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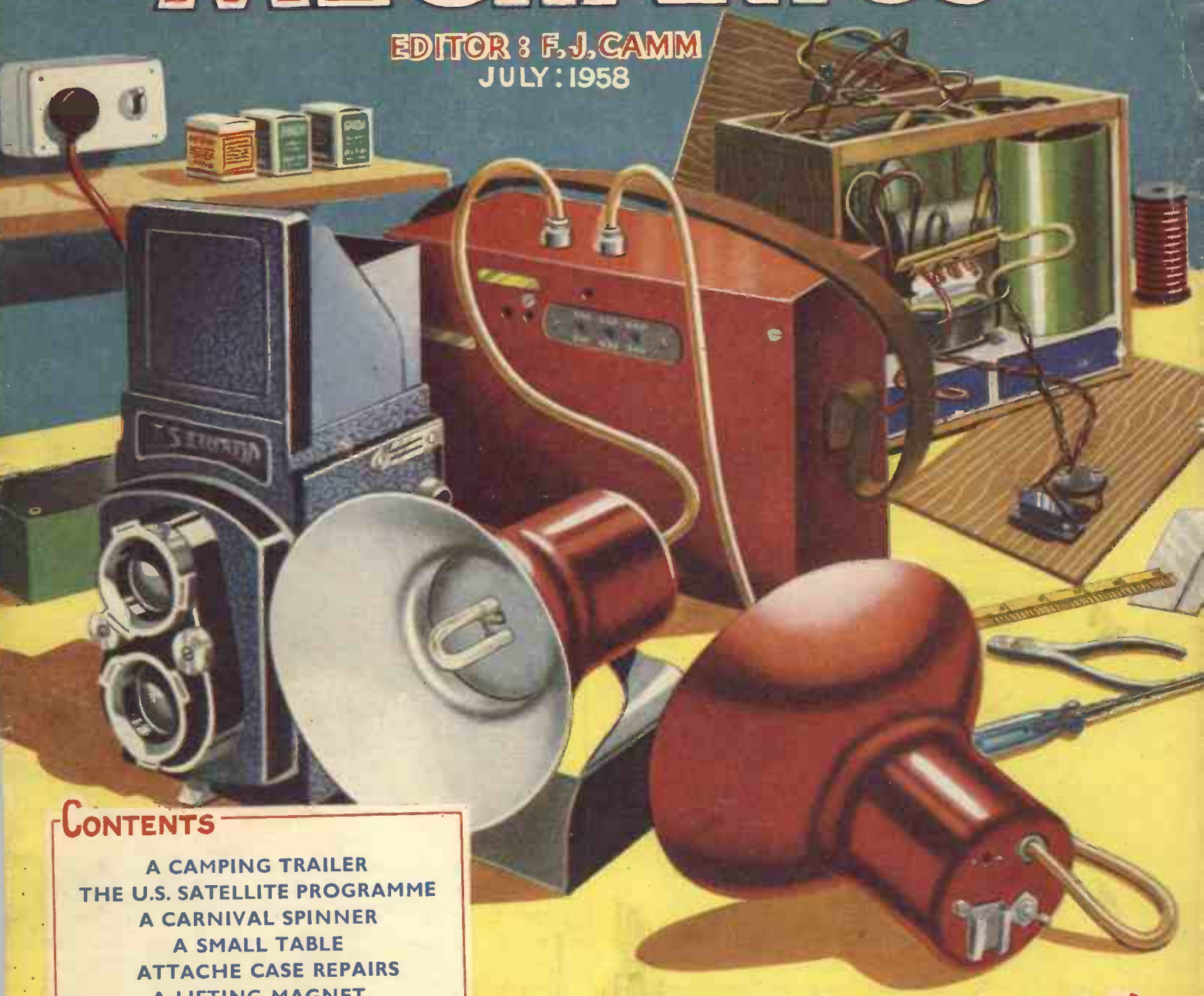
PRACTICAL MECHANICS

EDITOR : F. J. CAMM
JULY : 1958



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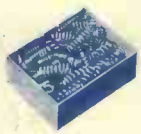

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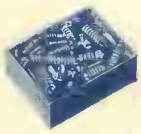

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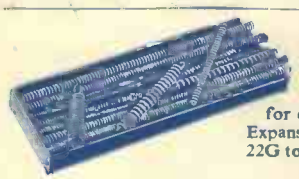

