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NEWNES

PRACTICAL MECHANICS

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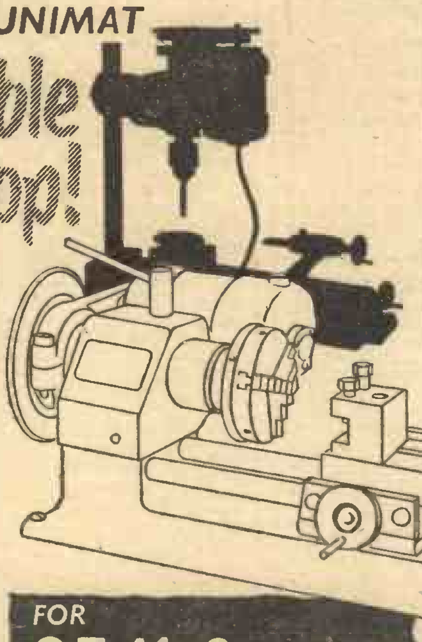
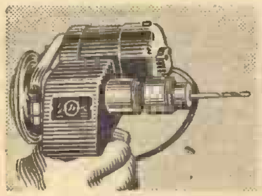
EDITOR: F. J. CAMM

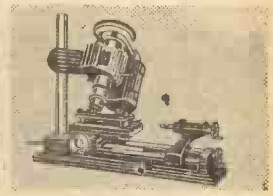
JANUARY 1956

THE AMAZING EMCO-UNIMAT

Complete portable power workshop!




Hand drill.


Milling machine.

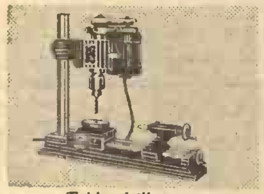
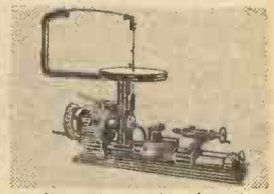
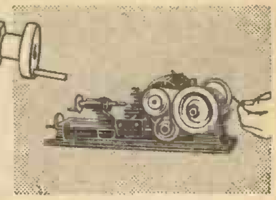


Table drill press.


Jig sawing machine (extra).


Tool grinding machine.

The Emco-Unimat, a miniature ball-bearing machine tool is the perfect equipment for model makers and amateur craftsmen. The standard motorised lathe, as illustrated, can be used as a pillar drill, milling machine, grinding machine, or hand-drill—*and no extras are needed*—though much additional equipment is available for its more extended use. We emphasise the fact that the Emco-Unimat is a *precision* tool, capable of a variety of machine shop operations on a miniature scale.

1. TURNING
2. DRILLING
3. MILLING
4. GRINDING
5. WOOD TURNING
6. POLISHING

Emco Unimat

FOR **£5-11-6** DEPOSIT and 40/11 p.m. for 12 months

CASH PRICE £27 17 6

SPECIFICATION

Centre height $1\frac{3}{8}$in. Takes between centres $6\frac{5}{8}$in. Hollow Spindle admits $\frac{1}{4}$in. Drill Chuck Cap. $\frac{1}{4}$in. Chuck to drill table, max. $4\frac{3}{8}$in.

ADDITIONAL EQUIPMENT

Jig saw, SC Lathe Chuck, circular saw, drilling vice, milling table, and clamps, Flexible shaft.

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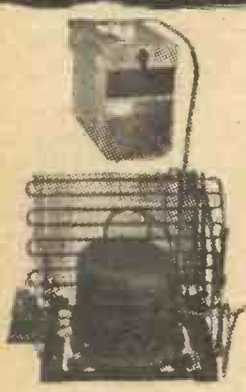

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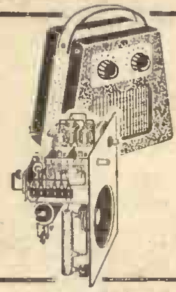

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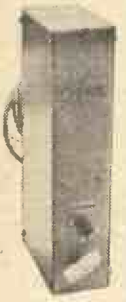

LONDON & MIDLANDS models now available. Your T.V. will receive the commercial programmes by the simple addition of our converter. No mods. to the T.V.—simply plug in the aerial leads and connect to the mains. Converter is in neat stove-enamelled case with provision for fixing to the side or back of the T.V. Price £6.10.0 or £2.10.0 deposit and five payments of £1. **BUILD YOUR OWN CONVERTER.** If you build the converter yourself you can save up to £2.0.0. We will supply all the components including stove-enamelled case, valves and even transfer for decoration and identification for £4.4.0. Data is included free with the parts or available separately price 1 6.
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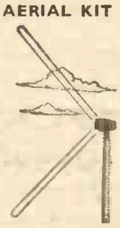

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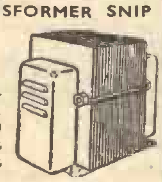
Post 2/-



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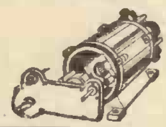

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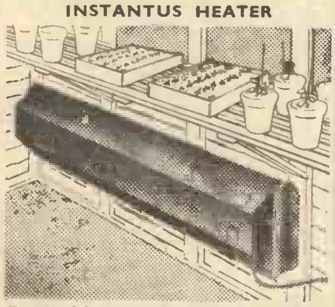

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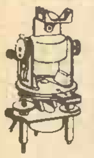

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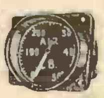

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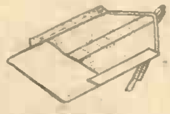

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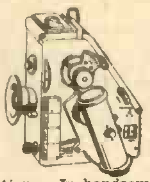

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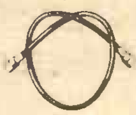

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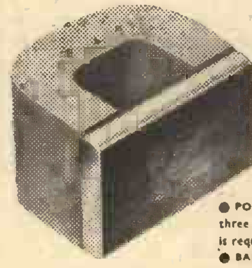

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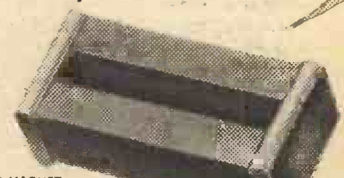

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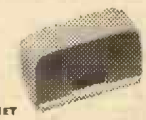

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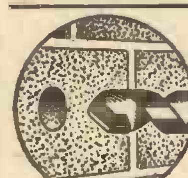

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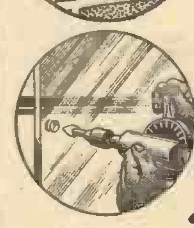

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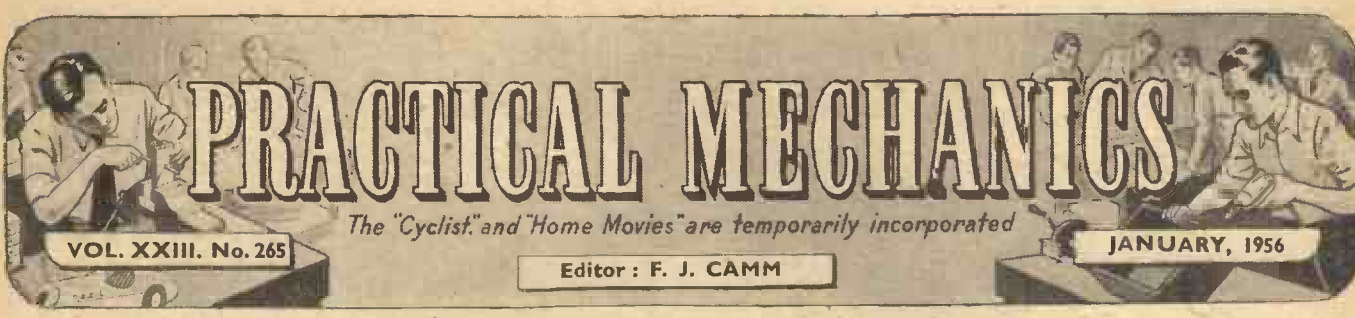

FAIR COMMENT

By

The Editor

Fishing by Electricity

THE discovery that fish are sensitive to minute currents of electricity in the water has led to experiments in the application of electricity to fishing. These experiments have revealed that if the voltage of a current passed into water is progressively increased from zero volts the fish will react in three different ways at three definite stages in the raising of the voltage. The first reaction is that the head of the fish perceptibly jerks, and there is a certain amount of tremor of the gills and fins, with perhaps a small change in the position of the fish. As the voltage increases the fish is activated and commences to swim listlessly, presumably to escape from the electrical field. The last reaction as the voltage reaches maximum appears to make the fish bereft of action, and it remains, so to speak, transfixed, the gills cease to flutter and the fish sinks to the bottom and lies on its side. If the voltage is maintained at the level which brings about this state of affairs, the fish dies. If the current is switched off, the fish is none the worse for the experiment and speedily recovers a state of normality. Anyone can experiment on these lines with a small tank with fresh- or salt-water fish with either A.C. or D.C. According to Mr. J. G. Cattley, M.Sc., of the Fisheries Laboratory, Lowestoft, the reactions of the fish are most noticeable when it lies with its length along the direction of the current and are at a minimum when it is at right-angles to the current. It was observed that the fish often turned when they first felt electrical stimulation, so as to be in a position where they are least affected by the current. When D.C. is used, the second stage of stimulation takes on greater significance, for the fish is compelled to turn its head towards the source of electric current and to swim towards it, and any alteration in the direction of the current causes a comparable change of direction in the fish. A typical tank for experiments is of glass in which the ends are occupied by conducting plates or electrodes. The resistance of the water causes its temperature to rise and it is well known that, unlike metal, the resistance of the water decreases as the temperature rises. This, of course, is a deciding factor in the voltage and current required.

There is no suggestion, as yet, that electrical fishing will replace the usual methods of catching by trawlers, but the Scottish Home Department and the Ministry of Agriculture and Fisheries are working in conjunction with the Electrical Research Association, whilst the Herring Industry Board is also interested in the experiment. The object is to produce the most efficient and portable apparatus for use in fresh water and an equipment for marine use of a size which would represent a commercial possibility.

Doctor Kreutzer demonstrated in 1952 that herring and cod previously caught and released into the electrical field were attracted and swam for the anode from a distance of 10 and 15 metres respectively. He was responsible for developing an electrical device to overcome the struggle to hook tunny, resulting in ease of capture, and therefore economy of the number of crew required.

Electricity and electronics continue to make inroads into almost every aspect of human endeavour.

A Junior Mechanic's Section

WE often receive requests for articles on subjects which appeal only to the junior mechanic, the lad who has reached an age where he begins to take an interest in practical hobbies. Articles on the construction of an orrery, or a telescope, or a radio-controlled model are usually beyond his equipment, his pocket and his ability. To encourage these junior readers we propose next month to introduce a new feature entitled " The Junior Mechanic," and in that feature we shall publish very elementary material designed for the very beginner. Thus it will act as a sort of apprenticeship to the wider spheres of practical activity covered by the majority of our articles.

Incidentally, those readers interested in television may like to know that in our companion journal *Practical Television*, I have commenced publication of my new series of articles entitled " A Beginner's Guide to Television." It will be a companion series to " A Beginner's Guide to Radio," a series I contributed to *Practical Wireless* and which has now been republished in book form at 7s. 6d. (7s. 10d. by post).

Readers are reminded that they can obtain, by sending a stamped and addressed envelope, a free catalogue listing all our technical books in the fields of radio, television, electronics, engineering, electricity, model making, etc. It is a useful catalogue to have by you. There is bound to be at least one book in the list which will be of interest. I often receive requests for titles of books on particular subjects, and our catalogue supplies the answer.

Fog!

THERE is an implied criticism of our technicians that they continue to ignore the problem of fog and the enormous loss it causes to industry and, therefore, to the State every year. Aeroplanes can fly to America in fog, the aircraft can be landed without the assistance of the pilot in fog, ships continue to sail on the ocean in fog, and yet the railways with their closed tracks and track-circuiting methods have not yet devised a system which enables them to maintain a normal service during fog. The fact is that they have not tried, and have accepted fog as one of the insoluble problems.

The conditions on the roads during fog are even more chaotic. Those who should be responsible for directing traffic in such a critical time desert the job and go home. It should not be beyond the wit of technicians to evolve a solution to road and rail travel during foggy periods. There is a public responsibility and the solution is not to abandon it with the bland notice " fog service."—F. J. C.

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Underwater Photography

Details for Making a Waterproof Camera Case and Some Notes on Technique

By D. PEMBERTON

MANY swimmers will have become interested in underwater exploration during the past couple of years, due to the inexpensive apparatus available and the several books which have been written on the subject. So widely has this interest been stimulated that underwater clubs have been formed throughout the British Isles, their headquarters being the "Underwater Explorers' Club," 2, Thames House, Queen Street Place, London, E.C.4. Hand in hand with this sport goes photography, which is, as yet, a wide open field and not delved into by the average amateur, mainly for fear of ruining equipment. This need not be so, as an efficient camera casing can be made easily and cheaply by anyone with only a limited knowledge of woodwork and basic materials.

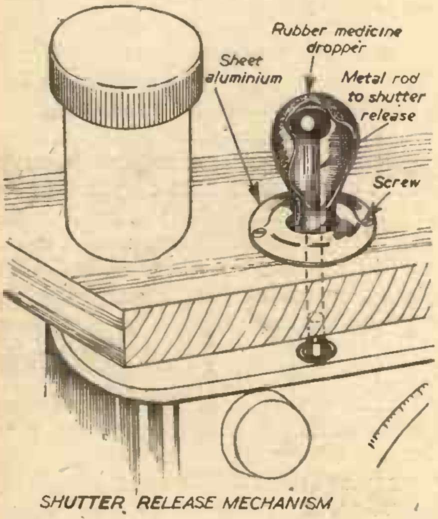


Fig. 1.—Using a rubber bulb to cover the shutter release.

Almost any camera can be waterproofed for underwater operation, but if the case is to be home-made two features on the camera are desirable; they are automatic film wind stop and a self-cocking shutter. The first of these permits the swimmer to wind on his film without viewing the number through the camera back. The self-cocking shutter eliminates the need for a waterproof cocking lever and prevents double exposures. It is not recommended to use the camera range-finder under water as it is difficult to get the eye near to the rear window and visibility is likely to be extremely low.

Materials for the Case

Wood, about ½in. to 1in. thick, is the best material to use for diving to 50ft., particularly when diving from a small boat or rocks, as it is comparatively resilient and thus protects the camera. The removable cover must, however, be made from metal. My own case was constructed from wood and glass with a sheet aluminium base (brass could also be used). The design of the case is left to the reader to suit his own camera, but the photograph Fig. 2 and the sketch Fig. 3 should provide something to work on.

The casing is made out of ½in. plywood, glued with a watertight resin glue and screwed securely, care being taken that the joints are at right angles and a flush fit. The base is then made flat by placing the case on a sheet of glass and filing the predominant surfaces.

The base consists of a sheet of ¼in. aluminium cut and filed to the shape of the case, with provision made for the gussets enabling the base to be secured to the casing by four brass turnbuckles, fitted for ease of operation with wing nuts. This main joint is made absolutely watertight by inserting a piece of gasket rubber between the casing and base, usually greased with Vaseline or similar substance.

Perhaps the best way to make this joint is, after planing and sealing the bottom edges of the wood, to position a ⅛in. pure gum rubber gasket with a rubber bonding cement all round the open bottom end of the case. Another rubber gasket, about 1/32in. thick is cemented to the base plate so that it will be pressed into the thicker gasket on the box when the clamping screws are tightened. As the water pressure increases the seal becomes tighter, thus ensuring a truly waterproof joint.

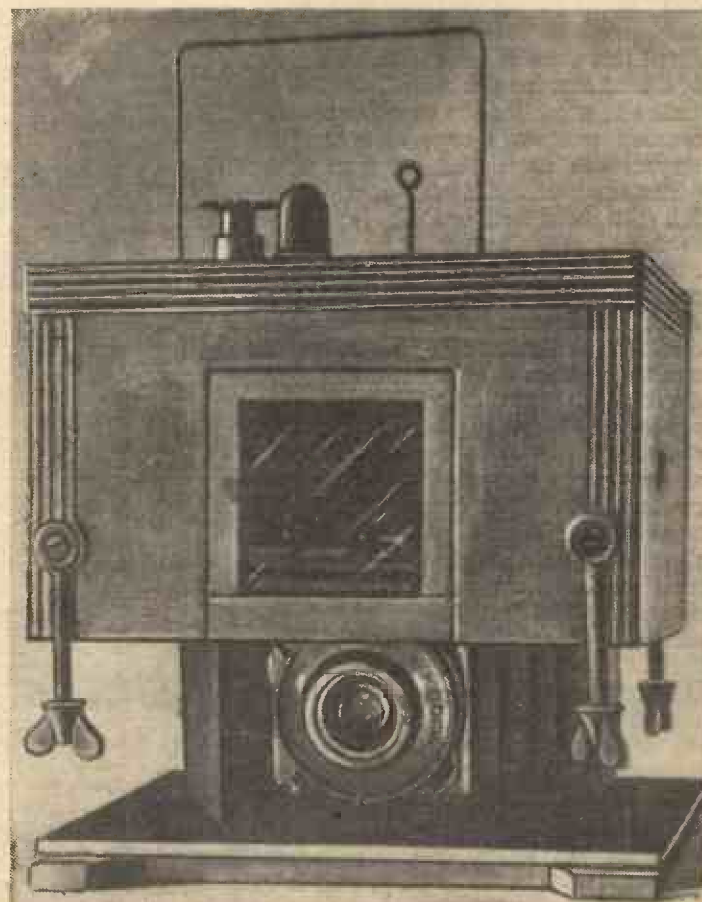


Fig. 2.—The author's case with camera in position.

The Window

In Fig. 3 the window is shown as a piece of glass sandwiched between two wooden frames which are set into the thickness of the camera front. All the contacting surfaces should be coated with a waterproof glue and the outside treated with model aeroplane clear dope.

Another way of fitting the window is to cut a recess round the window opening on the inside of the case. Into this recess fit a rubber gasket. The glass is next placed on the gasket and should stand proud above the edges of the recess. The addition of a brass plate screwed to the inside of the front of the case will press the glass against the rubber gasket. The front and back of the gasket should be well covered with rubber solution.

The best type of glass is the type used for car windscreens. This consists of two pieces of glass cemented together and if broken underwater will still remain watertight due to the cement film between the two thicknesses. Ordinary plate glass can also be used.

Camera Controls

Next it must be decided what controls are required. The more controls that are fitted the more versatile the unit becomes, but against this must be considered the greater chance of leakage and the more mechanism to go wrong. The "super luxury" underwater case would probably be fitted with controls for shutter cock and release, film wind, focus, aperture setting and shutter speed, but for the enthusiast building his own case the first two only are absolutely necessary.

Shutter release is effected by depressing a length of metal rod, passing through the casing, the hole being drilled to a size which allows an easy sliding movement. The end of the rod protruding through the casing is made watertight by covering it with the rubber bulb of a medicine dropper firmly attached to the casing with rubber solution and a thin piece of aluminium sheet screwed to it (see Fig. 1).

Winding the film is accomplished by a similar rod passing through two or more greased leather washers, as shown in Fig. 4. A piece of brass tubing can form the basis of this device, the washers being fitted inside. An alternative to the washers is a round plug made from graphited steam valve packing. A good way of securing the piece of brass tubing to the wooden camera case, is first to braze it to a flat metal plate and then drill and screw the plate to the case. A milled knob as shown is fitted to the top of the rod. One of the best ways of attaching the bottom of the rod to the camera film wind knob is to fit a snug-fitting cap over the knob and attach this positively to the shaft.

A focusing device could no doubt be contrived on similar lines. I did not fit one to mine as I prefer to pre-focus the camera before diving. For those cameras with aperture setting adjustment by a knurled ring on the lens barrel a rubber friction disc is the answer. All cameras are different, and working the controls from outside the case must be left largely to the maker's ingenuity. The only definite rule is that all wires rods, etc., passing out of the case must do so via a watertight gland.

The camera should not be allowed to move inside the case even when the swimmer (and his camera case) is upside down in the water. This can be achieved by bolting the camera to the metal base, or by means of wood or sponge rubber blocks fixed to the sides.

Handles can be fitted if desired, but my camera has sufficient buoyancy to rise to the surface if released underwater. All exterior metal fittings, including the frame viewfinder, should preferably be of brass.

Final additions to make the casing watertight are few, three good coats of model aeroplane clear dope on the wood is ample and a greasing of movable parts is all that is required.

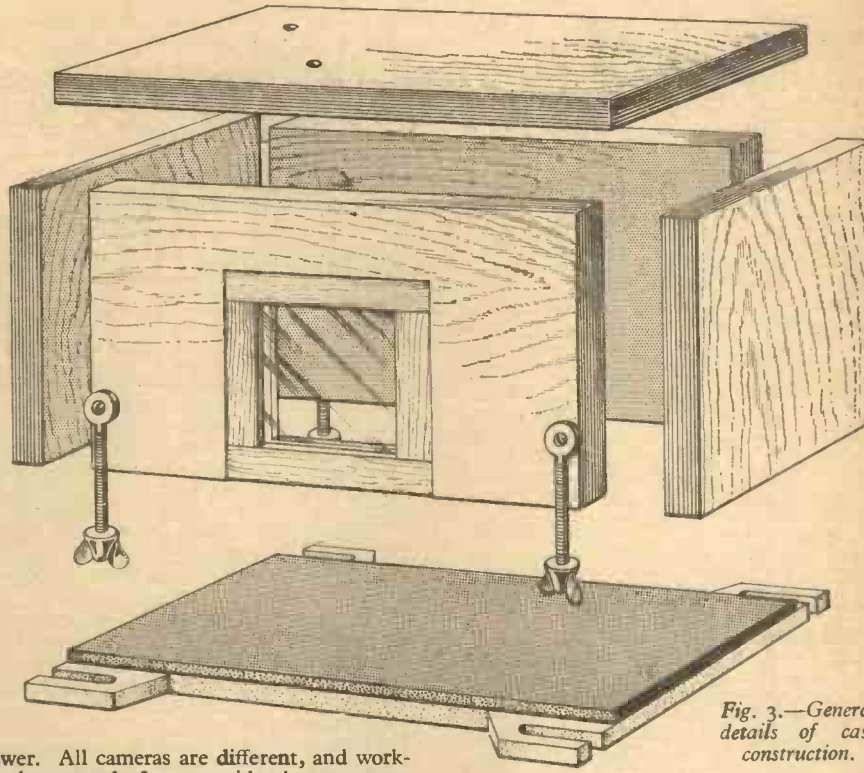


Fig. 3.—General details of case construction.

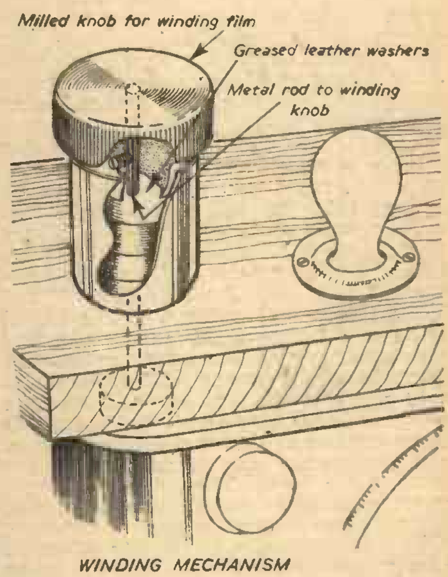


Fig. 4.—The waterproof gland for the film-wind mechanism.

Fig. 5. — Two underwater photographs taken by the author.

(Above) An underwater scene. (Right) A close-up of a spider crab.

Testing

At first the casing is immersed to the depth at which it is to be used without the camera inside. Any water found inside the casing on opening indicates a leakage, which is filled with the resin glue. Do *NOT* believe that air bubbles from the casing are the only indication of a leakage; they are not. Since air is compressible water may force an entrance and fill the original volume occupied by the air. Should any mishap occur in salt water and the camera receives a wetting it should be immediately washed in boiled fresh water, dried and sent to a reliable repairer for cleaning. The fresh water used will wash away any salt present, which would cause chemical action and oxidisation of the metal mechanism.

(Concluded on page 218)

Two-wheelers for 1956

As Shown at Earls Court

By THE MARQUIS OF DONEGALL

The all-British Dayton Albatross.

AT the opening ceremony Mr. Peter Thorneycroft, Minister of Transport, mentioned that the cycle and motor-cycle industry has sent more than one-third of is production to overseas markets. At the Press conference on the day preceding the opening Mr. H. Evan Price, president of the Manufacturers and Traders Union, told us that the industry, while dominating the markets of the world in orthodox motor-cycles, had now determined to challenge the Continent in the fields of mo-peds and scooters. Although there were many foreign exhibits in this field—plus those built here under licence or foreign powered—the first examples of the British challenge mentioned by the president could be inspected by all.

New British Scooters

The crowd round the B.S.A. stand showed that every visitor was determined to see the powder-blue Beeza and the little Dandy 70. The Beeza, on which Peter Thorneycroft posed for photographers, has a 200 c.c. 4-stroke engine with electric starter, does 100 m.p.g. and costs £204 12s.

Let us look at some prices (including purchase tax) in the field that made the news of this year's show. Douglas have, of course, been making the lighter Italian Vespas for some years. Their 124 c.c. Douglas-Vespa will do 120 m.p.g. and costs £138 1s. 1d., whereas the Italian-made 150 c.c. Lambretta does 130 m.p.g. and costs £154 17s. 5d. A curious anomaly is that complete scooters pay less import duty than portions of scooters, but there were, nevertheless, British scooters with German, Italian and French engines.

The German Rolletta is about the last thing in attractive luxury. It does 56 m.p.h., 93 m.p.g., has a 4-speed gear-box, starter, flashing indicators and costs £229 8s. In the lighter categories the B.S.A. Dandy 70 c.c. costs £74 8s.; the Lambretta 150 c.c. (Model D) £134 3s. 1d. Two neat newcomers were the Bambi (D.M.W.) and Hermes (Mercury) scooters. The Bambi has a 98 c.c. Villiers fan-cooled engine and an enclosed luggage compartment under the seat. It sells at £99 4s. The Hermes is very nearly as cheap to buy and run as a mo-ped. It has a 49 c.c. engine, but affords the protection of a scooter against weather, and the running cost is reckoned at one farthing per mile. The price is £89 5s., and the model displayed on an illuminated turntable was finished in maroon and grey.

It was claimed for the Dayton Albatross scooter that a rider has stood up on it and drunk a cup of tea with both hands, at 40 m.p.h.! The Albatross does 65 m.p.h., is powered by 225 c.c. Villiers two-stroke and does 84 m.p.g. The machine sells at £198 10s.

Another good-looking scooter was the Excelsior-Heinkel, finished in cactus green. Altogether there were 10 Excelsior models from the 98 c.c. Autobyk to the 250 c.c. Talisman. The cheapest 100 c.c. machine in the whole show was their Consort at £75 5s.

The Mo-ped

All visitors will have noticed that the mo-ped has completely ousted the bicycle with clip-on motors. Dozens of firms were manufacturing these midget motors and there are over half a million on British roads. Of these about 100,000 were built by Power-Pak. But in January of this year, a thriving industry, with considerable export value, was killed overnight when the Government made the purchase tax of clip-ons the same as that of complete motor-cycles. Power-Pak's sales fell from 30,000 motors a year to 500 units in 1955.

The immediate result of this legislation was a flood of imported mo-peds which the show under review sets out to counteract by the introduction of the new all-British mo-peds.

The first of these that we saw was the Hercules Grey Wolf of 49 c.c. with two-speed gear and with a top speed of 35 m.p.h. The price is £61 15s. Before leaving the stand, we recall that it was on Hercules bicycles that Brian Robinson and Tony Hoar achieved the 1955 distinction of being the first Britons ever to finish in the murderous Tour de France cycle race.

Being the possessor of a vintage Norman Autobyk which the R.A.F. used obligingly to convey as part of my war reporting baggage, I was interested in the new Nippy: a 50 c.c., 200 m.p.g., 30 m.p.h. machine with running cost of one farthing per mile. The price is £71 18s. 6d.

Altogether, there were in the show eight mo-peds (four entirely new), six scooters (five entirely new) and over 50 lightweights. The prices of the mo-peds ranged from about £40 to £70-odd, those of the scooters from under £100 to about £200 and those of the lightweights from £80 to £170. It will be interesting to see whether the mo-ped eventually sheds its pedals and merges into an adolescent motor-cycle or whether the scooter gradually pushes the mo-ped off the roads. The comfort of the mo-peds has been increased by the introduction of sprung forks and they are cheaper to buy and run than a scooter. The ability to pedal is also an advantage when faced with a recalcitrant two-stroke. It will usually pedal-start when no amount of kick-starting makes it even splutter.

Record-breaking Machine

On the Triumph stand was the most unorthodox exhibit in the show. This is the cigar-shaped, all enclosed machine on which Johnny Allen did his record-breaking run on Utah Salt Flats last September 25th. He did the flying kilometre at 193.72 m.p.h., being the mean of two runs—one in each direction. I was told on the stand that, taking into consideration the conditions, Allen must have touched 220 m.p.h. Illuminated turntables displayed the 649 c.c. Thunderbird and the Tiger 110, which is a hotted-up version of it. Crystal-grey has been added as a new finish.

Let us note here that Britain remains the largest exporter in the world of bicycles and orthodox motor-cycles in spite of the decision of President Eisenhower to raise the duty on imported bicycles. This year's available figures show that the U.S.A. remains one of the first three of our markets. Home sales, owing to purchase tax and hire purchase restrictions, are lower than immediately pre-war. Our chief customers for motor-cycles are the U.S.A., Australia and Sweden—in that order—and the total production of motor-cycles in 1955 will probably equal the 1954 record figure of 190,000 machines. The twin industries have earned one million pounds more in foreign currency than in the corresponding period of 1954: nearly 30 million pounds. And the dollar earnings should be about 10 million pounds by the end of 1955—seventh among our dollar-earning exports.

Altogether, the twin industries can be proud of their 1955 achievements. Apart from Johnny Allen, Robert Burns and Russell Wright of New Zealand, who achieved the world's motor-cycle speed record, were present.

Large Motor-cycles and 3-wheelers

Unless I missed another giant, the Royal Enfield 692 c.c. Meteor, finished in maroon, chromium and polished aluminium, was the most powerful motor-cycle in the show. Next came the Norton Model 99, 597 c.c., and after these the Matchless 592 c.c., the A.J.S. 592 c.c., and the B.M.W. 590 c.c.

The most unusual sidecar in the show was the Canterbury Carmobile. This vehicle seats three adults or, presumably, six children, and costs £124 13s. 11d. The A.C. 346 c.c. Petite has three speeds and reverse and is made in blue, green and red. The makers of the Bond Minicar (197 c.c. Villiers), claim that it is the cheapest-to-run car-shape product on the British market. In this field, the Gordon, the Reliant (hard-top), of 748 c.c. and, of course, the 191 c.c. Messerschmitt which, in my opinion, is the glamour girl of this type of vehicle, were well worth seeing.

