pad or cloth, allow a while for it to soak in, and then burnish with fine steel wool.

If using the bowl for decorative purposes a varnish finish is suggested. If desired this can also be burnished with fine steel wool and then given a coat of wax polish. Whatever type of finish is used they can all be applied when the work is still on the lathe.

KIT CARS

**How much do they cost
Do they use standard parts
Are they difficult to build ?**



The answers to these questions and many more are given in this comprehensive report by CHRIS WEBB

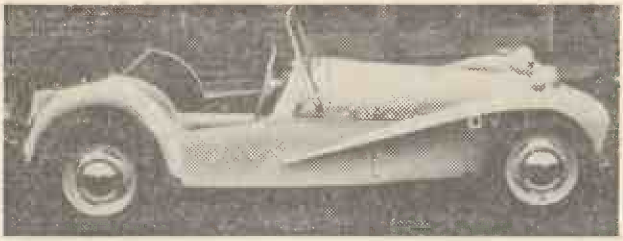
HOW would you like a new, up-to-the-minute 1963 car, hand built, with the performance and road manners of a thoroughbred—and for far less than the cost of a comparable production car?

This is no sales talk, it's hard fact. There are thousands of these cars on the road today, all of them hand built by the owners. For they are bought as a complete kit of components for assembly in the home garage. Although each kit car has a character of its own, most of the main components—engine, transmission, brakes, steering—come from a production line; Ford, B.M.C. and Standard-Triumph components being favoured by most kit car manufacturers. This means that a car with a high-sounding name like the Fairthorpe Zeta in fact uses a Ford Zephyr engine (although in this car it is tuned to give a maximum in the region of 130 m.p.h.). Even a car bearing the name of Lotus—runner-up in the world constructor's championship last season—usually comes with a Ford engine, the road version that is.

This system of using production car bits and pieces in a different body and chassis means that the kit car owner is not out on a limb when it comes to spare parts. He just goes to the main dealer and gets spares like the production car owner. The system also simplifies servicing, as garages can cope with cars using production line components.

Another advantage of buying a kit car, although not so great now as it was a year ago, is that you pay no purchase tax on a car you build yourself. This means that most kit cars fall in a price band from just under £500 up to £1,100.

And what do you get for your money? Well, this varies. Most of them have disc brakes at the front with drums at the rear and about 50% have independent suspension all round. Practically all of them have aerodynamic fibre-glass bodies, because this material is best suited to small-scale production. Also it won't rust and doesn't dent or crease in the event of light impact. A heavy impact will shatter it locally but, unlike a steel body, it does not transmit the shock to other sections, so

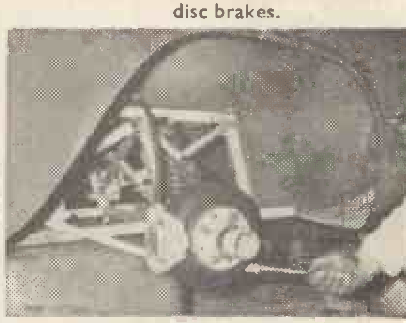


Left. The Lotus Super Seven is available with a 1500 c.c. Ford engine. It will reach 60 m.p.h. from standstill in 7 seconds and is a popular model for club racing.

Below. The Rochdale Olympic is a sports saloon having room in the back for two children. It has a unique, one-piece, all glass-fibre body-chassis.

Below. The Ginetta G4, which is available with Ford 997 c.c., 1340 c.c. or 1500 c.c. engines, has phenomenal road-holding. This makes it an excellent choice for competition work or fast touring.

Below. Final tightening up on the front suspension of a Falcon. Note the space-frame chassis of square-section tubes and front-wheel disc brakes.



Left. The Elva Courier is now made up by Trojan Ltd. It uses a B.M.C. B-series 1622 c.c. engine giving it a 100 m.p.h.-plus top speed. The popsy is not included in the kit!

that the damaged piece can be cut away and a new piece grafted on. Small repairs are well within the capabilities of the average handyman.

Probably the greatest appeal of kit cars is the tremendous choice available. Many of them use a separate tubular chassis, sometimes in the form of a ladder frame onto which is bolted the body, while others use the more complicated, but lighter and stronger, space frame. This has great resistance to twist and therefore discourages rattles developing in the finished car. There are other methods. Marcos cars, which have won the Autosport championship for the last three years, have a body-chassis unit using a combination of plywood and glass fibre. So far there has not been a case of structural failure on any of these cars which could be traced to this type of construction, although rumour has it that the scrutineers check them for death watch beetle before a race meeting! Fibre glass on its own has tremendous strength, and the Rochdale Olympic GT car uses a body-chassis unit of fibre-glass alone as a basis for the car. In places, particularly where important items such as suspension pivots are mounted, it is $\frac{3}{4}$in. thick. In normal use, this will stand up to a ridiculous amount of maltreatment before anything gives. I once drove a Rochdale Olympic seven days after it had been involved in an accident in which it had looped the loop. Body-chassis damage was limited to a crack on the underside and two small sections shattered on the nose and tail—all of which had been repaired in two days. The occupants walked away from the crash.

Kit cars, on the whole, are tough. They are also versatile. Even individual models are generally offered with a choice of engines, gear ratios and back axle ratios and in various stages of engine tune which will make the car suitable for a variety of uses from out-and-out racing to office commuting. The usual system is for the kit car manufacturer to produce a car suitable for racing and de-tune it for road use. This has obvious advantages, one of them being that a car designed with a top speed on the track of say, 120 m.p.h., will have a large safety

Right. A finished Falcon GT saloon. The time taken to build such a car depends mainly on the builder. It is best not to rush the job and it pays to double-check each operation as you go along—just to make sure.

Top. Final fitting of the steering column to a Falcon GT. It comes with the body and chassis pre-assembled. *Centre.* The engine requires fitting in the Falcon but the wiring loom is in place, ready to connect. *Bottom.* Luxury from the Falcon kit. Crash padding is liberal and seats, steering column and pedals are all adjustable.

margin in road trim where its top speed may be in the region of 85-90 m.p.h.

Because there are a lot of potential kit car owners who are not interested in race track performance, but would prefer a couple of extra seats in the back for children, a number of kit cars have been designed to appeal to the family man particularly during the past year. These fully-enclosed Grand Touring cars generally use a 1½ litre engine and will cruise in the 80-90 m.p.h. range. Inside they compare with some of the more luxurious production cars, with particular attention being paid to insulating the passengers from the noise of a high-performance engine.

Are kit cars easy to build? This burning question cannot be answered in one word. Let's say that most people who enjoy tinkering with cars, and who have done the odd maintenance job, such as a decoke, themselves, should have no trouble. But someone who doesn't know what goes on under the bonnet and isn't really interested, would find it difficult. Because no purchase tax is payable, kit car manufacturers are not allowed to include in the kit a list of detailed instructions. Like a jig-saw puzzle, you get all the bits, and it's up to you to put them together. The "no instructions" policy is laid down by the Inland Revenue Department who regard instructions as "professional help" which is taxable. But there are ways and means of finding out which bit goes where without professional help. The handbook for the particular car will often yield a good number of construction clues—especially if it has a chassis diagram as a lubrication guide. Then there is the list of parts. This generally accompanies the bits and pieces, and the system here is to go through it, and check that all the bits are there. This way you often find out that four peculiar lengths of drilled angle iron are listed as "seat brackets—four". Finally, there is nothing to stop you from visiting the nearest dealer, or the works, to have a look at a finished car. This is the surest way of sorting out where the spare bits go.

One of the peculiarities of the kit car industry is that some of the factories seem to put the mechanical ability of their customers on a par with the professional fitters that they employ to make complete cars (kit cars are also sold complete, and in this form include tax). This means that some advertise the fact that their cars can be assembled in something like 20 hours. Unless you are a professional fitter yourself, it pays to completely disregard optimistic estimates like this. I kept a log of time taken when I built a two-seater Turner about 12 months ago, and it took me a total of 105 hours spread over two months, before it was ready for the road. A main agent had said it could be made roadworthy in a weekend, but my first weekend was spent identifying most of the pieces.

The actual amount of hard graft you have to put into construction varies from car to car. Most have the body and chassis fixed together—if only temporarily. Some come with the engine, gearbox and final drive unit in place, which means that you don't need a hoist to get the power unit in. On other cars, the engine/gearbox unit must be fitted by the builder. Wiring is as a rule supplied as a complete loom, and some of the connections will generally have been made. This usually applies to cars where the lights and instruments are already fitted. Brake and clutch hydraulic pipes generally have to be connected up and usually the steering has to be put in. Some of the interior trim may be fitted but generally needs a good deal of finishing. Work on the suspension varies from fitting shock-absorbers and such extra parts as Panhard rods, to fitting the lot. This is not usually difficult, but takes time.

On some cars, you may find that the odd component will not fit exactly. Some manufacturers get over this difficulty by assembling the car at the works before it is sold, taking it to pieces again for delivery in kit form. Others don't do this, and occasionally a fitting snag crops up. When this happens, the part can usually be changed for one which does fit, or if you don't want to waste time, a small amount of modification usually puts it right.

Like methods of construction, tools for the job also vary. If the engine needs fitting you'll require a block and tackle, although the only other piece of heavy lifting gear that you are likely to need is a jack and a set of prop-stands or blocks so that the car can be raised to a reasonable height. A power drill is a great help, also a set of socket spanners of the appropriate sizes. Sometimes a car can be finished using only a selection of ring and open-ended spanners, but a good socket set will save a lot of time and energy. Add the odd file, a mallet, hammer and a couple of screwdrivers, and you should be ready to start.

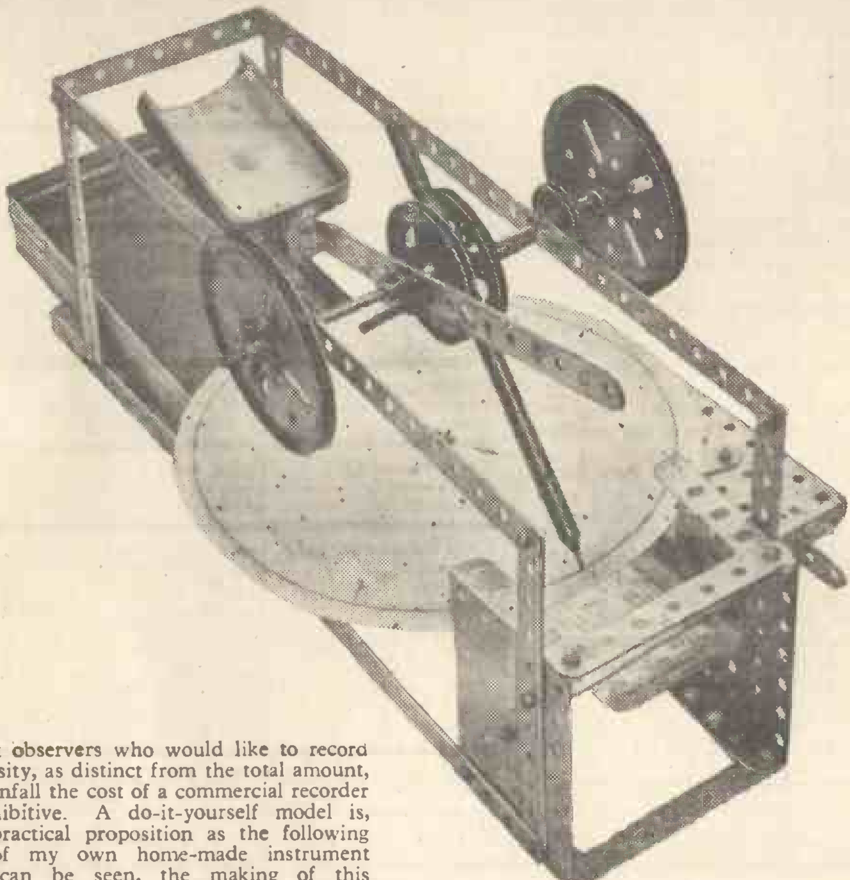
(Continued on page 382)

KIT CARS AT A GLANCE

MANUFACTURER	CAR NAME & ENGINE	SEATS	PRICE
Trojan Ltd., Purley Way, Croydon, Surrey.	**Elva Courier III** (B.M.C. 1622 cc)	2	from £716
Fairthorpe Ltd., Station Rd., Gerrards Cross, Buckinghamshire.	**Electron Minor** (Herald 1200 cc)	2/3	£498
	Electron (Coventry Climax 1100 cc or 1216 cc)	2/3	£757
	Rockette (Vitesse 1596 cc)	2/3	£625
	Zeta (Zephyr 2553 cc)	2/3	£735
Falcon Cars, 23, Highbridge St., Waltham Abbey, Essex.	**Falcon 515 GT** (Ford 1500 cc)	2/3	£845
Gilbern Sports Cars (Components) Ltd., Pentwyn Works, Church Village, Pontypridd, Glamorgan.	**Gilbern GT** (B.M.C. 1800 cc)	4	£845
Ginetta Cars, Witham, Essex.	**Ginetta G4** (Ford 997 cc, 1340 cc or 1500 cc)	2	£499-£535
Heron Plastics Ltd., 123, Calvert Rd., London, S.E.10.	**Heron Europa** (Ford 997 cc, 1340 cc or 1500 cc)	2	£730-£755
Lotus Components Ltd., Delamere Rd., Cheshunt, Hertfordshire.	**Lotus Super Seven** (Ford 977 cc, 1340 cc or 1500 cc)	2	£499-£585
	Lotus Elan (Lotus-Ford 1500 cc twin cam)	2	£1095
	Lotus Elite (Coventry-Climax 1216 cc and Spec. Equip. model)	2	from £1299
Marcos Cars Ltd., Greenland Mills, Bradford-on-Avon, Wiltshire.	**Marcos GT** (Ford 997 cc or 1500 cc)	2	from £750
	Marcos Spyder (Ford 997 cc or 1500 cc)	2	from £750
Rochdale Motor Panels, Littledale Mill, Littledale St., Rochdale.	**Rochdale Olympic Ph.3,** (Ford 1500 cc)	2/4	£735
Turner Sports Cars, Pendeford Airport, Wolverhampton, Staffs.	**Turner 1500** (Ford 1500 cc)	2	£699
	Turner 1500 GT (Ford 1500 cc)	4	£870
Layton Sports Cars Ltd., Hoo Hill Works, Bispham Rd., Layton, Blackpool, Lancs.	**T.V.R. Grantura Mk III** (B.M.C. 1600 cc)	2	£862

a home-made rainfall recorder

By P.G.Hooker



FOR most observers who would like to record the intensity, as distinct from the total amount, of the rainfall the cost of a commercial recorder will be prohibitive. A do-it-yourself model is, however, a practical proposition as the following description of my own home-made instrument shows. As can be seen, the making of this instrument is simple and straightforward and it gives reasonably accurate and intriguing results.

A suitable timepiece to use is an alarm clock of about 4in. diameter from which the glass front and minute hand should be removed. An alarm clock is recommended because these clocks are usually of robust design, of suitable size and comparatively cheap, although the alarm mechanism is, of course, superfluous. The gap between the clock face and the case is sealed to exclude damp. A circular piece of stout paper of about 7in. diameter is pivoted at its centre on the clock spindle and the hour hand threaded through two slots in the paper. The paper is thus rotated by the movement of the hour hand.

The clock is mounted horizontally in a Meccano framework with the attached paper uppermost. The framework extends upwards and a fixed Meccano rod is mounted horizontally about 3¼in. above the centre of the clock. The rod acts as a pivot for a balance, one side of which supports a fine-pointed ball pen to mark the paper and the other a receptacle into which the rainwater is directed.

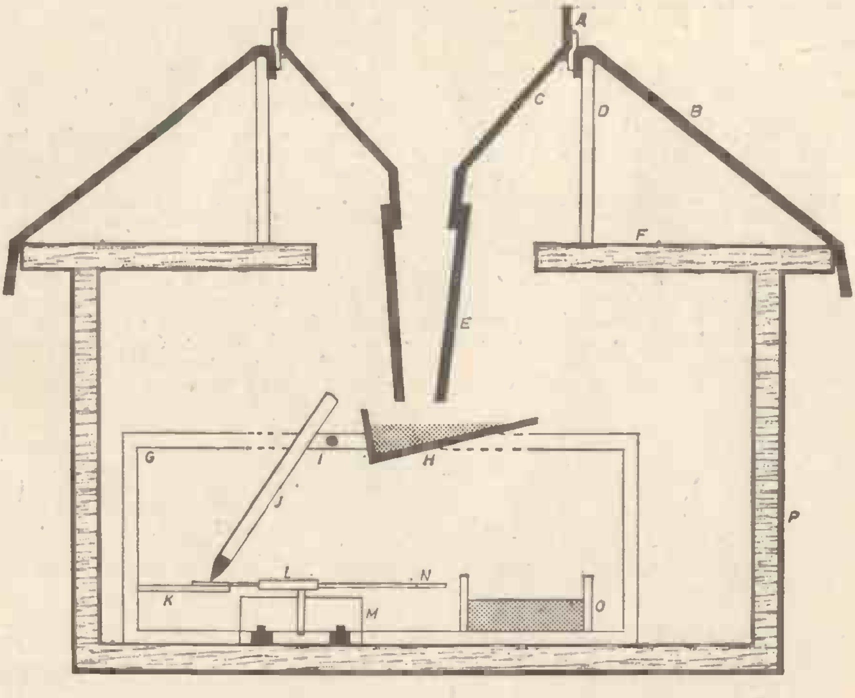
The ball pen is normally on the heavier side of the balance and is positioned so that when at rest the point is in contact with the paper at an angle of about 45°, about ¼in. from the circumference of the paper. At this point the paper is supported by the end of a piece of cardboard about 2½in. long which is fixed to the framework only at its other end, so as to form a springy platform.

The receptacle is a small aluminium tin approximately 1¼in. by 2in. by 3¼in. deep, one of the shorter sides being cut away. When the balance is at rest the receptacle makes an angle of about 20° with the horizontal as shown.

My balance was weighted by experiment so that when exactly 6 cc of rainwater have collected in the receptacle the balance tips, spilling the water into a large removable container at a lower level. From this the total rainfall can be ascertained using a measuring cylinder. 6 cc of water corresponds approximately to 0·02in. of rainfall collected in a 5in. diameter funnel, which is the quantity of rainfall necessary to activate official instruments.