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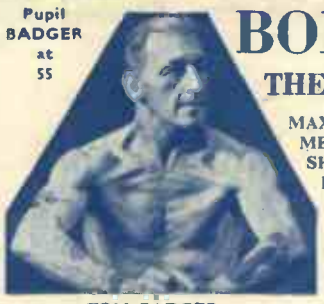

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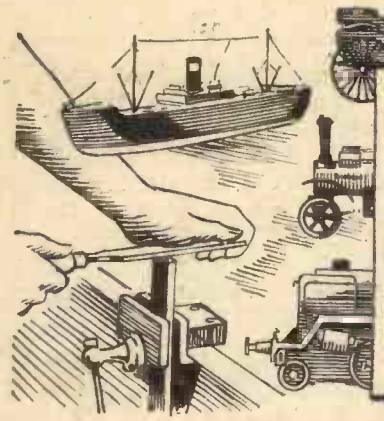

Practical Mechanics

Vol. XXV. No. 293 JULY, 1958

"The Cyclist" and "Home Movies" are temporarily incorporated

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CONTRIBUTIONS

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

FAIR COMMENT

MINIATURE POWER VEHICLES

ONE remarkable feature of the bus strike has been the calm with which the public accepted the challenge. There has been no public outcry and members of the public resident in the affected areas, inured to transport strikes, this time took immediate steps to find alternative means of transport. Some were able to use the Underground railways, a comparative few were able to obtain lifts, but a vast number took to two wheels, either pedal or power propelled. The public in other words has taken steps to make itself independently mobile, and scooters, mopeds and motorised bicycles have sold in great numbers during the past few weeks. These handy vehicles are reasonably fast and reliable, they give weather protection to the rider and they cost very little to run, most of them doing more than one hundred miles to the gallon, some nearly 200 miles. The strike has indeed forced the individual to realise that the settlement of a strike is but a temporary affair, whether in transport or in any other sphere. The modest bicycle which costs practically nothing to run and even when used for utility purposes combines a healthy pastime has also been selling well.

The transport industry, therefore, as a result of the strike, has lost a large number of its customers who are unlikely to tolerate further the risk of inconvenience and increase in their travelling costs, for whatever claim is granted must eventually come out of the pocket of the user. The handy and reliable moped has provided a ready-made solution. These tiny vehicles came into use immediately after the war as the result of Continental development. Until British manufacturers got busy all of the machines were of Continental manufacture, but now there are several British makes. The user, apart from saving money by this fascinating form of travel, has eliminated the discomfort of bus and Underground travel. He can run to his own time schedule and is no longer the victim of strikes. The Cyclist Touring Club, as was expected, scorned them. Its secretary described them as neither fish nor flesh. They, however, are here to stay and have affected the sales of bicycles. No doubt London Transport are very concerned at this turn of events. Indeed, they warned busmen that the strike is likely to lose them custom. It is quite apparent and the facts must be faced that individuals should no longer place reliance upon archaic means of transport such as buses, trams, Underground railways and trains, and the aim should be towards making oneself completely independent of them. "With the congestion on the streets, the heyday of the bus is gone," says Sir John Elliot, chairman of London Transport. The strike, therefore, has performed one useful purpose, in demonstrating that one of the main causes of congestion is buses—not private cars.

The sales of the miniature bubble cars continue to rise, and further fortify the opinion that the travelling public intends to become independently mobile. The buses, the trams and the Underground railways have been losing millions a year for a long time, and the gradual scrapping of surface vehicles will help to lessen the burden of taxation. Buses in the not too distant future will merely be used in outlying districts.

THE "BEGINNER'S GUIDE TO TELEVISION"

OUR new handbook entitled "Beginner's Guide to Television," a companion volume to "Beginner's Guide to Radio" (now being produced also in Braille) will be published on July 19th. It is an elementary guide in fifteen lessons, and those who require a rudimentary introduction to television should study this book which costs 7s. 6d., or 8s. 3d. by post from the Book Department, address as on this page.—F. J. C.

CAMPING EQUIPMENT

The First of a Short Series

Making a Camping Trailer

A DUAL-PURPOSE CARRIER AND COOKING ANNEXE

By F. HOOK

THE trailer will form the ideal method of carrying camping gear. If the motorist is a regular week-end camper, then the trailer will be of especial benefit, as, when returning late on a Sunday night, the trailer is unhitched and the equipment is all ready for the next week-end and need not be all unpacked.