An Easily Constructed SNOW SCOOTER

Two Versions of a Novel Device on Which Anyone May Emulate the Accomplished Skier

By MAURICE ELLIS

UNFORTUNATELY the English climate provides suitable conditions for so short a time that the beginner has little chance to learn anything about ski-running except how much more difficult it is than it looks.

Moreover, in the event of a ski-ing mishap, there is considerable danger to the knee and ankle joints, due to the leverage exerted by the length of ski.

These difficulties led me to devise the snow scooter described. It is not suitable, as skis are, for cross-country travelling over deep snow, but it does provide the excitement of running down-hill. The constructor will have little difficulty in learning to ride it since it is balanced in just the same way as a bicycle. Owing to the large area of the runners it will travel over soft snow much better than the average toboggan.

Two Alternative Designs

The first design is taken from the model already constructed with a tubular frame and the joints made with sif-bronze. For those without oxy-acetylene equipment it would not be an expensive matter to make the component parts and have them made up by a welder. This method of construction is probably the lightest and most durable.

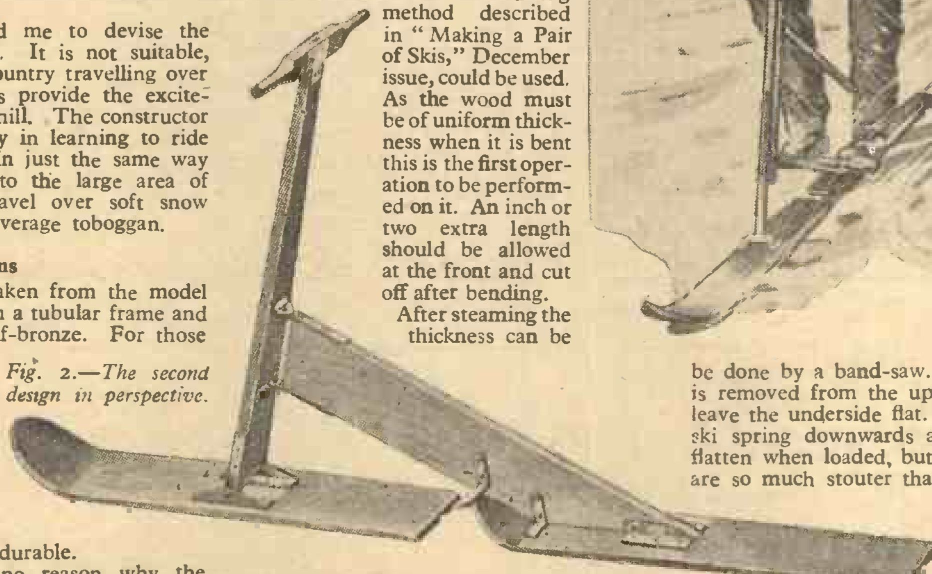


Fig. 2.—The second design in perspective.

There is, however, no reason why the frame should not be built up from wood, and the second design is for those who prefer to work in this material.

The reason why skis run so well over soft snow is, of course, that the weight is distributed over so large an area that the pressure is insufficient to make them sink. The length of the snow scooter is comparable with that of a ski, and as the runners are nearly twice as wide, they have the same effect.

A ski tapers in width from front to back since if it were parallel it would tend to run straight in its own groove and would be difficult to steer. It would not do, however, for the ski to be free to wander too much. This is prevented by a shallow rounded groove formed in the base of the ski from front to back. The snow is compressed into the groove and provides enough hold to give the ski a certain amount of lateral bite. The snow scooter has both these features.

The front runner is free to swing up and down in the plane of the machine. This enables it to follow the varying contours of the snow, thus both providing a better bearing surface, and also obviating the severe strains which would otherwise be imposed where it is attached to the steering column.

The Runners

These are alike in both designs. In the original they were made of beech, which has proved very satisfactory, but they could equally well be made of ash if it is obtainable.

I did not consider it worth while improvising the means to steam the bends when I could get it done very reasonably by a commercial firm, and the work was carried out for me by Robbins Ltd., Cumberland Road, Bristol 1.

The bending method described in "Making a Pair of Skis," December issue, could be used. As the wood must be of uniform thickness when it is bent this is the first operation to be performed on it. An inch or two extra length should be allowed at the front and cut off after bending.

After steaming the thickness can be reduced towards the two ends where less strength is required, and the weight thereby reduced. It will save hard work if this can be done by a band-saw. The surplus wood is removed from the upper surface so as to leave the underside flat. The two ends of a ski spring downwards a little so that they flatten when loaded, but the scooter runners are so much stouter that there is very little spring in them.

After the under-surface has been planed up the groove should be run down the middle with a half-round grooving plane. The best

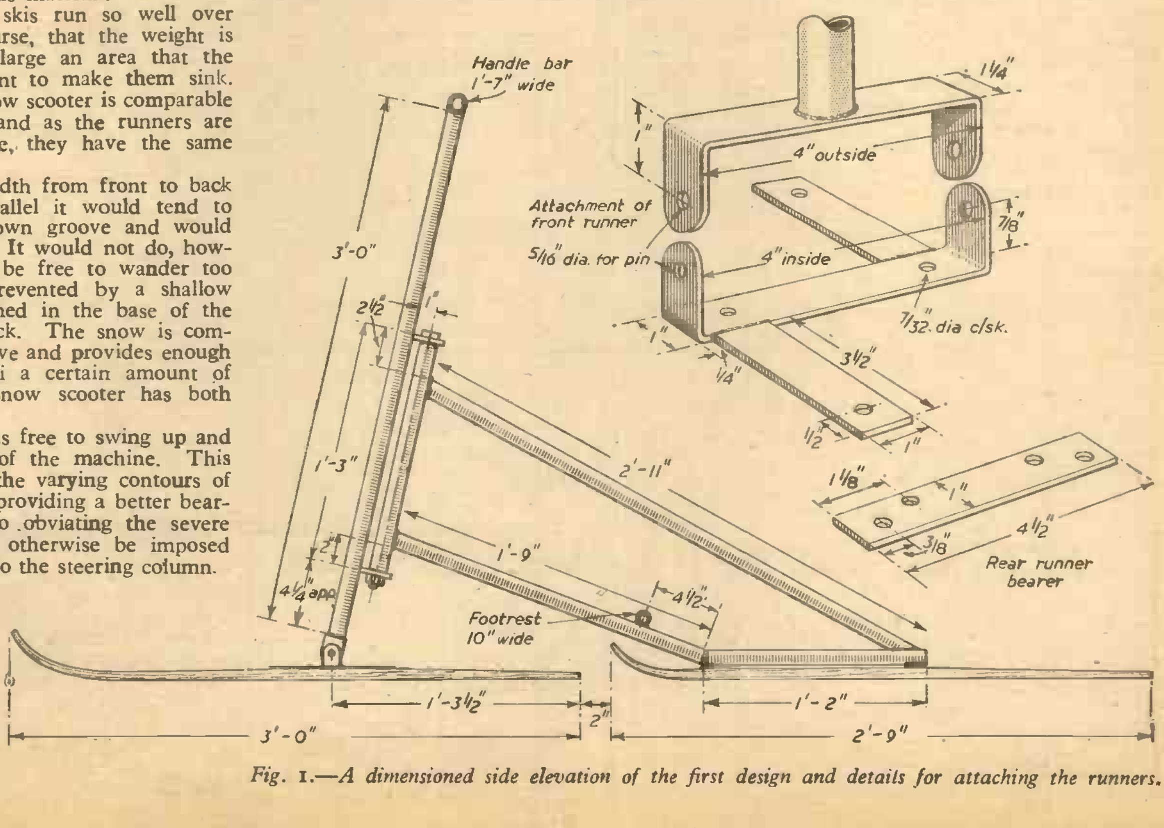


Fig. 1.—A dimensioned side elevation of the first design and details for attaching the runners.

way is to mark the two ends of the mid-point of the groove, and then to clamp a batten to the runner for the plane to run against so that it passes over the two marks. If any small error is made, it will be of no consequence, since the sides can be marked off from the groove afterwards.

The front runner comes to a rounded point, and the front corners of the rear runner are rounded off. The runners taper from 6in. at the front to 5½in. at the rear, but the scooter would probably run even better if they were wider, say, up to 8in. at the front.

The scooter is not heavy, but there is no point in pushing unnecessary weight uphill. It is recommended, therefore, that the edges of the runners should be chamfered off on top except where the fastenings come.

The First Design

The runners are secured by ¾in. x No. 12 screws. The front runner is held to a member made to the dimensions show in Fig. 1, although it might be less trouble to use angle iron for the purpose as described for the second design.

The steering column, and indeed the whole of the frame except the footrests, is made from 1in. seamless electric conduit, which I obtained from a scrap yard. There should be no difficulty in getting this new if necessary, but otherwise water-pipe would no doubt serve, even though unnecessarily heavy.

A bracket of 1¼in. x ⅛in. strip steel at the bottom holds the pivot for the front runner (inset in Fig. 1), and the handlebars are brazed across the top. They are 1ft. 7in. wide.

The dimensions of the frame are shown in Fig. 1. Two brackets of 1in. x ⅛in. steel hold the rear runner, and all the joints are made with sif-bronze except the obtuse-angled one near the front of the rear runner, which is butt-welded.

The swivel-pin for the steering passes through two bushes in the front member of the frame brazed in position. The bushes are 1in. long, and the pin is of ⅜in. or 7/16in. round, mild steel. A head is brazed to the top, and it is threaded for a nut at the bottom.

The lugs at the rear of the steering column should be attached last. The machine should be set up temporarily on a flat surface in order to make sure that the rear runner is level with the front one.

The foot-rest is simply a piece of ¾in. conduit 10in. long brazed across the frame.

The handlebars and footrests are provided with rubbers obtained from a motor-cycle dealer.

The Second Design

This design is shown in perspective in Fig. 2.

The front runner is secured to two pieces of 1¼in. x 1¼in. ⅛in. angle iron 6in. long, the vertical webs of which are tapered to the ends.

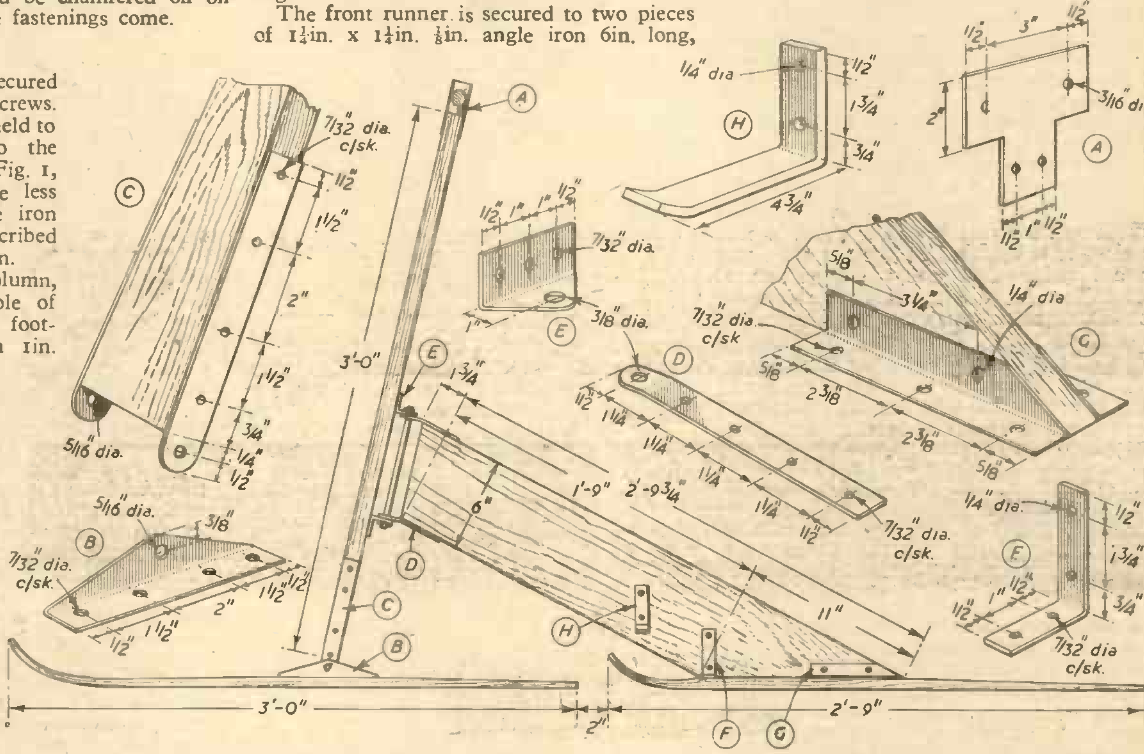


Fig. 3.—A dimensioned side elevation of the second design, and constructional details and dimensions of all the parts.

The steering column is made of hardwood 1in. thick, tapering from 4in. wide at the bottom to 2in. at the top, where it is mortised into the cross-piece which forms the handlebars. The latter tapers from 2in. x 1in. at the middle to 1in. round at the ends, and the joint is strengthened by 1/16in. plates at front and back.

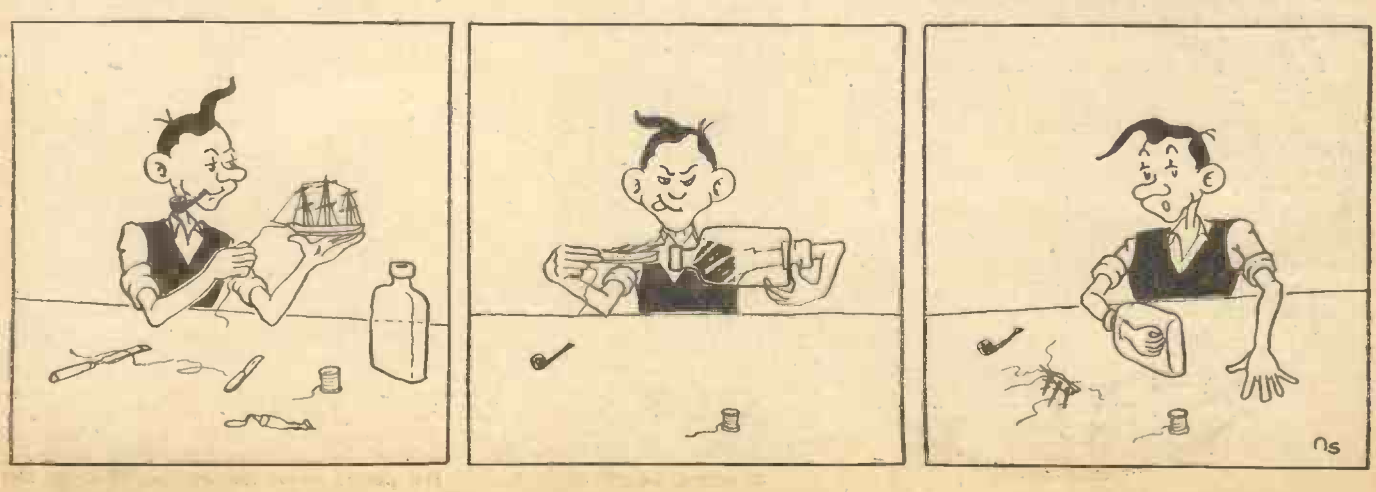
The front runner is carried by two pieces of 1in. x ⅛in steel 7in. long screwed to the bottom, and which pivot, inside the angle-pieces on the runner, on a 5/16in. diameter pin. This pin is held in place by split pins at the ends. The hinge for the steering is also made of the same 1in. x ⅛in. material. The backbone of the machine is a piece of hardwood 6in. deep by 1in. wide, but if it were deeper it would be no detriment.

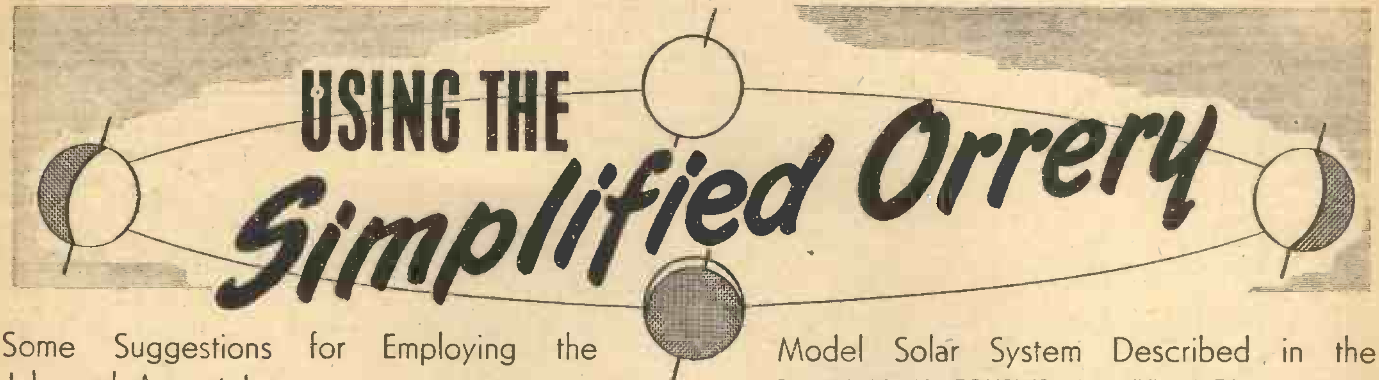
Four right-angle brackets hold the rear runner. The front ones are made from 1in. x ⅛in. strip and the rear ones of 1¼in. x 1¼in. angle. Main dimensions are given in Fig. 3 and the lettered items are also shown in perspective with full dimensions.

The size of the angle-iron components is not critical and if there is any difficulty in obtaining this material, which is rather scarce these days, bedstead sides can be used. The footrests are made of 1in. x ¼in. stuff, bent up on the ends, or alternatively they may be fitted with rubbers.

The brackets and footrests, being fitted symmetrically, are held on by bolts passing right through the backbone member.

ANDY MANN — THE PRACTICAL MECHANIC





USING THE Simplified Orrery

Some Suggestions for Employing the Model Solar System Described in the July and August Issues

By FRANK W. COUSINS, A.M.I.E.E., A.C.I.P.A., F.R.A.S.

IN this short article only the outer fringe of many possibilities for using the orrery can be offered for consideration.

A serious-minded constructor may care to use the model with the classic work, "Elementary Mathematical Astronomy" (by Barlow and Bryan, revised by Sir. H. Spencer Jones, the Astronomer Royal), at his side.

From the photograph of the author's orrery (Fig. 1) it will be seen that an adjunct is necessary if the orrery is to be related to the celestial sphere. The adjunct is a circular card marked in indian ink to agree with Fig. 2. This card is then mounted at the base of the orrery, its centre being coincident with the centre of the solar column.

The card shows three important features:
(i) The Zodiac.
(ii) Right ascension.
(iii) The months related to the position of the Sun against the Zodiac.

(i) The Zodiac is the imaginary belt in the heavens within which lie the apparent paths of the Sun, Moon and major planets. It is bounded by two parallels generally taken as 8 deg. on either side of the ecliptic or path of the Sun in its annular course. The Zodiac is divided into 12 equal parts of 30 deg. called signs *not* used by astronomers, see below.

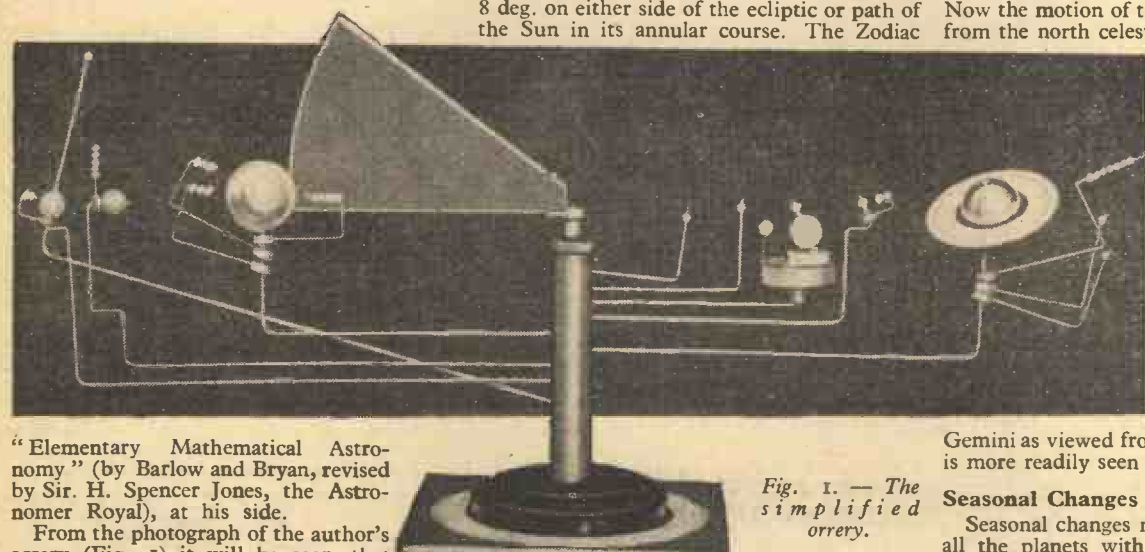


Fig. 1. — The simplified orrery.

Signs of the Zodiac

ARIES	♈	LIBRA	♎
TAURUS	♉	SCORPIUS	♏
GEMINI	♊	SAGITTARIUS	♐
CANCER	♋	CAPRICORNUS	♑
LEO	♌	AQUARIUS	♒
VIRGO	♍	PISCES	♓

The signs take their names from certain constellations of stars with which they once coincided. They are assumed to begin at the vernal equinox or intersection of the plane of the ecliptic with that of the equator. This point is still called the 1st point of Aries, although the sign of Aries now lies in the constellation Pisces, some 30 deg. to the west.

On the celestial sphere the signs are disposed as shown in Fig. 3.

The circular card (Fig. 2) is also provided with right ascension marks; 24 equal divisions representing hours of light ascension on the celestial equator measured from the 1st point of Aries *eastward*. (Similar to terrestrial longitude.)

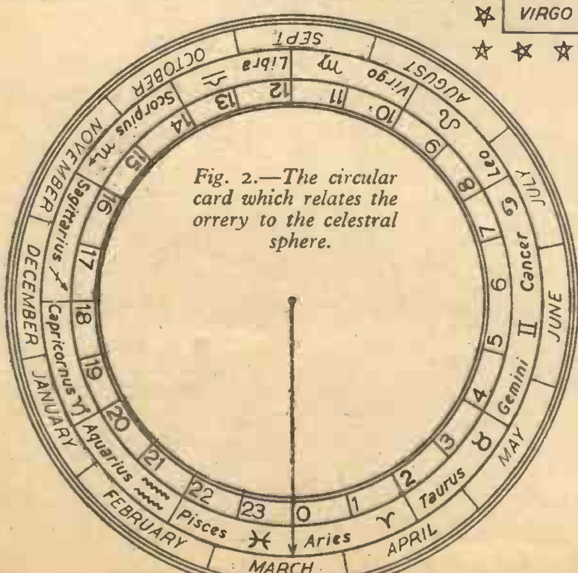


Fig. 2.—The circular card which relates the orrery to the celestral sphere.

Finally, the outermost circle shows the months when the Sun is in the juxtaposed sign of the Zodiac *on the card.* For example, the Sun is seen in the 1st point of Aries about March 21st. (The vernal equinox.) Now the motion of the Earth in its orbit seen from the north celestial pole is *anti-clockwise.* Remove the Sun sector and let the upper part of the central column represent the Sun. Set the Earth rod so that the Sun, the Earth bead and the 1st point of Aries are in line. Now move the Earth rod anti-clockwise and the Earth bead, Sun and Taurus will be in line; the Sun is said to be in the sign of Taurus. Continue the anti-clockwise motion of the Earth rod and the Sun will be seen to be in Gemini as viewed from the Earth bead. This is more readily seen from Fig. 4.

Seasonal Changes

Seasonal changes may be demonstrated for all the planets with tilted axes of rotation. The Earth and Mars are good examples.

The disposition of the Earth will agree with Fig. 5 (use the enlarged Earth bead). It is necessary to twist the Earth carriage, for the Earth's axis must point to a selected position in the room irrespective of the revolution of the Earth rod about the central column. Notice that the tilt of the Earth's axis is of non-effect regarding tilt toward or away from the Sun at the positions marked Spring and Autumn in Fig. 5. This may be clearly seen in the simplified orrery. In the case of Mars his seasons are demonstrable *mutatis mutandis.* His period about the Sun is, however, 687

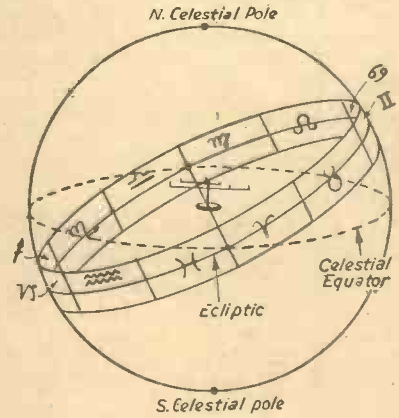


Fig. 3.—Signs of the Zodiac on the celestial sphere. The orrery (i.e., Solar system) is at the centre.

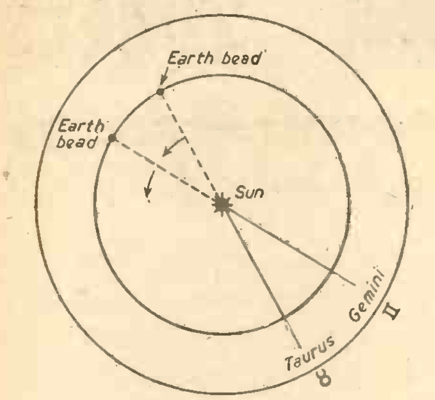


Fig. 4.—Diagram showing the apparent path of the Sun through the signs of the Zodiac.

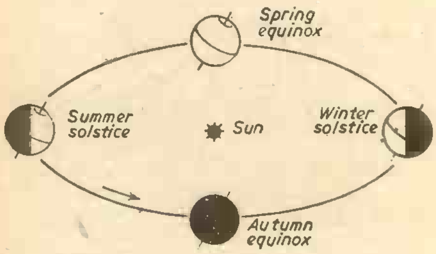


Fig. 5.—The seasons in the Northern hemisphere.

days 23 hours. The model cannot give a highly accurate treatment of Mars' seasons which are greatly affected by its position in orbit; an orbit of great eccentricity.

Inferior and Superior Planets

An inferior planet is one whose orbit is such that the planet is always between the Sun and the Earth's orbit. The model clearly shows the inferior planets to be two in number, Mercury and Venus.

A superior planet is one whose orbit is such that the planet is always moving outside the Earth's orbit. The model shows that all the other planets are superior planets.

Let us consider with the help of the model and Fig. 6 the case of an inferior planet (we choose Venus). Place the Earth rod and the Venus rod as shown at (a). Venus is at *inferior conjunction* with the Sun (position A, Fig. 7).

Place the Earth rod and the Venus rod as shown at (b) in Fig. 6. Venus is at superior conjunction (position B, Fig. 7). If the Venus rod is moved slowly from position A anti-clockwise to position B and back to A (Fig. 7) it will be seen that after inferior conjunction at A the planet is seen on the westward side of the Sun at V_1. The elongation S.E.V. gradually increases till the planet reaches a point U such that EU is a tangent to the orbit. The planet is then at its greatest elongation, the angle SEU being a maximum.

Subsequently, as at V_2, the elongation diminishes and the planet approaches the Sun, until superior conjunction occurs as at B. The planet then separates from the Sun, reappearing on the opposite side (eastern), as at V_3, attains its maximum elongation at U^1 and finally comes again to inferior conjunction at A. The real geometry of the orbits of Mercury and Venus are shown in Fig. 8.

Notice in Fig. 7 that S in SEU $= \frac{SU}{SE}$

that is $\frac{\text{distance of planet}}{\text{distance of Earth}}$ = sine of greatest elongation.

This method is only approximate in that the orbits of the inferior planets are ellipses.

A similar manipulation of the orrery may be effected for a superior planet.

Let us take Saturn. Place the Earth rod and the Saturn rod as shown at (a) in Fig. 9. Saturn is in *opposition* with the Sun (position A, Fig. 10). Now place the Earth rod and the Saturn rod as shown at (b) in Fig. 9. Saturn is in conjunction (position B, Fig. 10).

It will be readily appreciated that the planet Saturn in our example is nearest the Earth at A (Fig. 10), and since its orbital velocity is constant its relative angular velocity is then greatest and the elongation SEJ is decreasing at its most rapid rate. As the planet moves round from opposition A to conjunction B the elongation SEJ decreases continuously from 180 deg. to 0 deg.

At R the elongation is 90 deg., at T it is 270 deg., and the planet is said to be in *quadrature* at R and T. Note that the time between two successive conjunctions or

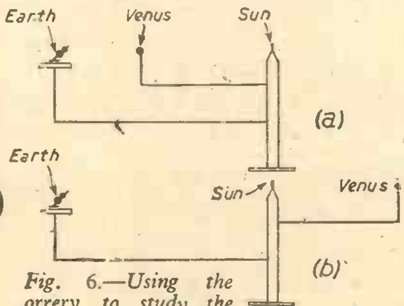


Fig. 6.—Using the orrery to study the orbit of an inferior planet (Venus).

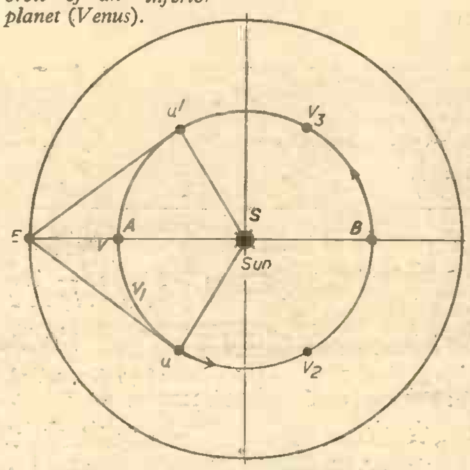


Fig. 7.—Plan view of motions in Fig. 6.

oppositions is termed the synodic period. In the case of the inferior planets the time between two consecutive conjunctions of the *same kind* (superior or inferior) is called the synodic period of the planet.

Relations between the Synodic and Sidereal Periods

The sidereal period of a planet is the time

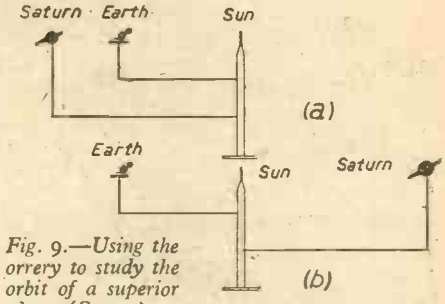


Fig. 9.—Using the orrery to study the orbit of a superior planet (Saturn).

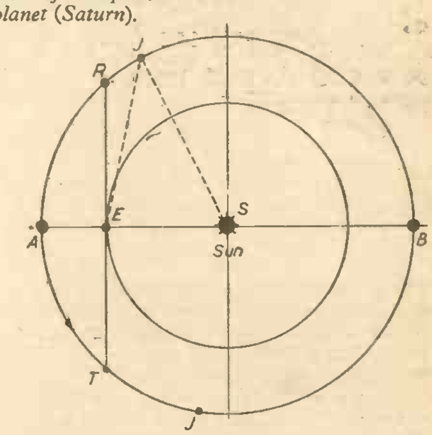


Fig. 10.—Plan view of motions in Fig. 9.

taken for the planet to make one revolution in its orbit about the Sun relative to the stars.