As the balance tips, the ball pen point is lifted clear of the paper and falls back on to the paper as soon as the water is spilled from the other side of the balance. The cardboard supporting the paper acts as a springboard which is depressed as the ball pen point strikes the paper and immediately recovers. The effect of this is that the pen makes a distinct mark about ⅛in. in length along a radius of the paper, clearly distinguishable from the circle drawn as the paper passes under it while rotating. The distances between the marks are inversely proportional to the intensity of the rainfall. Knowing the diameter of the circle traced by the ball pen, the volume of water required to tip the balance and the diameter of the collecting funnel the calibration of the instrument can be calculated. The time when rain occurred can also be ascertained if a mark, corresponding to a known time, is made on the paper before the instrument is put in operation.

The instrument is fitted in a painted wooden box with a removable wooden lid slightly larger than the box. An aperture about 2in. by 2in. is cut in the lid above the tray. On top of the lid around the aperture, a metal cylinder about 8in. high and 5in. diameter is securely fixed. For this purpose I used a 7lb jam tin with both ends removed. A plastic funnel of exactly 5in. diameter is fixed into the top of the cylinder, a watertight joint being made by means of a length of draught excluder which is glued round the cylindrical part of the funnel as shown in the diagram. A polythene tube extension to the funnel ensures that the rainwater falls into the tray without splashing. Also incorporated in the joint between the funnel and the cylinder is a sheet of flexible waterproof plastic material which forms a sloping roof for the box to prevent water entering through any aperture other than the funnel. It is secured around the perimeter of the lid and overlaps on all four sides.



A Watertight joint with draught excluder
B Curtain material
C Funnel
D Cylinder
E Funnel extension
F Lid
G Meccano framework
H Collecting tray
I Pivot
J Ball pen
K Cardboard
L Hour hand
M Clock
N Paper
O Collecting tin
P Box

Bolts and nuts
Limits & tolerances
Tailplane
Elevator
Fin

BEFORE commencing to build the Luton Major it is as well to be aware of various points relating to nuts and bolts, fits and tolerances, etc., which apply throughout the construction. In fact they apply equally to the construction of any wooden aircraft. This month we deal with the points first mentioned, next month with points applicable to making metal fittings.

Bolts and nuts

Bolts attaching load-carrying fittings to the aircraft structure may be fitted with plain nuts peened over after tightening, but it is preferable to use stiff nuts or lock nuts, without peening. Bolts holding in position components which may be dismantled occasionally, *e.g.* tailplane attachment to fuselage, should be held with split-pinned castle nuts. Bolts holding parts not subject to high stresses, *e.g.* instrument panel, may be fixed with plain nuts, but here also stiff nuts or lock nuts are preferable.

Hinge pins, pulley brackets etc., which must not be pulled up tight, may be in the form of steel pins fitted with split pins, or they may be bolts with castle nuts or turret nuts, and split pins.

Bolt heads and nuts pressing against timber require large " penny " washers to distribute the load and prevent them pulling into the wood. Nuts tightened against metal fittings should have small steel washers to prevent damage to the fittings during tightening, but boltheads pressing on metal need no washers.

All bolts must be of aircraft quality, either mild steel (4A1) or high-tensile steel (A25).

Every bolt should have the correct length of plain shank; shanks that are too long or too short are equally bad. All that part of the bolt bearing on the timber or metal, should be plain in order to develop the maximum bearing area (see Fig. 1). This applies especially to bolts subjected to side loads, such as when anchoring bracing wires. In the case of bolts which are long in relation to their diameter, when only the bolt head is subject to side loads (Fig. 2a), a short length of threaded shank within the timber is acceptable. However, if side loads are present at both ends (Fig. 2b), the shank must be plain throughout.

Limits and tolerances

Spruce members should generally be within $\frac{1}{64}$in. of their nominal cross-sectional dimensions, but limits of $+\frac{1}{32}$in.-0in. are preferable to $+\frac{1}{64}$in.$-\frac{1}{64}$in. It is not easy to lay down tolerances with any degree of rigidity, as the strength of various members is affected differently. Obviously, a reduction of $\frac{1}{64}$in. on a 1in. dimension represents a loss of only $1\frac{1}{2}\%$, but the same reduction on a $\frac{5}{16}$in. member represents a $7\frac{1}{2}\%$ loss. On the other hand, ribstock of, say, $\frac{1}{2}$in. $\times \frac{3}{16}$in., oversize $\frac{1}{32}$in. on both dimensions results in the ribs being roughly 20% over the design weight. It would be better to specify limits of say $+5\%-0\%$, but this would not be practicable.

Sheet steel fittings should have a bend radius of not less than the gauge of the sheet and preferably $1\frac{1}{2}$ times the gauge thickness.

Bolt holes in timber and metal should be $\frac{1}{64}$in. above nominal. Reamed holes should be to B.S.S. Class " X ", *e.g.* 2 B.A. and $\frac{1}{4}$in. diameter, $\pm 3/1000$in.

Pressure testing. Fuel tanks should be tested to $1\frac{1}{2}$ p.s.i. and oil tanks to 3 p.s.i.

Fig. 1. Left to right.—(i) Thread ends in washer thickness, ideal; (ii) thread ends just below washer, acceptable; (iii) thread penetrates wood deeply, bad; (iv) plain shank prevents nut tightening, very bad.

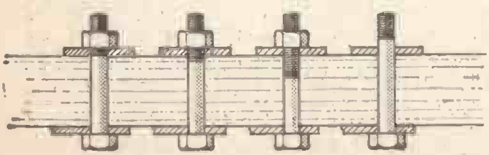
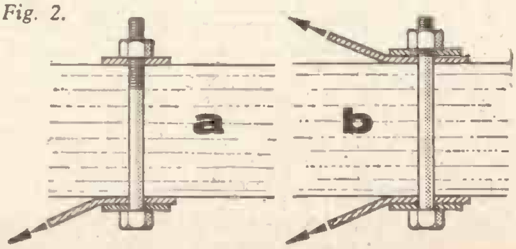


Fig. 2.



Tailplane and elevator

The ribs have solid $\frac{1}{16}$in. plywood webs, with $\frac{3}{8}$in. or $\frac{1}{2}$in. x $\frac{3}{16}$in. spruce capstrips. The combined tailplane and elevator ribs should be built in a simple jig and cut apart after the glue has set. Small hardwood blocks should be positioned on the jig, $2\frac{7}{16}$in. apart, to ensure accurate cutting apart of the tailplane and elevator portions of the ribs. Vertical blocks $\frac{3}{8}$in. x $\frac{3}{16}$in. should be positioned immediately in front of the tailplane spar and behind the elevator spar—that is on either side of the blocks in the jig. They should be very accurately positioned, exactly perpendicular to the chord line, to ensure proper alignment on assembly. After making the four main ribs and the centre half-rib, the jig should be slightly modified for the pair of tip ribs. In gluing up the ribs leave the front 6in. unglued to enable the capstrips to be slipped over the front spar, leaving the final gluing until assembly of the tail unit.

Additional plywood gussets about 2in. in width can with advantage be glued to both rib sections where they abut the spars after the rib/spar assembly has been carried out. In the case of the tailplane spar these gussets should extend over the vertical packing blocks in the spar (Fig. 7).

The front tailplane spar also acts as the leading-edge and is of 2in. x 1in. spruce, with the top and bottom front corners rounded off to a $\frac{3}{4}$in. radius, with $\frac{3}{16}$in. deep notches cut in the upper and lower faces to accommodate the rib capstrips.

The tailplane rear spar has a solid $\frac{1}{16}$in. ply web, with $\frac{3}{4}$in. x 1in. spruce flanges, suitably blocked at all rib and hinge attachment positions. The spar tapers over the tip portions to $\frac{1}{2}$in. depth. The recommended way of obtaining the bend in the flanges is to make two horizontal saw-cuts through the outer 12in., slip glued 1 mm ply strips in the saw cuts and, whilst the glue is wet, bend in a suitable jig and leave to dry. Shape the extreme end after removal from the jig. Alternatively, the flanges may be reduced to $\frac{1}{4}$in. depth over the tip portion and bent to the required shape with the aid of boiling water poured on at X—X in Fig. 6.

The elevator spar should be shaped from a piece of solid spruce, $3\frac{7}{8}$in. x $\frac{3}{8}$in. with a $23\frac{1}{2}$in. long reinforcing piece of similar section, glued centrally to the rear face.

Assembly of the tailplane is best done in the vertical plane with the main spar clamped to a flat surface such as a bench. Care should be taken to ensure that all the ribs are properly aligned and perpendicular to the spar; temporary clamping of the rib extremities to a stiff member is recommended while the glue sets. Glue and tack the ribs to the spar, adding the 2in. ply gussets, if used. Add the drag struts, with wedge-blocks at the spar face and where

Figs. 3 and 5.—Two views of a tailplane and elevator under construction by Mr. G. F. M. Garner of Bristol.

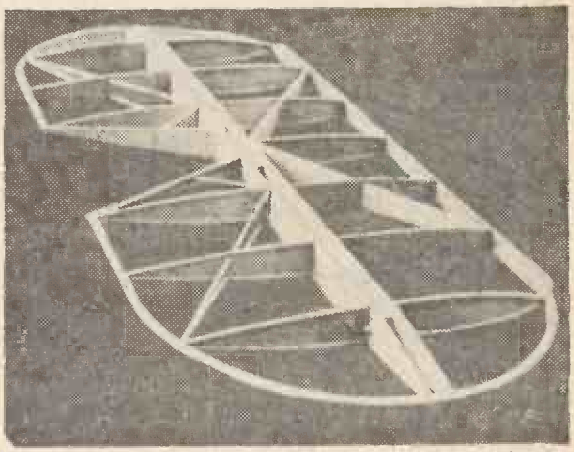


Fig. 3.

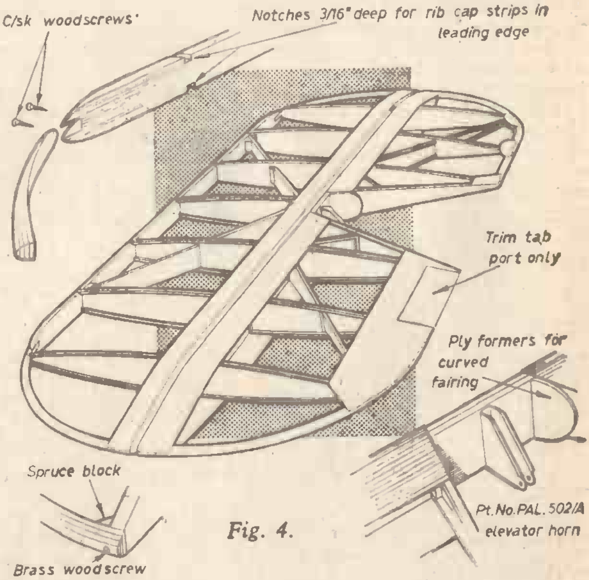
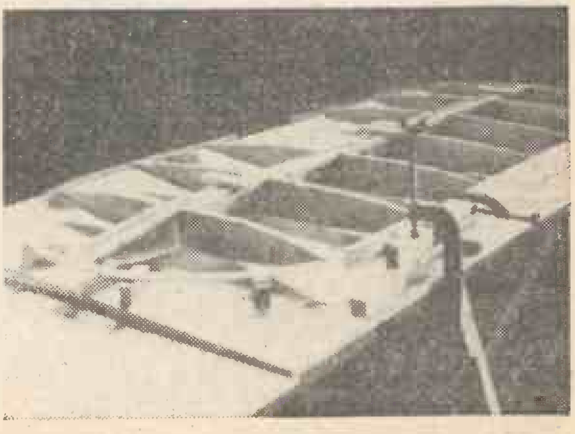


Fig. 4.

Fig. 5.



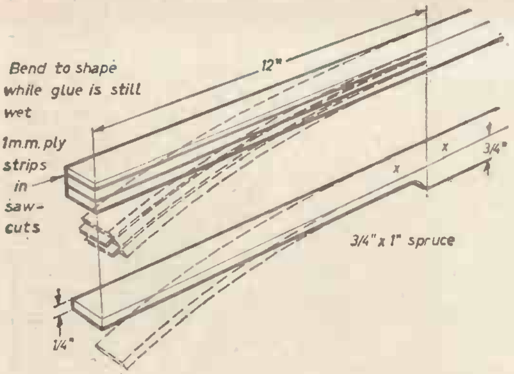


Fig. 6.—Two methods of shaping the tailplane rear spar boom ends.

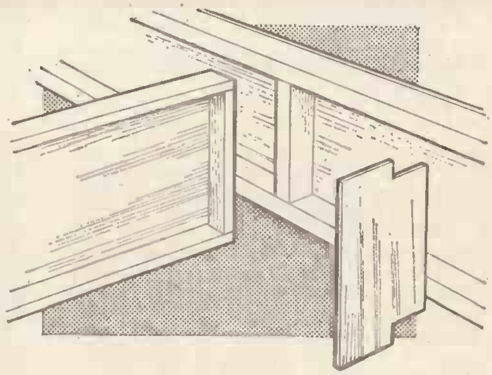


Fig. 7.—Fitting the tailplane ribs and extra gussets to the tailplane rear spar.

they pass through the rib webs. Fit the leading-edge by gluing and screwing with No. 4 x ½in. c/sk woodscrews. At the same time glue up the forward parts of the rib capstrips, and shape their outer surface to the leading-edge contour.

Assemble the elevator ribs, drag struts and spar similarly.

Laminate the tailplane and elevator bows in one piece for each side, using a simple jig. This can simply consist of headless nails knocked into a flat surface in the required shape, using small wedges to clamp the laminations together while the glue sets. Alternatively it can be more elaborate, using wood blocks for the shape with eccentrically pivoted, circular clamping buttons. This also applies to most of the other jigs required for the Luton Major.

Next clamp the elevator and tailpiece spars together with 1in. thick spacing blocks between them. Fit the two laminated bows and add the long top and bottom plywood strips and all remaining gussets etc. Make and fit the trim tab and finally carefully cut the tailplane and elevator bows apart between the spars using a fine saw. Fit the hinges and other metal parts.

Rudder and fin

The rudder spar should be shaped from a piece of spruce, 3½in. x ⅜in. with the base increased in width by adding two ¾in. x ⅜in. flanks. Mark out the spar centre line, from which the tapered widths can be set out. The topmost taper may be made by sawing off the surplus material to within ⅛in. of the final line, cutting from the wider part towards the tip, finally finishing off with a smoothing plane. Mark out the positions of all ribs and fittings.

The ribs should be made in a simple jig, using 1in. headless nails at 2in. or 3in. spacings. The ply webs should preferably have the outer grain perpendicular to the centre line. Build up the ribs and two diagonal struts on the spar, slotting the ribs to receive the diagonals. Make the laminated edge member in a jig as for the tailplane bows. When thoroughly set, glue it in place around the

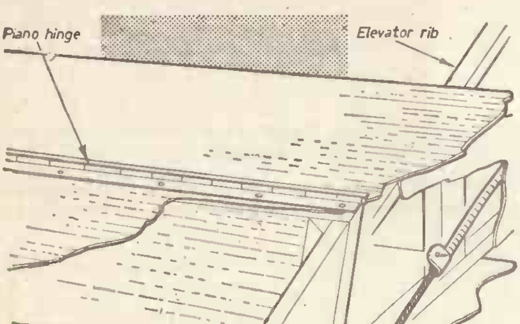


Fig. 8.

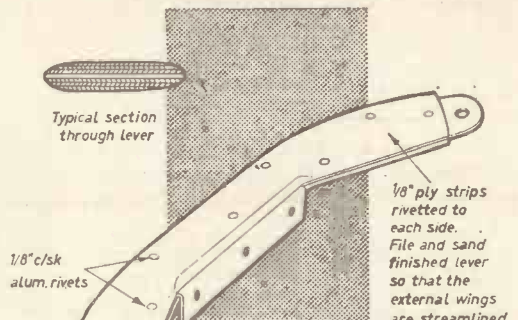


Fig. 9.

Fig. 10.

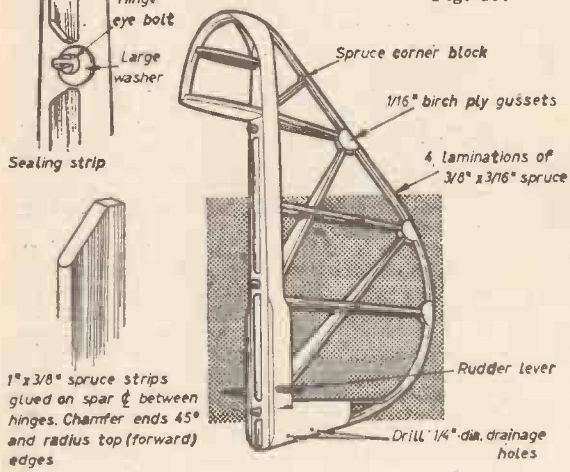


Fig. 11.

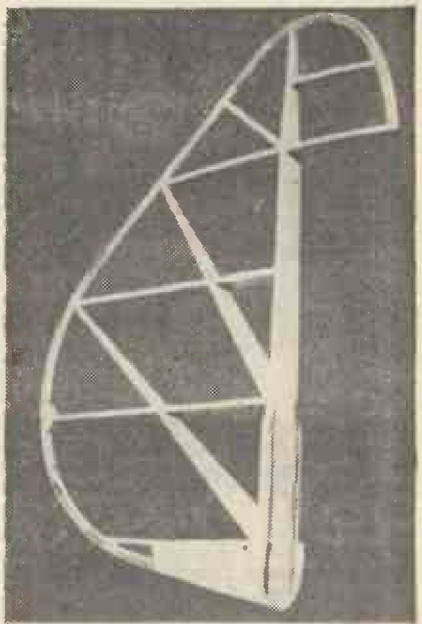


Fig. 12.

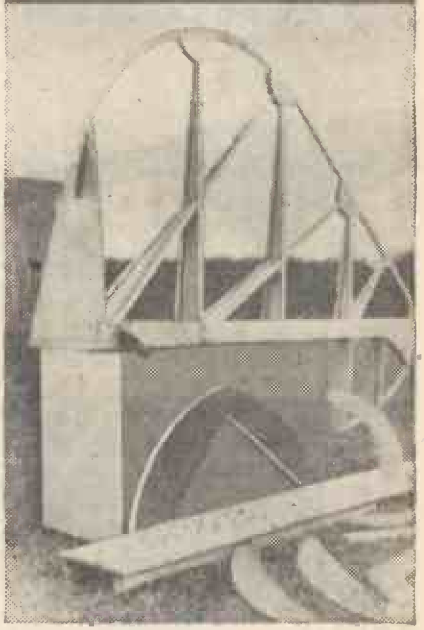


Fig. 10.—General arrangement of the rudder.

Fig. 11.—A view of a partly built Luton Major rudder by T. G. Stott of Wincanton.

Fig. 12.—Completed rudder with rib jig using nails, and rudder bow templates, by Mr. G. F. M. Garner.

Fig. 13.—Details of the tail fin.