A good many of the dimensions of this trailer will be dependent on the type of axle which is used in its construction. The reader will have to visit the car-breakers' yard and look for the front axle with the two semi-elliptical springs suspension found on the old Morris Minor and similar cars. The trailer shown in the photographs was built upon a very ancient Morris axle. It was rather heavy but very robust, and the 19in. wheels made it rather higher off the ground than could be wished for. Nevertheless, very heavy loads of gear have been carried in it many thousands of miles.

As the unladen weight of the trailer will exceed 2 cwt. it will be necessary to fit overrun brakes to the trailer in order to comply with the law. Therefore, when purchasing the axle, examine the brakes fitted to the wheels to see that they are in working order and may be easily adapted to work from the over-run mechanism on the towing bar.

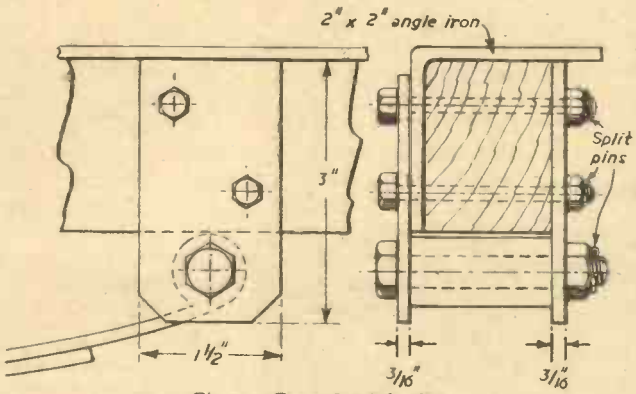

Fig. 1.—Front fixed shackle.

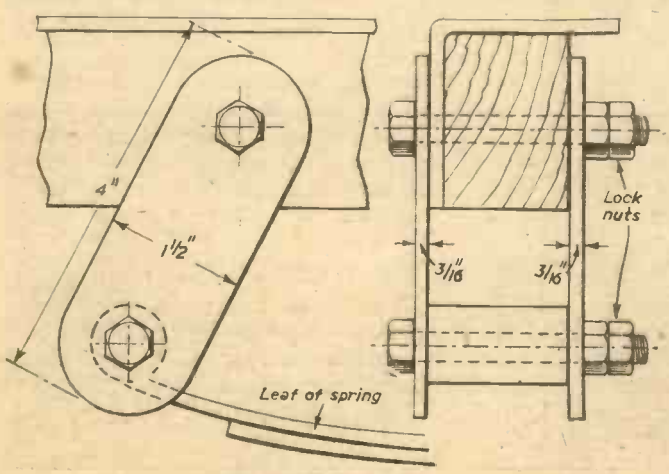

Fig. 2.—Rear shackle

On some axles the brake arms may be so arranged, as was the case of the author's axle, that the axle, when fitted to the trailer, ran forwards in the reverse direction to that which it did in the car to which it was originally fitted. In such a case it will be necessary to adjust the track rod connecting the two wheels so that the pair of wheels do not "toe out." It will be remembered that the front wheels of cars generally do not run parallel but are toed-in about ⅛in. to improve steering characteristics.

The Axle

First of all obtain a suitable front car axle, strip it of all unnecessary fittings and

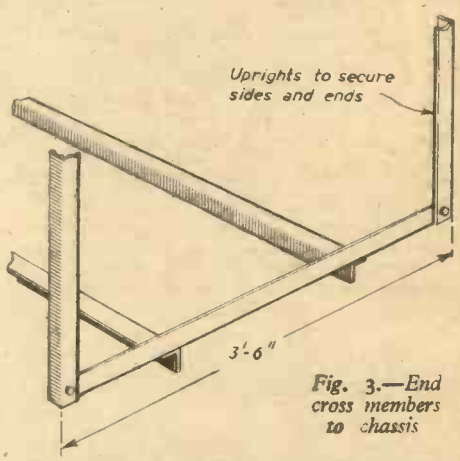

Fig. 3.—End cross members to chassis

WHAT THE SERIES WILL COVER

TWO types of trailer will be described. Firstly, details are given of a rather larger box-type trailer with lids which rise up and form the walls of an extremely simple caravan-like structure. This will be most useful as a cooking annexe in camp or it may be used for washing purposes, etc. The 6ft.-long seat along one side of the trailer may also be pulled out to form an occasional bed if desired.