On the model, for example, take Jupiter and revolve it on its orbit rod from alignment with the first point of Aries, and return.

The synodic period, already mentioned in some detail, is the interval between two conjunctions with the Earth relative to the Sun. To demonstrate this have a friend move the Earth rod one turn in one minute and you move the Jupiter rod one-twelfth of a turn in a minute. (Jupiter moves about the Sun once in 12 years.) Notice the period between two consecutive conjunctions.

Let S be the planet's synodic period. P its sidereal period. Y the length of a year, that is the Earth's sidereal period. Measure all periods in days.

Inferior Planets	Superior Planets
$\frac{1}{S}=\frac{1}{P}-\frac{1}{Y}$	$\frac{1}{S}=\frac{1}{Y}-\frac{1}{P}$

Below are the synodic periods of the planets:

Mercury	...	115.8 days
Venus	...	583.9 „
Mars	...	779.9 „
Jupiter	...	398.8 „
Saturn	...	378.0 „
Uranus	...	369.6 „
Neptune	...	367.5 „
Pluto	...	366.7 „

Note: The sidereal periods were given in the previous articles.

(*To be Concluded*)

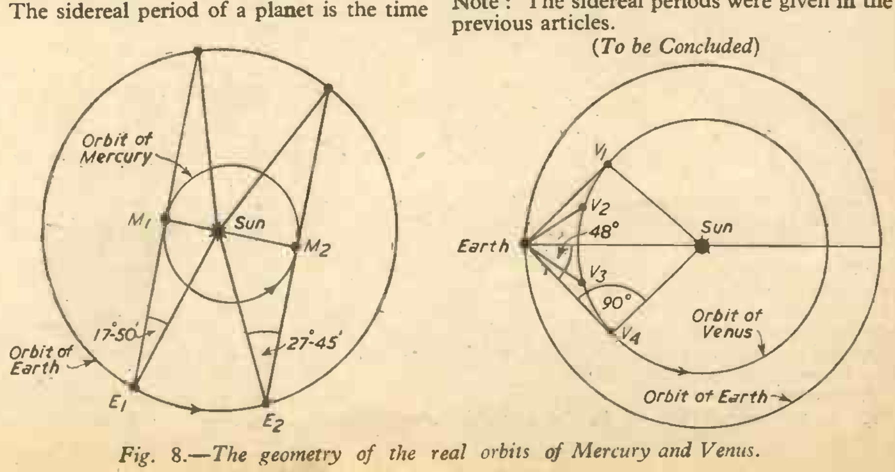


Fig. 8.—The geometry of the real orbits of Mercury and Venus.

RADIO CONTROLLED MODELS

By Members of I.R.C.M.S.

7.—A Proportional Steering Circuit and Reversible Sequence Engine Control Gear

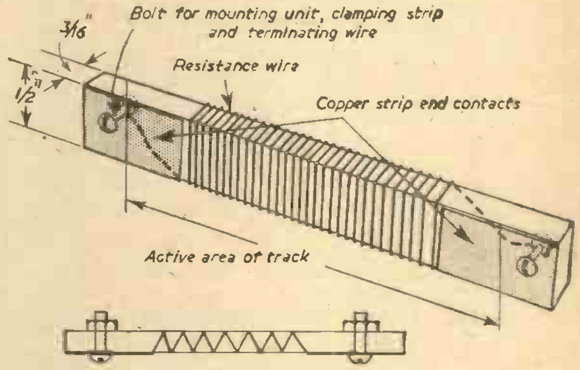


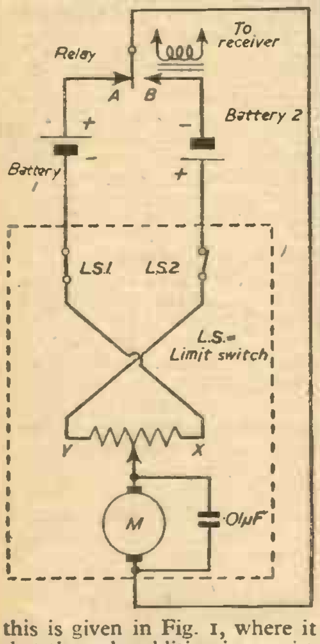
Fig. 3.—Wiring diagram of steering unit. Unit "B" in Fig. 6.

READERS who have experimented with the Mark/Space system of control for models, as described in this series, will appreciate that one of its defects is the need for the exact setting of the 50/50 ratio to ensure that the steering of the model does not creep either to port or starboard, but holds still exactly where set. It is, however, possible to steer the model by deliberately sending unbalanced ratios, i.e., 20/80 and 80/20, and this is the basis of the system to be described now.

By a simple addition to the steering mechanism in the model it is possible to make it "fully proportional," i.e., an alteration to the ratio of the pulse transmitted is followed by a proportional change in the position of the rudder. Therefore by sending a 50/50 ratio pulse the rudder will automatically centre whilst 20/80 and 80/20 (approx. ratios) correspond to full port and full starboard or vice versa.

The basic circuit to achieve this is given in Fig. 1, where it will be seen that the only addition is a resistance element. A slider, attached to the tiller mechanism, is arranged to track across the resistance and this must be wired so that the speed of the motor slows as the tiller travels to the opposite limit switch. Note the crossed wiring to the limit switches (see also Fig. 2). The action is as follows:

Assuming the relay is in position A (Fig. 1) and the slider at X, the steering motor M will receive the full battery voltage from Battery 1 and the slider will start to track towards Y. When the relay is in position B, however, almost all of the resistance is in the circuit of Battery 2 and the motor therefore makes fewer revolutions in the opposite direction. If the relay is being pulsed in a 50/50 ratio (i.e., equal lengths of time on A and B) the motor will position the slider so that the current obtained through the two halves of the resistance (i.e., between slider and X and Y respectively) is equal. A 50/50 pulse therefore automatically gives midships rudder whilst unbalanced ratios give proportional positions. This is a very effective system and no trouble has been experienced in its use, with the exception of the fact that it is rather slow to find its exact point of balance and a certain amount of over-steering is necessary. A little practice, however, soon gives the necessary skill.



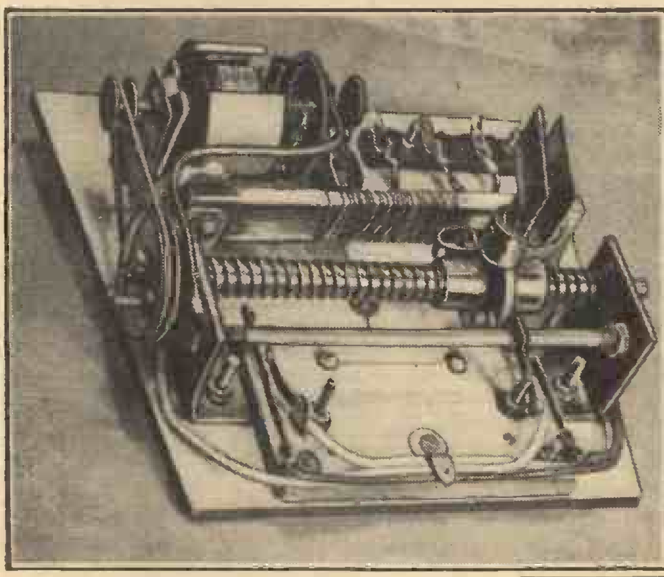
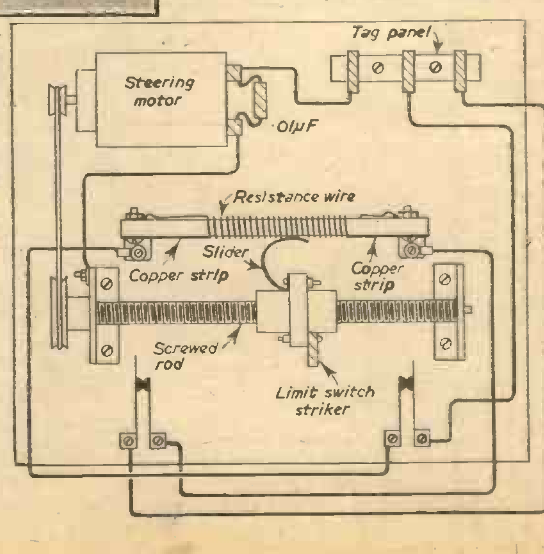


Fig. 2.—Proportional steering gear unit used by the writer. Note the resistance unit situated behind the screwed driving shaft, and the slider which travels across it to produce the automatic positioning according to the Mark/Space ratio sent.

Fig. 1 (Left).—Basic circuit of proportional steering mechanism, components inside dotted lines are those situated in stern steering gear.

Fig. 4 (Right).—Making the resistance track-length as required.



Figs. 3 and 4 show a practical arrangement of the scheme. The resistance is wound on a ½in. wide strip of plywood or paxolin and the wire is obtained from an electric fire spiral 750-watt type. The exact length of wire necessary will depend on the motor used and experiments will have to be carried out first. The aim is to cause the motor to slow to a little over half speed with the full resistance in circuit. In the unit shown the end sections are made from copper strip whilst the centre part only is made of resistance wire. This gives the proportional effect about the centre, but quicker steering on full rudder positions.

From the foregoing description it will be realised that all steering of the model is now being carried out by using pulses of varying ratio (at a fairly low frequency) and that we are left with two very useful channels of

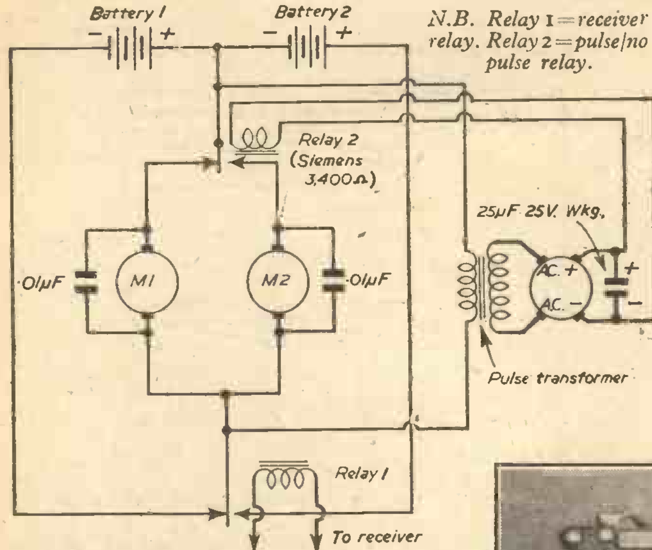


Fig. 5.—Circuit for using two control motors (steering and engine change speed) both of which will operate in both directions.

control, i.e., "Mark" and "Space," to perform other duties in the model. These are non-pulsing channels and can easily be separated to control engine speed. Fig. 5 gives the basic circuit for this system and readers who have been following this series will recognise the elements of the two-battery circuit which is extensively used for model control. Here, however, one of two motors is controlled by Relay 1, according to whether the relay is pulsing or not pulsing. If a steady Mark or Space is sent (i.e., non-pulse conditions) Motor 1 will be driven either clockwise or anti-clockwise from Battery 1 or 2. If, however, the relay is pulsed a current will be generated in the secondary of the pulse transformer, rectified by the meter rectifier, stored in the electrolytic condenser and applied to the second relay (which is adjusted to close on a very small current). Motor No. 2 is therefore brought into circuit and this functions on the Mark/Space pulses received. Both motors can, therefore be worked in either direction or held still at will and this circuit is approximately equal to a four-channel control.

Both the circuit of Fig. 1 or Fig. 5 is usable as it stands and both are worth experimenting with in simple equipment, but some difficulty may be encountered when it is attempted to insert limit switches into Fig. 5. They can be avoided, however, if slipping drives are used for the servo motors.

Combining the Circuits

It will be realised that the circuit in Fig. 5 provides the very conditions for Motor No. 2, which can be used in the proportional steering circuit in Fig. 1, although it will be necessary to alter the circuitry.

The complete circuit to do this is given in Fig. 6 and it operates as follows. All pulsing brings in the steering Unit B, which then controls the rudder position according to the Mark/Space ratio sent. A non-pulse signal (either Mark or Space), after a short time delay caused by the drop out time of the Pulse/No-pulse Relay, which is slugged by the 25 μF 25 volts working condenser, then brings in Unit A. This is the engine speed control switch and is arranged to provide a reversible sequence. "Space" is used to increase speed and "Mark" to reduce speed and to go astern. This is very useful as it is not necessary to go through all of the positions before returning to one just used, as it is with all normal sequences.

Start at the receiver relay, which is a Siemens High-speed type in the writer's equipment (see Fig. 7). This is used to energise a double-pole double-throw slave relay, connected as a reversing switch. The pulse transformer is also connected between the receiver relay slave and the centre tap of the intergear battery. As described last month, this is a 1S4 output transformer rewound with 32 s.w.g. enamelled copper wire in place of the original thick secondary. (This new winding now forms the primary.) Pulsing from the receiver, therefore, causes current from alternate halves of the battery to flow through the pulse transformer primary and a current is generated in the secondary. The meter rectifier (5 or 10 mA type) rectifies this and applies the D.C. output to the electrolytic condenser and finally to the second Siemens relay (the Pulse/No-pulse relay). The closing of this relay causes its double-pole double-throw slave relay to close and the Mark/Space pulses are therefore channelled into Unit B, which is the steering unit. If pulsing ceases the Pulse/No-pulse relay and its slave will drop off and Unit A therefore becomes energised. The motor of this unit will therefore run either clockwise or anti-clockwise according to whether the receiver is accepting a steady "Mark" or "Space."

In practice the unit works quite well and

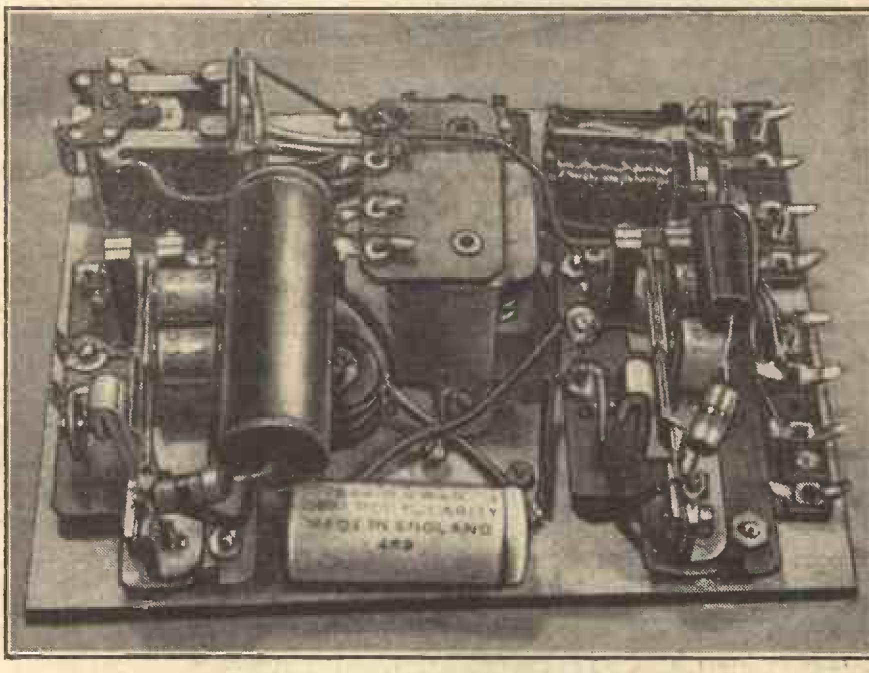


Fig. 7.—The complete "intergear" unit (pulse decoder) described in this article. Left: Siemens H.S. receiver relay and above it its slave relay (D.P.D.T.). Note the large (1 μfd.) condenser and 22 ohm resistor to the right of the Siemens relay used as a spark suppressing unit. Centre: Top: Pulse transformer. Below to the left: The meter rectifier. Bottom: The 25 μfd. 25 v. D.C. working electrolytic condenser. Right: Bottom: Siemens H.S. Pulse/No-pulse relay (with spark suppressors) and above it its slave relay (D.P.D.T.). All connections are brought out to the tag boards on the right, and at the top except the receiver connections which are joined to the relay tags on the left.

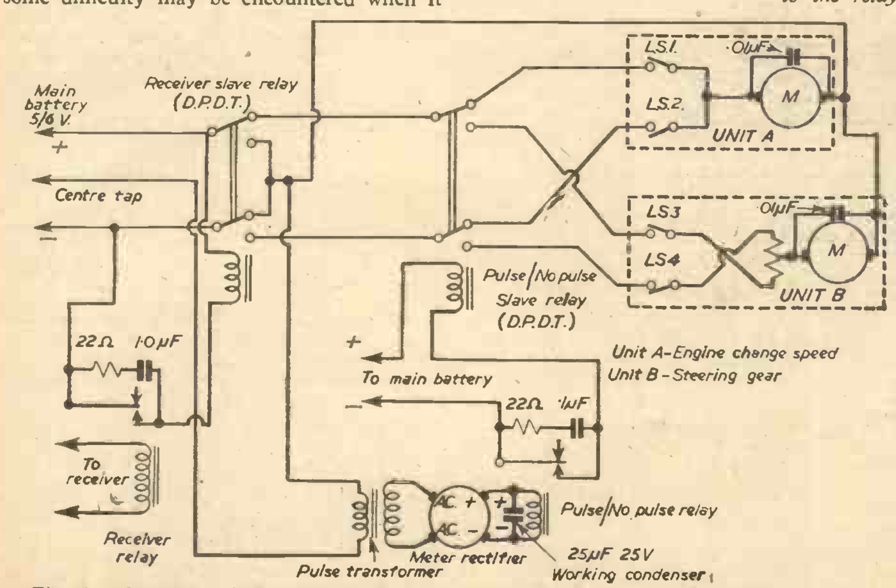


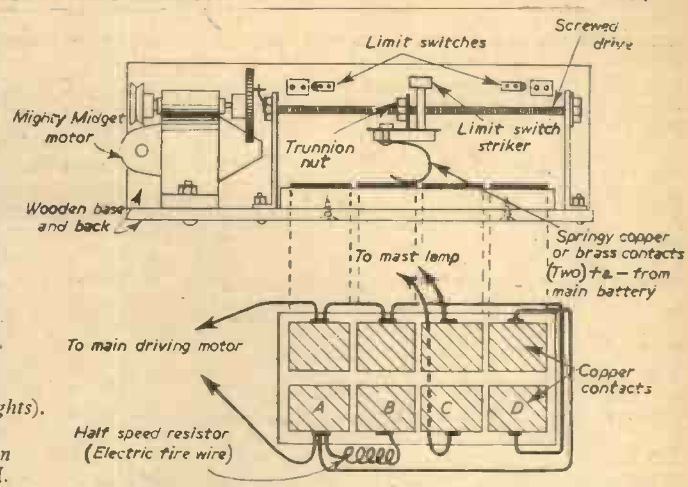
Fig. 6.—Complete wiring diagram of circuit to give proportional steering and reversible sequence engine speed control.

it should be set up so that the Pulse/No-pulse relay just holds in when an extreme ratio pulse is being transmitted (i.e., 80/20 or even 90/10 if you can make the receiver slave relay follow this ratio). This will ensure that the changeover time between Pulse and No-pulse conditions is as short as possible and that the steering is therefore affected as little as possible when an engine speed change signal is sent. There is a tendency for the steering motor to run during the drop out time of the second relay.

The Engine Change Speed Switch Unit

Figs. 8 and 9 show this unit, which is driven by the ubiquitous "Mighty Midget" motor. A pin driven into the large gear wheel engages with a crank soldered to a nut which is locked on to the end of a length of screwed rodding. The drive is thereby transmitted to a nut secured to a flange on the top of the travelling contact assembly. According to the direction of the motor, the contact assembly will be driven up or down the length of the screwed rod. A pair of limit switches governs the extent of its travel, so preventing the jamming of the moving parts against the end bearings.

The two moving contacts, which are made from springy copper or brass, bear down on to a copper track and these carry current from the main battery by means of flexible connections. The track on the original was made from two strips of soft copper, 33 s.w.g. thick and cut the full length of the track; they were tacked down on to a plywood base, using brass brads. The individual sections were cut afterwards by sawing across both halves with a fine-toothed saw. As many positions as desired can be cut and a later version of this unit had short strips interposed between each engine speed section, wired so as to ring an engine room telegraph bell. The four sections illustrated will, however, give very good control and the off or stop position is wired so that the current passes to a mast head lamp, thus indicating when the motor has stopped even though the model is still under way. Note the use of a piece of electric fire spiral to reduce current to the driving motor in the half-speed position. The length of wire required must again be determined experimentally so as to give the correct low speed ; the motor used will have a big effect upon the length required. If the driving motor used is of the energised-field type the field must be connected directly to the battery and not through the switch, otherwise it will not be possible to reverse. With this arrangement the field will be energised even when the motor is stopped and this can be overcome by bringing in a relay energised from the mast lamp circuit which opens the field circuit in the motor "Stop" position.



A.—Full speed ahead.
B.—Half speed ahead.
C.—Stop (mast lamplights).
D.—Full speed astern.
N.B.—The wiring shown is suitable for a P.M. driving motor.

Fig. 8.—Reversible sequence engine change speed switch.

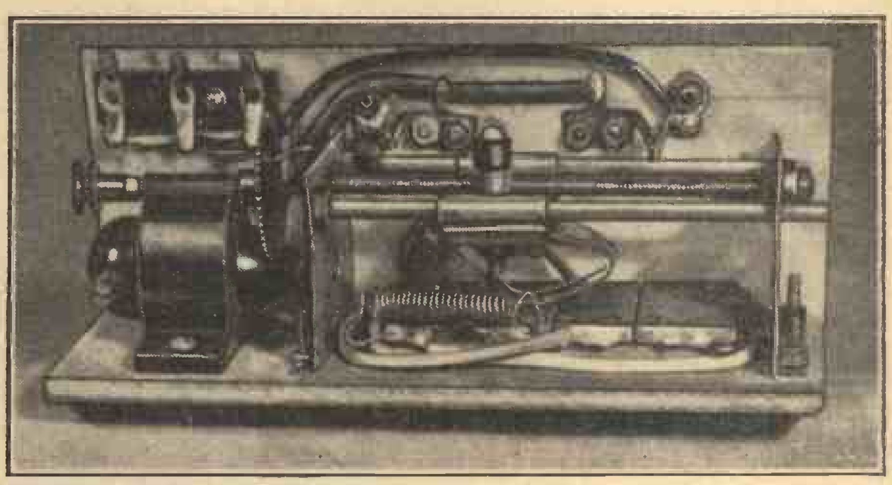


Fig. 9.—A reversible sequence engine speed control switch for electrically driven boats. For the photograph the two flexible leads, connecting to the two moving contacts, have been removed. These leads bring in power from the main driving battery and distribute it according to the position of the travelling contact unit.

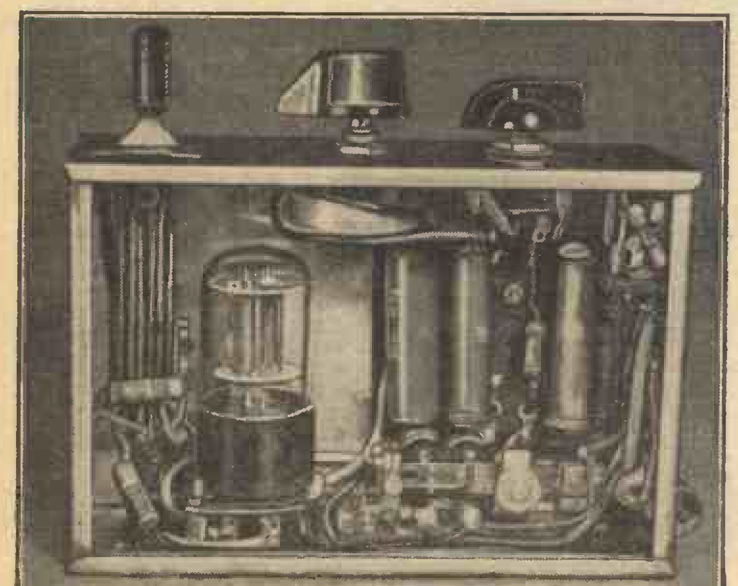


Fig. 11.—The writer's multivibrator (Mark/Space) control box. The key switch at the front is used to increase speed when pushed forward and to reduce speed (and reverse) when pushed back. It is normally in the position shown when the box generates Mark/Space pulses in the ratio determined by the centre (steering) knob. The switch knob (right) is an experimental control and gives 80/20, 50/50 and 20/80 in its three positions.

The Control Box

No mention has been made so far of a control box for this system, but obviously an adaptation of the pulse-drum type previously described will serve. Only one pulse frequency is required, but as the Mark/Space ratio has to be altered to steer, arrangements should be made to control the movable brass

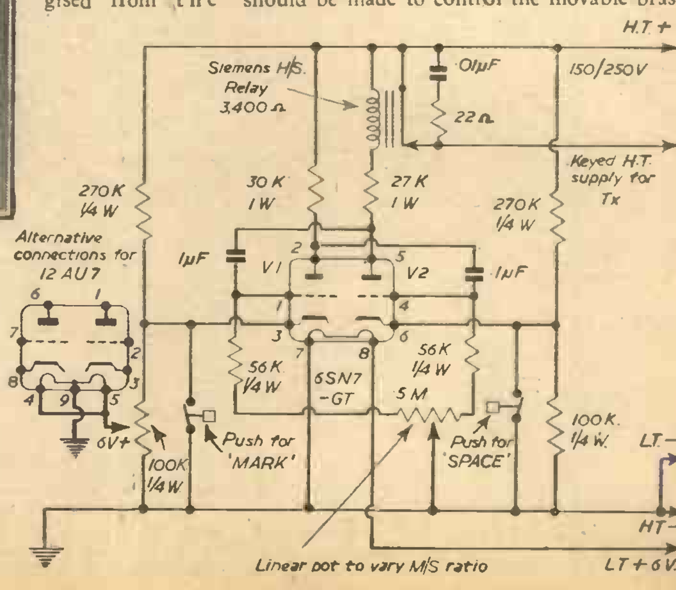


Fig. 10 (Right).—Multivibrator circuit to provide variable Mark/Space ratio.

contact arm, which bears on the pulse drum, by means of a knob on the outside of the box. Full mark and space are no longer steering controls as before and the switch (or switches) used to provide these signals should be labelled "Reduce Speed" and "Increase Speed" (respectively).

A point about this system is that if by any chance a fault develops and the model goes out of control the pulsing will stop and the equivalent of a space will be sent. This means that the model will steer on the last course given and the engine speed switch will move to the "Full Speed Ahead" position. (It should be arranged so that "Full Speed Ahead" is given on receipt of a Space and not a Mark.) The model will therefore keep going until it reaches the side of the pond (unless it so happens that the last course was one of extreme rudder), which is a lot better than a series of tight circles which is the usual result of a Mark/Space boat going out of control.

A Multivibrator Control Box

An alternative type of control box can be made up using the simple multivibrator circuit in Figs. 10 and 11. This circuit has been used by the writer for some time now and it is recommended as being entirely trouble free and 100 per cent. effective. The original used a 6SN7-GT valve (a double triode), which requires a rather heavy heater current, and later versions used 12AU7 valves, which are more economical and also more compact. Even so the current for the heater in particular limits the circuit to the operation of transmitters fed from an accumulator supply. There is, however, no reason why a battery valve version (using a 3A5) should not function well providing that the Mark and Space controls are incorporated after the relay as there are, of course, no cathode connections in a battery valve.

It will be seen that the normal multivibrator circuit is used, in which each valve (half of the 6SN7) is cut off alternatively and the keying relay, in the anode of one valve, is therefore pulsed in unison. The pulse frequency is controlled mainly by the grid condenser/grid leak time constant of each half and the pulse frequency is therefore controllable by increasing or reducing the value of the grid condensers. The Mark/Space ratio is varied very smoothly by the linear potentiometer in the grid leak circuits. The two fixed grid resistors govern the extreme ratios which can be obtained and these are the only components which may need adjusting to obtain best results. A knob on the potentiometer controls the Mark/Space ratio and is thus the steering control for the model.

"Mark" and "Space" are obtained by opening either of the two cathode circuits. This has the effect of elevating the cathode to a potential of about 50 volts and the valve is therefore cut-off. With V.1 cut off a Mark is sent and with V.2 a Space.

Gradual Closing for your RADIOGRAM LID

A Novel Use for a Bicycle Pump

By J. A. BROOKS

A NUMBER of modern commercial radiogram cabinets have a useful fitment on the lid which enables it to close gently "under its own power." Details are given here of an easily-constructed unit, the basis of which is a metal bicycle pump.

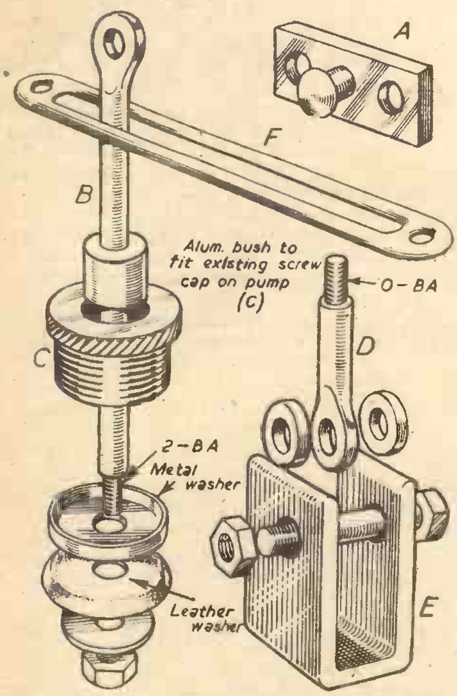


Fig. 2.—The various parts required shown in perspective.

Measurements are not given as these will depend upon the type of cabinet to be adapted.

It will be noted that the layout, Fig. 1, shows the unit fitted to the side of the cabinet but it could, of course, be fitted in a central position. This would probably be the better place in order to avoid any strain on the lid, but was not possible in the writer's case.

The operation of the unit is quite simple. The weight of the lid compresses the air in the tube and the rate of leakage controls the speed at which the lid will close. It was not found necessary to provide any outlet at the base of the tube since there was sufficient leakage through the thread of pivot D.

Bracket A was taken from the original stay fitted to the cabinet. Rod B is a length of ¼in. diameter aluminium flattened at one end and drilled to fit on to the pivot on bracket A. The opposite end was turned down and threaded to take a 2BA nut. On this was fitted the original leather washer, etc.

An aluminium plug was made to make a tight fit in the centre hole of the threaded bush (part C) on the pump and this was then drilled ¼in. clearance to take the rod.

Pivot D was made from ¼in. diameter aluminium rod, threaded 0 BA at one end and flattened and drilled at the other end. The latter end pivots on a spindle fitted into bracket E.