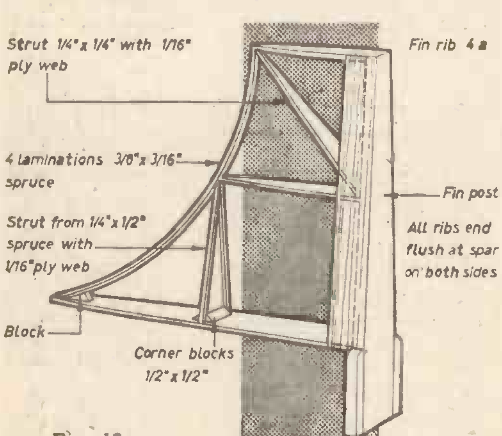


Fig. 13.

Fig. 8 (opposite page).—Detailed construction of the elevator trim tab showing the conduit for the control wire.

Fig. 9 (opposite page).—The rudder control horn with its streamlined ply fairings on each side.

rudder assembly. Fit the ply gussets and the lower plywood fairing over the 12in. straight part of the laminated bow, together with the upper diagonal strut and the 2in. long-grained plywood strips each side of the spar.

The construction of the fin is basically similar to that of the rudder and requires little separate description. Remember however that the curve of the laminated leading edge must fair smoothly into that of the rudder.

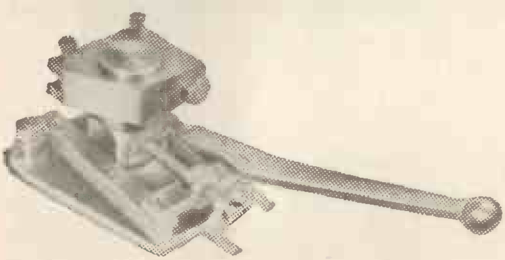
LATHE GADGETS

Part 17

BALL TURNING TOOL 1

By L. C. MASON

THE radius turning tool described last month enables concave surfaces to be machined. However, many surfaces—in some cases to match—are convex; that is, the surface to be machined is a ball, or part of a ball. A swinging tool can still be used for the job, but the vertical line through the tool point, around which it has to swing now passes through the centre of the job.



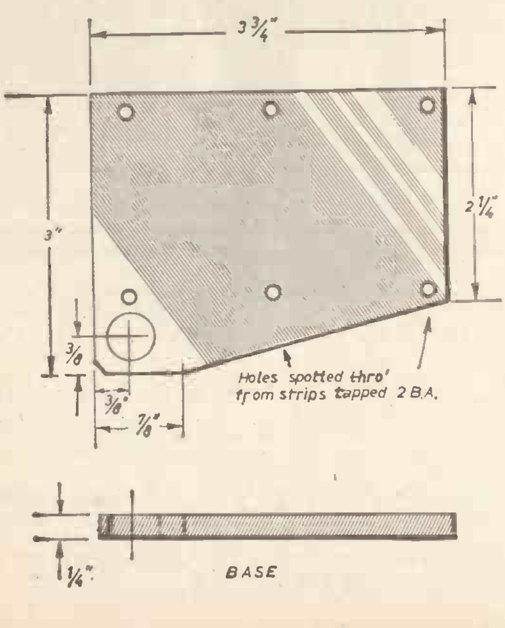
Consequently the tool required is a little more complex than its opposite number used for concave shapes.

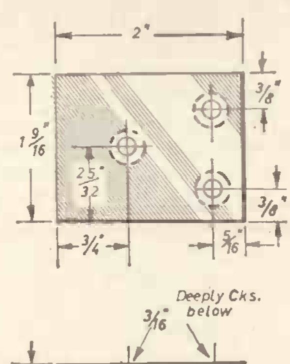
The ball turning tool has to provide for the swing centre to be accurately located, and also for the tool point to be fed along a radius line swinging about that centre. The tool now shown does this by providing its own pivot point, which can be precisely located in relation to the job by the calibrated lathe movements, and its own radial tool feed via a small slide which can be swung in an arc about the job.

The slide is built up from ¼in. thick mild steel strips, sandwiched together on a base plate of the same ¼in. plate. The base widens out at the front nearside corner to accommodate a flanged bush which is bolted to the cross slide, the whole tool swinging about this stationary bush to give the tool its circular motion. The pivot point being well off-set enables an adjustable type toolpost to be used to hold the tool and yet bring the tool point over a line passing through the pivot centre. It also permits the tool to be swung round close to the chuck as the mass of the tool holder is thus positioned away from the chuck.

Construction of the base and ways is quite straight-forward, assembly being by 2B.A. screws countersunk in the top strip. Note that not all the holes should be countersunk. Locate and assemble the outer side first, complete with gib strip, then lay the slide plate in position to locate the nearside ways. Leave the fit fairly slack for eventual close adjustment by the gib strip. The gib strip, it will be seen, has a 90 degree bend at each end to fit small recesses filed in the ends of the middle strip of the ways. This is to retain the gib strip endwise, as its thinness is hardly sufficient to allow dimples to be drilled in the usual way for the adjusting screws.

The slider plate is of the simplest possible form, being merely a truly squared rectangle of ¼in. steel plate. This carries the toolpost column, attached to the plate by three 2B.A. countersunk screws

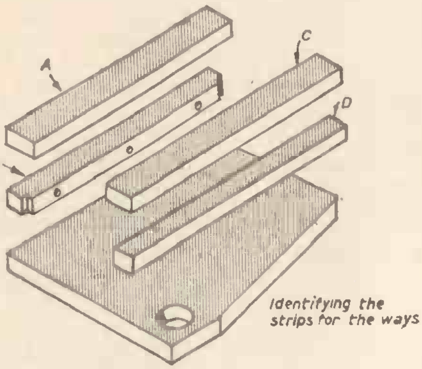


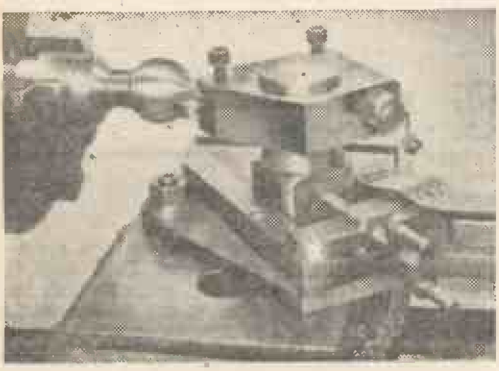


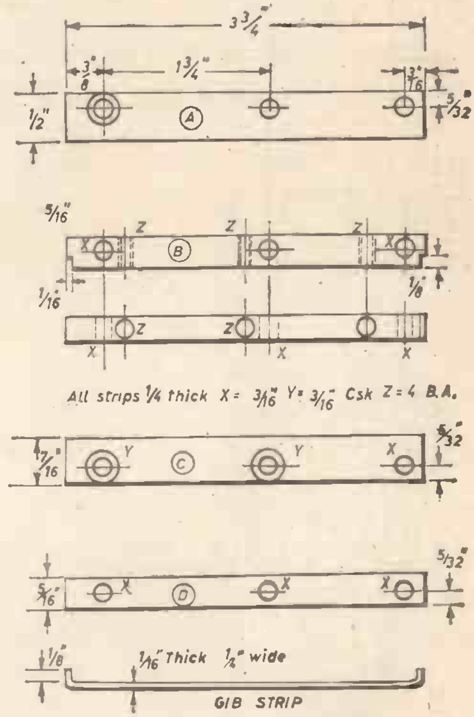
Top left.—The completed ball turning tool.

Left.—The base and slider plate constructional details.

Below right.—The gib strips.
Below left.—The tool set-up during a ball turning operation.



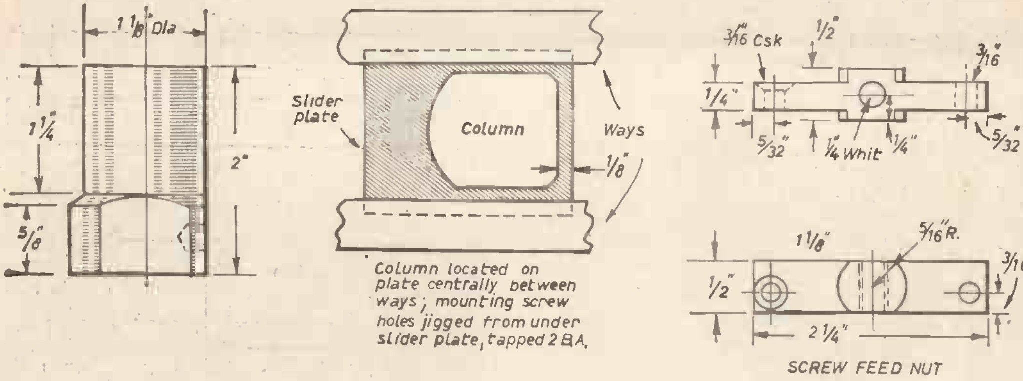




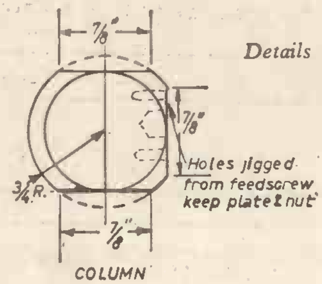
inserted from underneath. The column should be made from 1½in. round bar, with three flats end-milled or faced on the larger base diameter. The two side flats provide side clearance between the ways, while the third flat at the back is used for attaching the feed screw keep plate. The tool holder follows very much the lines of the one described for use on the ML7 topslide. Full details for making this type were given in the January 1962 issue, so a quick re-cap should suffice here. Square up the block to its outside dimensions and face both sides in the four jaw chuck. Mark out for the various holes, replace in the four-jaw chuck and bore the column hole. Drill and tap for the clamp stud, cut the split and fit the stud and nut. Rough out the tool slot, finish mill this and drill and tap the top of the holder for the tool clamp screws. The holder provides for tools of ¼in. or 5/16in. section. The column could be extended slightly to make it tall enough to carry a holder made from 1in. thick material if desired, in which case the tool slot could be enlarged to take ⅜in. or ½in. tools as used on the lathe itself. This is probably a doubtful advantage however, as the nature of the operation itself is one calling for light cuts—hence the provision for small section tools only.

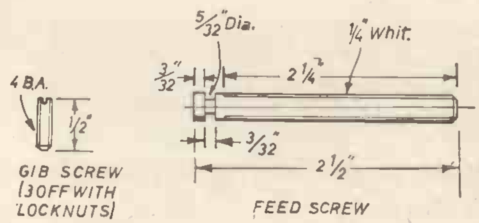
The cross bar forming the nut for the feed screw should be shaped up from ½in. square bar by turning it up in the four-jaw chuck. The piece should lie centrally across the chuck face and a L.H. knife tool should be used. Centre pop the spot for the feed screw hole and drill No. 9 for tapping ¼in. Whit. Before tapping the hole, slip the tool column on its plate between the ways and slide it back to contact the cross bar. Spot through the drilled hole in the bar onto the back flat on the column, as a clearance hole will be required here for the end of the feed screw. The resulting dimple will be off centre to the right; this is quite in order, as although the feed screw hole is central with regard to the outside edges of the ways, the column is 1/16in. off this centre line because of the gib strip.

With a tailstock dieholder cut a 2¼in. length of ¼in. Whit thread on the end of a piece of ¼in. round rod for the feedscrew, making it a shakeless fit in the tapped hole in the cross bar. Part off to leave ¼in. or so of plain rod beyond the end of the thread, reverse the rod in the chuck and with a narrow parting tool turn a 3/32in. wide and 5/32in. diameter neck for the keep plate, facing the cut end at the same time.



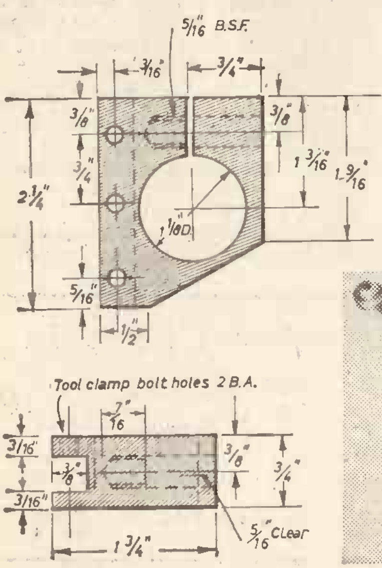
Details of the column and feed components.

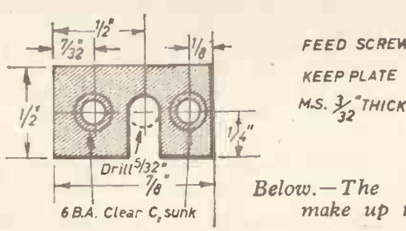




The keep plate should be filed up from a scrap of $\frac{3}{32}$in. steel strip. Drill the feed screw hole $\frac{5}{32}$in. and the two fixing screw holes to clear 6 B.A. Saw and file out a slot into the $\frac{5}{32}$in. hole, so that the plate will drop over the neck on the end of the feedscrew. Assemble the parts completed so far, and slide the column up to the end of the feedscrews so that this enters its clearance hole. Place the keep plate over the end of the feed-screw, square up the plate on the column, and spot for the fixing screw holes in the column through the holes in the plate. Drill and tap these 6 B.A. These holes will probably run into the ends of the screws holding the column to the slider plate, but this is of no consequence.

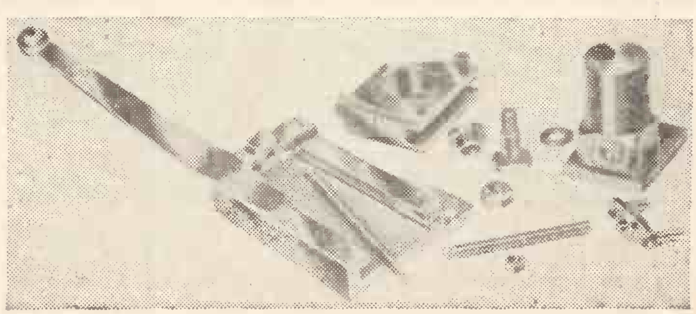
Before screwing the keep plate finally in position, remove the feedscrew or run it back as far as it will go, and adjust the gib screws so that the slider runs evenly and smoothly, with a slight resistance, over its whole range of travel.

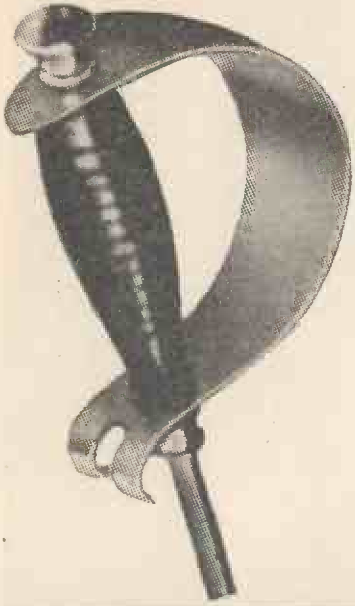




Left. — The tool clamp and feed screw keep plate.

Below.—The sub-assemblies which make up the complete tool.





MAKE A SWORD TYPE POKER

... *Says John WALLER*

DESPITE the change-over to central heating and the replacement of many old-time domestic open fires by imitation coal electric ones the poker is still an essential tool not only for stoking the fire but also for more decorative purposes in keeping with tiled and brick fireplaces. The design shown here invites comment by visitors as the brightly polished guard and other parts are indeed eye-catching when the poker is in place on the hearth.

Fig. 1 illustrates the completed poker. The chief feature is the copper guard which, though not a new innovation, overcomes the usual look of austerity which these items have. The differing colours of the two materials—copper for the guard and brass for the circular knobs—add to the attractiveness of the finished article.

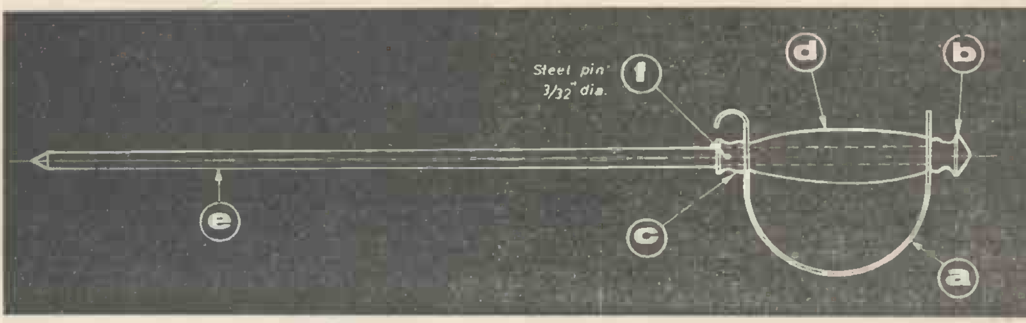


Fig. 1.

Fig. 2 shows the chief details of this poker and the method adopted in fitting the parts together. Readers who have the necessary facilities for brazing small items will undoubtedly prefer to hold knob "C" in place on the rod in this way. For others who are limited to a drilling machine an alternative is shown in Fig. 1 of using a tiny steel pin—brass is also suitable.

As the guard is the chief feature of this poker it is suggested that a start is made on this item, using either 18 or 20 gauge copper sheet—both thicknesses are easily purchased. If thicker material is used than 18 gauge it gives the poker a heavy appearance and tends to make it too massive. Cut the sheet to the dimensions shown in Fig. 2a. Scribe the large radii if you have the necessary compasses. Those not so fortunate can knock two sharp-pointed nails through a wooden lath at 21in. centres to make a rough and ready trammel compass. Cut round the profile either with a fine-tooth hacksaw or by snipping off the surplus material, using tinman's snips. Dress off the burrs with a fine file to complete this item with the exception of the drilling stage. This is best left until after the part has been formed to shape and the holes have been purposely omitted from this sketch.

Bending sheet metal, using a bottle as a former, is an old idea, but if the reader has not got a bottle with a diameter of approximately 4½in. recourse can be made to a piece of shaped wood as a former. Gently form the sheet to the required radii—a combination of pulling and tapping is usually necessary for items of this nature—until the required shape has been attained. See that both ends are correctly aligned with each other. The end having the slot—this gap is merely a decorative feature and can be omitted if a preference is felt for a solid guard at that point—should be bent round a piece of scrap bar material ¾in. in diameter. Use a pair of pliers for this operation but take care not to damage the soft copper by gripping the metal too hard or perhaps allowing the tool to slip. This bending work is not so difficult as it sounds if care is taken to gently tap the copper with a "soft" hammer. Strange as it may seem, rubber-headed mallets are available and these are ideal for jobs such as this—but never attempt to hit the sheet with the usual fitter's hammer as this instantly bruises the sheet and causes an unsightly appearance. Once the desired shape has been accomplished drill two holes to just clear the rod "E".