Secondly, a description is given of a very light, low loading trailer, especially useful for high-speed touring and designed to take camp gear only. It is covered with a tarpaulin or the ground sheet of the tent.

This trailer chassis can be adapted to carry the PRACTICAL MECHANICS Pram Dinghy described in our issues dated August to November, 1956. In such a case the camp equipment is carried in the dinghy.

Tent designs are very numerous, but the simple Cottage Tent is still the best seller and is ideal for family camping. Details of making such a tent in lightweight material will be given.

With transport and shelter taken care of one's thoughts turn to further camp comforts. A design will be given for a cooking unit in which one may cook in a gale without the stove blowing out. This will be followed by a design for a set of light folding table and chairs which will add greatly to camp comfort with but little extra weight.

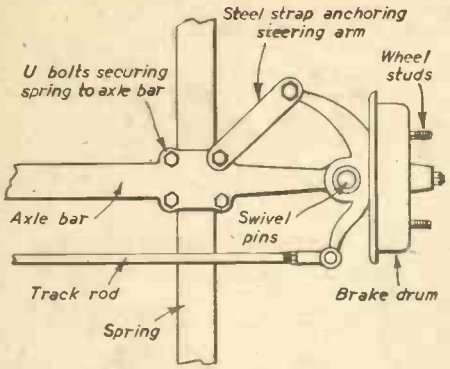

Fig. 4.—Method of anchoring the steering arm.

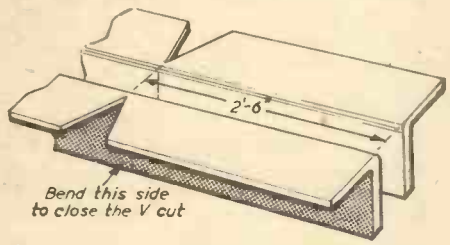

Fig. 5.—V notches in the towing bar.

note the direction in which the brake arms have to be pulled in order to apply the brakes. Then arrange in which direction the axle will move so that the brakes are applied according to the instructions in the previous paragraph.

Next, note that the ends of the springs nearest to the front end of the trailer are fixed to the chassis whereas the rear ends of the springs are fixed to a movable shackle plate to accommodate the movement of the springs when the trailer is in use.

The two main members of the chassis are made of two pieces of 2in. × 2in. angle iron each 7ft. 6in. in length. On the inside angle of these members are two lengths of timber of thickness arranged so that together with the thickness of the angle iron the width of the eye at the end of the springs is obtained. Refer to Figs. 1 and 2 which give the constructional details of the front and rear shackles.

Having bolted the shackles to the chassis members, next drill the ends to which are secured two pieces of angle iron as shown in Fig. 3. Bolt together very securely after ascertaining that the framework is square.

Note that on the backplate of one brake drum is the steering arm which is interconnected with the other wheel by the track rod. Adjust the wheels to be parallel with the chassis members and then securely fix the arm to a point on the chassis so that it cannot move. On the trailer now described, the point of anchorage was the end of one of the U-bolts securing the springs to the axle (Fig. 4).

The Towing Bar

At 2ft. 6in. from the ends of the two pieces of 7ft. 6in. long angle iron for the towing bar make a V-cut as in Fig. 5. This will enable the iron to be bent to the angle shown in Fig 6. When the correct angle has been obtained the V-joint should be welded. It is suggested that if welding cannot be done a suitable plate could be bolted across the joint (Fig. 7).

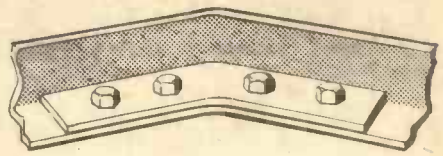

Fig. 7.—Strengthening the V cut with a plate bolted on.

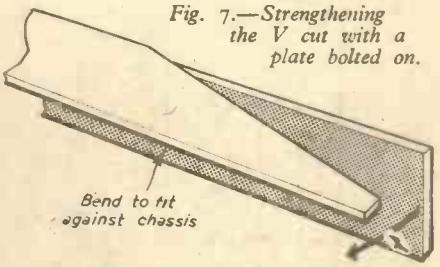

Fig. 8.—How the ends of the towing bar are cut and bent.