A slot has to be cut in the cabinet facia board to accommodate the movement of the rod B. This proved fairly simple in the writer's case and was accomplished with a fretsaw. A finishing touch is the plate F, which can be cut from aluminium sheet. This part is, however, not essential if the slot is cut in the wood and finished off neatly.

Only parts A, B and F are visible when all is completed and these could, if preferred, be made from brass and then plated.

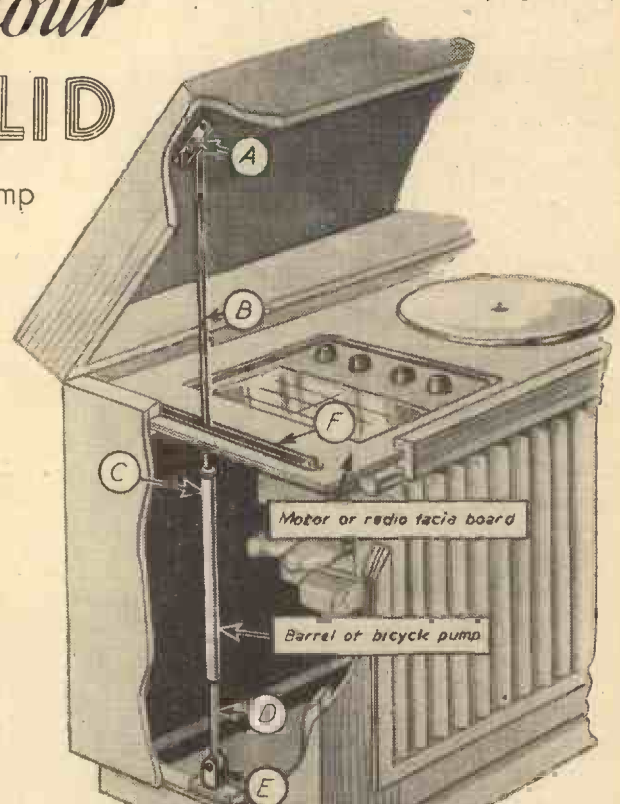


Fig. 1.—The device assembled in a radiogram.

It should be noted that the lid must be allowed to open fully, until it is almost on its point of balance, where it will remain when required; a gentle push being all that is necesary to start it on its travel.

This should prove to be a worthwhile attachment where small children are concerned since a falling lid could be disastrous to a child's hand.

A Sailing Model of the Golden Hind

By E. W. TWINING

This Concluding Article Deals with the Masts, Spars and Rigging

THE fore and main masts only are stepped; the mizzen can be all in one piece and the fore and main topmasts can be single lengths. All masts, lower and upper, mizzen and bowsprit, should be tapered slightly as shown in Fig. 3 (last month's instalment). The diameters at the lower ends should be such that they look just right to accord with the size of the model. If the 24in. model is being made, the diameter of the main mast at the foot should be 5/16in. full, or 11/32in. tapering to a full ¼in. The foremast can be 5/16in. tapering to ¼in. and the mizzen 5/16in. base, tapering to ⅛in. The main topmast should be ¼in. tapering to ⅛in., and the foretopmast, these figures base. The bowsprit should have a diameter at the butt of ¼in. full, and be reduced to ⅛in. at the outer end. The taper should be more rapid towards the end so that it is not uniform but results in a curve. This applies to all the yards, also; the taper commencing at their centres and curving towards the ends, where they are shaped as shown in Fig. 12.

The stepping of the fore and main masts cannot be done until the tops are on (these are sometimes known as "fighting tops") together with their supporting brackets. These brackets are cut from thin plywood, about 3mm., pinned and cemented to the masts.

The tops are best turned in the lathe from pieces of hard boxwood. They are shown in Fig. 3 and from this drawing their dimensions can be scaled. The form, in cross section, can be seen in Fig. 9. Note that the foretop is smaller than the main.

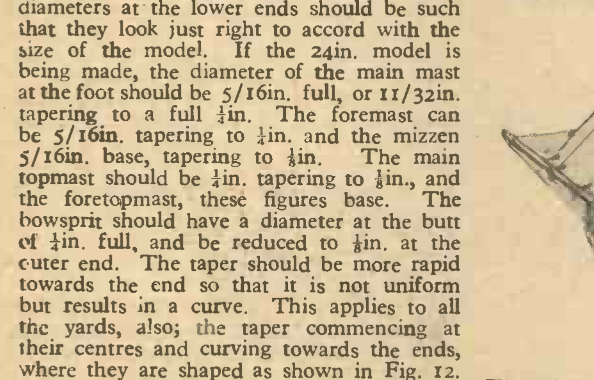


Fig. 8.—Details of chain plates and channels.

After turning, a row of holes must be drilled and filed square and a large square opening must be cut in the centre for the shroud connections to pass through. The tops must be well cemented to the brackets with Durofix.

Stepping the Topmasts

This is done, first by inserting two tiny pieces of wood between the upper end of the lower mast, and the lower end of the upper mast and then putting two lashings of fine tinned iron wire around the two masts, as shown in Fig. 9. About six or seven turns are applied in each lashing, which are then soldered all over: to tighten it the lashing is indented on each side.

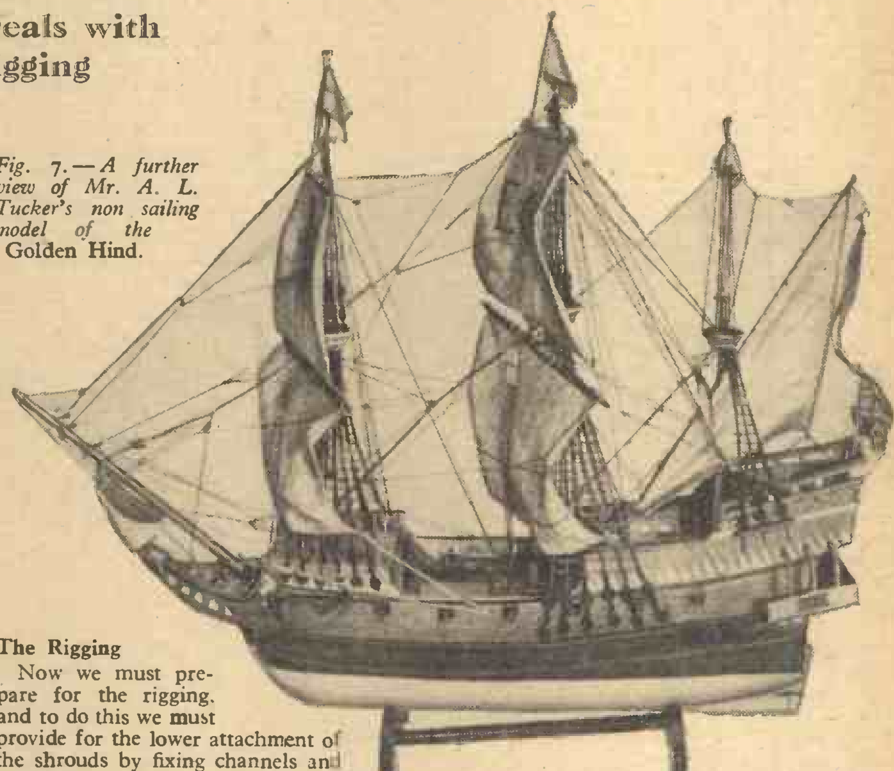


Fig. 7.—A further view of Mr. A. L. Tucker's non sailing model of the Golden Hind.

The Rigging

Now we must prepare for the rigging, and to do this we must provide for the lower attachment of the shrouds by fixing channels and chainplates in the hull. Just why the first named were called channels I do not know; they were flat boards projecting from the sides of the ship and from near the outer edges of these platforms, the shrouds were taken by means of pairs of deadeyes. Each shroud was made off on an upper deadeye, whilst the lower one of each pair had a link passing through the board and this, by the chains, was attached to the chainplates. The deadeyes were connected by a rope or cord which passed up and down through three holes in each deadeye, so the shroud could be lengthened or shortened by letting out or taking up the cord.

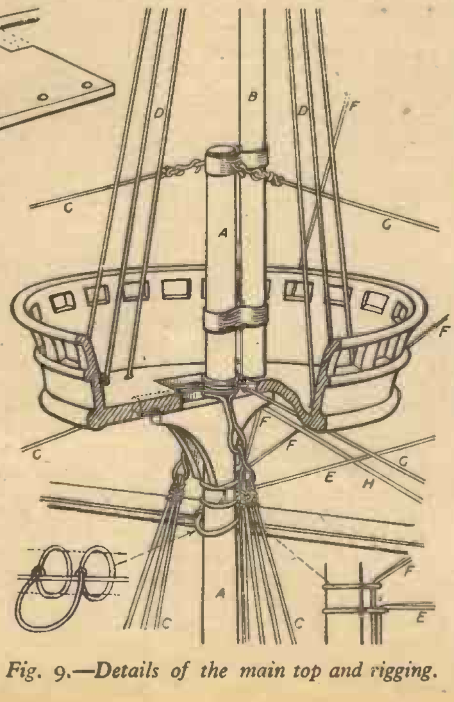


Fig. 9.—Details of the main top and rigging.

In this model the channels will be cut out in plywood and inserted with Durofix through slots cut as shown in Fig. 8. The letters Y and Z refer to the points in the waterline hull planks, and are only introduced to show the levels at which the channels are to be fixed. To represent the chains and plates fine copper wire will be brought down from the deadeye through the channel under a brass pin, such as an escutcheon pin, crossed over, around a second pin, again crossed and under a third pin, where the wire ends may meet and be soldered.

The sketch on the right of Fig. 8 represents the foremast and main channels, that on the left being the mizzen only. So it will be seen that, altogether, there will be 44 deadeyes required. These may be bought or they can be turned in boxwood, bone or celluloid. In each of the four channels, main and fore, there is a hole shown abaft the deadeyes, these are to take the topmast backstays which are shown in Fig. 3.

Turning again to Fig. 9: A is the lower mast; B the topmast; C.C. the lower shrouds; D the topmast shrouds; E the fore lower yard braces; F.F. the topsail yard braces; G.G. the main lower yard lifts and H the main forestay. This stay is taken to the foot of the foremast and set up in the manner shown in Fig. 10, where the stay is lettered J. Actually, since the drawing represents the foot of the mainmast, this stay is the one leading to the mizzen. The method of dealing with the forbraces E and F, is also shown in Fig. 10. The lower yard braces are, for geometrical reasons, variable in length as the yard is swung around and so I have allowed for this variation in apparent length by inserting a very small elastic band at C. These bands are normally about ¾in. long. It must be understood that in all cases in this model both braces and sheets, except the sheet of the lateen sail, are continuous from yardarm to yardarm or in the case of the sheets, from clue to clue of the sail and the slewing of the yards and sails is done merely by pulling on the braces and sheets, making them slip through the eyes or copper wire hooks, as the case may be. Fig. 10 shows the lower adjustable parts of E and F, and the upper parts of them are shown in a little sketch in the lower right-hand corner of Fig. 9.

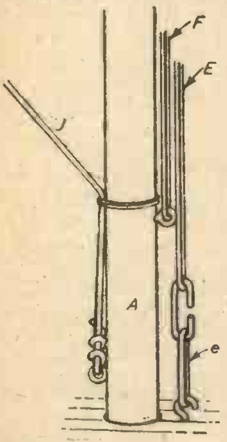


Fig. 10.—The main mast at the deck.

All the lower shrouds C, on each side, are brought together and made off on a common wire hook, which engages with a copper wire loop around the lower mast head. Thus to dismantle the model for transport all the shrouds can be unhooked. So, too, can all "ropes," that is to say, braces, sheets and other points in the rigging be disconnected at one end or the other, but I have not thought it necessary to remove yards from the masts, though it would not be a difficult matter to do so.

Fig. 11 shows the working of the main yard braces and the mainsail sheets on the poop. Here the braces have the same tensioning arrangement as the foreyard braces, shown in Fig. 10, namely, a rubber band. The sheets do not need any such tensioning, indeed, it is, of course, not possible to put it on since the clue of the sail is loose. When the sail is under wind pressure the friction in the holes on the bulwarks will hold the cord. Here, in Fig. 11 the braces are lettered B, S are the sheets. The lateen sail sheet is also S; it is single and terminates in a deep hook, which can swing, when the ship goes about, across to the other side, on a horse which is a piece of brass wire having ends cemented in holes in the bulwarks.

The Sails

Fig. 12 shows a portion of one of the sails, the yard lifts G.G., the mast A; the brace B; and the sheet S attached to the clue of the sail. All of these will be obvious except perhaps the method of attaching the sail to the yard. The sail is rectangular, is hemmed all round, and has a cord enclosed in the hem. What is not quite obvious, is that, at the top, the hem is just a little deeper than it is everywhere else. Where the inner yard lifts come, there is an eye formed in the wire around the yard, to which the lift is attached, and to avoid this loop there is a notch cut in the sail. There is another eye in another ring of wire around the yardarm outside of the sail; there are, therefore, four eyes throughout the length of the yard. These eyes are to take a steel wire which, being threaded through the top hem in the fabric and through all the eyes, will hold the sail up to the yard. The ends of the wire can be bent slightly downward and, if it is not too straight in its length, will put enough friction in the eyes to hold it in its place; at the same time it renders the sail easily detachable from the yard for washing or mending.

It may be noticed that in Fig. 3 were drawn dotted lines across the main and fore lower sails at points about one quarter of their depth from the bottom; these are intended to represent lines of stitching and the stitching represents the lacing on of an extra strip of sail. In the 16th century the reefing of sails by means of reef points had not yet been invented and in vessels of comparatively small tonnage a single band of additional sail was attached to the foot of each lower sail by lacing on through eyelets. This extra was called a "bonnet." In vessels of big tonnage another strip was laced to the bonnet and this was known as a "drabbler." When it became necessary to shorten sail the drabbler was first unlaced and if a further reduction later became expedient the bonnet was also removed. The *Golden Hind* would, in all probability, be fitted with bonnets only and no drabblers.

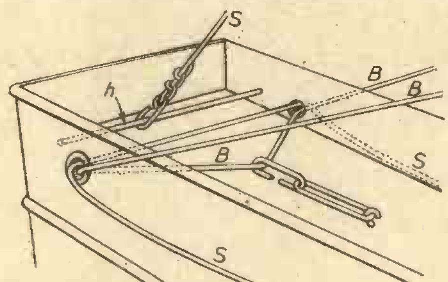


Fig. 11.—Rigging on the poop.

Although I have drawn single dotted lines I think that if the largest model is made it would appear a more realistic job if an extra piece of sail were stitched on and both fabrics hemmed at the join. The whole sail can still be completely hemmed around the edge and the cord enclosed in the hem.

Painting

I think it highly improbable that any records are in existence as regards the colours in which Drake painted his ship. Quite possibly she was redecorated more than once, but I do not think that everyone who makes a miniature of the vessel from my drawings should paint his model the same as every other so made, so that all representations of the *Golden Hind* shall be alike; for colours will form an important means of identification.

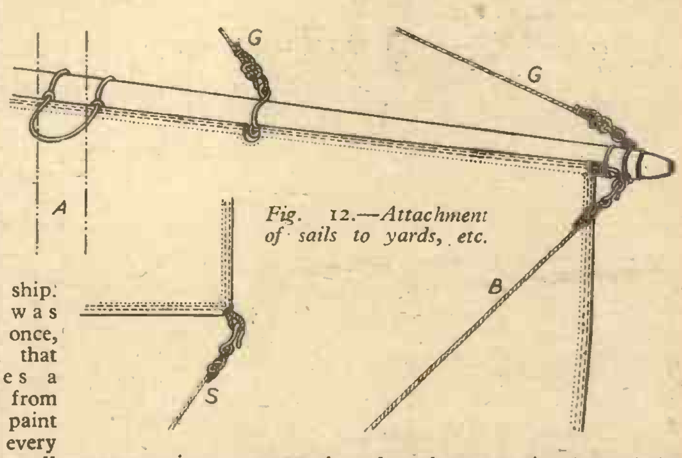


Fig. 12.—Attachment of sails to yards, etc.

First, the bare wood must be prepared to receive the paint. This preparation can be the same as I gave in the case of the paddle steamer (November, 1954, to January, 1955, issues), which was: three successive coats of shellac lacquer rubbed down between each with No. 0 glasspaper. Then give it, all over, except the deck, a coat of lead colour priming of which the base is white lead. You could use a tube of Artists' Flake White oil colour, which is pure white lead. Force the drying of this with a little Japan gold size.

The broad strake running along above the load water line should be painted black; below this, right down to the keel is white. The main colour above the strake is "Raw Umber" brown. This should be carried up to the beading above the windows which are outlined with gold; use either gold paint or gold leaf, preferably the latter.

The bead above the windows and the uppermost bead are gold and white; the white being laid in diagonal stripes across the gold. Between the two beads the deep space of the bulwarks should be painted "emerald green." At the forecastle only the upper bead of the bulwark should be gold and white and the panel below this is of emerald green. The bead below this panel, being a continuation of the one aft below the windows must be brown.

These are the only colours to be used unless any shields of armorial bearings are added on the poop bulwarks, but I do not know what arms could be shown nor do I think it likely that Drake would show any and therefore I should omit them. The larger man-carrying navy week model, to which I have referred and which was shown last month in Fig. 6, carried no shields of arms. The colours: green and white, may be used to decorate some parts of the fighting tops on the masts, but all the masts and spars will be the same umber-brown as the hull.

In the reigns of the Tudors, green and white were the principal colours used in decorating ships, with some addition of gold on relief and carved work, especially ships of the navy and others on Royal Commissions.

Both of the lower sails, the main and the fore, should have large, plain crosses painted on their forward sides in vermilion, and the flag, which I have drawn in Fig. 3 at the main mast head, will have the same red cross, which is, of course, the cross of Saint George. These crosses must be painted with vermilion oil colour, but, before painting, the fabric must first be prepared so as to prevent the colour from creeping beyond the outline of the cross and spreading into the weave of the fabric. A stiff starch solution or a coat of celluloid lacquer, applied to the middle of each sail and to the flag, will enable a clean, sharp outline to be obtained to each cross.

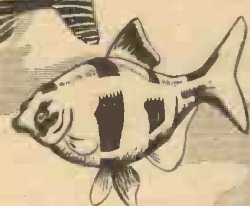
Installing a TROPICAL AQUARIUM

What to Buy and How the Aquarium is Installed

By I. W. BRASSINGTON

A TROPICAL aquarium forms a most fascinating yet restful focal point for the lounge, hall or study of any home. The whole set-up need cost under £11 and the materials required, with their approximate cost, are listed at the foot of this column.

(*Left*).—*A Zebra Danio.*



(*Right*).—*A Tiger Barb.*

There are many types of thermostat, but I have found that the semi-submerged type, with adjusting screw above water level, is reliable and cheap. A spirit-filled thermometer with rubber sucker is quite satisfactory, while the compost is a fairly coarse (about ⅛in.) gravel. The lighting shade needs to have a lampholder at each end to hold two 60w. bulbs, which should be used for about six to eight hours daily.

Fig. 1.—*How the gravel should shelve from front to back.*

MATERIALS	£	s.	d.
Tank. (Size 24in. x 15in. x 12in.)	3	0	0
Two-tier Stand	2	10	0
Thermostat		15	0
Heater. (100w.)		10	0
Thermometer		4	0
30lb. Compost		12	0
Plants		15	0
Fish	1	5	0
Electric Light Shade		15	0

All these should be available from your local aquatic dealer.

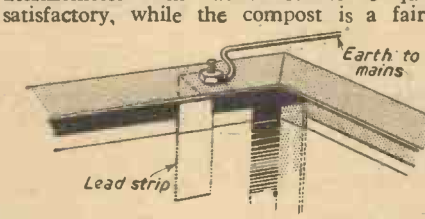


Fig. 2.—*The earth connection with lead strip suspended in water.*

(*Left*).—*A Guppy.*

(*Right*).—*A Neon Tetra.*

Fish and Plants

Probably the best type of aquarium for a beginner is the "community" tank which contains fish of different species that will live amicably with each other. Here is a list of these from which to choose:—Guppies, Neon Tetras, Platys, Zebras, Swordtails, Black Widows, Mollies, Harlequins, Penguins, Beacons and Tiger Barbs. The artist's sketches below illustrate these.

Most of the above grow in between 1in. taken into consideration when stocking the tank. The usual mistake is to overcrowd, and this is most unwise. A good rule is to allow 20 sq. in. of water surface to 1in. of fish. So that with a 24in. x 12in. surface area (288 sq. in.) we have a safety margin of just under 15in. of fish. Allowing for the fish to grow, it would be sensible to start with, say, five pairs from the above list.

Choice of plants should be restricted to about three varieties only. Here is a list: Group 1 (for background effect) Vallisneria spiralis. Group 2 (for foreground clumps) Vallisneria spiralis torta, Ambulia, Hygrophylla, Miriaphyllum. Group 3 (for centrepiece) Indian Fern, Cryptocoryne.

There are several reputable firms in the trade only too willing to supply their catalogues for your information.

You will need four dozen Vallisneria, perhaps three or four of one variety from Group 2, and one plant from Group 3.

Fig. 3.—*Lead weight and correct planting depth.*

Setting Up the Tank

Give the tank a good wash to get rid of dust and put it on the stand in its final position. You will be unable to move it later as it will weigh something over 200lb. Now put in the gravel, having first scoured this several times with boiling water to remove the great quantity of dust which it contains and also to sterilise it. Bank the gravel up to the rear of the tank as illustrated in Fig. 1, but do not allow pockets or depressions where food may collect and putrefy unnoticed.

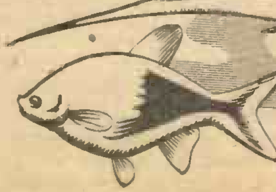
Next, three-quarters fill the tank with clean tap water and put in two or three suitable rocks to enhance the under-water

(*Left*).—*A Platy.*

(*Right*). — *A Black Widow.*

(*Left*).—*A Black Mollie.*

(*Right*).—*A Swordtail.*



(*Left*).—*A Harlequin.*

picture. Do not use limestone or other calcareous rocks. It is surprising what a pleasing scene can be made by using well washed coal, and it is a modern theory that coal helps to keep the water crystal-clear. As with a garden rockery, strive towards a natural setting when placing the rocks.

When this is to your liking the next job is the heating and lighting. Fig. 4 will help you to follow the circuit. For the heater connect as follows: Live to thermostat (B), which is clipped in the back upper corner. Thermostat to heater (A), lying on top of the gravel along the back. Negative from heater back to mains. Earth to some point on the frame. A good plan is to drill the top of the tank for a nut and bolt, holding a strip of sheet lead, and join the Earth lead to the nut and bolt. See Fig. 2.

For the lights connect Live to a switch. Switch to lampholders. Negative from lampholders back to mains.

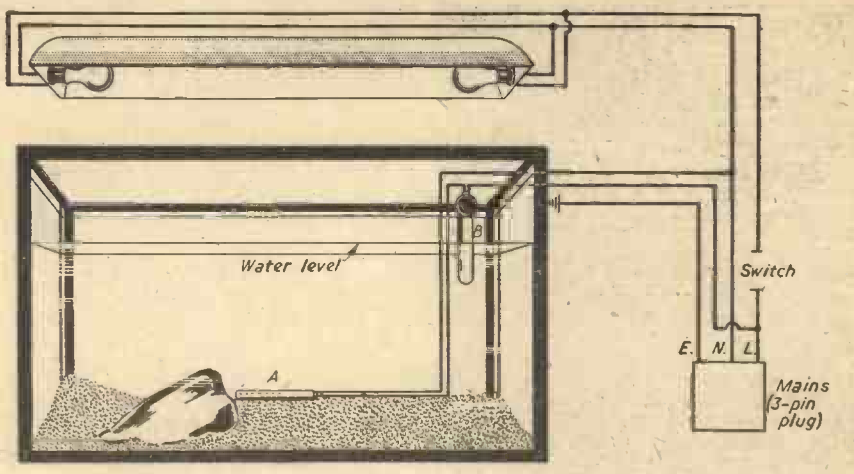


Fig. 4.—The wiring diagram: A—heater, B—thermostat.

Fit the thermometer by its sucker, about halfway down the inner surface of the front of the tank, on the same side as the thermostat.

When complete, switch on and allow the heater to bring the temperature up to 74 degrees, and the thermostat should now be set to switch off at this temperature. Make sure that there is sufficient water in the tank to cover most of the thermostat. Watch the temperature variation for a couple of days and you should find the heater coming on at about 70 and off at 74 degrees.

The plants may now be introduced. Trim the roots back to half an inch and cut off dead leaves with a sharp knife, and do not plant deeply. Before starting, cut a piece of sheet lead into little strips about 1in. long and ½in. wide, to form a little weight for each plant. Bend one of these around one of the runners usually found at the base of the plant; see Fig. 3. Again, do not plant below the crown. When the plants are in place the aquarium must stand for a week in order to settle down before the fish are put in. Now top-up with lukewarm water and put a sheet of glass on top to prevent evaporation.

If you can fetch the fish yourself it is far better than sending for them by rail. A large glass jar with screw top should be put inside a box or bag which will allow insulating material (paper or straw, etc.) to be put around the jar to keep in the warmth.

On returning home with your prize float jar and fish in your aquarium for 24 hours. This ensures an identical temperature when the fish are released and also acts as a quarantine period during which you may spot any signs of illness.

Two Rules

1. Do *not* change the water, merely top up, when necessary.
2. Do *not* overfeed. Give only what the fish will finish within five minutes, and this not more than twice a day.

A Pebble-dash Cigarette Box

A Novel Design which is Easy and Cheap to Construct

By GORDON ALLEN

THE principal requirements are a sheet of faced ply, 20in. square, four 1in. x ¾in. brass hinges, a packet of tiny coloured pebbles as used in home aquariums,

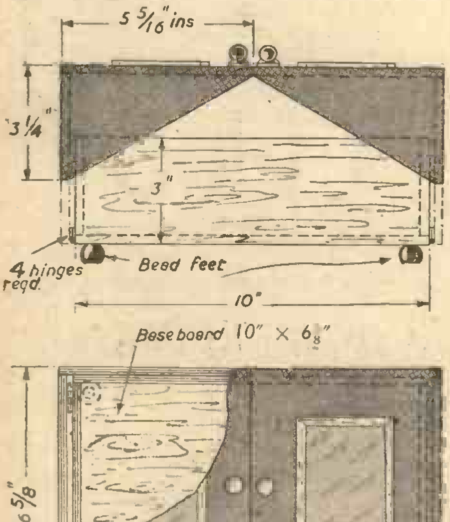


Fig. 1.—Constructional details and dimensions.

and oddments such as wooden beads and thin strip wood.

Using the dimensions shown in Fig. 1, the various components comprising the main structures of the box and lid are cut out from the ¼in. ply and are sanded true and square. The sides and ends of the box itself are fixed along the edges of the baseboard with woodworker's Scotch glue, which should be used sparingly. Butt joints are used throughout, but great care should be taken to see that the whole assembly is dead square.

The two swinging sides of the lid are assembled in the same way—by gluing the ends and sides to the top boards.

At this stage the framing of the photographs can be carried out. The box is designed to take a 3¼in. x 2¼in. contact print on each half-lid, but any similar size photograph can be used. Each is fixed centrally on the lid, using photo mounting paste or thin gum. They are then framed neatly with pieces of very thin strip wood (approximately ⅛in. wide and 1/16in. thick) which are mitred at the corners and glued in place on the lids. These are later colour enamelled. Alternatively, the framing can be covered with veneer and polished. If desired the photographs can be protected by inserting a piece of clear celluloid underneath the framing.

The knobs on the lid can either be bought or they can be fashioned from ½in. dia. dowel screwed in place and enamelled.

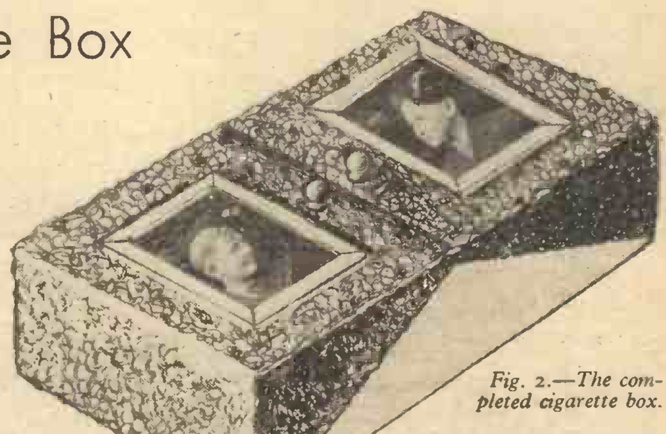


Fig. 2.—The completed cigarette box.

Following this the hinges are fitted in the positions indicated.

The pebble-dashing of the lids is accomplished in stages. A small area at a time is smeared with heated glue and immediately after a handful of pebbles is sprinkled over it. They are pressed level and when the glue is almost set the surplus pebbles are shaken off. Care is taken to see that no pebbles overhang the joint of the two halves of the lid.

To complete the box portion the bottom edges are rounded off and the whole is vigorously sand-papered. If the ply used has a pleasing facing it can be stained with at attractive wood dye and french polished. Alternatively, wood veneer can be fitted and polished. In any event, the *insides* of the box and lid are fitted with closely fitting pieces of marquetry veneer which are polished.

The feet of the box are wooden beads suitably enamelled and screwed in place.

Finally, the free leaves of the hinges already fitted to the lid are screwed to the box ends so that the lids fit snugly in the closed position.

Making a Blower Heater

Some Further Notes on the Type of Motor to Use and How to Make the Fan Blades. (Constructional Details Appeared in the November 1955 Issue)

By D. J. HARMER

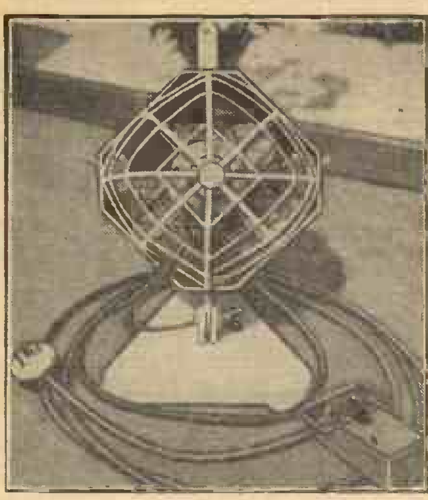


Fig. 1.—A rear view of the blower heater.

THE constructional article in the November issue contained but little information on the fan and motor unit. This was due to the fact that, when publication was well advanced, it was learnt that the suppliers had sold out their stock of fan units.

A suitable motor has now been found. It is an induction motor, shaded pole ; that is to say it has no brushes to cause radio or TV interference and therefore does not need a suppressor. The consumption is 7 watts, which equals approximately 1/100 h.p. and runs at 1,550 r.p.m. A brush motor is much too noisy in motion. Details for ordering the motor are British Thomson-Houston Motor, Type B.P.1304, Catalogue No. D.16647.