Turning the brass knobs "B" and "C" requires little description as they are merely beginners' practice jobs, but make sure the tapped hole is a tight fit on the rod to ensure that when these two parts are finally attached to each other there is no risk that they can come apart. As tight items are often awkward to assemble, leave some extra material on the coned end of this knob—about 1in. is sufficient. File flats on this for gripping with a spanner or between the jaws of a vice and use this to thread the knob on to the rod. The thread should be made a few thousandths of an inch larger than the tapped hole—just leave the die-holder screws slightly slack and tighten the one in the centre to open out the die a little—the knob will then assemble correctly with no fear of the poker falling apart during normal usage. Remove the surplus afterwards.

The handle "D" can be made from a length of hardwood or a piece of coloured plastic, but exercise some care in the selection of this latter material otherwise it tends to detract from the good appearance of the finished poker. Drill the hole only just larger than the rod. A few grooves turned on the grip—about ½in. apart is ample—will relieve it of any bareness. However, some readers may care to try their hand at carving on the handle and for those skilled in this work it provides an ideal site. The rod is simply a length of bright mild steel with a cone turned on the end. An overall length of 24in. is ample as this leaves about 18in. protruding from the guard.

The assembly of the various parts is an easy task and is performed in this order. Secure the knob "C" to the rod in the appropriate position either by brazing or by drilling the hole for the cross pin. Slide on the guard and handle and finally tighten the knob "B" so that the handle cannot rotate. A brief rub up with metal polish after making sure that all burrs are absent gives an attractive fireplace tool which is easy to use and can be made at negligible cost as most readers will have suitable scrap pieces of metal on hand.

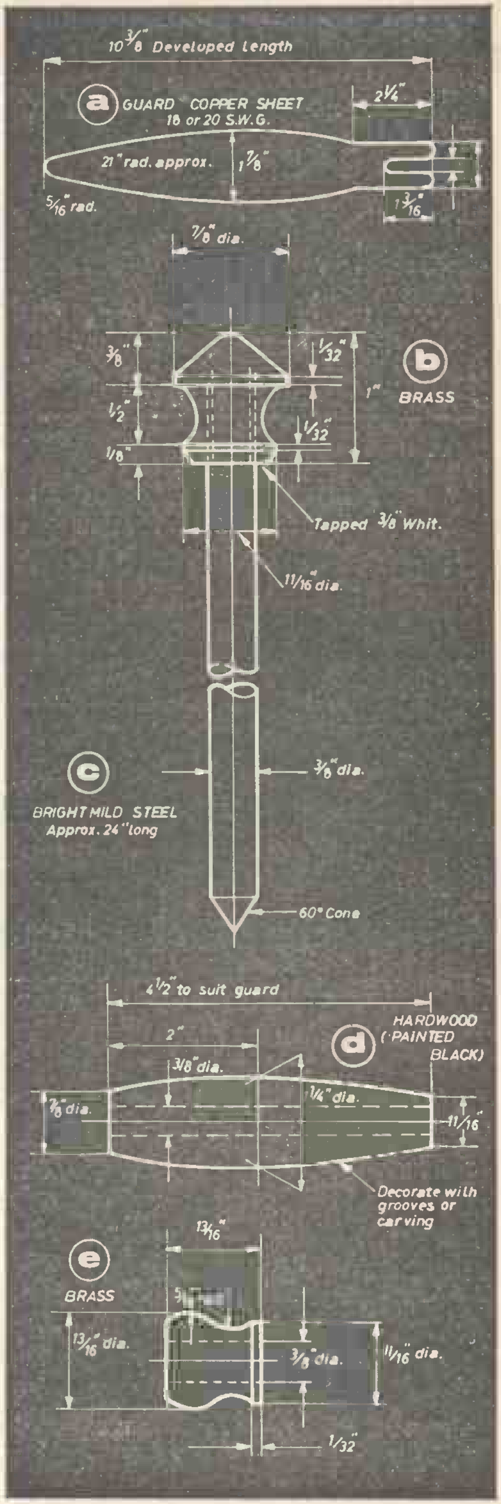


Fig. 2.

NO ROOM IN THE MINI?

YOU NEED THIS CAMPING TRAILER!

THIS trailer was designed to be towed by an Austin Seven Mini car to carry *all* the camping equipment, including provisions and clothes, for four adults and two small children. Previously this gear was packed on the roof rack and in the boot and the interior of the car was packed to capacity also. The rummaging that went on to find anything and the constant unpacking and repacking induced me to make a trailer in which everything has a "home" and in which there is a kitchen unit complete with drawers for cutlery, crockery (plastic!) and food, an icebox, gas cookers, wash-bowl and water-carrier, the portable kitchen being easily available for a meal at the roadside.

Design features

The following points were considered when the trailer was being planned:

1. It must not weigh more than 8cwt fully laden (Austin recommendation).
2. It should have the same size wheels as the car to avoid taking another spare.
3. Suspension to be independent, easily fitted and fully reliable for Continental camping.
4. Over-run brakes must be fitted and an automatic breakaway brake is desirable.
5. The tow-bar should be removable. This can make boat passage cheaper and is an added security when left unattended.
6. It must be possible to see over the trailer through the rear window of the car.
7. Drawers are better for packing clothes than cases or bags.
8. It should be possible to lock it up.
9. It should be fitted with lights as on the car and the cooking section should have a light from the car battery also.
10. It must have retractable legs, easily adjustable to varying ground levels.
11. It must be as cheap as all these requirements will permit!

Chassis

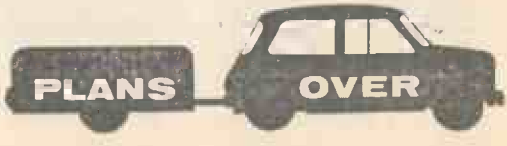
This should be made from 1½in. x 1½in. x ¼in. angle iron, welded at all joints. Anyone without welding equipment could bolt onto corner plates or get the local garage to weld it for him. An alternative is to go to a metalwork class at the local evening institute (I am a metalwork teacher!). The plan makes it clear that the angle iron provides a positive shelf for the body shell to rest on. It also provides a convenient channel in which to bolt the two suspension units.

The front cross member has a bracket, through which the tow bar passes, welded to it, and the rear bracket for the tow bar is attached to a second cross member 6in. behind the front one. As these cross pieces take the full load when towing they are braced to the suspension channel. The front cross member is welded to the front rail, so providing a 3in. front end to the chassis.

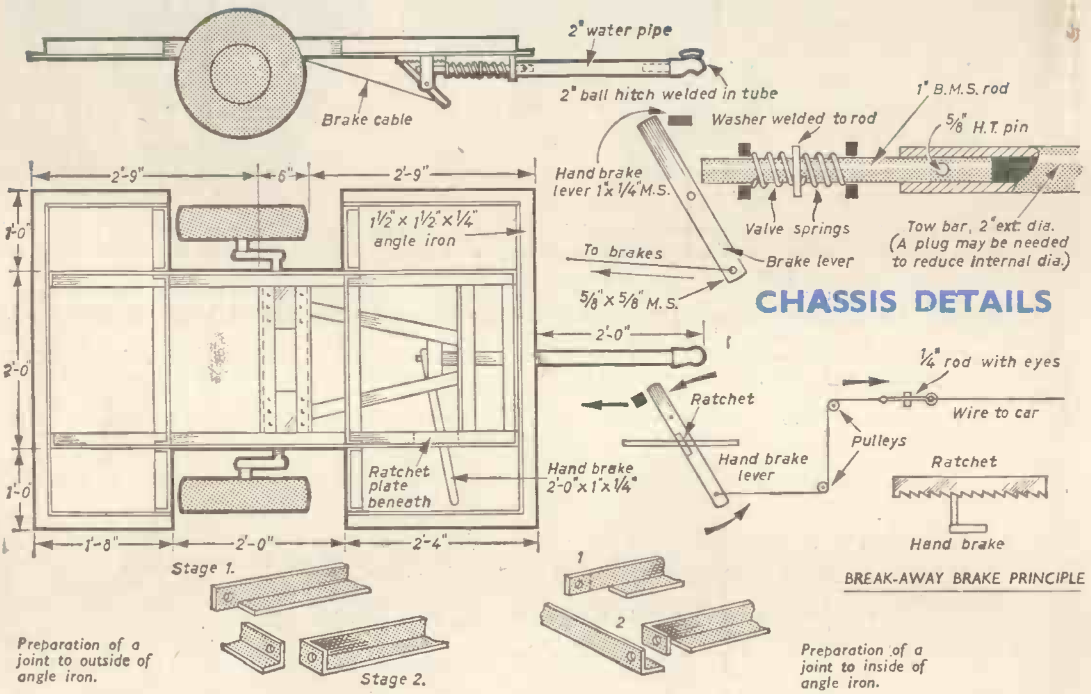
It is essential to provide a rigid chassis to attach this type of suspension to, and the suspension units themselves must not be used to help make it rigid. Failure to ensure this can lead to excessive tyre wear (or worse!). A wooden box frame could be used instead of a metal chassis, but it would have to be very solidly constructed and a metal channel would have to be bolted across it to take the suspension units.

Suspension

This was obtained ready made from the Bramber Engineering Co. Ltd., Springbok Works, Waterloo Road, Cricklewood, London, N.W.2. This firm manufactures "Flexitor" independent rubber suspension units and will supply a detailed booklet on request. The assemblies vary in price according to their carrying capacity and whether the wheels are removable or fixed, also whether they have brake drums or not. A trailer of less than 2½cwt unladen weight does not require (legally) brakes, but I think the extra safety factor is worth the extra cash. I used the No. 6 Flexitor assembly, which is effective in the 6cwt-9cwt range. Complete with mini wheels (less tyres) and with brakes they cost me

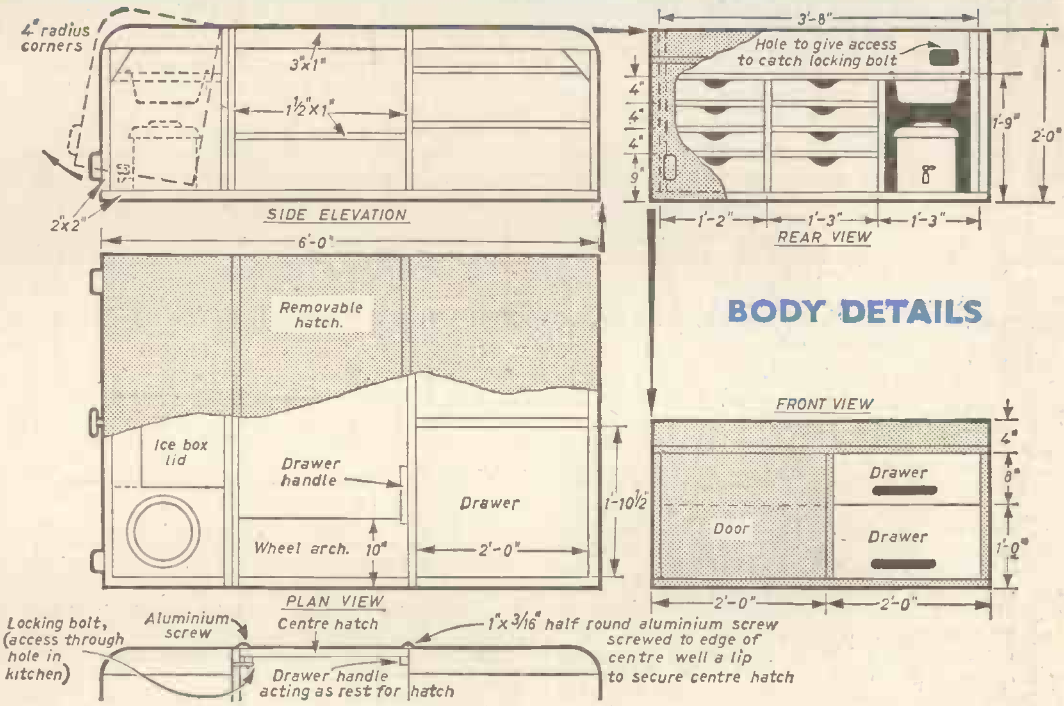


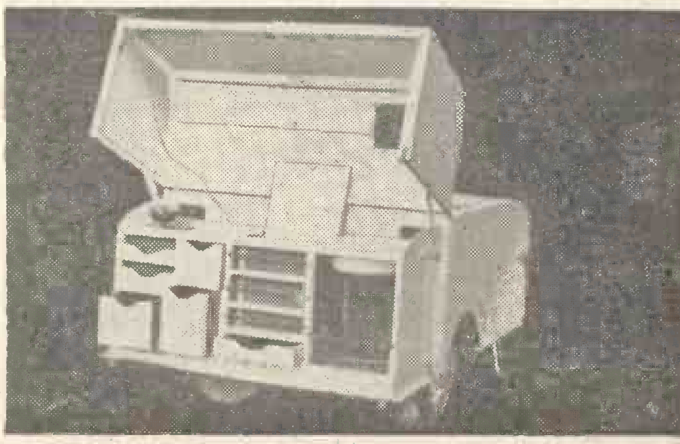
Here's how to make the ... CAMPING



TRAILER

by G.A.KNIGHTS





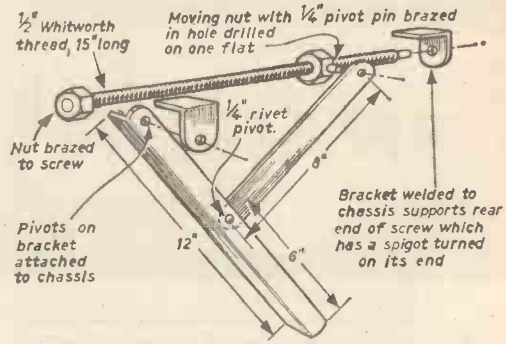
£19. This is an expensive item but I feel it is justified by the reliability of the trailer. The units take up little space and the simplicity of fixing is a great asset. They should be bolted to the chassis with high-tensile steel bolts. They must be set up accurately so that the wheels toe in as shown in the manufacturers' booklet.

The body frame

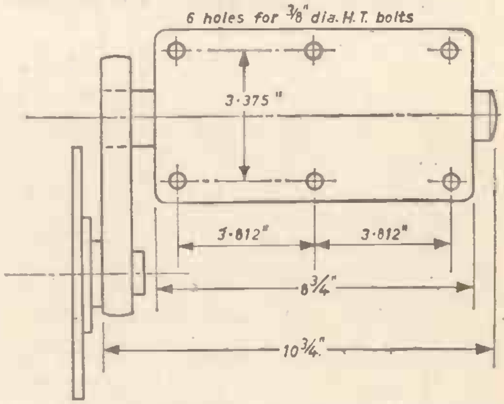
The plan shows the hardboard skin partially removed so that the skeleton framework is visible. Only basic dimensions are shown as these depend on one's individual equipment. The overall dimensions of my trailer are: length 6ft (without tow bar), width 4ft and height 2ft. With the wheels the height is 3ft. Much thought is required to fill the space to the best advantage and I weighed everything before I could position the wheels (on which the position of the wheel arches and hence the proportion of each section depends). It is an advantage when towing to have the trailer slightly nose heavy. Those who think that this balance can be achieved when the packing is done may find great difficulty in doing so. The kitchen equipment in my case weighs more than the clothes, so I have made the clothes drawers and the centre section each 2ft 3in. long, leaving the "kitchen" 1ft 6in. The corner posts are 2in. x 2in. and so is the bottom framework. All timber is softwood and, apart from the top rails of the side frames, which are 3in. x 1in. to allow for the curved shaping, all the rest is 1½in. x 1in. I bought all the timber planed. Mortice and tenon joints are the principal joints used. Strengthening metal corner brackets were required at the bottom corners, but the structure is very strong when clad with hardboard. This I glued with Aerolite 306 before pinning and at the top edges it was possible to sand a pleasant rounded edge. It will be found necessary to soak the hardboard in warm water before pulling it round the top end curves. If the top, flat area is pinned first it will take the curve all right, but there is a considerable strain on the bottom edge and it is necessary to trap the hardboard here under a half-round strip of aluminium and screw it down. The side frames were made first, in one piece, and it was not until the rails linking the two sides together were in position that the kitchen end was sawn apart and hinged to the top rail. It was found necessary to cover this hinged joint with rubberised material as rainwater poured through inside when the kitchen roof was raised! It was also necessary to remove part of the bottom side rails when the access semicircles to allow the wheels to be changed were cut out.

Two doors, framed in 2in. x 1in. wood and clad in hardboard, give access to the drawer space. They open over the tow-bar. The two drawers opening into the centre section make use of the space in the curve. The handles of these drawers provide a "shelf" for the centre section hatch to rest on. This hatch is held in position beneath a lip of half-round aluminium. The other side of the hatch has another strip of aluminium screwed to it to form a lip which prevents the hatch from dropping inside. The hatch is locked in place with two bolts operated from inside the kitchen unit. The drawer doors are locked from outside. The kitchen roof is locked down with a boot-type lock.

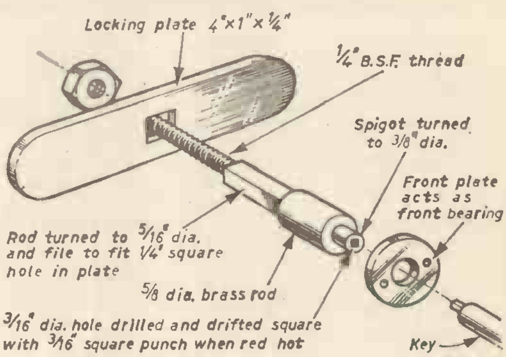
Apart from a sketch of the fitted kitchen, little detail of this will be given, as again this depends so much on individual gear. I have a large Camping



To operate the trailer leg mechanism the screw is turned with a wheel brace. The moving nut thus travels along the screw and the leg is raised or lowered. With such a leg at each corner it is possible to support the trailer firmly in a level position on any uneven ground.



Plan view of a Flexitor unit without wheel. Attach to cross members with G-cramps so that the wheel "toes in" correctly then drill fixing holes to suit. Toe in from wheel rim to trailer centre line should be $\frac{1}{16}$in. for 8-10in. wheels, $\frac{3}{32}$in. for 12-13in. wheels and ⅛in. for 16in. wheels.



Exploded view of door lock mechanism, to be set in rail dividing the two doors. The plate fits into a recess in each door when turned by a square key. The smaller the square key hole, the more difficult is the lock to pick.