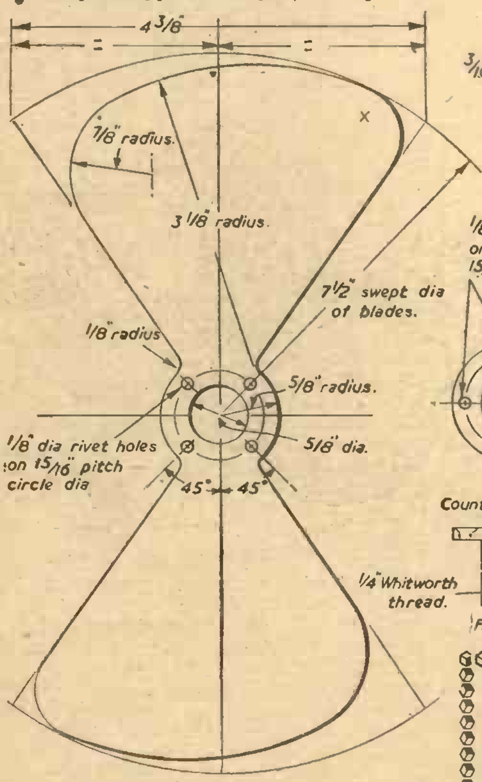


Fig. 3.—The fan blades (2 off). X = ½ in. rad.

The Fan

Make the propeller hub from brass or light alloy to the dimensions in Fig. 2 and cut two fan blades from 20-gauge sheet steel or light alloy. Make these very carefully to the drawing (Fig. 3), as any deviation from the line will put the propeller out of balance and will cause vibration and unnecessary wear on the motor bearings. Place the two blades over the hub round the correct way, that is, the large radius is the leading edge. The motor rotates anti-clockwise when looking at the front. Next, rivet them to the hub with ⅛ Ctsk. rivets, seeing that the centre line of each blade is at 90 deg. to the other. Twist the blades from as near the roots as possible, the leading edge turned towards the motor. The r.p.m. of the motor will not alter the consumption of the heater, neither will the amount of pitch of the blades. Only enough twist to the blades is required to move sufficient air to keep the elements at black heat.

Mounting Arms

There are three mounting arms made from ½in. × ⅛in. mild steel bar, instead of the four in the original unit, but Fig. 6 shows how this unit is fitted. The shape and dimensions for the two lower mounting arms are shown in Fig. 4 and those for the top mounting arm in Fig. 5.

The only alteration in the wiring is a small junction box fitted inside the lower rear part of the body. This is because the motor has no plug to use as a junction box. Fix the earth wire from the trailing lead from your power plug on to the body by means of ⅛in. Whitworth nuts, bolts and washers.

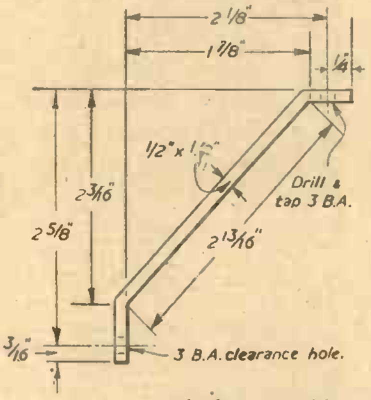
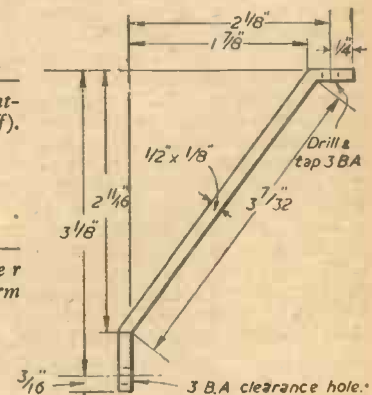


Fig. 4 (left).—The lower mounting arms (2 off).

Fig. 5 (right).—The upper mounting arm (1 off).



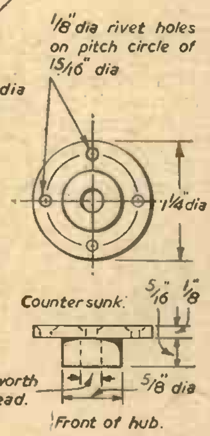


Fig. 2 (left).—The propeller hub.

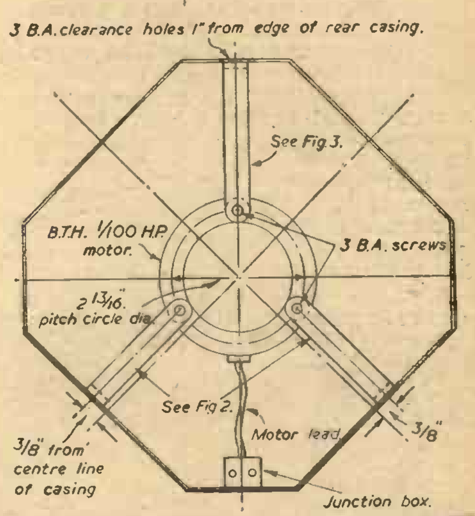


Fig. 6 (right).—How the arms are fitted.

MOPEDS &

A Review of the New

BRITAIN, which is still the greatest exporter of bicycles and motor cycles in the world, is this year starting to compete in a new field—that of the scooter and the moped. The moped is the logical development of the "clip on" motor and takes the form of a specially designed cycle with a built-in engine unit. Prices are in the £55 to £65 range, and the machines, with their modest performance, provide a safe, independent means of travel with the lowest possible cost.

The more powerful scooter has a higher performance and, with its completely covered-in construction, appeals strongly to business people. This market was previously monopolised completely by the Continental makers, but at the 1955 show there were shown several British models which will provide strong competition.

Fig. 3.—The new B.S.A. "Dandy."

New Hercules Moped

Designated the "Grey Wolf," this machine has a 49 c.c. two-stroke engine, bore 42 mm., stroke 35.5 mm. Designed on modern lines, it is an "over-square" engine. The separate gear box is bolted up to the engine to form one unit, and contains a multi-disc clutch and two-speed gear, operated by handlebar twistgrip and clutch lever combined. As will be seen from Fig. 1, the frame is built from taper-drawn "D" section tubes with the seat tube supported on pressings mounted upon the main members.

Other features include front fork suspension; Dunlop 23in. x 2in. tyres; internal expanding type brakes, the rear one being operated by back pedalling action. The fuel tank has 1¼ gal. capacity. A Miller flywheel magneto with lighting coils provides power for ignition, lighting and the electric horn. A speedometer is available as an optional extra.

The "Grey Wolf" has an average fuel consumption of 140-180 m.p.g., a normal max. speed of 33-35 m.p.h., and weighs 80lb. unladen. Price complete with accessories is £61 15s.

B.S.A. Scooters

B.S.A. are entering the scooter market with two entirely new British-designed models, the 198 c.c. "Beeza" (Fig. 2) and the 70 c.c. lightweight, the "Dandy 70" (Fig. 3). Below are given brief details:—

The "Beeza." 198 c.c. alpha-head (high-angle valve) four-stroke engine, shaft drive, electric and emergency starting, four-speed gearbox with heel and toe control, quickly detachable and interchangeable wheels, comfort ensured by pivoted suspension front and rear; tandem silencers; thief-proof steering lock, overall length 72in., overall height 37in., wheelbase 50in., ground clearance 4½in., saddle height 28½in., handlebar width 24in., weight 270lb., tyres 3.50 x 12in. Price £204 12s.

The "Dandy." 70 c.c. single-cylinder two-stroke engine, aluminium alloy engine throughout with hard-chrome bore, easy gear change, two-speed pre-selector with handlebar control, simple starting, hand or foot operated, pivoted rear suspension with enclosed driving chain, pressed steel frame and adequate weather protection, overall length 67in., overall height 33½in., wheelbase 45in., ground clearance 4½in., saddle height 28½in., handlebar width 24in., weight 85lb., tyres 20in. x 2½in. Price £74 8s.

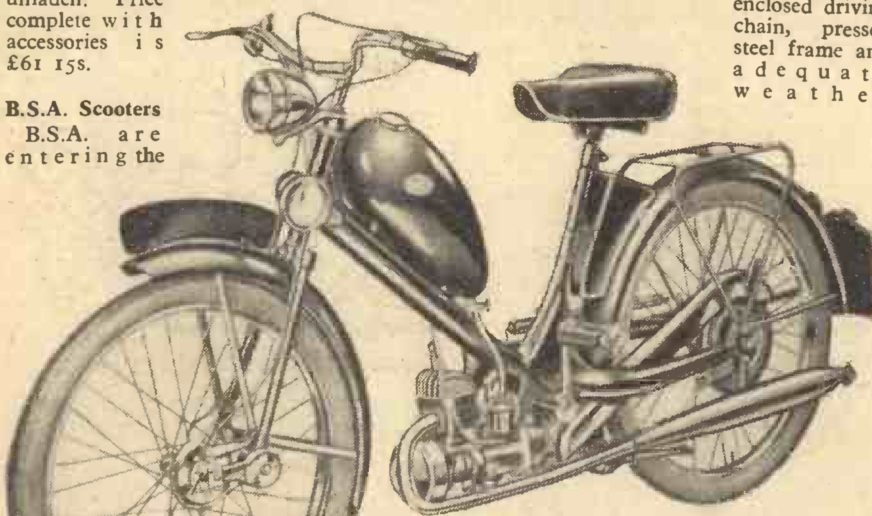


Fig. 1.—The "Grey Wolf," a new moped made by Hercules.

Production of the B.S.A. "Winged Wheel" continues as before.

New Mercury Industries Models

On the stand of Mercury Industries Ltd., Mercury Works, Dock Lane, Dudley, were shown for the first time the "Hermes" scooter (Fig. 4) and the "Mercette" moped (Fig. 5).

The "Hermes" is powered by a 49 c.c. single-cylinder two-stroke engine. Ignition is by flywheel magneto with 6-volt lighting, transmission is two-speed in unit construction. Rear drive is by chain ½in. by 3/16in. Forced draught cooling by integral fan is incorporated. Lubrication is by petroil.

Other features include a specially constructed frame, telescopic front suspension, totally enclosed engine and transmission, Dunlop 20in. x 2½in. balloon tyres, and 4in. fin-cooled internal expanding brakes. The controls are a twistgrip throttle control, twist grip gear change combined with clutch lever and foot operated rear brake. For lighting the machine is equipped with a chrome headlamp with ignition cut-out, double filament bulb, parking light, tail light incorporating reflector, combined dipper and horn switch. The price is £89 5s.

Fig. 2.—The new B.S.A. 198 c.c. "Beeza" moto

Fig. 4.—The "Hermes" scooter, by Mercury Industries, Ltd.

The outstanding feature of the "Mercette" moped is its four-stroke engine. It is a 48 c.c. overhead valve "square" and gives this moped a top speed of 37 m.p.h. and a petrol consumption of approximately 240 m.p.g. Some of the machine's main features are sump lubrication for the engine, 2in. Dunlop tyres, telescopic forks and 4in. internal expanding brakes, hand-operated. The controls are a twistgrip throttle control and combined gear change twistgrip and clutch lever. The complete machine as shown in Fig. 5, less pillion seat and footrests, costs £64 12s. 7d.

Fig. 5.–

Power Pak Moped

This machine, shown in Fig. 6, employs a specially built cycle-type frame of pressed-steel construction and is equipped with

SCOOTERS

Models at Earls Court

sprung front forks. It is powered by a newly designed 49 c.c. two-stroke Power Pak which drives the rear wheel by means of a positive locking roller drive. Special features include 26in. x $1\frac{3}{4}$in. wheels, internal expanding brakes, an over-$\frac{1}{2}$-gal. tank, a dash panel with built-in illuminated speedometer, ignition switch and illuminated switches for lights and traffic indicators. The equipment includes flywheel magneto generator, 4in. headlamp with standby battery, combined stop and tail lamp, front and rear winking traffic indicators, electric horn, ignition switch, tyre pump and pressure gauge, pannier bags, mud flap, rear wheel dress guards, rear carrier and licence holder. Some of this equipment is optional, but including all the fittings mentioned the price is £66 10s. 6d. Without optional extras the price is £56 12s. 6d.

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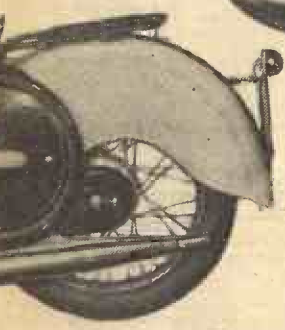


"Moped" by Phillips

Going into production early this year is the Phillips "Moped" shown in (Fig. 7.) This has a petrol consumption of over 180 m.p.g. and is to cost £68 15s. The main features are: unit construction, 49 c.c. two-stroke engine with stroke and bore 38.25 x 40.5 mm., coupled with 2-speed gear and multi-plate oil-bath clutch, chain drive direct to rear wheel. Whilst the machine is stationary the engine can be started by the pedals in neutral gear and driven away by using the handlebar controlled clutch. Twistgrip gear change, telescopic front fork, flywheel magneto ignition and electric lighting, complete with front and rear lamps; provision in front lamp for speedometer; internal expanding brakes (front and rear); large-size tyres. Tank capacity $\frac{7}{8}$ gallon, with reserve supply for emergencies, complete the machine's main features.

Fig. 7.—The Phillips 49 c.c. "Moped."

The Norman "Nippy"

Another new moped at the Show was the "Nippy," introduced by Norman Cycles Ltd. The main features of this machine were that it has a petrol consumption of 200 m.p.g. and can do 30 m.p.h. plus. The tank capacity is nine pints. Two hub brakes, the rear one worked by back-pedalling action, are included and the machine is powered by a two-speed Sachs engine. The frame is of pressed steel construction and a feature of this model is that it may be pedalled in both gears. The weight is 90lb. and a special carrying handle is fitted. The specification includes a 15-watt lighting set, electric horn, full width hubs and a flamboyant red finish. A speedometer can be supplied as an extra. The Norman "Nippy" costs £71 18s. 6d.

A Scooter by D.M.W.

This lightweight scooter, named the "Bambi," is of all-British construction and is powered by a fan-cooled 98 c.c. Villiers engine. There is a two-speed gear and the drive to the rear wheel is by enclosed chain. The headlight and horn work direct from the generator on the engine and a dry-battery supplies parking lights. The streamlined body completely encloses the engine and the front shield provides adequate weather protection. Fig. 8 is an artist's impression. The price is £99 4s.

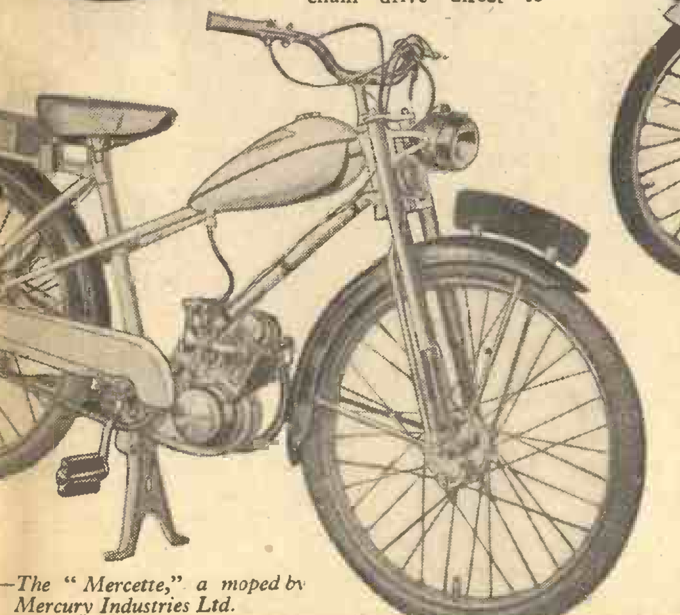
The Bown "50"

Introduced by the Aberdale Cycle Co. Ltd., Bridport Works, Edmonton, London, N.16, the Bown "50" employs a 47 c.c. Sachs engine. The two-speed gear box is controlled by a twistgrip on the handlebars. The brakes are 4in. internal expanding and the rear one is foot-operated. The frame incorporates a built-in petrol tank with a capacity of $9\frac{1}{2}$ pints and the forks are equipped with swinging link front wheel suspension. Dunlop 23in. x 2in. wheels and tyres are used. The 15-watt lighting equipment is operated from the magdyno and includes a 5in. diameter headlamp. The clutch and gear change control are sited on the handlebars. Equipment includes number plates, hooter, pump, complete set of tools, grease gun, rider's handbook and a built-in tool box. Petrol consumption is 200 m.p.g. and the price is £74 10s.

The Dayton "Albatross"

This large luxury all-British scooter has been reviewed before in this journal, but this year it has several improvements. The body has been re-designed to comprise four separate components instead of one and this is to improve the speed and ease of maintenance and to cheapen the cost of accidental body damage. All the control and brake cables have now been buried in specially contoured handlebars which have the brake and clutch levers built into the boss of each handgrip. More powerful than most scooters, the "Albatross" is ideal as a runabout as well as in its originally planned role of a comfortable long-distance tourer. It is powered by a Villiers 224 c.c. two-stroke engine and can cruise all day at 50 m.p.h. Top speed is over 65 m.p.h. and fuel consumption is 84 m.p.g. The price is £198 10s.

Fig. 6.—The 49 c.c. Power Pak moped.



—The "Mercette," a moped by Mercury Industries Ltd.

Fig. 8.—The all-British D.M.W. "Bambi."

The "Berini" Autocycle

Although called an autocycle by the makers, this machine (shown in Fig. 9) has a specification which corresponds to a moped. Designed in Holland, and manufactured in Britain by Cyclemaster Ltd., Tudor Works, Byfleet, Surrey, the "Berini" employs a 49 c.c. engine unit which is virtually a larger edition of the Cyclemaster. The engine is "over-square," i.e. the diameter of the piston (40mm) is greater than the length of stroke (38mm). The primary drive is through enclosed helical gears. The frame resembles the conventional cycle more than that of most of the mopeds, the main difference being the built-in petrol tank in the down-tube and the telescopic front forks. The brakes are of the hub type, the rear being operated by a back-pedalling action. Wheels and tyres are 25in. x 2in. The "Berini" costs £67 14s. 1d.

Fig. 9.—The Dutch-designed "Berini" autocycle.

Zundapp "Bella"

On the stand of Ambassador Motor Cycles, Ltd., Pontiac Works, Ascot, Berks, was shown the "Bella" scooter. Two models are available, one with a capacity of 150 c.c. and the other 200 c.c. The following features are common to both machines:

Single cylinder block type two-stroke Zundapp engine developing 10 h.p., electric starter, Bing double slide carburetter, 4-speed footshift, electrical neutral indicator, telescopic front fork, rear swinging arm suspension, valanced mudguards with legshields and dual seat.

Among optional accessories are listed a hood, windscreen, spare wheel, fittings, tyre and tube, wheel cover and pannier case. A sidecar is also available at £73 19s. The 150 c.c. "Bella" costs £194 13s. 7d. and the 200 c.c. model £204 12s. These models are imported from Germany.

The "Parilla"

Manufactured by Moto Parilla of Milan, this machine was shown by the concessionaires, Messrs. G. Nannucci, 58, Newman Street, London, W.1. The machine is totally enclosed as seen in Fig. 10, and costs £170 10s. A windscreen, extension and carrier are available as extras. Some of the chief points in the specification are given below:—

Single cylinder 2-stroke "over-square" engine, 153 c.c. Petrol-oil mixture is used for fuel and lubrication. The carburetter has a built-on air filter. For ignition and lighting a flywheel magneto with ignition through rectifier and coil is used. A 6-volt battery for parking lights is charged through the rectifier. A four-speed gear box in unit construction drives the rear wheel by chain transmission. Telescopic forks in the front and swinging arm with conventional shock absorbers in the rear comprise the suspension. The controls are: right handlebar twistgrip throttle with main switch, horn, cut-out and headlight control. Left-hand clutch. Foot-operated gear change and right footboard pedal for rear brake. Standard equipment includes electric horn and speedometer. A comprehensive tool set is housed underneath the dual saddle.

Excelsior-Heinkel Tourist

This scooter appeared on the stand of The Excelsior Motor Co. Ltd., Kings Road, Tyseley, Birmingham. A shortened specification is given below:—

Motor: o.h.v. single-cylinder four-stroke. Gear box and transmission in single unit with motor. Capacity 174 c.c. Cooling high speed air blower. Starting by 12v. 9w. combined dyno-starter Siba, with automatic ignition for starter boost.

Fig. 10.—The "Parilla," made by Moto Parilla, Milan.

Gear Box: Four-speed control by twist-grip. Wheel drive by oil bath chain.

Suspension: Front—double telescopic fork with central suspension. Rear—combined spring-leg, a coil-spring and oil damped hydraulic shock absorber.

Wheels: Easily interchangeable. Tyres 4.00 x 10in. on divided rims.

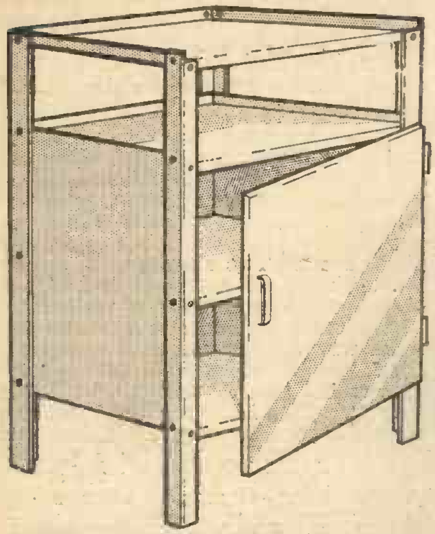
Tank: Capacity $2\frac{1}{4}$ gallons.

Brakes: Internal expanding. Hand brake to front, foot brake to rear.

Performance: Top speed (two up) 58 m.p.h. Petrol consumption—average at 40 m.p.h. cruising speed—120 m.p.g.

The price of the Excelsior-Heinkel is £247 10s. 7d. Optional extras are available.

In this review emphasis has been laid on the new models at the show and space shortage has precluded any mention of the many already well-known and established scooters and mopeds. In the scooter field probably the best known are the Vespa and Lambretta and in the field of mopeds, the N.S.U. "Quickly" is a very popular choice.



A Metal STORAGE CABINET

A Strong Cupboard to House the Workshop's Heavier Equipment

By TUBAL CAINE

To avoid a search every time a tool is required storage space should be designed with a view to allocating a particular place for each accessory or tool.

Equipment should be divided into different categories—all the spanners and wrenches in one cupboard, lathe tools, perhaps, on a shelf under the machine, chucks in a nearby cupboard, drills in a suitable rack, screwing tackle on a rack described in the last article of this series. For the hundred and one other gadgets which may be seldom used but find their way into the shop, a cupboard tucked into some odd corner will generally serve.

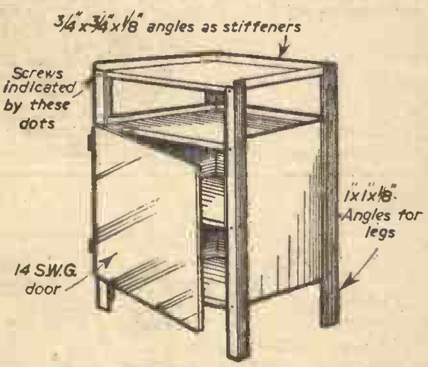


Fig. 1.—The general outline of this type of cabinet.

In many home workshops a collection of cupboards and relics of furniture perform valuable service, but occasionally a really well designed metal tool cabinet is an asset for the storage of heavy equipment.

The Design

The perspective sketch, Fig. 1, illustrates a cupboard of this type approximately 24in. x 18in. x 12in.; these suggested dimensions may be modified to suit the reader's own special conditions.

Due to lack of space in the small workshop and the unwieldiness of an object like a cupboard, it was decided to abandon the idea of rivets and to use instead dome-head screws with the usual washers under the nuts. These are obtainable very cheaply from most good-class ironmongers and are not worth making.

The angle pieces are cut from lengths of 1in. x 1in. x ⅛in.—the four chief members being the legs, which are 24in. long. Mark out the position of the screw holes as indicated in Fig. 1 and drill them No. 8 for the 2 B.A. screws. File off any burrs and step the front edges as shown in order to maintain a level platform on the cabinet top.

Cut the stiffening angles from slightly smaller material this time, say, ¾in. x ¾in. x ⅛in.—eight pieces 18in. long being necessary for the front and rear items and another eight lengths 12in. long for the side members.

Cut and drill these as shown in Fig. 2—remember if one is marked and drilled and then placed with another angle back to back it will then act as a jig and all the hole centres are a perfect match. A pair of simple "U" clamps exert enough pressure to hold the parts securely while this process is carried out, and the home-made variety is shown in Fig 3 with the angles already in place.

Panelling

The cutting of each side panel, the top and shelves require no comment on my part other than to say that 14 s.w.g. steel plate is just that little extra thicker than 16-gauge material and is less likely to bend when heavy objects are dropped on it. Do not, however, overdo this question of thick plate, otherwise the cabinet becomes awkward to handle when it becomes necessary to change the layout of the workshop.

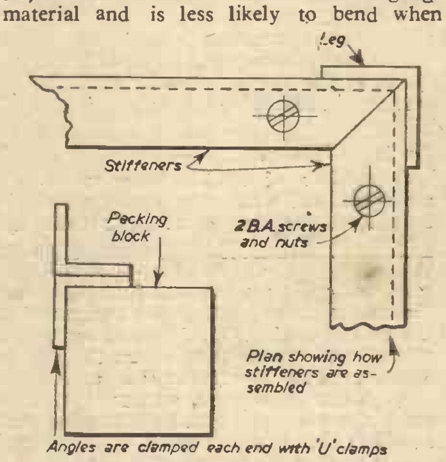


Fig. 2.—How the stiffening angles are drilled.

Drilling

Having removed all the sharp edges and corners, leave the drilling until you have roughly assembled the framework, i.e., do not insert all the screws where they are indicated on the arrangement ; and if the frame just holds together this is all that is necessary.

Now place the panels in position, and for this work you will undoubtedly find it more convenient to lay the framework on its side. Check to see that when it lays there all the uprights are square with each other as nothing looks worse than a lopsided article of this type. Mark the holes through those already drilled in the legs (readers who have an electric hand drill can pass this through straight away). Clamp the plates with simple "U" clamps in the manner indicated earlier to prevent a slight knock disturbing them if you attempt this latter method. In the marking process hand pressure on the plate is enough to hold it secure.

Do not merely drill and assemble the plates, but after drilling dismantle them and spend half an hour removing the burrs. Radius all the corners as this will make subsequent assembly much easier. While the plates are being drilled, before putting them aside until the cabinet is ready for final assembly lightly countersink the side where the drill breaks through and so skim off the usual sharp edge which occurs when that tool emerges.

Those who are relying on the marked article will notice that the plate stands away from the angles a little due to the presence of the screw heads, but this need not affect the work unduly. Scribe a circle where each hole is to eventually appear, very carefully centre-pop each one and then carry out the drilling in the prescribed manner.

You may find on assembly a slight discrepancy between the hole centres in the angles and in the plates may have appeared. To overcome this take a small round file and after ascertaining which hole is the offending member, elongate it a little until the screw assembles easily. The secret is to know which way to file, otherwise all your effort is for nothing and you must again

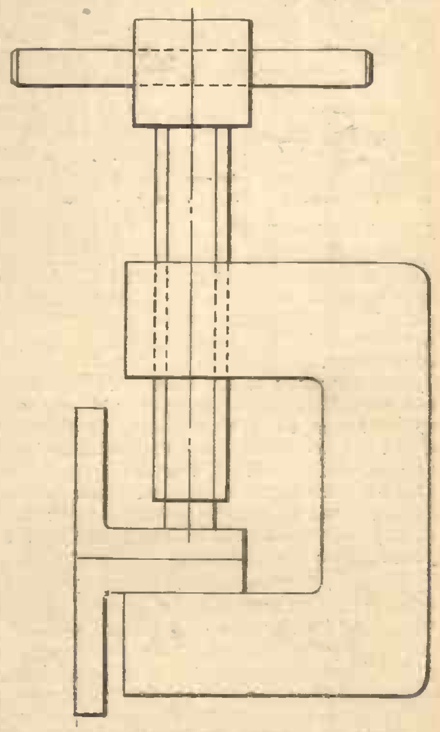


Fig. 3.—A home-made "U" clamp made up from small pieces of scrap material and used while drilling stiffeners

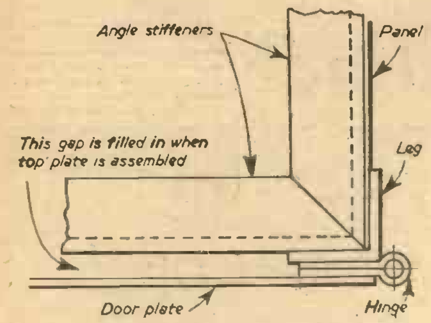


Fig. 4.—How the hinges are fixed.

file the "other way" to correct the plate.

You may encounter various assembled articles where the screws are pushed through elongated slots instead of the usual small hole which we are using and these automatically allow the fitter to assemble the parts without having to resort to filing. In plate and angle work of this type these slots are punched, but for thicker components each slot is milled separately.

The Door and Hinges

Using the same material as for the panels and the same method, cut out the door.

To save time and considerable labour, purchase a pair of hinges from the ironmonger—those about 2in. long are ideal, provided they are not too heavy. You will probably have to make some countersunk-headed screws—2B.A. for preference to suit the holes in these hinges, though I suggest that you make inquiries when buying the hinges whether these are available.

The turnbuckle type of latch is as effective as any and certainly simple to construct, but if a lock and key are considered essential then attach an eye through which a padlock can pass. For the class of cabinet in question this type of lock has the advantage of being cheap and easily replaced should it eventually break through constant use. Fig. 4 illustrates the door fixing.

Painting

Before commencing the final assembly it will be easier to paint the various details and this, of course, means you must now set the framework square once more if it has in any way moved during the latter operations. I prefer a dark green colour, personally—it contrasts well with the light walls of my shop, but any colour may be used to harmonise with the rest of the workshop. Paint the framework, shelves and panelling, and then let them all dry thoroughly for two or three days.

Assembly

When the parts are next ready for handling clean out all the paint from the holes and attach the remaining angles forming the structure. Tighten them up well.

Add the lower and top shelves as these will give greater rigidity to the assembly and, of course, take care to see that you do not cause any disturbance while performing this operation.

The two remaining members and the securing of the door will take very little time because only the latter requires fixing—the shelves in this case merely stand on the angles and are not bolted in the usual way.

Fixing the Door

Everyone has encountered a door which aggravatingly swings open instead of staying "pushed to," in a small workshop and one is continually walking into it, and such a situation could be dangerous.

This condition is generally avoidable if care is exercised when initially setting the door.

One hinge is temporarily clamped with the aid of two screws and the other slightly altered after trying one or two positions to find one where the door will swing gently to a closed position. Obviously the best place to try this setting is the site on which the cabinet is eventually to rest or, alternatively, a perfectly level floor if you anticipate moving it about at frequent intervals.

An Inner Drawer

A number of readers who are skilled engineers, and who have used similar cupboards for the storage of their tools and equipment, will have found the addition of an inner drawer extremely useful because they can stow delicate instruments such as verniers, micrometers and boxes of slip gauges where heavy tools cannot fall on them.

I prefer a wooden drawer, and if you can obtain the plywood, say, $\frac{3}{8}$in. thick, then add this under the top stiffener. Line it with green baize in the same way as small cases are finished, and include two or three partitions to prevent the equipment from sliding about. Two runners made up from $\frac{1}{4}$in. thick material as shown in Fig. 5 are secured to the steel shelf by countersunk screws, and two pieces of the smaller angle which was used for the cross members of this framework are attached to the drawer sides to hold it. A screw passed through the upper plate is a very useful feature to prevent anyone dragging the drawer completely out when looking for a particular item of equipment and tipping the contents on the floor—a serious situation with delicate instruments.

I have shown the shelves as being equally spaced, but this again is a matter of opinion. As the heavier items of equipment will find their way on to the lower shelf then obviously the lower member is best made somewhat wider in order to accommodate accessories of larger dimensions.

(To be continued)

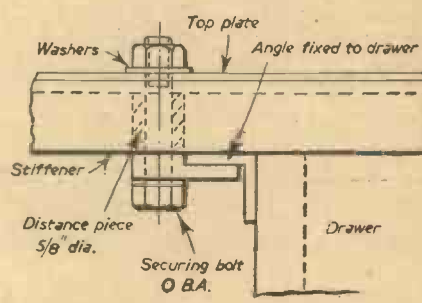


Fig. 5.—A suggested method of securing the runners for the drawer.

Free Flowing Resin

A FREE-FLOWING form of stabilised resin, promising greater ease of handling, has resulted from research performed in America. It remains free-flowing because it has been pelletised and treated with a special conditioner.

Various forms of resin are used in rubber compounding, varnishes, paper sizing and many kinds of pressure-sensitive adhesive tapes. At present it is shipped in steel drums as a solidified mass which is chopped into small pieces for use. The new free-flowing form can be shipped in paper bags or fibre drums, as well as steel drums, and can be poured from the container.

A New Radar Sonde

TEST flights of new equipment—the radar sonde theodolite—designed to replace the existing radio sonde and radar wind-finding apparatus, are now taking place at the Meteorological Office, Crawley, Surrey.

The radar sonde theodolite, which will give more accurate observations from greater ranges, consists of two parts—a miniature combined radio receiver and transmitter and the measuring apparatus, and equipment at the ground station. The ground equipment receives and records signals from the balloon and, following by radar its movements through the atmosphere, automatically computes the wind speed and direction at each height as the balloon ascends.

The most marked advance offered by the new equipment is its ability to compute the upper winds when the balloon has been carried distances of up to 100 miles, compared with only 50 miles with existing equipment. The average height achieved is in the region of 60,000ft., although on occasions considerably greater altitudes may be reached. By providing a permanent record, compared with visual readings of dial and scales of the present system, the radar sonde theodolite results can be evaluated at leisure, avoiding mistakes in observations and providing data for detailed research in the upper atmosphere.

The Cyclotron in a Hospital

THE first cyclotron in the world to be installed in a hospital is at Hammersmith, London. The cyclotron, an accelerator of heavy particles, the electro-magnet of which weighs 120 tons, is used in the Medical Research Council's Radiotherapeutic Research Unit. It is equipped by Dunlop with silicone rubber hose couplings for the cooling system of its magnetic coil, chosen because silicone rubber is unaffected by the potassium dichromate in the cooling solution.

New Man-made Rubber

FIRESTONE TYRE AND RUBBER CO., LTD., have just announced that their research men have produced a man-made rubber (synthetic rubber) the equivalent in every way of natural rubber.

The new Firestone product is made from isoprene by polymerisation in the presence of ionic type (alkali metal) catalysts.

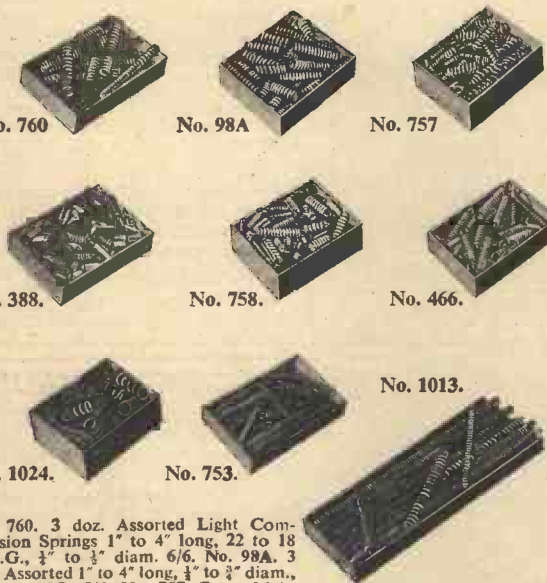
Firestone have been developing this new rubber for two years and more than half a million test miles have been run by tyres made with it. It has been proved to be outstanding in its resistance to heat.

Garret Workshop of James Watt

THE contents of Watt's workshop are on public view again in the Science Museum, South Kensington. They are displayed in their correct positions in a replica of the workshop incorporating the old door, window and floor-boards.

Specially interesting exhibits are Watt's two sculpture-copying machines and lathe, all treadle-driven; many small tools, plaster busts and casts and his old leather apron.

The garret workshop was on the second floor at Heathfield, the house near Birmingham built by Watt in 1790, where he lived till his death in 1819. He used the workshop during his retirement for many experiments but not for the development of the steam engine, which he did 25 years previously in Boulton's factory at Soho.



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(SPECIAL LIGHT ALLOY)
AND VEE BELTS

"A" SIZE (½" WIDE AT TOP OF VEE)

PULLEYS

Outside dia.	1¾"	2"	2¼"	2½"	3"	3½"	4"	4½"
P.C. dia.	1¼"	1½"	1¾"	2"	2½"	3"	3½"	4"
Price, each	2/3	2/6	2/9	3/-	3/9	4/6	5/-	5/6
Outside dia. ...	5"	6"	7"	8"	9"	10"	12"	
P.C. dia.	4½"	5½"	6½"	7½"	8½"	9½"	11½"	
Price, each	6/-	7/-	10/-	11/-	12/6	15/-	25/-	

Up to 4" dia. available with bores ⅜", ½", ⅝", or ¾" dia. Over 4" dia. available with bores ½", ⅝", or ¾" dia.

MULTI-GROOVE PULLEYS

4-STEP

Outside dias. ... ... 2", 3", 4", & 5"
P.C. dias. ... ... 1½", 2½", 3½", & 4½"
9/- each
Bores available ... ... ½", ⅝" & ¾"

3-STEP

Outside dias. ... ... 2", 3", & 4"
P.C. dias. ... ... 1½", 2½", & 3½"
7/6 each
Bores available ... ... ½", ⅝", & ¾"

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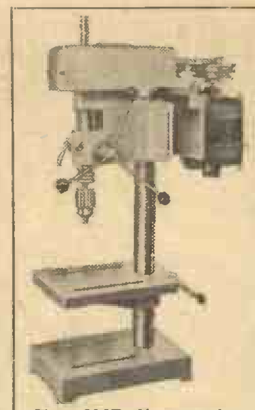

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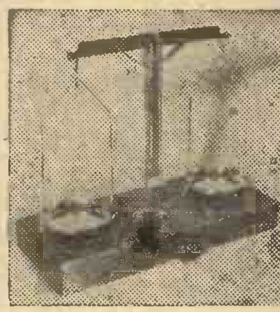

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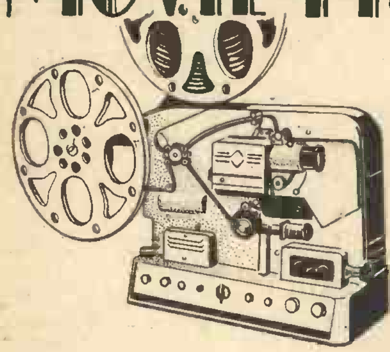
MOVIE PROJECTOR MECHANISMS



Notes on the Various Functions of Parts of a Cine Projector

By F. G. RAYER

THE construction of a home motion-picture projector is not a matter of very great difficulty, and a good deal of entertainment is possible from its use. A variety of films, in all standard sizes, may be obtained, new and secondhand, from various photographic dealers. These range from simple cartoons for children up to full-length features, and are available in both black-and-white and colour. The possibility of taking shots for oneself, with reversal film, should also be kept in mind.

The illumination system of such a projector resembles that employed in a slide projector or lantern, and it is accordingly not proposed to go into this in detail. As shown in Fig. 1, the lighting system will normally use a projector lamp, chrome reflector and condensers to concentrate the light on the film in the gate aperture. The spacing between lamp, reflector and condensers is adjusted to give the best illumination.

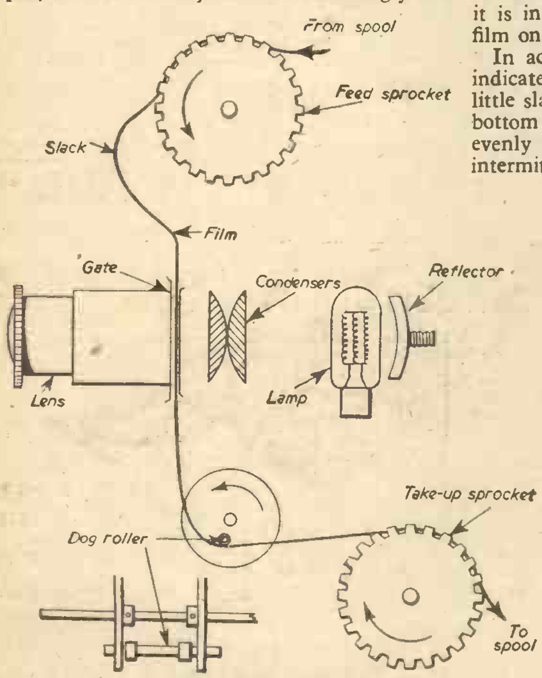


Fig. 1.—Simple dog movement.

With very powerful illumination appreciable heating of the film will arise when still. To avoid danger in this direction the lamp should not be switched on until the film transport mechanism is running. Some commercial projectors employ a metal shutter between lamp and film, which falls into place when the film is still. It is also possible to place heat-resistant glass between condensers and film. With ordinary small projectors no danger arises, but with the more powerful illumination systems the possibility of overheating the film by leaving it stationary in the gate must not be overlooked.

Transport Mechanisms

Very many different arrangements for moving the film exist, and some lend themselves well to home construction. In order that a moving picture may be shown, the film must move through the gate in a succession of jerks, each frame remaining still in the correct position for a fraction of a second.

A simple method of accomplishing this, and one among those first used in cinematography, is shown in Fig. 1. Here, the feed sprocket draws the film steadily from the full spool. This sprocket, in common with the take-up sprocket, rotates evenly without jerks, and is required in all types of movement. The film passes down through the gate, where its edges are held flat under slight pressure. Below the gate is a roller, eccentrically mounted upon two discs which rotate evenly. The roller is so shaped that it is in actual contact with the edges of the film only, to avoid scratching.

In action the sprockets and dog rotate as indicated, the top sprocket always keeping a little slack film available above the gate. The bottom sprocket tends to draw the film evenly through, but this is transferred to an intermittent motion by the dog roller striking the film. In order that the mechanism may work correctly the gear ratio between dog axle and take-up sprocket must be correct. The ratio depends on the number of perforations per frame on the film and number of teeth on the sprocket. If the film has four holes per frame, and the sprocket 20 teeth, one revolution of the sprocket will draw five frames through the gate. The ratio between dog and sprocket must thus be 5:1. The degree of eccentricity of the dog roller is not critical, since the movement automatically becomes correct if the ratio between dog axle and sprocket is suitably chosen, as explained. Small edge rollers or springs keep the film upon the sprockets, if necessary.

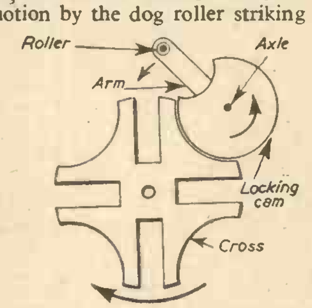


Fig. 2.—Maltese Cross.

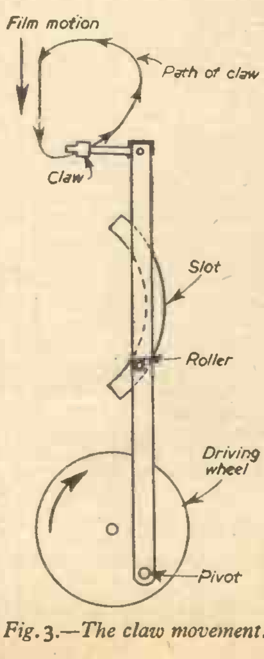


Fig. 3.—The claw movement.

Maltese Cross and Claw

Another movement, extensively employed, is shown in Fig. 2. Rotating sprockets keep the film ready, with slack, as in Fig. 1. The film is drawn through the gate by a further sprocket fitted to the same axle as the Maltese cross and engaging continuously with the film perforations.

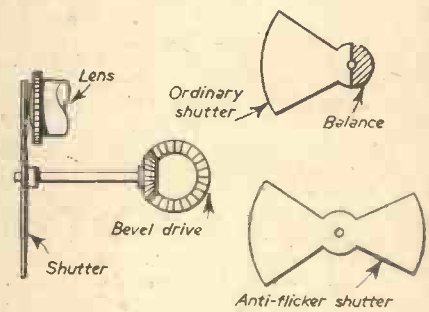


Fig. 4.—Rotating shutters.

The cam and arm form the driving member. As the arm rotates, the roller engages in a slot in the cross. At the same time the locking cam, on the same axle, has moved to such a position that the cross can rotate, impelled by the roller, which passes down into the slot and out again as the cross turns. As the roller emerges, the cross is locked by the perimeter of the cam, which fits the curved sides of the cross. As a result the cross moves rapidly through 90 degrees every time the arm rotates once. The sprockets fitted to the cross axle have a suitable number of teeth, so that one-quarter revolution moves the film one frame.

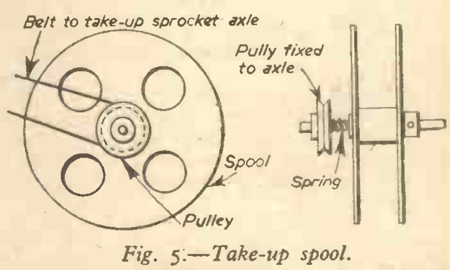


Fig. 5.—Take-up spool.

The projection time is quite long, compared with the movement time (which is lost). This arrangement is found in many commercial projectors. Well made, it is smooth and reliable and unlikely to damage the film.

Another movement frequently employed is illustrated in Fig. 3. A claw, shaped to engage with the film perforations, is fixed to a strip which is pivoted to the driving wheel. A roller on the strip engages in a curved slot, as shown. As the driving wheel turns, the claw makes an intermittent motion, drawing the film along during the straight portion of the movement.

This type of mechanism can be relatively quiet as it lacks the abrupt mechanical movement of the Maltese cross. It does, however, require to be carefully adjusted so that the film is not torn by the claw failing to strike exactly into the perforations.

With all types of movement the film is drawn steadily into the projector by rotating sprockets and wound upon a take-up spool. It is important that slack film be left above the gate to permit of the rapid jerking motion which is necessary.

Lens Shuttering

It is not essential that the lens be covered during the interval when the film is moving, especially with the Maltese cross arrangement. However, in all but the simplest projectors such covering improves results. A simple rotating shutter, arranged in front of the lens as in Fig. 4, provides a suitable means of cutting off the light when the picture is moving. Bevel gears are usually employed for driving the shutter.

With this type of shutter the screen is illuminated during the interval when the film is still in the gate and obscured when the film is in motion. This tends to cause some flicker, especially at slower speeds. One method of reducing this is to employ a two-bladed shutter. The smaller blade obscures the screen when the film is motionless in the gate. However, as the changes from illuminated picture to darkness are now twice as fast, the eye tends to miss them. Some projectors even use three or four blades, giving a picture without apparent flicker because the changes from light to darkness are too rapid for the eye to record.

The blade obscuring the light in the simple type of shutter should only be just sufficiently wide to allow the film to move on to its next position.

Spool Arrangements

The spool of unshown film is normally placed upon a free axle so that it can unwind as it is drawn into the projector. The axle may be fitted to an arm above the projector and be free at one end to permit the spool to slip on.

The take-up spool is driven and requires to keep a light tension on the film. As its speed of rotation changes, a solid drive is impossible, and a friction arrangement such as that in Fig. 5 is necessary. The belt drive rotates the spool just fast enough to take up the film when the spool is winding on its smallest diameter—e.g., when commencing. As the winding diameter increases, due to layers of film, the spring friction drive slips, so that the spool is always able to rotate at just the correct speed.

It is usually simplest to have belt, axle and friction spring permanently fitted to a long bearing so that no further bearing is required. It is then only necessary to slip the spool in place and fix a spring or screw collar to the axle.

Complete Driving Mechanism

It will have been observed that there are several axles, each requiring to be driven at definite speeds. Arrangements for driving these need not be difficult. Where exact definite ratios are required (as between sprockets and impulse movement mechanism) gears or chain drives are necessary. These may be arranged from parts sold by model-maker stores or available in various constructional-toy sets. For the take-up spool a belt drive is suitable.

The layout of a projector of simple design is shown in Fig. 6. Here, one double sprocket serves to feed film into the gate and draw it out after the transport mechanism has imparted the necessary intermittent motion. The necessary definite ratio between sprocket and transport mechanism axle is provided by a small chain drive. The mechanism for moving the film is not shown, but may be any of those already described. Rollers or other guides on the edges of the film keep it in contact with the sprocket teeth. The centre of the film bearing the picture frames should not be in actual contact with any part throughout the projector.

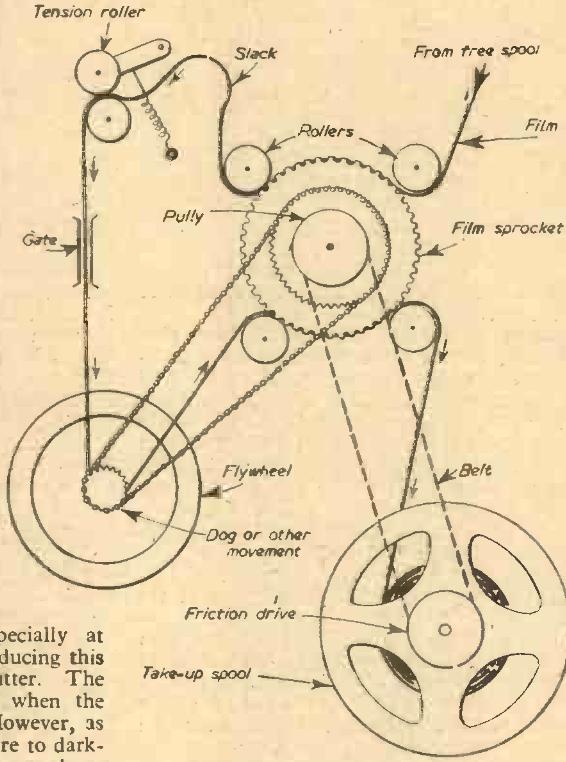


Fig. 6.—Driving mechanism of complete projector.

With hand-driven mechanisms a flywheel of fairly heavy type is helpful in maintaining a steady movement. With motor-driven projectors a considerable reduction ratio will be required between motor and the main projector driving spindle. With handle drive a moderate step-up ratio will be necessary. A handle speed of about 60 to 100 turns per minute is convenient, and the speed necessary for any particular arrangement may readily be worked out by noting the perforations per frame, number of sprocket teeth and step-up gearing employed.

When threading it is essential to leave slack, or the film may be torn. It is also necessary to get the first frames into the correct position before engaging the film with the transport mechanism and take-up sprocket. Alternatively provision can be made to slide the whole gate, lens and lamp assembly up or down slightly, to correct a horizontally divided picture.

With electrically-driven projectors a three-position switch may be wired as follows: Position 1, Off. Position 2, Motor on. Position 3, Motor and lamp on.

This assures that the film will never be stationary in the gate with lamp on. With hand-driven projectors a small metal shutter is sometimes arranged to be lifted by a flyweight or friction drive. This is not necessary with lighting of moderate power or if care is taken not to switch on the lamp until the film is in motion.

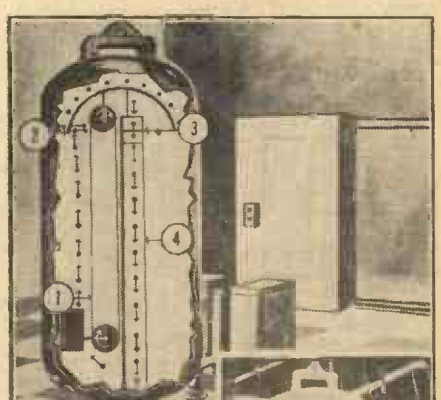
Largest Atom Smasher in Industry

A THREE-MILLION-VOLT Van de Graaff particle accelerator—sometimes called an "atom smasher"—has been purchased for the Emeryville, California, research laboratory of Shell Development Company, U.S.A. It will be used in studying the effects of radiation on fuels, lubricants, plastics and other oil-derived products.

The accelerator radiates a high-intensity beam of electrons travelling at almost the speed of light which bombarding a product can cause changes in its physical characteristics. It makes a plastic harder, increases its resistance to solvents and enables it to hold its shape at high temperatures.

The photograph on the right shows how the atom smasher will be installed. The photo inset shows the actual housing for the voltage generating column which produces the electron beam; this will be on the upper floor. Material being exposed to radiation will be passed through the beam on the floor below.

The diagram explains its operation. An electric charge sprayed on a fast-moving belt (1) is carried to the top of the column and transferred to a terminal (2), resulting in a great voltage difference between the upper and lower ends of the machine. Charged particles leave the terminal through a heated cathode (3) and pass downward along the high vacuum tube (4), where they are accelerated to almost the speed of light. A funnel-like attachment (5) directs the particles precisely on to material being irradiated, which is passed through the beam on a conveyor belt (6).



THE EVOLUTION OF GUIDED MISSILES

No. 2.—The War-head : Kinematics and Aerodynamic Heating : Lag Effects : Range of Missile : Propulsion : Ram Jet : Design of Air Intake

By G. W. H. GARDNER, C.B.E., B.Sc.

(Director-General of Technical Development (Air), Ministry of Supply)

War-head

IN designing a missile of this kind one must first decide the nature and size of the war-head. It can be designed to produce a blast effect or to radiate fragments at very high velocity. A few pounds of high explosives would be adequate if there were a high chance of a direct hit (Fig. 10). Since this is improbable it should instead carry sufficient high explosive (100lb. or 200lb.) to ensure lethal damage from a near miss when the war-head is detonated by a proximity fuse. If the miss were greater than about 100 yards a prohibitive amount of explosive would be required. Accordingly, one must arrange to guide the missile to within that distance of the target. This is no mean task since the closing speed of

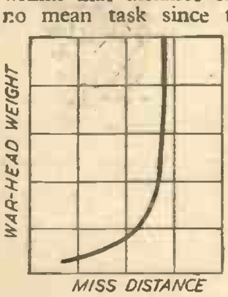


Fig. 10. — Typical relation between war-head weight and miss distance.

target and missile may be about half a mile per second, and the target may be manœuvring.

Guidance

A guidance system must be devised to achieve the required accuracy. One possible system provides for the missile to seek and home on the target (Fig. 11). This can be done by illuminating the target with a radar

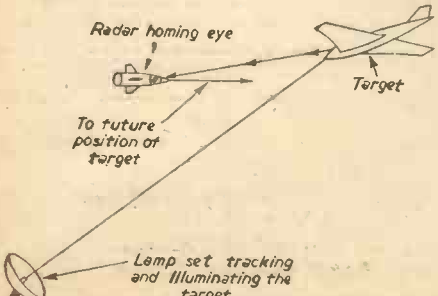


Fig. 11.—Semi-active homing.

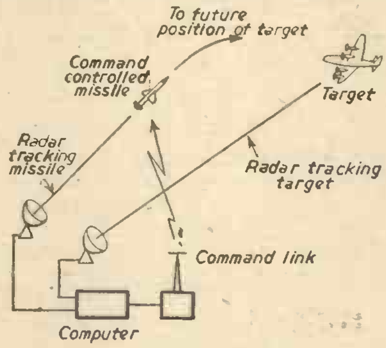


Fig. 12.—Radar command.

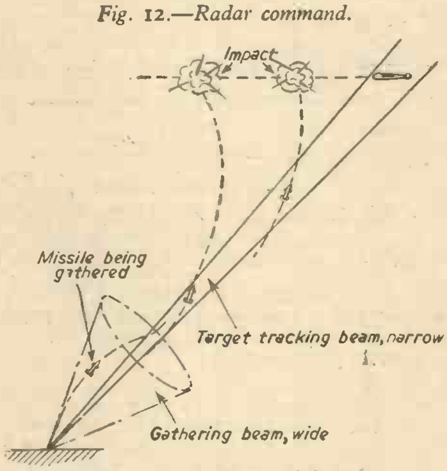


Fig. 13.—"Beam riding."

beam transmitted by the missile (active homing) or by a source outside the missile (semi-active homing) and by fitting a seeker in the missile able to pick up and "look" towards the target which acts as the source of the reflected radar energy. A control system can then be devised to cause the missile to fly towards the target. But this system demands much complication within the missile.

A system which permits simpler missile equipment can be provided by continuous measurement by radar from the ground or ship of the positions of the target and the missile (Fig. 12). This information is fed into a computer which transmits, to the missile automatically by radio, commands in the form of steering instructions designed to ensure interception of the target.

Another method is to lock a narrow radar beam to the target and cause the missile to measure its own position in relation to the centre line of that beam and fly as close as possible to this line. This method is normally called "beam riding" (Fig. 13).

Kinematics and Aerodynamic Heating

After the form of guidance has been decided, it is then necessary to consider the kinematics of the interception, the configuration and propulsion of the missile and, finally, to close the loop, the control system required to provide the necessary stability and manœuvrability.

The missile must fly at very high speed. The "sound barrier," which exists because of the sharp rise in drag in the region of the speed of sound, can be surmounted by designing for low drag and by providing adequate thrust per unit frontal area. Acceleration can thereby be ensured through the trans-sonic region to the higher speeds necessary to achieve the desired interception performance. The "thermal barrier," however, presents a problem which becomes progressively more severe as speed rises (Fig. 14). Air in the boundary layer (adjacent to the skin) which is accelerated to the speed of the missile is heated by friction and compressive forces; and the skin is thus heated by conduction. This phenomenon is known as aerodynamic heating. To a first approximation, the temperature rise in the stagnation regions of a body, in this instance due solely to compression of the air, can be expressed by the simple relation $\triangle T=(V/100)^2$, where $\triangle T$ is the temperature rise in deg. C. and V is the true air speed in m.p.h. Thus it is seen that whilst,

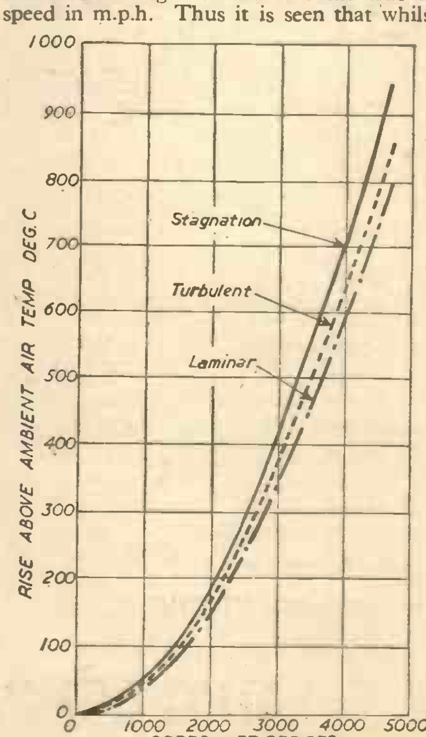


Fig. 14.—Variation of air temperature rise above ambient with the speed of a body.

at 100 m.p.h., ΔT is only 1 deg. C., it is 400 deg. C. at 2,000 m.p.h. The actual temperature rise experienced over most of the body is about $0.85\Delta T$.

Lag Effects

Lag effects play a prominent part during transient conditions. Fig. 15 depicts the temperature rise experienced by a fibreglass conical forebody over a period of 50 seconds. Clearly, if a missile or aeroplane is required to fly for more than a very short time at a speed much greater than twice the speed of sound, it will be necessary in the structure to avoid the use of aluminium alloys which lose strength and stiffness rapidly above 150 deg. C. and to use instead titanium alloys or possibly steel to withstand higher temperatures (Fig. 16). Some alleviation of this difficulty can be obtained by insulation of the structure by, for example, the use of a carboniferous material having a high specific heat and high melting-point.

If to the aerodynamic heating effects are added temperature effects due to a rocket-motor combustion chamber and exit nozzle in which the flame temperature may be 2,500 deg. K., and to a liquid oxygen supply which may cause the temperature of parts of the missile to fall as low as 120 deg. K., the resultant engineering problems become truly formidable.

Range of Missile

The range of the missile will emerge from geographical, economic and kinematic considerations. It is interesting to note that a given missile can achieve a greater range by following an indirect route to the target than by following a direct path. Fig. 17 shows that a typical rocket-propelled missile can travel two or three times as far by following indirect paths which minimise the time spent in the denser air at the lower heights. Choice of path is linked to choice of guidance; for example, beam riding would not permit either of the indirect paths shown.

The manœuvrability required at different heights must next be determined, so that sufficient lifting surface or wing area and adequate effectiveness of control can be provided for the greater heights and sufficient strength for the lower heights. It is readily seen that a simple pursuit-course interception, in which the missile at all times points straight towards the target, can demand accelerations which are impossible to provide (Fig. 18). The demand can be limited or even caused to vanish after a time by adopting some such arbitrary law as $d\Psi/dt = k d\theta/dt$, where Ψ is the direction in which the missile is pointing and θ is the angle of the line of sight to the target (Fig. 19). The constant k can be chosen to ensure that the path approximates to a constant-bearing collision course, and to reduce thereby the maximum acceleration demand. Acceleration capability must also be made to compete with any manœuvring of the target and with impurities on the radar intelligence. All of these considerations together may demand the ability to manœuvre at between 10g and 20g.

With a knowledge of the war-head size, the speed, range, guidance method and control law, the propulsion system and aerodynamic form of the missile can be determined.

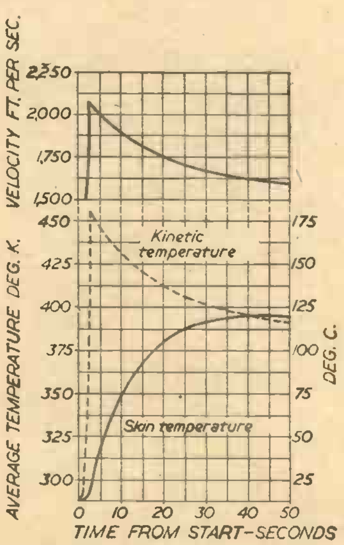


Fig. 15.—Transient skin temperatures for a conical forebody in accelerated flight at sea-level. Variation of average skin temperature with time: Material, fibreglass; cone length, 4.33 ft.; cone total angle, 20 deg.; skin thickness, 0.040 in.; boundary layer, laminar.