Gaz bottle and a Super Bluet cooker on a shelf, held in position with shaped blocks. Small shelves have straps cut from an old inner tube stretched across to keep tins and jars in position. The icebox is made from a large biscuit tin surrounded with expanded polystyrene 2in. thick. It will keep ice for 24 hours. The plastic wash-bowl sits in a hole cut in the shelf and beneath it we store our water-carrier. A separate framework is stood inside the trailer end to house these shelves and drawers. A mirror is a useful fitting, as is the interior light. The drawers were lightly constructed from hardboard pinned to ¾in. x ¾in. framing and corner blocks.

The body is bolted to the chassis and is readily removable, so that the chassis can be used as a boat trailer, or a different type box can be fitted if desired for some other purpose. The hardboard should be painted on all surfaces to seal it from the inevitable moisture prevalent when camping! The exterior I painted with Dulux Coach Finish to match the car, which gives a really professional finish.

The over-run brake

The tow bar was made from a piece of 2in. pipe and fits over a solid plug welded over the end of a 1in. rod. It is held in position with a ⅜in. high tensile steel bolt. The 1in. rod slides through two brackets placed about 6in. apart. Two compression springs (ex-A90 valve springs) should be threaded on the rod between the brackets, a thick washer being welded to the rod to separate them.

A pivoted lever is attached to the chassis so that its upper end rests against the end of the tow-bar rod. The bottom leg of this lever has the brake cable attached to it. When the car is pulling the trailer the washer compresses the front spring as a shock absorber until under way, when the spring tends to return to normal. When the car slows down, the weight of the trailer throws it forward on to the rear spring and the tow bar operates the brake lever. As soon as the brake is applied the trailer ceases to over-run the car and the brake is released. It is necessary to arrange a locking pin to prevent the tow bar moving if it is intended to back the car, otherwise the brake will be applied when the car pushes the tow bar back.

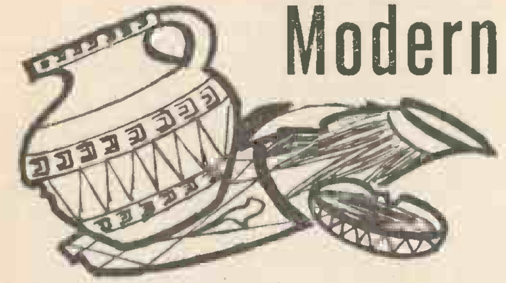
The break-away brake

A hand-brake lever was fitted to operate the same lever the tow bar operates. A small plate was brazed vertically to the hand-brake lever and filed to a bevel and case-hardened. Above this plate was fitted a piece of 1in. x 1in. x ⅛in. angle iron with teeth filed on one edge. These teeth were case-hardened and engage in the plate on the hand-brake.

A cable was attached to the end of the hand-brake lever and passed over pulleys and attached to an eye on the end of a ¼in. rod which slides through two brackets at the front centre of the trailer. An eye was formed at the forward end of the rod and a fine, soft iron wire (about 20s.w.g. binding wire) was tied to the eye and onto the car at some central point other than the towing bracket. Should the trailer break away from the car the wire operates the hand-brake, which prevents the trailer from careering into too much trouble. When the brake operates, the ratchet locks it on and the wire breaks, leaving the trailer free.

THE COST

	£	s	d
230ft x 1in. x 1½in. planed softwood 28ft x 1½in. x 1½in. planed softwood 28ft x 1in. x 3in. planed softwood 102ft x 1in. x 1in. planed softwood	3	17	0
Six sheets 4ft x 8ft x ⅛in. hardboard	4	8	0
Angle iron (second-hand)	2	0	0
Flexitor suspension assembly	19	0	0
Two 520 x 10 tubeless tyres	10	5	0
2in. ball coupling (Bramber Engineering Ltd.)	2	17	6
Lights	1	10	0
Paint, Wet or Dry etc.		15	0
16ft x 1in. x $\frac{3}{16}$in. half-round aluminium (Fay's Non Ferrous Metals Ltd., 129 High Road, Chiswick, W4.)		9	0
8sq.ft expanded polystyrene (ice box)		12	0
	£45	13	6



Modern Science Helps Archaeologists

By A. Nettleton

NOT so long ago, archaeology meant excavating for flints, pottery, bones, and similar remains from far-off times and dating them chiefly by comparison with others of known age. Today however, science is rapidly altering the approach to such studies by providing more reliable ways of ascertaining how old the remains are and thus enabling them to be fitted into the jigsaw history of civilisation more accurately.

Geologists, climatologists, physicists, and experts in a number of other scientific fields are co-operating increasingly with archaeologists in order to draw true pictures of life in distant eras. Over a dozen different methods of dating can now be applied to archaeological discoveries. They include pollen analysis, radiometric assay, tree ring analysis, and the study of soils. Volcanic lava and ash, lake deposits, and cores obtained from the ocean floor are further aids in studying the progress of human culture from the earliest times.

Marking the theodolite direction on a plaster cast surrounding an archaeological specimen before moving it. The direction must be known when determining the age of the specimen by its magnetism.

Two important new techniques have come into more general use by archaeologists during the last two years. One of these methods, known as obsidian dating, provides information by enabling the hydration layer of volcanic glass (or obsidian) to be measured. Hydration is the absorption of water by any substance from its surroundings. This absorption occurs at a known rate, and the exent to which it has penetrated the surface reveals the age of the substance containing it.

In the archaeological field, dating by hydration has so far been limited to articles made of volcanic glass, and objects made of this substance can now be dated by this method if they are between 2,000 and 50,000 years old. Implements such as knives, arrow tips and spear heads were often made from obsidian by primitive races, and it was also worked as a gem-stone by the Ancient Greeks and the Romans. Odsidian dating is considered to give a reasonably reliable indication of the age of such tools and weapons and can be regarded as a considerable advancement in scientific archaeology.

The other new process of dating archaeological remains is of equal interest, for it promises to be a more accurate method. It is based on the knowledge that potassium, when it occurs naturally, invariably contains a measurable proportion of a radio-active isotope. This decays over the years, to form calcium-40 and argon-40. The yield can be measured and its half-life is known. So when potassium is present, a relatively simple technique provides reliable information about the age of the substance in which it is found. Archaeologists expect this procedure to be helpful in their further studies of Man's earliest environment and evolution.

The need for a scientific approach to archaeology, prompted the founding of a research laboratory for that purpose at Oxford in 1955. Here special attention has been given to the development of advanced electronic and nuclear apparatus of practical use to the archaeologist. The research has recently been directed especially to thermo-remnant magnetism and the ways in which it can be used in dating pottery found during archaeological operations. Briefly, the principle behind this technique is that when clay is baked, as in the manufacture of pottery, the small amount of iron oxide present undergoes a change. In the unbaked article the magnetic field is random, but during the baking process it becomes aligned with the earth's magnetic field. When the pottery cools, the new alignment remains fixed. This knowledge is useful in dating pottery, because the angles of magnetism fixed in the clay can be measured and compared with records of the

Placing a museum specimen in a beaker containing distilled water. The ultrasonic probe is being used to dislodge impurities. Cleaning by ultrasonic cavitation is carred out in the tank behind the probe.

earth's magnetic field. That field changes with the passage of time, and the comparison may give a clue to the age of the pottery. Scientists are now trying to solve one or two problems which prevent the full operation of this dating technique in connection with archaeology. The major difficulty is the dearth of precise information about changes in the earth's magnetic field down the centuries. But reliable records going back to the 16th century are available, and approximate figures for earlier times are being worked out from other data, such as measurements of thermo-remnant magnetism in Roman pottery kilns. Further information is being obtained from different sources all over the world. The greater the amount of data collected, the more useful the magnetic principle will be.

The technique can be helpful in a number of other ways. It can be used to determine, for instance, whether fragments of pottery unearthed belong to the same object or different ones. In one actual case, it was found that the head and body of a statue were from separate figures and not from the same one. When the magnetic angles in both parts were measured, it was discovered that to equate the magnetic lines the head had to be placed backwards!

This technique of applying magnetic principles to archaeological discoveries also shows the extent to which the archaeologist today must be acquainted with scientific methods. To be of real value for dating by this technique, the specimens have to be removed from the site with exceptional care. The usual procedure is first to encase them in plaster while they are still in the ground. Then, by means of a theodolite, a line is drawn on the plaster to indicate true North so that the declination measurements can be taken. The top surface of the plaster has also to be made perfectly horizontal so that other measurements can be taken. At the Oxford laboratory the weak magnetism is measured with a spinning magnetometer, the specimen taking the place of the rotor in a dynamo, spinning slowly at the centre of the stator coils.

From the same research centre has also come an ultra-sentitive proton magnetometer for use in the field. It is able to measure the slight increase in the magnetic intensity created by buried kilns where pottery was made in distant days. Although the kilns may now be several feet under the ground, the instrument can locate them. The same method can be employed to detect other buried objects which have archaeological importance. With a proto-magnetometer an acre of ground can be surveyed in a few hours, whereas to search the same area by digging would take days or perhaps weeks.

Scientific examination of pollen and soil is also helpful to the archaeologist. Such tests, for instance, can be used to date changes in climate since the last Ice Age, because climate is reflected in the types of trees and shrubs that grew and these can be determined by microscopic examination of the pollen grains left behind.

Again, archaeologists are being helped by climatologists who take cores from the bed of the sea and enable them better to understand the weather conditions on land, ages ago. The cores disclose sea temperature changes, and a knowledge of these variations is useful because they are associated with glacial conditions on continental land masses.

Botanical research is still another branch of science to which archaeologists are turning for assistance today. Seeds, fruits, and other vegetable matter found at sites once occupied by Primitive Man have to be identified in order to find out how he lived. In some instances botanical scientists have been brought in to name vegetable matter in the stomachs of well-preserved corpses found in peat bogs, thus providing information about them. In other cases textile experts have been consulted in order that wool found during excavations could be dated. Sheep reared in Britain in medieval times produced different wool from that produced today, so a study of wool fibres is useful to the archaeologist.

Ultrasonics is yet another branch of science now being used to advantage in archaeology. Ultrasonic cavitation and vibration have proved useful in the laboratory for cleaning specimens with the minimum risk of damaging them. By subjecting them to sound waves, foreign matter is removed harmlessly.

All these new lines of scientific enquiry are making archaeology a much more exact activity. It is rapidly changing from mainly a field study to one pursued in laboratories. One of the latest moves is to apply these newly developed scientific techniques to a re-examination of the huge collection of human skeletons available for that purpose. In this way the ideas held by archaeologists about Man's evolution may be proved correct, or revised if they are found to have been at fault.

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Practical Mechanics and Science. May 1963

TIMING A CLOCK by M.S.F.

By F. G. RAYER

THE National Physical Laboratory MSF transmissions which are radiated on 2·5Mc/s, 5Mc/s and 10Mc/s, and which are used for scientific and industrial frequency checking, are maintained to an extremely high degree of accuracy. Pulses are radiated at one second intervals and it is possible to use these for clock timing. A short wave or all-wave receiver is required to receive the transmissions. In this country, the 2·5Mc/s (120 metre) transmission should generally be best received. The 5Mc/s transmission corresponds to 60 metres, while the 10Mc/s transmission equals 30 metres.

The 1 second pulses will be heard as a regular "tick" with a brief "pip" at each 60th pulse (1 minute intervals). There are also tone and announcement intervals, but these may be disregarded for the purpose described here.

If an oscilloscope is available, this offers a way of comparing the MSF pulses and clock ticks. If the oscilloscope has a sensitive vertical amplifier, the equipment can be set up as shown in Fig. 2. The time-base controls should be adjusted to produce a fairly slow horizontal scan. The actual scan speed is of no importance but should be adjusted to obtain a reasonable spread of tick pulses from the clock, as in Fig. 1a. If insufficient vertical deflection is obtained, due to lack of gain in the oscilloscope amplifier, it will be necessary to introduce a small pre-amplifier between microphone and scope. Alternatively, try a carbon mike with battery and transformer. The microphone can be in actual contact with the clock to produce the largest possible pulses.

The receiver should then be switched on, and the volume adjusted until the MSF pulse, as picked

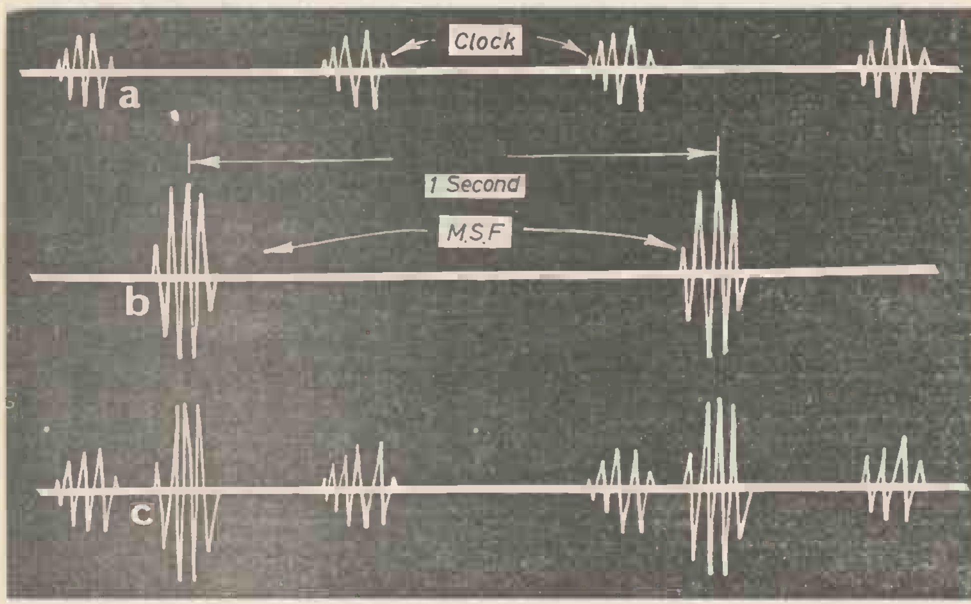


Fig. 1.

It is, of course, possible to regulate a clock of accurate time-keeping ability by the BBC Greenwich time signals, but this may take several days, as the loss or gain of the clock can only be noted after intervals of some hours. But it is apparent that if the clock had a 1 second pendulum, and its ticking were adjusted to agree with the 1 second MSF pulses, it would be correctly regulated. Similarly, if the clock produces 120 ticks per minute, every other tick should coincide with the MSF pulses.

up by the microphone, produces a suitable vertical deflection, as in Fig. 1b.

With both clock and MSF inputs reaching the scope, the trace will resemble Fig. 1c. If the MSF and clock pulses remain in the same relative positions to each other, the clock is exactly correct. If the clock is losing, its pulses will move to the right, relative to the MSF pulses. On the other hand, if the clock gains, its ticking will become in advance of the MSF pulses, thus appearing earlier in the trace, or moving to the left. The

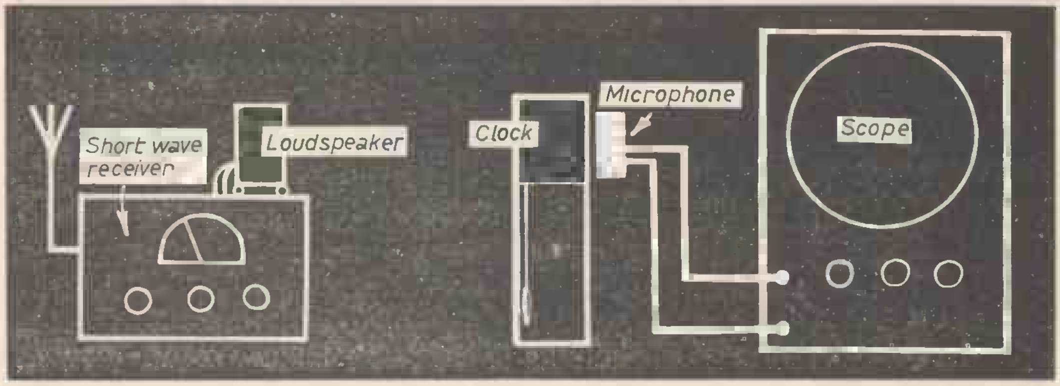


Fig. 2.

effect of regulating the clock is apparent at once. For high accuracy, there should be no apparent relative movement between clock and MSF pulses, even after some minutes. It will be easier to observe this condition if the time-base is synchronised to the MSF pulses so that these remain stationary.

Good time-keeping cannot be expected from cheap spring driven clocks, which are affected by temperatures, the extent to which the spring is wound, and other factors. The method described is only practicable when the beat of the clock has a simple relationship to the 1 second pulses, such as 1·1, 3·2, 2·1, 4·1, or so on.

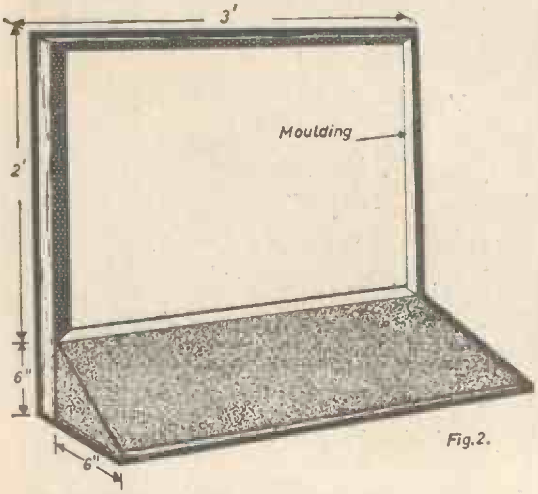
Fig. 1.—The completed map.

An Illuminated Map

By Schoolmaster

AN illuminated map is a visual aid which can either be used by the teacher or the pupil. A town street plan, or a map of a county or country is mounted on a piece of hardboard and drilled to take torch bulbs at points of interest. The bulbs will light up when a switch is turned at the foot of the map (Fig. 1). Naturally enough this idea of presentation grips a child's imagination and after the novelty has worn off the real thirst for knowledge takes its place. The bulbs can be coloured and used with a wall chart hanging alongside the map. The details of the location can thus be seen at a glance. The usefulness of this map for geography, history and industrial progress need not be elaborated. It can also be used for purposes other than school work.

The illuminated map shown here is of a city. At the foot of the map are two switches; one illuminates 18 of the city's more important industries when turned; the other shows ten of the city's social services, such as the gas works, main railway stations and so on. When the map is in operation a bulb remains lit to show the position of the school, as this gives the child an idea of relative positions. Moreover only one switch can be operated at a time so that one does not get the industries and social services lit up at the same time. If the map area you are considering requires only one multi-way switch then of course no such mix-up can occur. Alternatively you may require more multi-way switches, the procedure being similar to that mentioned below. Any number of

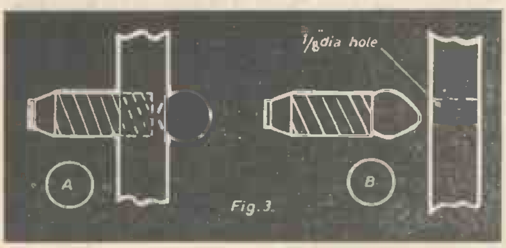


Method of constructing the framework using battens and hardboard panels.

lights can be on at the same time. This is important as some industrial concerns may require anything up to eight lights while other groups may require only one or two lights.