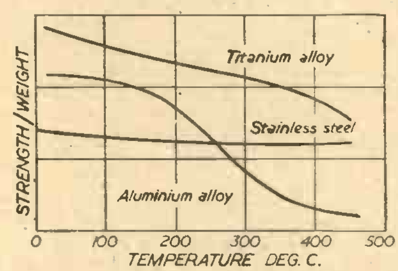


Fig. 16.—Variation of strength with temperature for an aluminium alloy, a titanium alloy and a steel.

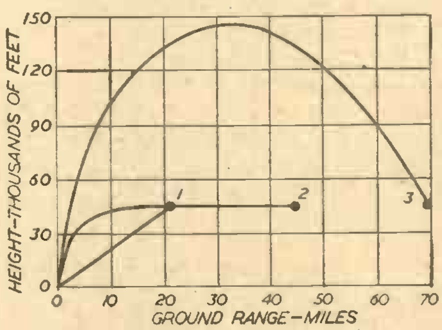


Fig. 17.—Typical effects of trajectory on ground range.

Propulsion

Because missiles are required to fly at very high speeds, and because the horsepower required to propel the missile rises as the cube of the speed up to about $M=0.8$, at a greater rate depending on the aerodynamic design up to about $M=1.5$, and beyond that speed at rather more than the square of the speed, it is essential to seek an engine of very high thrust per unit frontal area, and of low specific weight and fuel consumption.

A considerable excess of power must of course be provided to achieve very high acceleration. M, the Mach number, is the ratio of the speed of the missile to the local speed of sound. The outstanding work on the flight of projectiles and the flow of gases by Professor Ernst Mach, some fifteen years before the Wright brothers first flew in 1903, merits the perpetuation of his name in supersonics, a field in which he was truly a pioneer.

Jet reaction motors are most suitable and a choice of three types is available, the rocket, the turbo-jet and the ram jet. The rocket motor is independent of the surrounding atmosphere in that the source of the oxygen necessary for combustion is carried in the rocket in solid or liquid form. In contrast the turbo-jet engine and the ram jet draw their oxygen from the atmosphere.

Ram Jet

The ram jet, whose use is confined to high-speed flight, is notable for its simplicity (Fig. 20). The motor itself contains no moving parts. The function of the compressor in a turbo-jet engine is to raise the pressure of the incoming air to a value which will ensure good thermal efficiency. If, however, the turbo-jet is flying at twice the speed of sound at sea level the total head or ram pressure at the intake is 115 lb. per sq. in. abs., which is equivalent to a compression ratio of 7.8/1, assuming 100 per cent. intake efficiency. This process of compression by conversion of the high kinetic energy of the air usurps the functions of a mechanical compressor. If the compressor is dispensed with, it follows that no turbine is required and one arrives at the ram jet.

The ram jet is unable to provide thrust at zero speed and is so inefficient at low speeds that it must be boosted to a speed approaching that of its designed operation by other means (Fig. 21). For defensive missiles, this is not a handicap. Whatever propulsion motor is used, much more powerful boost motors giving thrust of the order of twenty to thirty times the weight of the missile are needed in addition in order to achieve an acceptable time from launching to operational speed.

Although the ram jet is simple, in the sense that it contains no moving parts, substantial aerodynamics, combustion and fuel-supply problems must be solved to ensure efficient functioning over a wide range of height and speed.

Design of Air Intake

The design of the air intake is a formidable problem. The air must be retarded, with minimum loss, from the flight speed to the internal flow speed at the entrance to the combustion region. At supersonic flight speed retardation can be caused by the

(*Continued on page 213*)

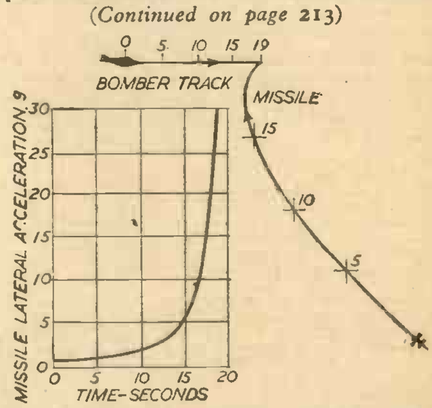


Fig. 18.—Pursuit course; missile against bomber.

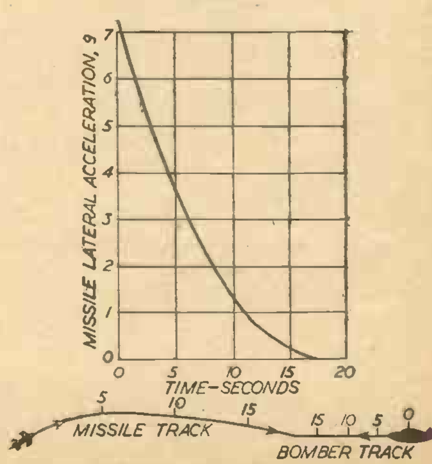


Fig. 19.—Proportional navigation course: missile against bomber.

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COMPRESSORS for sale, 2½ CFM, 180lbs. sq. in., on metal base, with driving wheel and receiver, price £3; ¼ h.p. Heavy Duty Motors, price £3; carriage forward. Wheelhouse, 1, The Grove, Isleworth. (Phone: Hounslow 7558.)

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MAKING YOUR OWN? Telescopes, Enlargers, Binoculars, Microscopes, projectors, or, in fact, anything that needs lenses. Then get our booklets "How to Use ex-Gov. Lenses and Prisms," Nos. 1 and 2, price 2/6 ea. Also our Stereo Book "3D Without Viewers," price 7/6. Comprehensive lists of Lenses, Optical, Radio and Scientific Gear, free for s.a.e. H. W. English, Rayleigh Road, Hutton, Brentwood, Essex.

SHIPS IN BOTTLES.—The constructional kit that tells you how to make them; build for pleasure or for profit; kits 6/- each from Hobbies Ltd., and model shops. Cooper Craft, Ltd., The Bridewell, Norwich.

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The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a scheduled Employment Agency if the applicant is a man aged 18-64 inclusive or a woman aged 18-59 inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order 1952.

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ARE YOU LOOKING FOR A RELIABLE FIRM for Timber, Plywood, Wallboards, Veneered Plywood; call at our warehouse or send s.a.e. for price lists. N. Gerver, 2/10, Mare Street, London, E.8 (near Cambridge Heath (E.R.) station). (AMHerst 5887.)

WOODWORKING MACHINES, all cast-iron constructed. Complete Saw Benches, 7in., £4/15/-; 8in., £5/10/-; 10in., complete, motorised, £30. Planers, 5in., £12; Bowl Turning Heads, £4; with 8in. Saw Tables, £7/10/-. Lathes, £7/10/-; Combination Lathes, £10/10/-. Motors, Pulleys, Belts, etc. 12 months written and money refund guarantee. 4d. stamp for illustrated booklet. James Inns (Engineers), Marshall St., Nottingham.

WOOD LATHES, Attachments, Motors and Control Gear. Circular Saw Blades. Spindles or Benches, Turning Tools, etc., interested? Then send 6d. for illustrated literature, price list and H.P. terms. D. Arundel & Co., Mills Drive, Farndon Road, Newark, Notts

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ENLARGER and Camera Bellows supplied; also fitted. Beers, St Cuthbert's Road, Derby.

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(Continued on next page)

creation at the intake entry of shock waves behind which the flow is subsonic; and thereafter a subsonic diffuser is used. At relatively low speeds, below $M=1.5$, one shock is sufficient, but above this speed a series of shocks is required to obtain efficient compression.

It is important to ensure that the characteristics of the air intake match those of the ram-jet combustion chamber. The air-swallowing capacity of the intake and its ability to compress the air efficiently are a function not only of the operating condition of the combustion chamber but also of the flight speed. Speaking quite generally, it may be said that an air intake which matches the combustion chamber at a given speed will be too large at a lower speed, and this gives rise to air spillage around the intake resulting in greatly increased drag and possible instability of flow, which in turn can have repercussions on the stability of combustion. This question of matching leads to perhaps one of the most difficult ram-jet design problems necessitating well-considered compromise. In practice this compromise may be turned to good effect since the intake characteristics can be utilised to provide a major control of thrust. For higher speed flight and longer ranges where fuel economy is of greater importance, a variable intake will probably be required to provide optimum matching over the speed range, although this would detract from the inherent simplicity of the ram jet.

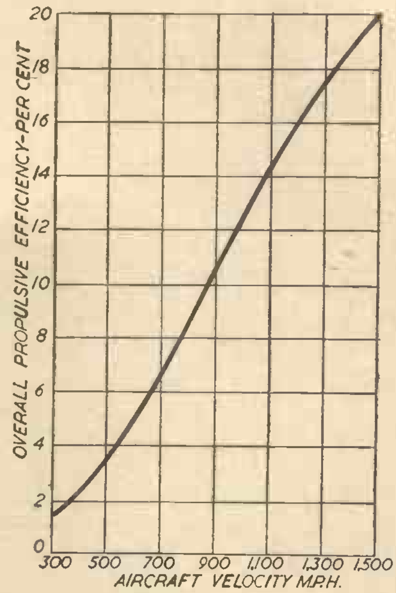

Fig. 21.—Overall propulsive efficiency of ram jet plotted against aircraft velocity.

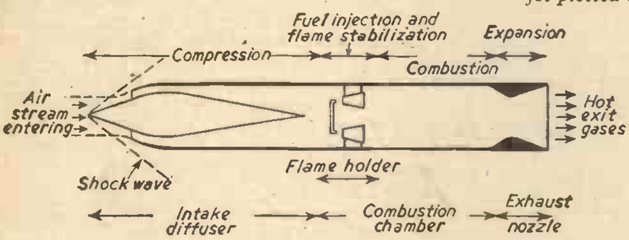

Fig. 20.—Ram jet.

Short Range Missile

For a ram-jet propelled missile of short range the overall weight is of great importance and it is preferable to save structure weight even at the expense of fuel economy. This fact, associated with the demand to get the greatest possible thrust from the ram jet, results in air-entry velocities to the combustion chamber of the order of between 200 and 300 ft. per sec. This in turn implies that the drag coefficient of the flame-stabilising system of the combustion chamber must be kept small and that, in consequence, the degree of mixing given to the fuel and air mixture and the combustion products is much less than that permitted in a combustion chamber of a gas-turbine engine.

Furthermore, the intensity of heat release demanded of a ram-jet chamber (about 4×10^6 C.H.U. per cu. ft. per hr. per atm.) is greater than that required from turbine engines and the flow pattern of the entry air is also more susceptible to operating conditions. All these factors aggravate the difficulties associated with combustion. Moreover, the large interchange of kinetic, pressure, and thermal energies can sometimes lead to vibrations of amplitude sufficient to cause severe damage. The general necessity to keep engines short in length does not mitigate these problems. Research and development programmes must be concentrated on obtaining combustion chambers which are reliable in the mechanical sense and capable of operating under a variety of air-flow conditions.

Usually increase in flight performance demands more complexity and reduced reliability of the many components of a high-speed missile or aeroplane. The ram jet is an exception in this trend. A ram jet capable of exerting, say, 100,000 h.p. can be built with less than a dozen moving parts and these are confined to the associated fuel-supply and control systems. None of these moving parts is in contact with hot gases.

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(To be continued)

An Electric Alarm and Lighting System

By R. C. TATLOW

As there was a child sleeping in the same room, the writer felt the need for an alarm somewhat less clamorous than the usual variety; and, as there was a six-volt night-light already in the room, the two were combined and elaborated to give a very convenient set-up, see Fig. 1.

The basis of the alarm is a Venner Clockwork Time-switch, purchased from the local electricity undertaking. All other components can be purchased from advertisers in PRACTICAL MECHANICS. The time-switch is set to "make" at the required hour for waking, and to "break" one hour later.

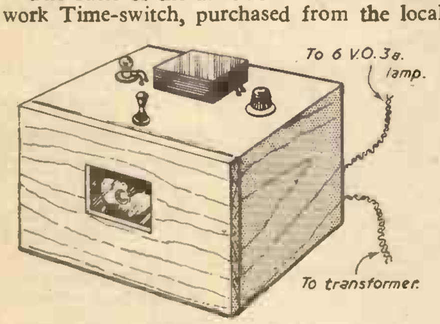


Fig. 1.—The completed device.

COMPONENTS REQUIRED

- 1 Transformer, 230-volt input, 6-volt 2 amp. output.
- 1 Rectifier to suit.
- 1 6-volt buzzer.
- 1 Venner Clockwork Time-switch.
- 1 20 Ω variable resistance with switch.
- 1 Jettison Switch, ex Air Ministry (from K. R. Whiston, Stockport).
- 1 Push-pull switch arranged for "pull-on."
- 2 6-volt M.E.S. bulbs (one 0.3 amp., one 0.04 amp.) with holders.

When the alarm operates, the buzzer sounds and the smaller six-volt bulb lights. On depressing the push-pull switch, the buzzer is silenced, but the small light stays on for one hour, when it is switched off by the time-switch. This light is useful for consulting one's watch, etc., on wakening—and for serving as a reminder, should one "turn over" and awaken later, after having switched off the buzzer! The brilliance of the small bulb is not sufficient to distract even the lightest sleeper whom it is desired to leave undisturbed. This light may be switched on when required (for instance, if one wakes during the night and wishes to know the time) by pressing the button of the jettison switch, thus completing the small light circuit and simultaneously breaking the buzzer circuit until the button is released. The device should be wired as in Fig. 2.

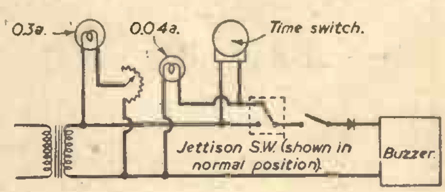


Fig. 2.—The circuit.

In practice, the transformer is mounted on the skirting-board behind any large item of furniture so that all visible leads and connections carry only six volts. The 0.3a. bulb, fitted to a small stand, is on an extension lead. A Perspex panel, drilled with one 5/16in. dia. hole, enables the time-switch to be checked and wound once a fortnight without having to open the box.

Trade Notes

The "Electric Tool User," Autumn Edition

PUBLISHED by Wolf Electric Tools, Ltd., this booklet will interest all those who own a small portable electric drill. The various well-illustrated articles it contains deal with many aspects of drilling from the heavy engineering industry to the home workshop. Copies are available from the publishers, Wolf Electric Tools, Ltd., Hanger Lane, London, W.5.

Camera Bellows

READERS who contemplate the construction of the press camera, constructional details of which appeared in the October issue, will be interested to know that Frederick Beer, 4, St. Cuthbert's Road, Derby, can supply suitable bellows. Bellows are available from stock, 4½in. square tapering to 2¾in. square, in best leathercloth, with an extension of 6in., at 17s. post free.

Bellows are available in any other standard size and quotations will be given for any non-standard size on request, though an extra charge is made for these. Bellows for any camera are supplied, and the average price for supplying and fitting new bellows to a 120 or 620 size camera is 18s. 6d. including return by registered post. Quotations are given without obligation and post free.

Electric Breast Drill

A THREE-SPEED breast drill now being distributed in the U.K. by Industrial Chain Supply Co., Ltd., of 625, Fulham Road, London, S.W.6, is the Peugeot Model 314.

The speeds are selected by pressing the crank

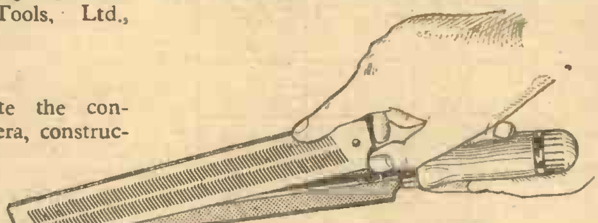
The Peugeot Model 314 breast drill.

handle on to one of three spindles protruding from the pressed steel gearbox: the two lower ratios of 2.25:1 and 5.63:1 corresponding to those found on the average orthodox two-speed breast drill and being used for general drilling of mild steel and harder metals. The third ratio of 14.06:1, giving drill speeds up to 1,400 r.p.m., is especially useful for drilling wood and for small holes in soft metals such as aluminium, zinc, copper, plastic materials, etc.

The 13mm. hand-screwed, three-jaw, perfectly-centred chuck accommodates drills up to ½in., and is carried on a 14mm. diameter screwed centre axle. All rotating parts in the gearbox are mounted on ball bearings, eight in all, and this results in very smooth action. The gears are permanently oiled, and the case is fully sealed against entry of dust and moisture.

The breast plate is movable by means of a locking ring at the bottom of its tubular shaft which also acts as a drill magazine. The side handle is detachable.

The full weight of the drill is only 3½lb. Nevertheless, the construction of the model is extremely robust and withstands considerable shock and rough usage. The finish is high-quality corrosion-proof grey enamel, with plated rings and ferrules. The drill is 16½in. long. It retails at the price of 72s. 6d.



The Tresa file.

Tresa File

THE Tresa file shown in the illustration above has a double-sided blade which has been specially designed as a universal file, and will be found indispensable for a wide range of jobs by the handyman.

It will be found to work faster and better than the conventional file on all metals, ferrous and non-ferrous, plastics and synthetic materials, leather, rubber, wood, etc. On each side of the file blade there are extremely sharp specially-hardened cutting edges, which ensure fast and efficient working. Furthermore, the arrangement of the slot-like openings between the cutting edges makes it impossible for this file to become clogged with filings or dirt, therefore there is no need to clean it, and continuous working is made possible.

It will also be found that this file is adaptable for sharpening edge tools (i.e., scythes, bill hooks, cutters, etc.).

There are three models of the Tresa file, namely, the Narrow file with cutting area of 9in. by ½in., the Standard file with cutting area of 9in. by 1in., and the Long file with cutting area of 12½in. by 1in.

They are obtainable from the Tresa File Company, Oxford Airport, Kidlington, Oxford.

Mixafix High Polymer Cement

THE sole distributors for this new adhesive are Ferguson and Timpson, Ltd., 155, Minories, London, E.C.3. It is sold retail at 5s. for a pair of tubes. These tubes contain two compounds "A" and "B," and to use these, half the estimated quantity required is squeezed from each tube on to a smooth flat surface and mixed thoroughly. The molecules in the cement link to form long polymer chains which form a tough structure of great strength and adhesion to many substances, including aluminium, glass, iron, wood, bakelite, etc. It is also highly resistant to attack by water, steam, grease and chemicals. It is interesting to note that Mixafix sets right through without exposure to air and does not shrink when setting as does a volatile adhesive.

The Johnson Photographic Year Book

THE 1956 edition of this popular handbook for the photographic enthusiast, on the same lines as previous years, includes a useful diary, which is detachable, an exposure calculator for use with standard, colour and cine reversal films and a technical data section which is a mine of information. The notes and tables include information on exposures, filters, films, development, printing and flash photography, light tables, weights and measures, price list of Johnson and Tabloid brand products and many other items. The price of the 1956 Year Book is 6s.

"Gripital" Chain Spanner

NEW and improved designs of the "Gripital" chain spanner are now in production, of which two models are at present available. A medium duty model, Mark III, provides a grip capacity up to 4in. in diameter and has a handle 9in. in length. The heavy duty model, Mark IV, will take diameters up to 6in., the handle being 15in. long.

As will be seen from the illustration, the new design consists of two steel bars cranked or offset and built up to provide the gad into which the chain is fitted. The chain is of the laminated type made up in combinations to ensure the required strength.

The "Gripital" chain spanner relies on the encircling grip of the chain which holds the object with a mild but positive grip. Within the stipulated capacities of each model it will turn any shape, round, square, hexagonal and irregular, such as is to be found in nuts, bolts, jar lids, pipe fittings, chucks, pulleys, sprockets, radiator caps, valves, or whatever it will surround.

Supplies of all models are obtainable from the sole selling agents, Industrial Chain Supply Company, Ltd., 625, Fulham Road, London, S.W.6.

"Gripital" chain spanner.

"All-in-Line" Rip Saw—Amendment

MESSRS. PORTABLE ELECTRIC TOOLS LTD., 31A, Sloane Street, London, S.W.1, whose Rip Saw was mentioned in Trade Notes last month, have informed us that owing to supply difficulties, nylon gears are no longer being used and are to be replaced by phosphor bronze gears.

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1 only **500 WATT TRANSMITTER** complete with Valves, Crystals, etc., 13 meters 3/2kW Variacs Range 6.25 to 12.5 M/cys. 12.5 to 25 M/cys. In very good condition, all fitted into rack approx. weight 5/6 cwt. **£100 to clear, buyer collects.**

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EX-R.A.F. ROTARY TRANSFORMERS Input 24/28 volts D.C. OUTPUT. 1,200 volts 70 M/amps. ½ hour rating, **10/-** each. Ditto 18/24 volts D.C. Input 450 volts 50 M/amps., Output constant, **25/-** each. These latter ones can be used as motors off A.C. mains with a little alteration.

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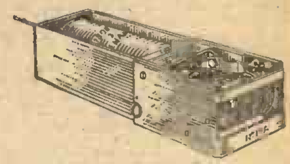
ELECTRO MAGNETIC COUNTERS



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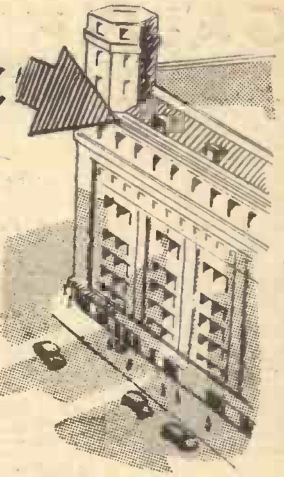
Letters to the Editor



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

Preserving Plant Specimens in Plastic

SIR—On looking through my old copies of PRACTICAL MECHANICS I came across a query from a reader who wished to use a cold-setting plastic to preserve plant specimens in such a way that there would be no deterioration or loss of colour.

Perhaps the following information may be of use:

Details of various methods of preserving—including a method of helping to retain the colour—may be found in "Common British Wild Flowers Easily Named," by T. Ernest Waltham, and "The Science Master's Book" (1st Series, Part II, 2nd Series, Part II, and 3rd Series, Part III), published by the Science Masters' Association.

A cold-setting plastic resin that I have used successfully is sold by E. M. Cromwell and Co., of Bishop's Stortford. A complete kit and mould—under the name Ceemar Embedding Kit—costs 35s.

This Ceemar resin was used successfully to embed insects and leaves. It is very easy to use and of pleasing appearance when hard, looking like methyl methacrylate (Perspex). The estimated cost of an inclusion is in the region of 6d. or 1s.

If the maker's directions are adhered to there can be no difficulty. It was found that, by using a mould made of four pieces of glass (held upright by moulding clay) on a sheet of glass, the loss of heat—produced during setting—was much quicker. This enabled me to produce them more quickly and also to add layers of resin thicker than the maker recommends.

By chance it was discovered that a round inclusion, of pleasing appearance, could be produced by using a short test-tube as a mould. The glass tube is afterwards broken away. No doubt some of these inclusions could have been made into very pleasing brooches.

I have before me as I write two pleasing inclusions I made: one is of a bumble bee and the other of two beetles (Pterostichus Niger). In these the name of the specimen was incorporated in the block by writing it in indian ink on tissue paper, which was placed alongside the specimen.—J. EDWARDS (Bolton).

The Invisible Man!

SIR,—H. T. Wilkins, in his book "Flying Saucers on the Moon," says: "It is true that, in both London and New York, in the late 1920s, a man on a stage was rendered invisible by warping light rays between rapidly rotating magnetic poles."

Was this just an illusion or are such things possible? What became of this act and why do we see nothing of it now?

If it is actually possible to so bend light rays that material things become invisible, then the possibilities must be unlimited.

Wilkins also adds: "In 1934, in London, there was demonstrated, in a public hall (certain) apparatus. A young scientist, wearing what he called an 'electro-helmet' and a 'special mantle' went into a cabinet, open at the front, before a brilliantly lit stage, and with both hands touched contact gloves, which were over his head. An electric current was switched on and the man's body gradually vanished, from feet to head. One could step up and touch him but could not see him."

Was it fact or fiction, was it some kind of ray or was it "all done by mirrors"?—W. E. REYNOLDS (N. Staffs).

A Fine Paint Spray

SIR,—In reply to the query from A. Wooldridge (Norwich) "Information Sought" September issue, I suggest using the Airbrush type of spraygun as used by commercial artists.—W. R. RODGERS (London, S.W.17)

Model Schooner Yacht

SIR,—I thought you might be interested in the photograph below of a model schooner yacht which I built a few months ago from information and diagrams contained in your book "Model Boat Building." I have called the boat *Venetia* and find that she is very fast. I am very pleased with her.—L. R. LOADER (Twickenham).

Mr. L. R. Loader's schooner yacht

Cutting Glass Bottles

SIR,—In answer to your correspondent who was not very successful in cutting glass with a red-hot iron wire applied to a scratch mark, I would like to say that a red-hot pointed glass rod is much better, as, being soft, it makes better contact.

By this method I have succeeded in cutting round a carboy, about half-way between the middle and the neck, to make an aquarium.

I first filled it with water to the desired level, and made a chalk mark all round. Then I siphoned out the water, and dried the inside thoroughly where it was to be cut. I was able to get my hand inside, as the neck was broken off. (I first blunted the sharp edges with emery paper.)

I then led one of the cracks round the stump of the neck to meet my chalk line at a tangent, and continued the cut all the way round. It took me about an hour, with an assistant to heat a second glass rod while I was using the first one. When the glass rod lost its shape I reshaped it (while soft) with a pair of pliers.

The top of the carboy came off neatly, leaving a perfect circle. I then blunted the sharp edges with carborundum paper. The completed aquarium held about six gallons of water.

The easiest and neatest way to cut a "Winchester," however, is to make a scratch with a file about a quarter of the way round, using the edge of a wrapped piece of paper as a guide. Then take two strips of blotting paper at least $1\frac{1}{2}$in. wide, and long enough to go at least twice round the bottle. Tie them on, about $\frac{1}{4}$in. on each side of the scratch, and wet them thoroughly. (The *inside*, however, must be dry.) Then plunge the bottle straight into a bunsen flame, and keep turning, so that it plays on the bare part between the wet strips. In a few seconds the glass will crack neatly all round, and can be removed with a gentle tap. The edges can then be blunted with emery paper as before.

I have made a desiccator this way. The cut end only required a little grinding down on a sheet of carborundum paper pinned on a board. It cuts best with an "anti-lubricant" made of 8 per cent. camphor in turpentine. When finished, a ground-glass disc made a perfect air-tight fit with a little grease.—A. G. COLLINSON (Sheffield, 15).

Blower Heater Calculations

SIR,—As your series "Back to First Principles" has sought to show, a little knowledge of some of the theory of mechanics, electricity, etc., will often assist the handyman. I was intrigued by the statement in your issue of November, 1955, on the construction of an electric blower heater, that a 3 kW. heater can bring a room 22ft. x 12ft. x 9ft. from 48 deg. F. to 70 deg. F. in $7\frac{1}{2}$ minutes, and decided to check this statement against some theoretical calculations.

The basic formula is:

$$\text{Joule's equivalent (J)} = \frac{\text{Work done}}{\text{Equivalent heat}}$$

$$= \frac{Wt \times 10^7 \text{ ergs}}{M\theta Cp\,(\theta_2 - \theta_1) \text{ calories.}}$$

Where—

W = watts of electrical energy.

t = time in seconds.

$M\theta$ = Mass of air in grams at $\theta°$ C.

Cp = Specific heat of air at constant pressure.

$(\theta_2 - \theta_1)$ = increase in temperature in °C.

Now 48° F. ≏ 9° C. (θ_1) / 70° F. ≏ 27° C. (θ_2) (Calculated, or from tables)

For convenience, let us take the mass of air at the average room temperature of

$$\theta_1 + \frac{\theta_2 - \theta_1}{2} (= \theta)$$

$$\text{i.e., } 9 + \frac{27 - 9}{2} = 18° \text{ C.}$$

$M\theta$ = 34.37 gms./cu. ft. at 18° C. (obtained from tables of densities).

Then returning to the basic formula—

$$4.18 \times 10^7 = \frac{3{,}000 \times t \times 10^7}{34.37 \times 0.2375 \times 18}$$

(Cp = 0.2375).

which gives a value for t of 0.201 sec. per cu. ft.

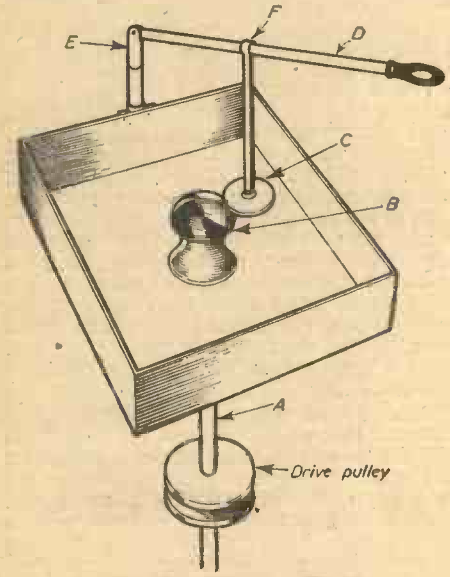
For dimensions given, viz., 22ft. × 12ft. × 9ft.

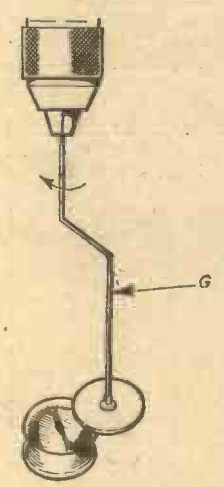
$t = 0.201 \times 22 \times 12 \times 9$ sec.
$= 477.4$ sec.
$\simeq 8$ min.

Near enough to the claimed figure ? I think so.—D. F. BURGESS (Redhill).

Lens Grinding Machine

SIR,—*Re* the request from Mr. Mansell regarding the construction of a lens grinding machine the following might be of some assistance, though I suggest he obtains a copy of *Amateur Telescope Making*, by the Scientific American Inc., New York. Edited by Albert G. Ingalls, it is a mine of information and encouragement in the whole field of telescope making. The ideas below are detailed in the above book amongst others.





The basic ideas of two systems for lens grinding.

The basic and simplest design for small lens manufacture seems to be a spindle A (see sketch), driven by any suitable means, passing through a tray, which collects splash of grinding compound, etc. On the top of this is mounted the means of carrying the lens or grinding tool B. The lens is usually fixed to this plate with pitch and the whole plate being interchangeable with a similar plate C above. This is an assistance when finally shaping and polishing the lens.

The plate C is fixed in such a manner that it has a certain amount of freedom to revolve and at the same time dip over, following the convex surface of B. Movement should be provided at E for the lever D to be moved from side to side and also raised and lowered. F should also be adjustable for varying its position above or off the centre of B.

Another very simple device suggested in the book mentioned above is where a drilling machine is available to bend various pieces of round iron of a size suitable to fit into the drill chuck, to a set of all the required distances of throw, or offset required, as illustrated at G (see sketch 2), which I think is self-explanatory.

The undriven face will turn by the force implied by the drivers, but if required the bottom lens or tool could be revolved by some means. Incidentally, the speed of revolution depends a lot on the size of lens or mirror to be ground. The larger the lens the slower the speed.

I have not attempted to go into any details but merely to convey the general idea which I hope will be of some assistance.—E. M. SUTER (S. Rhodesia).

Patent Delays

SIR,—*Re* the correspondence on "Inventors," perhaps my latest experience with a patent might be interesting.

When flexible mould material came on the market, I evolved a simple device to make moulds to a degree of perfection far beyond anything previously in use.

With the maker of this material, I had a discussion about my invention and told him it could be retailed at about 15/-. He said that if I would get it patented and more or less in saleable form, he would be only too pleased to take it up and put it on the market.

I took out provisional patent, then tried different ways of making it, and finally sent complete specifications and made the application. This was nearly two years ago and just over a month ago I got the letters patent.

The material maker has now lost all interest.

This simply means I have paid out £6, and gone to a lot of trouble, to give away a secret. I am too old to think of marketing it myself, and although several people have shown an interest, they expect me to get it all made, even to the extent of packing, then they will sell it.

Everyone that has seen its work admits all my claims.

The patent is granted from the date of application. So although no guarantee is given that an application will be granted, the time that it takes to get it through is taken off the period. So in effect the four-year period is actually only two.

Unless one is absolutely assured that there is a future for their invention, my advice is *DON'T*.—C. V. THOMPSON (W.14).

The Evolution of Guided Missiles

SIR,—In the very fine article concerning guided missiles it is perhaps mildly unfortunate that no reference is made to the fact, admitted by U.S.A., that the R.F.C. flew their "V.1" in 1917. It could be radio or gyro controlled and was launched by compressed air or gas. All controls were servo-operated.

The complete gear can be seen at the Imperial War Museum, where is also exhibited a copy of the patent for dirigible rockets, wire or radio controlled, which the R.F.C. endeavoured to introduce during the first world war.—PROF. A. M. LOW.

Copper-plating Fault

SIR,—In the November issue of PRACTICAL MECHANICS one of your readers was informed that the copper sulphate plating solution he was using was too strong or too warm. This is really not the cause of his failure, as metals such as iron and tin cannot be plated in an acid sulphate bath as they displace copper from this type of solution by chemical action. If these metals have to be plated in a sulphate bath they must first be started in a cyanide bath.—M. J. DUNPHY (Kilkenny).

UNDERWATER PHOTOGRAPHY

(*Concluded from page 183.*)

Photographing Technique

The technique of underwater photography is easily learnt and no difficulty will be encountered if reasonable care is taken over certain points. There are three problems encountered—these are focusing, lighting and exposure.

Due to the various refractive indices involved, objects viewed below the surface appear to be about a third closer than normal. This will affect focusing unless carried out by apparent distances; thus if the subject appears to be 6ft. away when seen through a diving mask and the camera is focused at that distance, the resulting picture will be in sharp focus.

Lighting below the surface varies as the distance from the surface squared, the exact amount depending on several factors none of which is constant. At 10ft. below the exposure necessary is about four times that on the surface in clear sun and about mid-day. This would give an exposure of 1/100 sec. at *f*.5.6 on a fast panchromatic film and 1/25 sec. at *f*.4.5 using colour film. The relative rigidity of the water permits slow shutter speeds to be used and the camera is steadied considerably—so poor light has not quite such a drastic effect on sharpness as it would have if a similar speed was used in air. Due to the lighting underwater being of a diffused nature, increased development time is required in order to gain sufficient contrast when using black and white film. Fig. 5 shows two photographs taken by the author.

Colour of the light is also of importance as the majority of the reds and yellows are removed when underwater, thus giving colour photographs an unusual bluish-green cast. It is, therefore, advisable when using colour to incorporate a suitable flash attachment to the camera for true rendition of colours. This point arises when using black and white films as well; since orthochromatic emulsion is not sensitive to red light panchromatic films should always be used, as they will record the remaining portion of the red end of the spectrum.

In conclusion may I warn you never to swim underwater alone, no matter how much you want privacy for your photography. It's too easy to get cramp. Secondly, do not swim through seaweed—you might lose your head if you get entangled.

Readers who are experienced photographers might also be interested to read a very comprehensive book on the subject, entitled "Underwater Photography" and published by the Cornell Maritime Press, Cambridge, Maryland, U.S.A.

Your Queries Answered

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

Replacing Gas Cooker Element

ON my gas cooker I have a lighter which uses a Vidor Cat. No. V-0011 battery or equivalent. When the resistance wire—or element—burns out I have to buy an expensive replacement part. Could you tell me what gauge of resistance wire I need, the formula for finding same and the best method of fixing ?—W. L. Harrison (Coventry).

ASSUMING that the battery is of the three-volt type, you could use a heater consisting of about 0.9in. of 45 s.w.g. nickel-chrome resistance wire. The required resistance of the wire is found by dividing the voltage of the battery by the current required. A suitable size of wire is then found from tables showing the temperature reached by various sizes of wire when carrying certain currents. The length of wire required to give the resistance calculated is then obtained from tables which show the resistance per foot of the various sizes of wire.

In the case of the wire in question this should reach about 500 degrees Centigrade if straight and in open air when carrying 0.46 amp., and the wire has a resistance of 87.5 ohms per foot. In the lighter the heater will reach a higher temperature than the tabulated values. The length of wire can be adjusted if necessary to give the best results in the lighter. The wire would probably be best passed through a slit or a loop at the top of the supports and twisted tightly round the support after cleaning the latter carefully.

Cartridge Paper for Lampshades

PLEASE furnish me with details for treating a good quality cartridge paper in order to make it suitable for making lampshades. Is there any method which would render the finished product reasonably fireproof ?—Bernard Raggett (Weston s. Mare).

CARTRIDGE paper can be made quite stiff and strong, as well as waterproof, by soaking it in a solution of a plastic. The latter should, of course, be in the uncured state, and when the paper is hung up to dry it will retain resin in its fibres Putting it in a warm but not hot oven for an hour or two will cure the resin and the paper will be stiff. There are various plastics you can use, which are dissolved in, for example, methylated spirit. Write to Aero Research, Duxford, Cambridge, who make melamine resins (plastics). They should be able to give you all data about concentrations, which should be around 10 per cent. by weight of resin in the paper for your purpose. Such paper will not burn easily, but tends instead to char.

Softened Water for Model Steam Loco

I AM going to operate a $10\frac{1}{2}$in. gauge steam locomotive this summer on a recreation ground. The local mains water is totally unsuitable for the boiler, as it causes it to prime badly. Rainwater and the water from a canal are both very suitable, but are both awkward to obtain. Could you please suggest any way of making the mains water more suitable, such as adding any chemicals ?—R. L. O. (Essex.)

WE advise the use of two tanks—the size must be decided by the amount of softened water you need daily.

Interconnect these tanks so as to be able to close one off from action while it is softening a batch of water. Then the next day you use the other tank as your softener and draw off from the first one. It would be as well to have some form of strainer tank common to the outflow of both in order to catch any solids which might be drawn off.

First estimate the hardness of your water by standard soap solution and soften down to 2 to 4 degrees of hardness. This softened water will not prime in your boiler.

For softening agent you can select one of two simple processes :

(a) Add trisodium phosphate ; or
(b) Lime and soda.

Try (a) first, as it is simpler, but you will need to allow to settle for a few hours and strain through wire mesh. If you use (b) you will have to allow the treatment tank to settle longer, say, 12 to 18 hours.

Obtain standard soap solution from Townson & Mercer, 101, Beddington Lane, Croydon. They supply a simple kit for the purpose.

In principle you run 10 c.c. to 25 c.c. of the hard water into a stoppered bottle and dilute it with 50 c.c. of boiled cool distilled water. You then run in your standard soap solution, one c.c. at a time, reducing as you get near the end to a quantity less than 1 c.c. and shake well after the addition of each c.c. of soap solution. When the lather remains unbroken upon laying the bottle on its side for a period of five minutes the estimation is finished, and you read off the degrees of hardness from the burette.

Alternatively, you may be able to gauge the degree of softening sufficiently near for your purpose by merely shaking your treated tank water with soap solution (as above described) and using the softened water like that. As the hardness of mains water varies very little you will soon discover how much of the chemicals to put into your reagent tank after a few experiments.

Readers are asked to note that we have discontinued our electrical query service. Replies that appear in these pages from time to time are old ones and are published as being of general interest. Will readers requiring information on other subjects please be as brief as possible with their enquiries.

Preventing Eye Glass Steaming

DURING the war a substance was sold in tubes and tins for preventing the steaming of the eye glass in gasmasks. Could you please tell me the nature of this material and how to make it ?—R. Jollands (Leicester).

THE transparent, wax-like substance to which you refer for preventing the steaming of eye glasses and lenses was usually pure stearic acid or any clear hard soap. The following composition, however, is much more easily applied and is more effective and economical :

White hard soap	1 oz.
Water	1 quart.
Glycerine	1 oz.

To the above, about $\frac{1}{2}$ oz. Turkey Red Oil can be added with advantage. The product sets to a jelly-like form on cooling and it can be applied conveniently to the glass by means of a soft rag or a tuft of cotton wool.

Sawdust and Binder Flooring Material

I DESIRE to level rough, uneven wood floors by laying sawdust mixed with a cold binder, this to harden in about 10 hours.

Can you inform me of the name of such a preparation and the proportions used for mixing with the sawdust, also names of possible suppliers ?

If it is possible I would attempt to stain

and polish the finished covering.—F. Moore (Kendal).

THERE is no existing cold binder for sawdust which you would be able to obtain, for all the binders of this type are based on various proprietary plastic materials which are not available for general use. If you wish to make your own direct inquiries in this matter we can refer you to Semtex, Ltd., 15-16, New Burlington Street, London, W.1, and also to Catalin, Ltd., Waltham Abbey, Essex.

It appears to us that the best material for your purpose would be a magnesite binder which will harden within about 30 hours (not 10 hours). This may be prepared yourself by mixing about equal quantities (by measure) of calcined magnesite with the sawdust and by slaking the mixture to the condition of a buttery paste with a solution containing 40 parts of magnesium chloride in 60 parts of water. The product so obtained may be coloured to any shade by admixture of a suitable amount of pigment such as yellow ochre or red oxide. It is spread to a level surface by means of a trowel, like mortar. Here again, unfortunately, supplies are difficult and often unobtainable. For calcined magnesite, you should apply to Messrs. Everitt and Co., Ltd., 40, Chapel Street, Liverpool, 3, whilst for magnesium chloride your best suppliers would be Messrs. S. Pitt and Co., Ltd., 95, Bath Street, Glasgow.

H.P. Rating Required

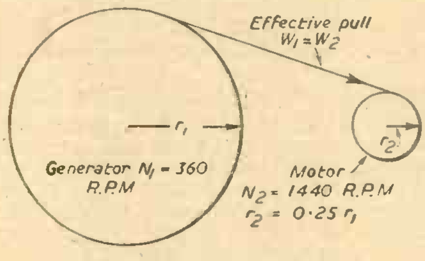
SUPPOSE an electric generator of about 40 h.p. output, in a motor generator set, be direct-coupled to a 40 h.p. motor of 360 r.p.m.

It has been suggested that if the generator was driven through a belt reduction drive of 4-1 ratio from a 1,440 r.p.m. motor (four times the generator speed), a 10 h.p. motor could be used (¼ the original power), neglecting frictional losses in power transmission. Is this correct or would it still be necessary to use a 40 h.p. motor irrespective of drive ratios ?—S. H. (Nottingham).

THE power equation for the horse-power of a motor or other source of power is :

$$\text{H.P.} = \frac{2 \times 3.142 \times N \times T}{33{,}000}$$

where N is the speed in revs. per min. and T is the torque at the driving shaft or pulley in lbs.-ft. Since $2 \times 3.142 \div 33{,}000$ is a constant it will be seen that H.P. is proportional to the product of the speed (N) and the torque (T). Thus the horse-power depends not solely on the



The 4-1 belt reduction drive.

speed of the machine, but also on the torque. The torque (T) is equal to W r, i.e., to the product of the radius of the pulley (r feet) and the effective pull (W lbs.) on the belt at the periphery of the pulley. W is actually equal to the difference in the tensions in the tight and the slack sides of the belt.

Thus in the case of the 40 h.p. generator having a pulley radius of r_1 ft. and a speed of 360 r.p.m. we may assume that a pull of W_1 lbs. would be required at the pulley. The horse-power is thus equal to

$$\frac{2 \times 3.142 \times N_1 \times W_1 \times r_1}{33{,}000}$$

Then W_1 is equal to $\dfrac{\text{H.P.} \times 33{,}000}{2 \times 3.142 \times N_1 \times r_1}$.

Therefore $W_1 = \dfrac{40 \times 33{,}000}{2 \times 3.142 \times 360 \times r_1} = \dfrac{584}{r_1}$ lbs.

If the generator is driven by a motor having a speed of 1,440 r.p.m. (N_2) the effective pull (W_2) at the pulley must obviously be the same as the pull (W_1) at the larger pulley on the generator. But the radius of the motor pulley must be one-quarter that of the generator pulley, i.e., $r_2 = 0.25 r_1$. Then the horse-power of the 1440 r.p.m. motor will be

$$\frac{2 \times 3.142 \times N_2 \times W_2 \times r_2}{33{,}000}$$

which is equal to

$$\frac{2 \times 3.142 \times 1440 \times 584 \times r_1 \times 0.25}{33{,}000 \times r_1} = 40\text{h.p.}$$

Thus it is impossible to drive the generator on full load by a 10 h.p. motor.

So far we have assumed there are no losses in the machines. In fact losses take place due to volt drop across the brushes, heating losses due to the resistance of the windings and the iron losses in the cores, etc., and there are losses due to bearing friction and belt slip. The efficiency of the machines may be about 90 per cent. each. Thus for a 40 h.p. output from the generator about 44 h.p. would have to be applied at the shaft, and about 49 h.p. would have to be put into the driving motor.

Forty h.p. could be obtained from the generator by driving this by an overloaded 40 h.p. motor but overload for a prolonged period is undesirable.

Painting an Aluminium Cowl

I WANT to make an aluminium cowl. This metal easily corrodes, so what anti-corrosive paint could I apply ? —H. Olver (Kent).

IT is not necessary to spray on a paint to aluminium, which does not corrode as much as steel in a normal atmosphere. It depends on what is passing through the cowl. If it is exhausted air you need not bother to paint, for a white oxide will form on the aluminium which serves to protect the underlying metal. If you must paint, use two coats of a good brushing paint or lacquer.

Information Sought

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

Drill Stand

PLEASE tell me how to make a stand for a ⅜in. Duplex electric drill. I have access to various machines at my place of work.—T. Wilkinson (Fulham, S.W.6).

An Engineer's Stethoscope

I WISH to make an engineer's stethoscope. I have the facilities of a small, well-equipped workshop. Can you supply the necessary information ?—N. Davies (Lancs).

Propulsion Unit for a 12ft. Boat

I INTEND to make a Hotchkiss cone propulsion unit for a 12ft. vee-bottom boat and I shall be glad if you will give me any information concerning same. I propose to use as a power unit a converted Ford 8 h.p. engine.—N. Corrie (Eire).

Automatically-controlled Car Gates

I AM seeking information in connection with the automatic operation of gates or doors. The approach of a car, either by the transmission of a radio signal from the car or by its passage over a concealed detector in the approach, would operate the gate mechanism and cause it to open. Closing could, of course, be effected by some form of time switch. The mechanism should be effective with the approach of the car from either direction. I have considered photoelectric cells and the interruption of a beam of light, but have discarded these as, unless this could be arranged to operate by some means due to the presence of a car alone, the gates would open on the approach of all forms of transport and pedestrians.

Can you put forward any suggestions ?—H. J. Bridge (Liverpool, 21).

Spray for Insecticides and Fertilisers

COULD you suggest a design for a spray gun for spraying insecticides and fertilisers, attached to the domestic garden hose and operated by water pressure, together with a means of adjusting the chemical strength of the spray ?—G. C. O'Farrell (Tasmania).

Swimming Pool Construction

CAN you give me details for constructing a home-made swimming pool, and also tell me how long the water will remain pure during the summer months, and how often it would have to be changed ?—S. W. Pearse (Cornwall).

Duplicating Photographs

I WISH to duplicate photographs by means of a flat-bed duplicator. I know that the stencils to do this can be " cut " commercially by the firms that specialise in duplicating materials, but I should like to do it myself if it is possible. Can you please give me an outline of the processes involved or alternatively where I can obtain details of the chemicals, etc., required ?—J. C. Larson (Sheffield).

Setting Fishing Flies in Plastic

I AM making a cigarette box and for decoration wish to insert in the top of the box fishing flies set in transparent plastic.

Could you inform me :

(1) Would cellulose lacquer be suitable for the plastic, or is there a better medium that could be employed ?

(2) If the fly was mounted in a metal mould and floated over with the plastic would the surface need polishing ?

(3) If the mould was slightly greased (with white vaseline) would this enable the plastic to be easily removed, or would the lacquer dissolve the grease and thereby discolour it ?—A. M. (Warrington).

The Tattooing Process

COULD you please advise me on the purchasing or making of the equipment necessary for tattooing, also the name and address of any firm able to supply suitable inks, etc. ?—R. Graham (Preston).

Making a Small Trailer

I WISH to make a small trailer suitable for conveying livestock to a maximum weight of 10cwt. The trailer, which should have a dropped axle, will be towed by a Ferguson tractor.

Approximate overall measurements of body: 5ft. 6in. x 3ft. 4in. x 2ft. 6in. deep.

Can you please advise me on the planning of: (a) Wooden chassis to fit on a car front axle; (b) Chassis from steel angle section (welded) with own dropped axle ?

In both cases it is essential that the chassis weight be as low as possible.—R. D. Weale (Hereford).

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Editor: F. J. CAMM

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Phone: Temple Bar 4363
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WHAT I THINK

By F. J. C.

The 1956 Tour de France

AT the moment of writing there seems to be some doubt as to whether England will support the 1956 Tour de France, a professional race which is front page news in that country and which provides valuable publicity for the sport, the industry, and the riders. An invitation has been issued to the manufacturers over here, and this seems to have upset the National Cyclists' Union, which feels that as a body which is affiliated to the Union Cycliste Internationale it is the properly constituted body to receive, accept, or reject invitations to such international events. Perhaps the shadow of past events in connection with the N.C.U. and its undiplomatic handling of cycling matters has cast a shadow in the minds of those responsible for organising this great event. The attitude of the N.C.U. towards the British League of Racing Cyclists, towards the R.T.T.C. and to cycling sport in general has caused, undoubtedly, a lack of confidence in its judgment and in its ability. At present, it is suffering from shortage of money, and unless something drastic is done, a different outlook adopted by its executive and a new look given to its general policy, it will not be many years before its decease.

The N.C.U. has always been jealous of other bodies. It has always tried to be a militant body, and no other cycling body has ever generated so much heat with so little fuel. In some cases, its attitude has been deliberately malicious and spiteful and in others positively obstructive. One had only to chat with club men to learn what cycling opinion is. The N.C.U., however, blandly oblivious of this continues with its dictatorial policy, instead of existing to serve and to listen. It is possible that if we do send teams to compete in the Tour the trade would be better selectors than the N.C.U. It has not always selected riders for international events with the strict impartiality necessary for such a task, preferring to let personalities stand in the way of enhancing the prestige of British sport. Of course, the clubs themselves are to some extent to blame. They have ample powers collectively to reorganise the N.C.U., or to found an entirely new body to take over all cycle sport, including record-breaking. The N.C.U. alone has a permanent office. The others are very much run from the homes of their officers. Were one unified body formed a permanent address would be secured, and the task of governing all forms of cycle sport could be departmentalised with considerable financial economy. It would immediately rid the sport of the internecine conflict which has been smouldering like a volcano ever since the N.C.U. stabbed cycling sport in the back. The British League of Racing Cyclists has already expressed its willingness to amalgamate with the N.C.U. and to run the Tour of Britain jointly, and the committee appointed by the N.C.U. General Council for relations with other bodies has decided that there is only one satisfactory solution to present difficulties and that is to adopt our suggestion that the B.L.R.C., R.T.T.C. and N.C.U. should amalgamate. It is prepared to discuss the question of amalgamation. Why not do it quickly before it is too late?

The Origin of the Show

WE wonder how many of those who visited the Cycle Show realise that the first cycle shows were inaugurated towards the end of the last century. The Cycle Show grew out of the Stanley Shows held at the Agricultural Hall, Islington, while the National Cycle Show was held at the Crystal Palace. The Stanley Show, however, was the classic. It really grew out of the Stanley Bicycle Club, which was formed on May 1st, 1876, when the famous explorer, H. M. Stanley, was at the height of his fame, and the youthful cyclists, conceiving some analogy between themselves as explorers of the countryside and the new-fangled bicycle, adopted his name, as well as the Stanley helmet, as part of the club's official uniform. It could not have been a force of circumstance that the club's first meeting-place was the Lord Stanley Hotel in Camden Park Road. The Stanley B.C. made a speciality of social gatherings during the winter—or "off" season—these taking the form of lectures, debates, etc. For instance, on January 25th, 1878, a very prominent member, J. Dring, read a paper on "Luggage carrying." Early in 1878, the members decided to present their hon. secretary, J. Robinson Airey, with a testimonial, which took the very practical shape of a new bicycle—a "Timberlake," a make long since defunct and forgotten, but among the foremost in those far-off days. The presentation was made at a musical evening held at the club's headquarters, the Athenaeum, Camden Road, N.W., on March 12th, 1878; and, as a side-line to the musical items, some genius hit on the idea of inviting cycle-makers to send samples of their latest patterns for exhibition in the hall. The committee expected about a dozen machines, but the trade responded with such enthusiasm (being, even then, commercially minded individuals) that 70 bicycles and four tricycles were staged by 30 firms, and the affair was extended to cover two evenings. The leading bicycling paper of the period announced the function in the following words: "On Tuesday, March 12th, a bicycle conversazione and exhibition of bicycles takes place . . . a good programme of music has been obtained for each evening of the exhibition." The same paper reported the "do" in a paragraph of 26 lines.

The old Shovel
Cowley Middx.
A quaint old canal side inn near Uxbridge. Standing overlooking the lock it remains still an unspoilt corner of rural Middlesex . . . .

The second Stanley Show was held at the Foresters' Hall, Wilderness Row, in February, 1879, 110 machines being on view. By and by, Arthur Fox joined the club and became hon. secretary. The 1880 show, held at the Holborn Town Hall, was notable for the appearance of H. J. Lawson's first rear-driving "safety" bicycle. One hundred and fifty machines were staged. The show prospered beyond the wildest dreams of the originators, and was recognised by trade and public alike as the function at which new models appeared each season. In 1893, certain bicycle manufacturers cut adrift from the Stanley Exhibition and promoted a show of their own at the Crystal Place; this, known as the National Show, was held annually for 11 years, but the Stanley Show carried on, harmed very little by the opposition. In 1910 the present series of shows was inaugurated by the Cycle and Motor Cycle Manufacturers' and Traders' Union, at Olympia, and the old Stanley Show died.

Wayside Thoughts

By F. J. URRY, M.B.E.

Another Ratio

WE go on from development to development in the matter of changing the gear ratios of the bicycle, and the latest design in S.A. hubs is an ultra high and low four-change giving 33in., 45in., 60in. and 81in., a combination specially suitable for the tourist and particularly the foreign wanderer. I recently came into the ownership of such a hub, but have not yet tried it out sufficiently to make any pronouncement other than that the changes suit me admirably, for that very low range allows me to lounge up very long slopes at little more than walking speed, but lets me sit down to the job and even finish a smoke without undue puffing. The low gear requires the service of a separate trigger fixed on the left of the bar, but this to me is no detriment because it eases the pull of shifting the control rod, and as a result works easily.

It seems years now—and of course it is—since change gearing was confined to the normal two and three ratio types; but the perfecting of the chain gear made all of us more gear conscious (even the racing men), and gave to the elderly rider a genuine aid for the climbing of hills and long slopes without hurrying. I used to say there was a point when the low gear was too low for regular use; now I have shifted that opinion and think the high gear can be too high, for the travel conditions have to be ideal for me to need the 81in. They do occur occasionally, however, when the wind is howling down the road and hitting me in the middle of the back; then I begin to feel really superior when meeting the fellows butting into the gale.

The Reason Why

SOMEONE asked me recently why I did not fit motor power to one of my bicycles, and no doubt that notion has occurred to many an elderly cyclist. Speaking personally, the "fliffer" does not appeal for the simple reason that I am too fond of the pedalling exercise and, perhaps, almost unconsciously, the perfect silence of the bicycle, a virtue too seldom appreciated in this noisy world. Any kind of power help would destroy for me the simplicity of the bicycle.

I see quite a lot of these little "fliffers" on my journey to work and home, and frequently see their owners trying to persuade them to do their job, or pedalling the dead engine to the repair man. And I do not blame the motor, for most of the people who use this type of help neglect the condition of their bicycles and it naturally follows they run the motor to a standstill rather than give it the attention it demands. There are others who race the little fellow to death, apparently expecting it to undertake the function of an engine four times its size. My remarks should be taken, perhaps, with a grain of salt, for they are the opinions of a cyclist far too fond of his pastime to invade its silence with the beat of an engine. I like to feel independent of any kind of help, for to me it is one of the virtues of cycling to be free and let the swifter gathering miles go hang.

Fear Not the Weather

IT was a good summer in my area, with fine spells of sunny weather, and for cycling it was delightful, for its sunny benefit allowed me to keep coolly clad and lively. When you can sense the heat before it falls and are in no great haste you can select your halt and let the day roll by, later returning over the cooling roads, with their scorched borders long-shadowed by the evening sun. The quiet miles slip by graced with the vignetted visions of a lovely countryside.

There were times, though, when a shower would have been welcome as a refresher. At these times just travel in the tinkle of rain a trifle more slowly, so that the tent-like cape does not irritate too much. Often enough we make ourselves hot and sticky because pride or pigheadedness will not allow us to slow down; and when you come to analyse the conditions what do a few minutes matter when you are riding for pleasure?

I like the mixed days of shine and rain so long as the damp element does not predominate, for they keep the air cool and fresh and vivid, and a complementary match for your activity. Such times may not suit the sun-bather, who apparently likes to be roasted, but I prefer my sun-bathing to contain a measure of activity, and I know nothing quite so good as cycling to fulfil that rôle. Therefore I have no complaint against mixed weather, it keeps you cool and frames some enchanting views, but if I sat me down at some seaside resort maybe I should not feel so complacent, which is just another reason why people who can should take a cycling holiday.

High Rocks nr Tunbridge Wells.
Lying amidst lovely gorseland to the south of the town. The massive rocks are covered with curious inscriptions many over 200 years old.

A Question of Raiment

I AM by no means certain that the colourful raiment adopted by the younger element of cyclists has all the advantages they claim, nor indeed that there is real comfort for the wearers. Such an outlook may be old fashioned in the eyes of the younger folk, but I must confess I should not feel quite happy in an hotel lounge or an hotel dining room in brief shorts and a highly tinted jersey. I have known, too, many another individual with whom I have talked who plainly stated they could not disport themselves in the garb of the majority of the modern club folk.

Such folk have seemed to think modern cycling demands modern raiment, notwithstanding the fact they see daily hundreds of utility riders, including me, travelling to work in all sorts of garb. It cannot be too often stated that cycling needs no special form of raiment, and that which suits the individual suits cycling. So far as modern dress for cycling is concerned, I have tried it on various occasions and have not found it comfortable. Our variable weather, particularly during rest periods, gives me a chilly feeling as often as not, so I prefer to shed raiment and carry it in the bag when I am too warm than take the risk of chilly discomfort.

Scotland Under Storm

I RECENTLY spent eleven days in Scotland with a family party in a car, and because it rained nearly every day we travelled too many miles, and at the end of the sojourn I was weary of motoring and glad to sling a leg over a bicycle. Yet I enjoyed the change, for to see Scotland under storm, with rivers in spate, is an experience holding many compensations.

I saw a host of touring cyclists and that was a cheering thing following an opinion expressed that cycle touring was not quite so popular as of yore. Those great Scottish valleys full of the gloom of a cool and sometimes vicious early July, with but an occasional break of sunshine to jewel the lochs, were magnificent pictures with the clouds sweeping the flanks of the hills, the road to the Isles lapped by the waters of Lock Eilt. Every corrie was foaming with brown flood, and in places tearing away road surfaces. What the cycle campers thought of the weather I do not know, nor did those I spoke to tell me, for they were far too cheerful even to suggest to them the weather was a trifle inclement. I did notice, however, that the majority of riders were using the main roads, where the coaches swing round the bends at frequent intervals, and few of them were scattered along the lesser ways where the motor traffic was very thin.

I suppose I did the same thing when I first went to Scotland, yet how vividly I remember the old road from Corpach to Mallaig, with its jumps and wriggles and its atrocious surface. It still winds among the hills and lochs, but its erstwhile tattered garment has been mended. I remember, too, having ridden that forty miles, I turned round next day and retraced; it was so beautiful, and I still think it is the finest stretch of road in Great Britain.

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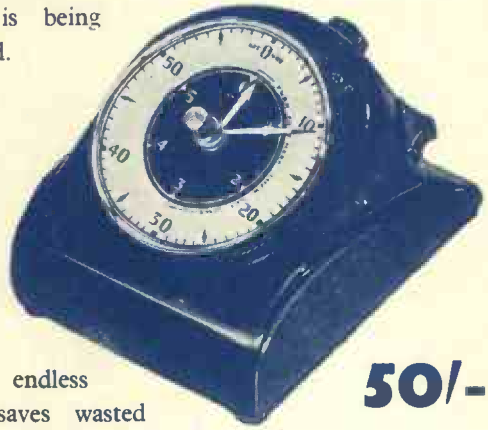

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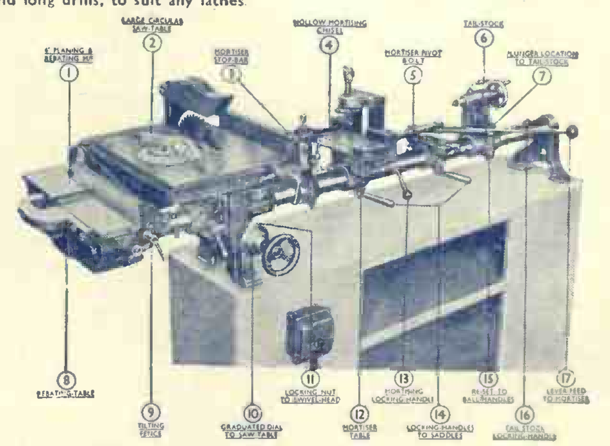

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