Construction

Actual sizes will vary but the dimensions shown give a guide to what is required. The map should be mounted on a hardboard panel which should be nailed to 1in. square wooden runners. The map can be edged with frame moulding to make a pleasing finish (Fig. 2). The switch panel should be mounted at 45° to the main panel and the spindle holes for the switches drilled. The switches are radio wafer types. The switch panel (Fig. 1) should have the operating instructions and the marked switch positions covered by a layer of celluloid or thin Perspex in order to protect the printing.



Two methods of using torch bulbs.

Mounting the bulbs

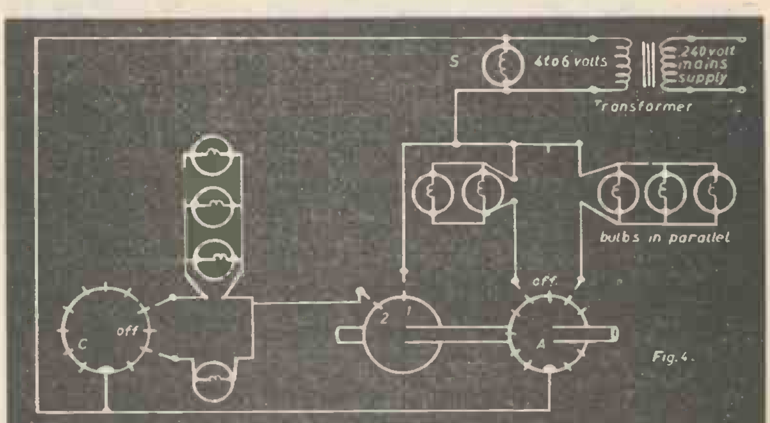
Torch bulbs are used and can either be screwed through the panel or mounted behind it (Fig. 3). If screwed through the panel (Fig. 3a), a ⅜in. diameter hole is required. When the bulb is mounted behind the panel (Fig. 3b), a ⅛in. diameter hole should be drilled. In this case, either the bulb can be coloured or a piece of coloured celluloid can be stuck over the hole. Both methods have their advantages. In one the bulb is easily replaced while in the other a neater job is obtained and no interference is possible from anyone trying to unscrew a bulb.

Electrical wiring

The electrical layout is as shown in Fig. 4. All bulbs are in parallel and are fed from a radio filament transformer. An ex-Government transformer of 4V is ideal and, due to the unpopular voltage rating, is often obtainable quite cheaply. If this type is unobtainable then a radio, 6·3V, filament transformer costs only a few shillings.

The bulb showing position of the building in which the map is operated is on continually and is marked S on the diagram. C is the wafer of one switch, A and B the wafers on the other.

The operation of the map is simple enough. When switch A-B is in the off position, contacts on wafer B (shown as 1 and 2) are closed and switch C is operational. However, as soon as the knob of switch A-B is rotated, contacts 1 and 2 on wafer B are open-circuited and switch C will not operate. Now the points of interest indicated by switch A-B will light as the contacts on wafer A of switch A-B are now operational. By means of this simple switching system, switches A-B and C are not working at the same time. For the sake of simplicity only the connections on either side of the OFF switch positions have been shown connected up. The other connections to the wafers are a repetition of those shown.



The electrical circuit.

TRADE NEWS

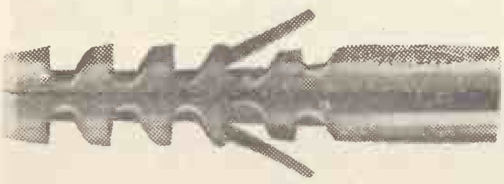
Unique nylon wall plugs

THE development of new building materials and new building methods have instigated the development of new wall plugs which are adapted to changing conditions and also meet increased requirements in every respect. Nylon has achieved an outstanding position in this field.

The impact proof nylon material is the decisive factor in the "Fischer" wall plugs, because this material incorporates all the properties required in the technique of modern wall plugs e.g.: elasticity, extremely good spreading capability, resistance to corrosion and ageing and high mechanical strength.

It has a wide range of applications. The characteristic features are the locking tongs for pre-fastening and securing against turning and the deep teeth that penetrate into the building material. A firm hold, even in porous material, is ensured by these teeth. Whether in coke breeze bricks, building boards, gas concrete, natural sandstone, common bricks, or concrete.

Insertion of the wall plugs is very easy; consisting merely of drilling or otherwise preparing the hole and simply pushing in the plug by hand. Because of the absence of any rim, it is equally well suited for flush mounting or push through mounting. When the plug is in the hole, then only the bolt, screw, nail or hook need be driven home.



Direct reading micrometer

THE construction of this new Micrometer follows conventional Frame design but the usual calibrated sleeve and barrel and the need for interpreting various divisions are all eliminated.

Direct measurements in decimals can now be read off *immediately* from a window located in the Micrometer Frame. The ¼in. white figures are easily seen against the black background, the appearance and functions having a marked similarity to a Speedometer Mileage Indicator.

The instrument is well designed and proportioned and comfortable to hold. The spindle lock is quick and positive and the rotary motion of the barrel has the smooth action to be expected from a precision tool.

Four models are available: — 0-1in. and 0-25mm at £9 17s. 6d. and 1-2in. and 25-50mm at £14 18s. 6d.

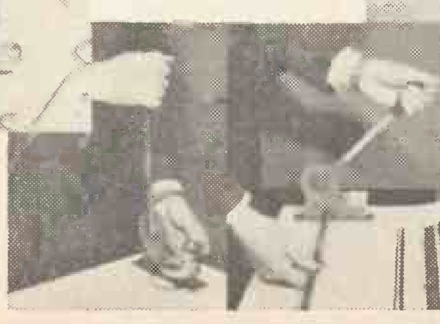
Wrought iron kit

THIS kit makes it possible for anyone to make their own wrought iron, and achieve a professional finish. The kit consists of a simple forming tool for making the scrolls, and a small guillotine which incorporates a punching block for cutting the metal strip to length, and making the holes for joining the work together.

This kit is made and marketed by J. and C. R. Wood (Wirecraft), 303 Hull Road, Anlaby Common, Hull, E. Yorks. Price 84s.

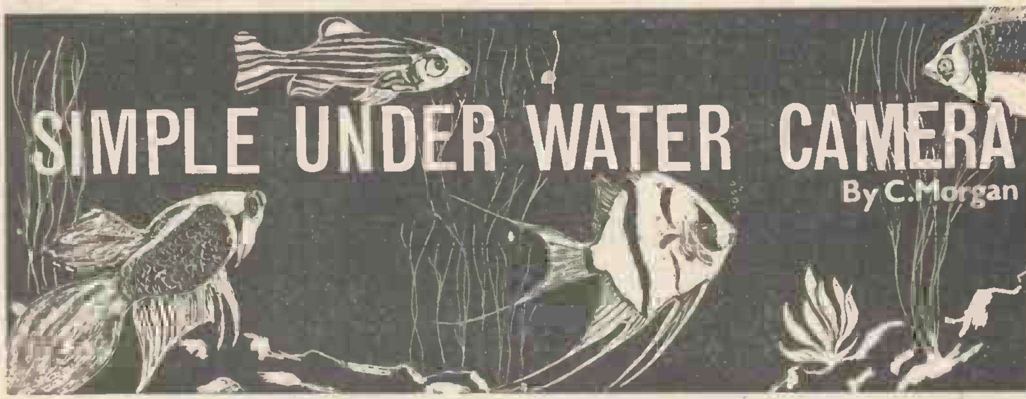
The forming tool being used to make a scroll.

(Photo right). Scrolls are joined with small nuts and bolts provided to make an attractive lamp bracket.



Cutting the metal strips to length required with the guillotine.

(Photo right). The punching block makes the hole for joining.



THE purposes to which the camera has been put are numerous indeed. One of the most interesting, yet also expensive, uses is for taking under-water photographs. If one has aspirations to tropical waters and aqua lungs for deep diving the cost rises still higher.

The simple waterproof camera case described here was designed by the writer for his own use in recording events under shallow water that otherwise could not have been photographed if the camera had been placed above the surface of the water. Ever since that eventful day the camera has been in almost constant use by members of the family for recording their aquatic abilities under the surface of the sea, while the owner and designer has had to wait patiently for his turn to use it in order to continue his hobby.

The detailed construction of the case will differ with cameras of different makes but the following diagrams and information should be sufficient general guidance in the construction of a case to suit any camera.

If reference is made to the diagram it will be observed that the front plate of the case has the window slightly to one side. Before construction is started the camera should be examined to see if the lens assembly is situated in the centre of the body or not. This is a point that can easily be overlooked. The wood used in the prototype was 5-ply, $\frac{5}{16}$in. thick, although any suitable wood will do providing it is reasonably strong and will not bend. Two front plates should be cut out and the edges chamfered to form a $\frac{1}{4}$in. deep groove when the plates are finally glued together. When the camera has been fitted in place a large ex-government balloon is fitted into this groove. A strong elastic band is then placed over the balloon in the groove, making it watertight. As the balloon is thin and therefore pliable the camera can be operated and the next film wound on under water.

The window in the front plates needs to be of such an area that no light is obscured from the lens. The thickness of the glass needs to be at the least $\frac{1}{8}$in. and it should be without any blemishes or scratches that would otherwise spoil the results. Glass for this was taken from a fairly thick mirror and cut to size, in my case 2in. x 2in. The silvering was simply removed by giving a piece of clean cloth or rag a few dabs of "Bluebell" brass polish and rubbing lightly over the back of the mirror. Rebate the edges of the holes in the front plates to take the glass, making sure it is a snug fit. Fit the glass into the face plate that will be nearest to the lens and seal the edges with a suitable glue. In the prototype, "Araldite" was used. Glue the whole assembly of face plates and glass together, making it a completely waterproof job. It is as well, in the interest of waterproofing the case, to run a little more glue round the edge of the glass when the front and rear plates have properly set, to make sure the joint is completely watertight.

The camera support blocks need little explanation except that when the camera is mounted in position it must be possible to operate the focusing and aperture controls and the shutter release. One point to remember is that the grain of the wood should run lengthways. This is so that the screws that enter the blocks through the camera holding strap will not cause any splitting of the blocks. If these two blocks are glued into position the wood will be all the stronger for it.

When the glue has set on the face plates and blocks, the camera can be placed in position on the blocks to determine the width and length of the rubber camera holding strap. The strap needs to be almost as wide as the camera and of sufficient elasticity to prevent any movement when the shutter release is pressed. In the prototype a piece of a rubber stair tread was used and found to be perfect for the job. The strap should first be secured to one block by two $\frac{3}{4}$in. x 6 round-head brass screws and should then be stretched over the camera and secured to the remaining block by two more screws of the same size. Trip the camera and observe whether it shifts. If so, tighten the strap a little more until no shift occurs. When necessary it is then a simple matter to loosen the screws, slide the camera out and load up with film.

The carrying handle needs little comment except to say that it is very handy to have on the case when clambering over rough ground. Also, when the swimmer is under the water, it does assist in helping to obtain a better photograph. Remember, when cutting out the various parts, to smooth all corners and edges. This will ensure that when the assembly is varnished and painted the water will have less chance of penetrating to the inside.

The balloon was purchased from a dealer in ex-government equipment and can be obtained in almost any of the shops that deal with ex-government property. The writer purchased his from "Ruby's", 57 Southchurch Road, Southend-on-Sea, Essex. The length of the balloon, including the nozzle, is 10in., and the width deflated is 5in. First shake out the preservative power that is to be found inside and then blow up the balloon; this will stretch it a little. It will be easier to blow up if it is first warmed gently. After releasing the air lay it out flat and, measuring 4½in. from the nozzle, make a clean cut across the width. The nozzle can then be discarded and the larger part remaining can be fitted over the camera and into the groove of the face plates. Gently ease the cut edge of the balloon until it fits snugly into position over the front panel. Next stretch a really strong elastic band over the balloon to fit in the groove of the panel. If doubt is experienced as to the ability of the rubber band to keep the water out of the case the balloon neck can be taped with a suitable material.

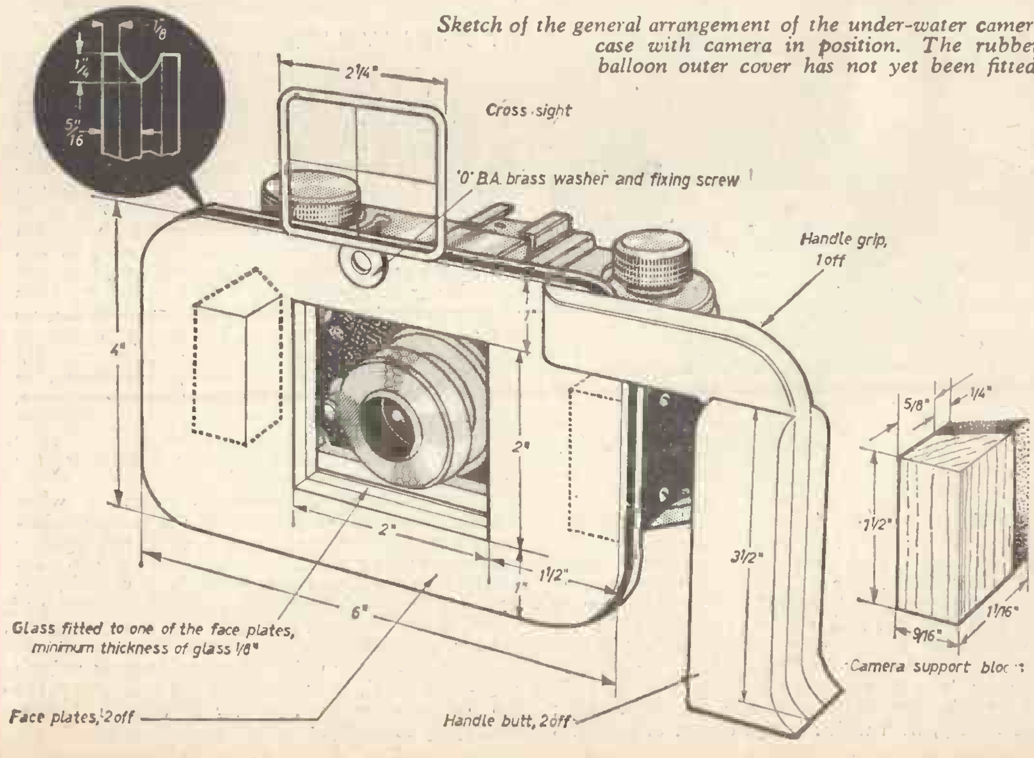
When the whole case has been assembled it should be given several coats of varnish which has first been thinned down with methylated spirit, leaving the first coat to dry before applying the second one. The prototype was done in black enamel paint. Two coats should be applied for preference and when dry the case should be given a water test for several hours. When giving the case its water test it is better if the camera is not in position; it can be placed inside when satisfied that no leaks exist. It will be found that when trying to submerge the case it will float, even with the camera in position. This is rather a good thing as it does help if the swimmer needs two hands in order to raise himself up to the surface of the water.

The camera sights have been left till last as the construction of them is simplicity itself. The sight should be constructed from 14-gauge copper wire with 18-gauge copper cross wires brazed into position. An O B.A. washer should be brazed on in the position indicated so that the assembly can be screwed into position directly over the lens at the top of the face plate. Several experiments were made to determine the size required and although the size of the sights, 2¼in. x 2¼in. outside measurements, may seem large on dry land, if one realises that the photographer is not on dry land and that he is aiming the camera and at the same time perhaps trying to swim the reason will be obvious.

One very handy point is that no camera shake is evident, due to the water being firmer than if the camera was being used in air. With a little practice it is possible for the sights to be used quite effectively and "spot on" results obtained.

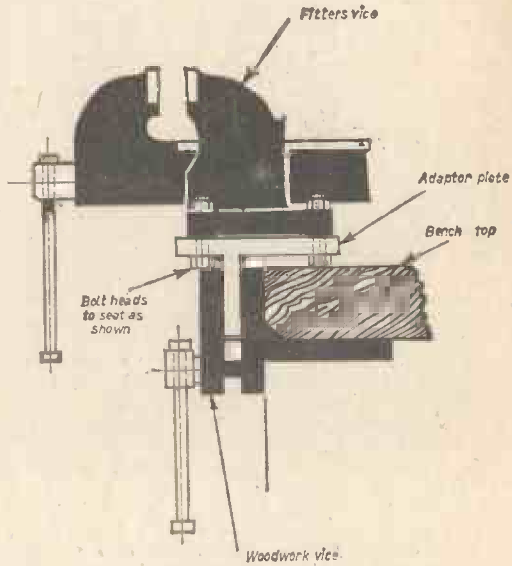
The same "stop size" and distance setting that are used on dry land can be used with under-water cameras if the depth is not too great. The writer has found that over 6ft down, however, the stop has to be increased to compensate for the reduced light. Remember that this instrument has not been designed with the purpose of descending to great depths; only special and expensive equipment can do that. Up to a depth of 12ft it has been found very satisfactory. Over that depth the wind-on and other controls on the camera are observed to be rather heavy to handle.

Sketch of the general arrangement of the under-water camera case with camera in position. The rubber balloon outer cover has not yet been fitted.



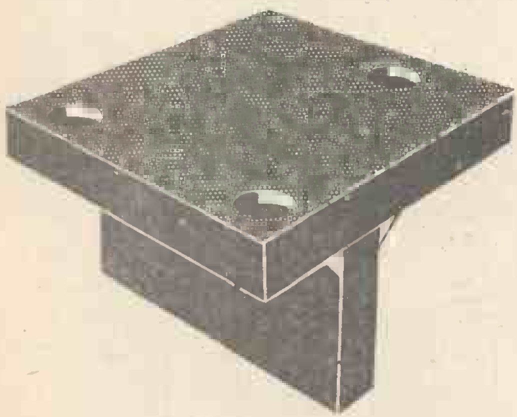
RESTRICTED space, especially on the work bench, is always a problem in the home workshop, whether this is a separate shed or a corner of the garage where overhauls on the car are carried out. In particular, though the orthodox fitter's vice is perhaps the most useful of all the tools in the kit, it does on many occasions make it difficult to lay a large article flat on the bench. When the bench is small, as many perforce are, the vice becomes a real nuisance However, to remove the bolts and stand it on the floor each time until operations are completed is time wasting, besides running the risk of breaking off the bolt lugs if the surface is uneven and too much pressure is applied. A simple solution to this problem is to look on the fitter's vice as a temporary piece of equipment on the bench, and to make an adaptor to allow it to be removed easily and quickly. Then, when required, it takes but a moment to install it again for carrying out work on small metal parts.

The illustration shows the basis of the idea. The woodworker's vice is flush with the bench top and is used as a clamp to hold the fitter's vice. Large articles can occupy the bench without obstruction yet the installation of the metalworking vice takes no longer than merely tightening a handle in the normal way. A metal base is needed for the vice, either two plates welded or brazed together at right angles to each other, or a short length of T-angle on to which the fitter's vice is attached by the usual bolts.



Removable Bench Vice

BY JOHN WALLER



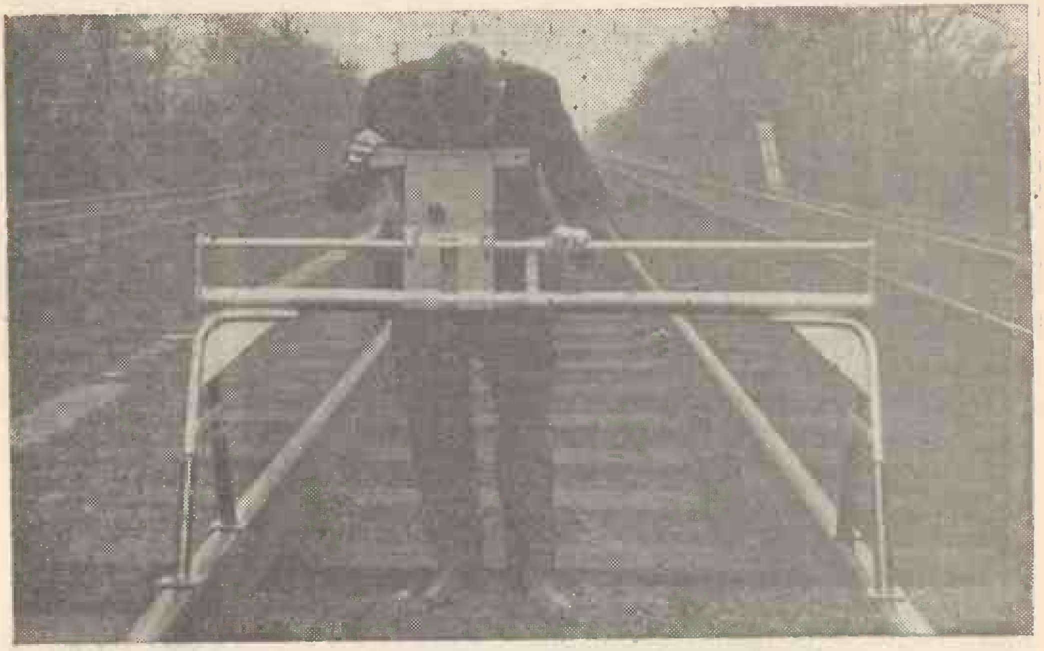
The size of the base depends entirely on the size of vice used, but the problem of welding both pieces together may appear a major difficulty to some readers. Fortunately any local garage that undertakes car repairs, as distinct from a service station only selling petrol and oil, will usually weld these two parts for you at a nominal price. It is also possible to screw the two pieces together by tapping three or four screws into the vertical plate, if this is made suitably thick. If they are of the socket head variety, with which a high degree of tightness can be obtained with the aid of a key or socket wrench, the two parts will remain steady against a fair amount of vibration. As most fitter's vices are also used as riveting anvils and for similar operations, there is however, a tendency to work loose in time.

Once the plates are assembled in the shape of a T, file away all the burrs and corners—a generous radius of about $\frac{1}{16}$in. is not too much as this makes the adaptor pleasant to handle and lessens the risks of cuts to the fingers. While doing this, see that no scale or welding material is left that will damage the jaws of the woodworker's vice. If the position of the vertical part of this plate is arranged to allow the top vice to seat as shown in the drawing, with the nuts at the front seating on the jaws while the rear nuts rest on the bench top, this will raise the base enough to make sure the weld clears the jaws of the woodwork vice.

Naturally some discretion is necessary when using this design, but fortunately the jaws of woodwork vices are wide and can thus exert considerable pressure without being overtightened. If you consider that your best woodworking vice will soon be ruined by using this method, set another old vice at the opposite end of the bench and use this solely for the fitter's vice.

For the reader who finds time to do work in both wood and metal, this conversion can well save many harsh words when next faced with a bench-occupying assembly.

Electrified Railways use Height and Stagger Gauge

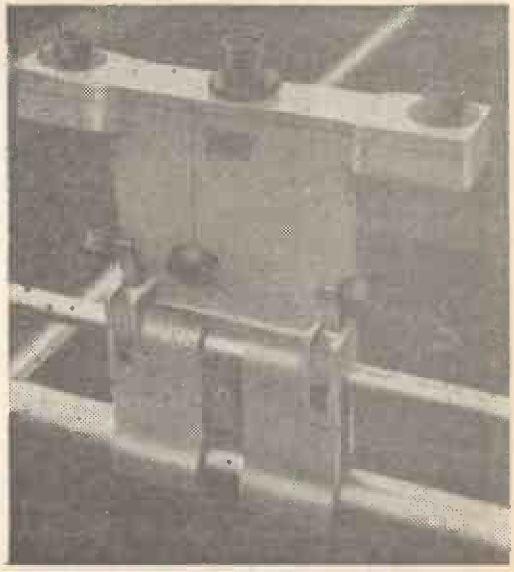


Described by G. Haydock

TO measure the distance from the ground to the contact wire on their overhead electrified lines, British Railways are using an optical range finder manufactured by Barr and Stroud Ltd. This gauge can also measure the amount of offset or "stagger" of the wire relative to the centre of the track. As this can be done at the safety distance from the 25,000 volt wire laid down by British Railways, any need for the power to be cut off while measurements are made, is avoided.

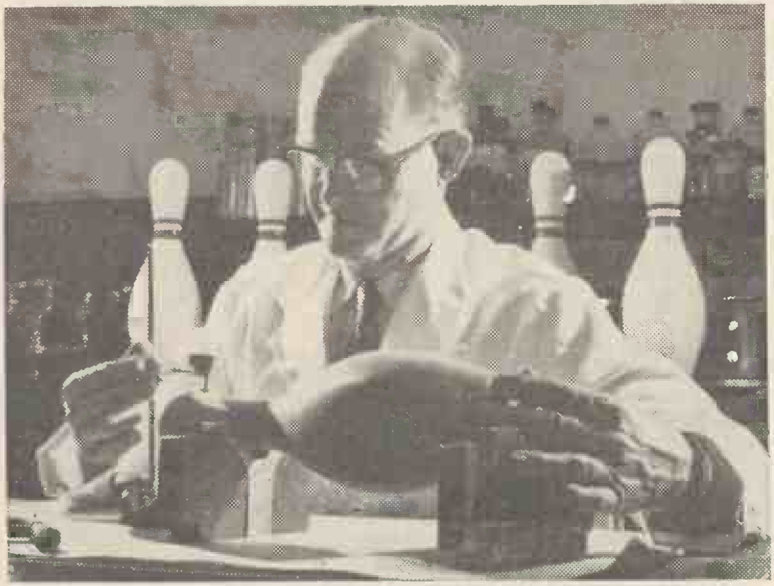
The optical unit is supported on a light, welded alloy stand and can be carried easily by one man. The rangefinder is located on the top bar of the stand. To carry out the simple operation of measuring "stagger" of the overhead contact wire the stand is rested on the railway lines. The rangefinder is slid along the graduated top bar until the image of the wire in the optics is correctly positioned as shown by the operator's view through the eyepiece. The displacement or "stagger" of the contact wire relative to the centre of the track is then read off the bar.

The height of the wire above the rails is measured by sighting through the eyepiece, and adjusting the rangefinder mechanism until the two images of the wire coincide. The height is then read directly from the circular scale.



PICTURE NEWS

FROM THE WORLD OF SCIENCE



Chemical wood

SCIENTISTS have developed a wood substitute which is called "chemical wood". They predict it will have a wide variety of uses in typical hardwood products.

Bowling pins, gun stocks, golf club heads, shoe lasts are among the products now being made and tested in research laboratories.

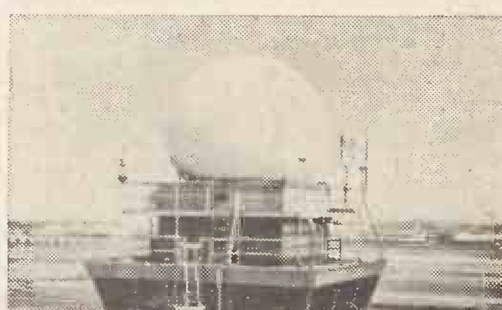
Chemical wood has been made by manipulating hard rubber and resins with pigments, fillers and other chemicals. The Goodyear Rubber laboratories, interested in the project, reports that their research division has created various "woods" that have the hardness of maple and persimmon.

Child's play?

NOT if it won't bounce! The tears of frustration as she tries to play with a non-bouncing ball are the results of a scientist's researches. He has developed the shockproof, bounce-free characteristics of butyl synthetic rubber. Tough on the kids but science marches on!

All-weather protection

AIRPORT radar equipment, as we know it today, will soon be a thing of the past. Nylon radomes will provide protection for airport surface detection equipment, a radar system for managing airport traffic. The radomes will not only hide present equipment but will act as landmarks to air travellers.



Spray-on fuel tank

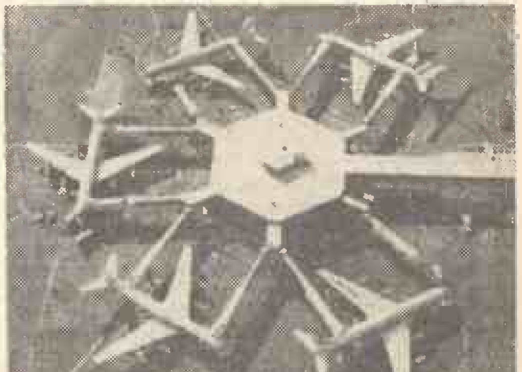
A REVOLUTIONARY rubber spraying technique is used by the Goodyear Tyre and Rubber Co., in the United States, to make fuel tanks for light airplanes. Developed by the company's research laboratory, the new method utilises a special liquid urethane rubber and cardboard forms to fabricate a superior tank. This new technology can be used also to manufacture many other rubber products.

Airborne executives

UNITED STATES business executives have taken to the air in a big way. Some 28,000 aircraft are owned by U.S. firms and it is predicted that 40,000 business-owned planes will be in use by 1970. The helicopter pictured here is a useful craft for short business trips.

Passenger transportation in the U.S.A.

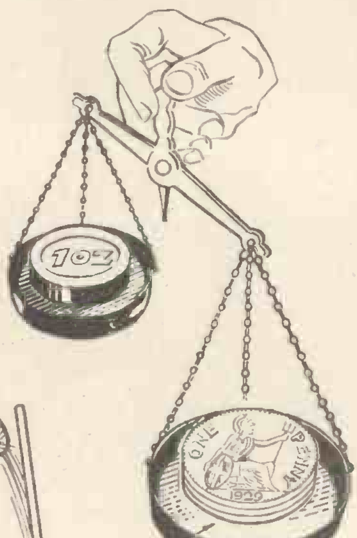
BELIEVE it or not, the symmetrical picture shown here is a loading and unloading terminal at the San Francisco Airport. The collapsible covered walkways lead from the terminal building to the cabin doors of the jet airliners. In this manner passengers are protected from all types of weather.

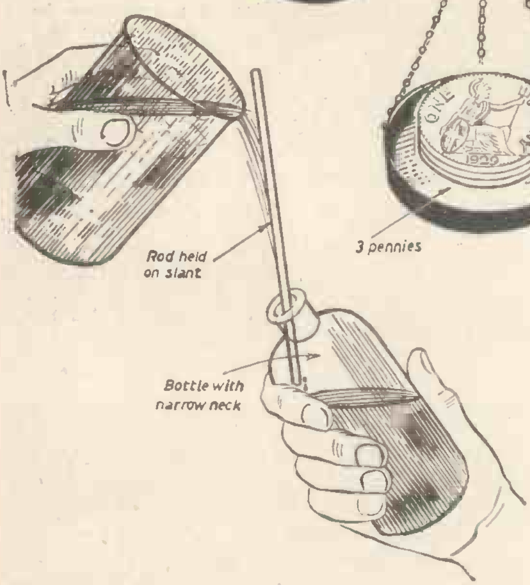


That's a good idea!

Useful hints passed on by our readers

WEIGHTS smaller than one ounce have an infuriating habit of disappearing mysteriously. On these occasions remember that five halfpennies or three pennies weigh one ounce to a good degree of accuracy. Fairly new coins should be used, not ones with the moulding nearly rubbed off. By weighing an ounce of identical small nuts or rivets and using the appropriate proportion of them smaller weights can be improvised.

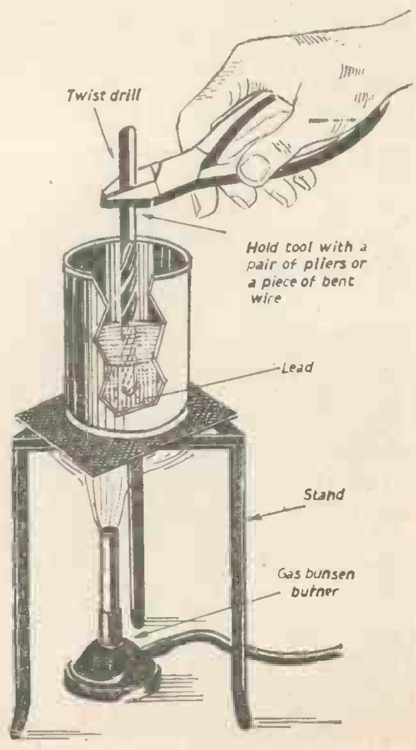


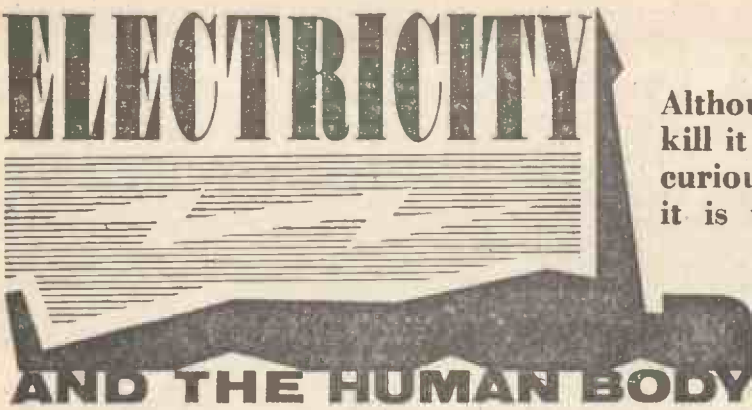


FILLING a narrow-necked bottle with liquid from a wide-necked container when a funnel is not to hand is easy if the liquid is allowed to run down the outside of a length of rod or tubing. Simply place the rod in the bottle, leaving both hands free to manipulate the containers. Any circular rod-like article will do—an old piece of gas pipe, a broom handle or even a cycle pump can save a flood of oil or similar liquid over the concrete path or garage floor.

OCCASIONALLY a small tool—a drill, cutter or some special chisel—requires heat treatment. The formation of scale can be prevented by heating the tool in a bath of molten lead prior to quenching. The lead bath overcomes the formation of scale on the finished cutting edges. Another advantage is that the cutting edge is less likely to pit or distort when a particularly frail tool is hardened.

The lead should be heated to its melting point of 620°F whilst the tools are preheating for a few minutes on a hot plate. Then they should be immersed in the lead which should be covered with a layer of charcoal pellets to overcome its tendency to oxidise. Sometimes a tool will warp when heated and stood in a container, so to guard against this, hang it up by means of a piece of wire resting across the top of the lead bath. Gently agitate the tool during the heating process and make sure the tool is clean before immersing it in the lead otherwise this may stick to it. Quench in oil or water according to the type of material being hardened.





ELECTRICITY AND THE HUMAN BODY

Although electricity can kill it can also cure and, curious as it may seem, it is used to do both.

BEFORE considering the effects of electricity on the human body in detail it may be best to explain the difference between amperes and volts and between direct current and alternating current. Very often there is confusion about these. Just as water might flow through a pipe at five gallons per second and at a pressure of 10lb per square inch so electricity flows through wires at a rate measured in amperes and at a pressure measured in volts. Electricity is present in quantity everywhere but it will not move unless a pressure difference is created. Everything offers some resistance to the passage of electricity; if the resistance is high then many thousands of volts may be needed to push a current through it; if the resistance is low then only a few volts will produce the same current.

Direct current flows continuously in one direction and is the kind of current obtained from batteries. There are now only very few direct current domestic supply mains. Alternating current keeps reversing its direction of flow. It grows from zero to peak value, declines again to zero and then grows again once more, but this time in the opposite direction. The rise and fall of alternating current and voltage takes the form of a wave as shown in Fig. 1. Mains current in this country is most often at a pressure of 240 volts.

Electric shocks

A car battery or even a large torch battery could give sufficient current to kill a man but the voltage is not enough to produce such a current through the high resistance of the human body and batteries are thus safe to handle. Electricity at high voltage, however, is extremely dangerous to life unless the source is such that it can only supply a very low current. It is the current that kills; the voltage alone is not dangerous. For instance, the ignition system on a car or motor-cycle may produce 10,000 to 15,000 volts and although a shock from the plug leads is unpleasant it is not in the least dangerous to a healthy person.

People vary in their susceptibility to the effects of electric shock and a shock that would kill a child would be harmless to an adult. What, then, is the fatal current? This is usually regarded as being from 1 to 2 amperes or more. In America, where some states use electricity as a means of judicial execution, a current of several amperes is passed through the body for several minutes at a pressure of 2,500 volts. The duration of the current is also important. A heavy current of short duration is far less likely to kill than a lesser current flowing for a longer period. That is why instant action is vital if a person comes into contact with live

Fig. 1.—The rise and fall of alternating voltage.

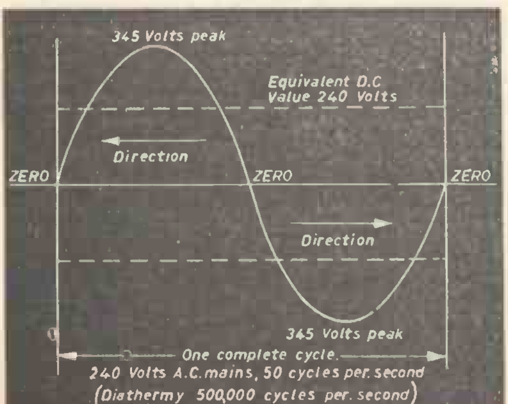
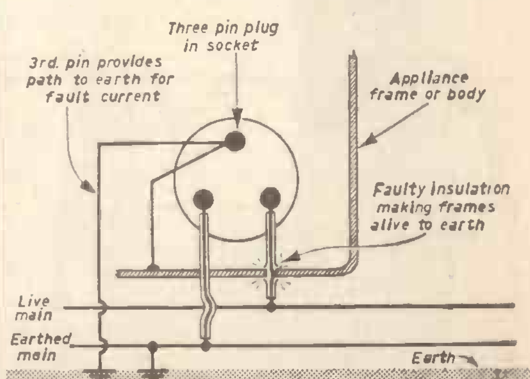


Fig. 2.—How the third pin prevents an appliance from becoming live.



apparatus or wires. If the current cannot be switched off at once the person should be pulled clear of whatever he or she is holding or touching, by gripping a loose portion of clothing. Artificial respiration should then be applied.

A lot depends on how a shock is obtained as to whether it is serious or not. Simply touching the end of a bare mains lead or the live contact in a bulb holder will only result in a mild shock—not that even this should be risked. The resistance offered to the current by the small area of contact between the finger and the wire or bulb holder plunger prevents a dangerous current flowing. If, however, a large metallic object is gripped in the hand such as a tool, iron or washing machine that has been incorrectly wired or is faulty, this could be quickly fatal.

One side of the supply mains is earthed at the generating station so that there is only one live main. If a single pole switch is used on any apparatus it should be connected in this lead. All electrical appliances should be connected to the mains with a three-pin plug, the third pin providing an earthed connection to the frame of the appliance (Fig. 2). When this is done any fault current goes straight to earth and blows the fuse. Without this earth connection the frame of the appliance would become live if the live mains lead touched it and if anyone then touched the appliance a current would flow through them to earth.

Electricity in medicine

Electricity has many medical applications. High voltage causes contraction of the muscles and electrical pulses at intervals of a few seconds can be used for exercising muscles to prevent atrophy during a long period of inactivity or when recovery from damage is taking place. When the frequency of the current is 10,000 cycles per second or over, muscular contraction does not take place, nor is the paralysing effect on the nervous system then present. The body now simply acts as a resistance and, like any other resistance, heats up when the current is passed through it. This heating effect is specially valuable because it is deep and not simply confined to surface tissues as is externally applied heat.

Apart from the uses in physiotherapy just described, very high frequency currents of 500,000 cycles per second and over are used in surgery. Just as an electric arc will cut metals so a surgeon can use it instead of a knife or scalpel. One electrode in the form of a pad of large area moistened with a salt solution is applied to a convenient point on the patient's body. The other electrode is somewhat pointed but does not touch the skin. The arc produced between this electrode and the body cuts like a knife and is preferable to the latter in some cases.

An interesting point to note about these high-frequency currents is that it is quite possible for two persons, each holding a lead of the circuit in one hand, to light a bulb by each touching the appropriate contact on the bulb holder with a finger as shown in Fig. 3. Similarly a train of sparks could be passed between the ends of two rods, one held in the hand of each of the persons concerned, and positioned so that there was a small gap between the ends of the rods. It should be understood that a special high-frequency generator is essential. On no account should these experiments be tried at mains frequency.

X-rays

X-rays are waves of very short wavelength falling between that of the shortest wavelength of visible light—that is, violet light—and the very short cosmic rays that come from outer space. The principle of the X-ray tube is shown in Fig. 4. The high voltage applied across the tube produces a high velocity beam of electrons which strike the inclined target. The impact generates X-rays, which are reflected outwards. By directing the rays through the body and placing a photographic film in a light-tight envelope in a suitable position to receive the emerging rays a photograph of the interior of the body is obtained. The body may also be interposed between the X-ray tube and a fluorescent screen similar to that on the end of a television picture tube. In this way the radiologist can see a picture of the interior of the living body. However, because the body adds up and stores doses of radioactivity, it is necessary to use X-rays with a certain amount of prudence.

Fig. 3.—A high-frequency current will pass through two people and light a bulb.

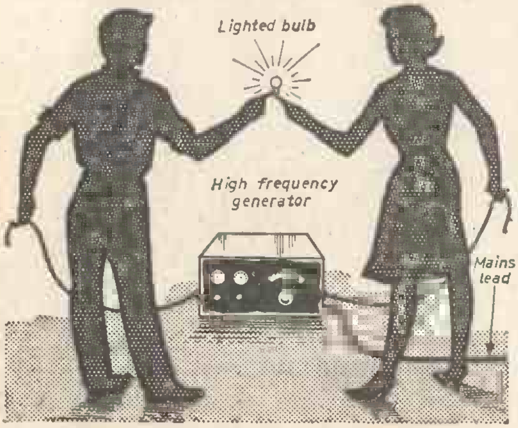
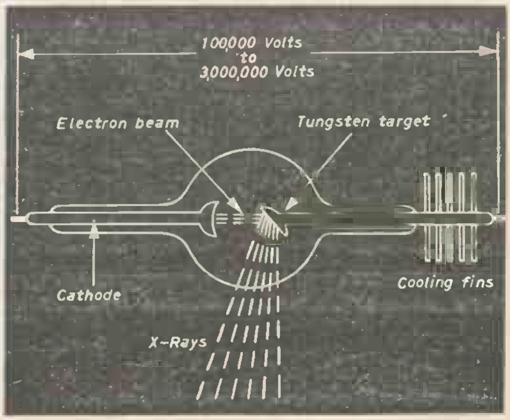
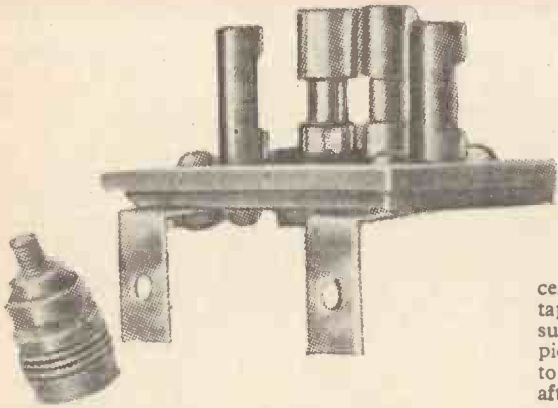


Fig. 4.—In an X-ray tube, high-velocity electrons from the cathode strike a target to produce X-rays.





"SLIDE PLEASE!"

A SLIDE-CHANGING TAPE ACCESSORY AS USED BY FRANK EASTON

WHEN projecting slides with a recorded commentary on tape I have been using a gadget I made to give me a signal when to change the slides. I tried an audible signal on the tape, but the audience get to recognise this and wait for it, which detracts from the commentary. So I evolved this visual gadget which works quite satisfactorily. With an automatic projector in which the slides are changed by pressing a switch button this gadget can be connected direct to the projector and will then change the slides automatically.

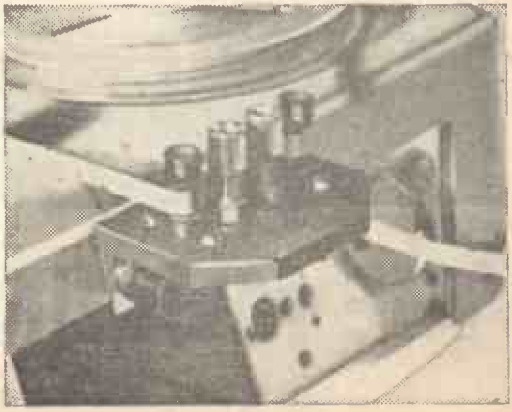
As can be seen by the illustration the tape, after passing through the sound channel, makes its way round one tape guide and crosses two more. On the back of the tape in appropriate positions are glued short aluminium foil (kitchen foil) markers which, when passing the two tape guides complete a circuit through a bulb and a mains transformer, giving an indication at the projector. The tape then passes round a fourth guide and on to the take-up spool. A prepared metal foil called "Metro-Stop" is also available instead of sticking on bits of foil. If you prefer the foil you should be careful of the adhesive used as some may wrinkle the tape or soften it. The two centre guides must be metal but the other two can be of plastic, etc. The centre guides also have holes in the top in which to plug the wires leading to the bulb at the projector and the transformer.

The foil, which need not be longer than the length necessary to bridge the gap between the two centre guides, should be stuck on to the back of the tape at about 25-second intervals. This gives sufficient time for the audience to view most pictures. Other intervals can, of course, be used to suit the commentary, the markers being added after recording when editing the tape. This idea can be used with two track tapes but then limits each track to the same intervals unless the tape is very carefully cut and positioned. On four-track tape this is hardly possible and standard intervals must be used. Sticking the foil on the back of the tape is more flexible than splicing-in metal tape, which could easily break. It also enables the commentator to continue with the commentary over two or three slides without a break.

The gadget was built up from a piece of ebonite, two brass angle brackets and two tape guides. The two outer guides were actually plugs from an old radio valve. The gadget should be fastened to the side of the recorder with two thumbscrews after finding a position in which the tape runs level and does not foul any knobs, etc., on the deck. It should be remembered also that large spools may be used and this should be taken into account.

On some projectors difficulty may be found in fitting a suitable bulb-holder, so some other means of having the bulb near to the projector will have to be concocted. The bulb-holder could, for instance, be mounted on a piece of wood with a suitable shade made from a small can and could simply be placed on the projector stand.

A 6·3-volt filament transformer can be purchased for a few shillings in any shop selling radio components and can be used with a 6·3-volt radio dial lamp. Alternatively a battery and torch bulb can be used. If the gadget is being used with an automatic projector no power supply will be needed, of course.



THE power used per head of population is a sure indication of how advanced a society is. Modern society is based on power. As long as the only sources of power were the windmill, the horse and the water wheel, little progress was possible. It was the steam engine that provided the power that started the New Age. Steam brought the railways, provided the power to drive the new machines and made ships independent of wind. Electricity made it possible to move power about in large quantities and to bring it even into the home. Later the small, compact internal combustion engine enabled man to leave the ground and fly. Finally came the rocket and the gateway to space was open.

What is power? Few people except an engineer or physicist could define what power is. Perhaps some would say it was strength and they would not be far wrong. Clearly a strong man can do more work than a less strong man could. Power is, in fact, the rate at which work is being done. In other words, the rate at which energy is being expended. Work is done when a force moves against a resistance and can be conveniently measured by means of weight. If you lift a 1 lb weight 1 ft against gravity you have done one foot-pound of work. There is hardly any limit to the amount of work a man can do given enough time. For instance, a man could lift a ton of bricks (2,240 lb) through 10 ft by carrying only a few bricks at a time. When he had moved all the bricks he would have done $2{,}240 \times 10 = 22{,}400$ ft.lb. of work. Of course it would take him some hours and the power or rate of working would be low. Now if all the bricks were lifted 10 ft simultaneously by a crane, exactly the same amount of work would have been done only more quickly, in a few seconds in fact, and the power involved is obviously greater during this much shorter time.

Horsepower

James Watt made the first efficient steam engine. He had to have some means of indicating how powerful his engines were, so he compared what they could do to what a horse could do. He estimated that a good draught horse, working eight hours a day, could do work at the rate of 33,000 ft.lb per minute and he called this rate of working one horsepower. This was a considerable over-estimate of what a horse can do but it remained with us and is the horsepower we know today. A light car engine develops about 35 h.p., a scooter engine about 6 to 10 h.p., while a racing car engine produces 300 h.p. or more. It has been estimated that a trained athlete can develop 6 h.p. for a short time. This may seem strange, since

THE MEANING OF POWER

By B. C. Macdonald

a man is clearly not as strong as a horse, but remember that horsepower is a rate of working. For instance, if a man spends £10 in one day he is spending at the rate of £365 × 10 = £3,650 a year. If he does not possess anything like £3,650 then obviously he cannot keep this up for long.

The largest steam turbine units, such as would be found in a generating station, produce about 100,000 h.p. These represent the most powerful engines made for the continuous generation of power. The motors of the largest space rockets produce about 2,000,000 h.p. but they do this for only a few minutes.

The nuclear bomb

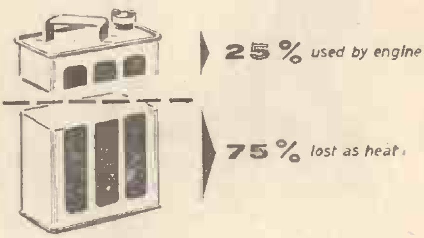
By far the greatest man-made power yet released is that of the nuclear bomb. The largest of these bombs yet exploded was equal to 50,000,000 tons of T.N.T. The total energy content of this is known and if we assume that the whole of the nuclear process in the explosion was completed in one-hundredth of a second, and it may well have been much less, then 46 thousand million million h.p. were released in the explosion. Immense as the power of the nuclear bomb seems to be it is quite small compared with the power in Nature. To equal the energy content of a hurricane it has been estimated that about 20 nuclear bombs would have to be exploded every hour, and this is only a local atmospheric disturbance. If we consider the tidal flow of the oceans and compare the power involved with that of the biggest bomb the power of the bomb becomes insignificant. On an even grander scale the sun radiates energy into space at a rate so great that its numerical representation is meaningless.

Energy and heat

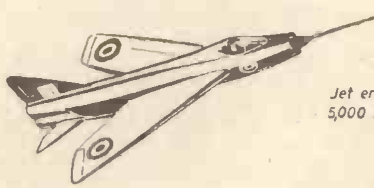
Mechanical energy and heat are mutually convertible. This was discovered by Count Romford, who noticed the intense heat generated during the boring out of a cannon barrel. He subsequently proved that the heat produced was proportional to the power absorbed. In fact 1,400 ft.lb of work is equal to 1 lb-calorie, the amount of heat required to heat 1 lb of water 1°C. One gallon of petrol completely burned would yield 85,000 lb-calories, which equals 119,000,000 ft.lb. The heat content of any fuel is a measure of the potential power it contains and the purpose of an engine is to convert as much of the heat energy as possible into mechanical energy. This conversion cannot be made without loss. The diesel engine, which is very efficient, converts only about 35% of the heat of the fuel into useful work. The petrol engine converts only 25% of the heat into work. In other words, only one gallon of petrol out of every four used is completely converted into power to drive the car. The energy content of the other three gallons is lost as heat to the cooling water, in the transmission, or escapes with the exhaust gases. In a similar way the conversion of power from one form to another involves loss. The output of a dynamo is less than the input by as much as 40% in the case of small machines to as little as 1% in very large ones. If a motor is used to convert the electrical energy produced by the dynamo back again to mechanical energy then losses of the same order as those in the dynamo take place.

Power and speed

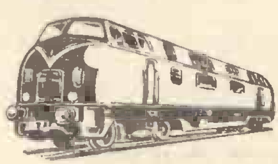
The faster we wish to go the more power we need, but if we double the power we do not double the speed. The power needed rises as the cube of the speed. The power required to give a car a speed of 60 m.p.h. varies with the shape of the car but is about 30 h.p. If we want to raise the speed of the car to 100 m.p.h. we must increase the power to 139 h.p. To put the speed up from 100 to 120 m.p.h. would require 240 h.p. This rapid increase in power required applies also to aircraft and ships. It would be comparatively easy to build a ship that would cross the Atlantic much faster than the "Queen Mary" but the cost would render the ship uneconomic.



Racing car
300 H.P. and over



Jet engine
5,000 H.P.



Diesel locomotive
3,000 H.P.

Queen Mary
200,000 H.P.

Space rocket
2,000,000 H.P.

land him with a SALMON TAILER

IN August 1961 we published an article called "How to make a Salmon Tailer". Since then we have received a number of enquiries from readers asking what this is used for. The author gives the following explanation.

When bank fishing or wading with rod and line for salmon in Scotland, four known methods are used to land the fish after hooking. A landing net, a gaff, hand tailing and beaching, or by use of the device known as a "Salmon Tailer". For the lone fisherman the landing net, because of its size, (when used for fish anything up to 40lb in weight) is a cumbersome and awkward implement. The gaff is ideal, but its use is barred on many rivers in Scotland, especially during the early part of the season when "Kelts" or spawned fish are numerous. "Kelts" here, by law, have to be returned to the river unharmed and undamaged—this of course is not possible when a gaff is used. Hand tailing and beaching is a risky business and can only be done in shallow water with a well spent fish. A "Salmon Tailer" is easy to carry and use, and can be used in either shallow or wading depth water.

The idea of the "Salmon Tailer" I believe, was originally evolved from the old poachers' method of extracting salmon from shallow pools and known lies by the use of a "Rabbit Snare" on the end of a stick or pole, which is of course quite illegal. It is permitted however to use a "Salmon Tailer" on fish which have been hooked legitimately with rod and line. The operation is simple and the fish unharmed. The spent fish is brought in, in the same way as it would be brought in to the net, and the unsprung noose is slipped over the tail of the fish; a quick pull is then all that's necessary to secure the fish, when it may be beached or lifted out of the water depending on its size.

KIT CARS

(Continued from page 347)

As the completion of the car draws near, it should be insured and licensed so that no time is wasted getting it on the road. Unfortunately, insurance companies require the registration number of the car, and the local tax office need a certificate of insurance before they will issue the registration documents. The insurance company usually gives in first, and issues a cover note, which is used to obtain a road fund licence. Application is on form R.F.1/1 together with a manufacturer's delivery note to prove that the car is new, plus the insurance certificate and the necessary finance. The car is then allocated a registration number and you are sent a tax disc. The log book comes after the chassis and engine numbers have been checked, often by the local policeman. If you ask nicely, the local tax people usually allow the car to be used before the log book is issued, providing it has been taxed.

When the car is on the road for the first time, it pays to terminate the initial outing at a garage to have the tracking of the front wheels checked, headlights set and, if you want a second opinion, the brakes checked. Adjustments such as these do not come under the "professional help" ruling.

After that it's up to you. A few cars come unpainted, and this is another job that you are allowed to have done. After the first 500 miles, most kit car makers or their dealers, like to see the fruits of your labours. Most will give the car a thorough check-over during the 500-mile service and correct any small points you may have missed. After this, there's no reason why it should not give as reliable service as a production car—with the bonus that it is different enough to be individual, but not individual enough to be difficult to maintain.

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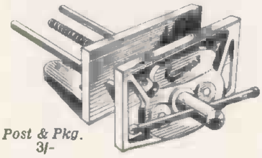

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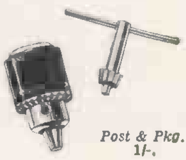

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