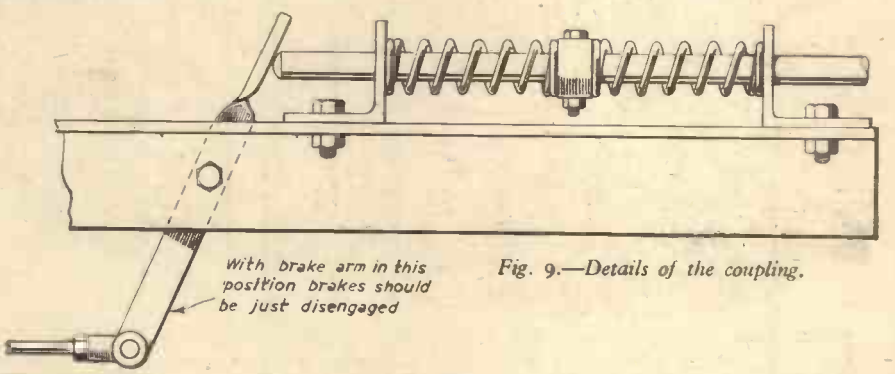

Fig. 9.—Details of the coupling.

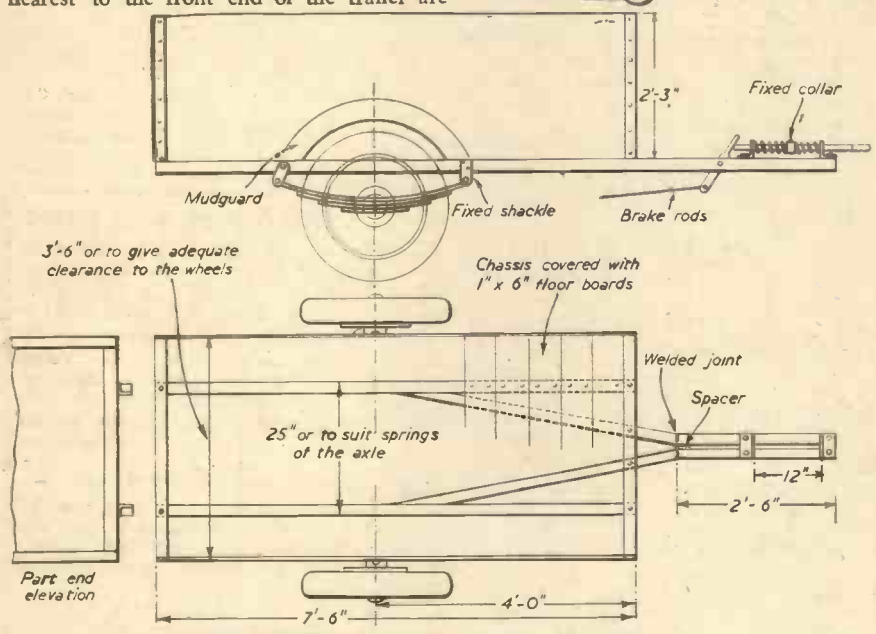

Fig. 6.—Side elevation and plan of trailer.

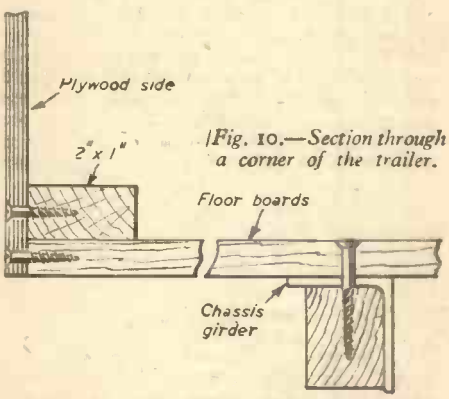

Fig. 10.—Section through a corner of the trailer.

The rear ends of these two pieces have a tapering piece sawn from the top sides of the angles to run in with the main members of the chassis. The vertical sides of the angles are then bent to fit against the chassis members to which they are subsequently bolted as in Fig. 8. Before drilling these members it is as well to hold them both in position with small G-cramps to test that the draw bar is on the centre line of the trailer. Also fit the spacer plate at the V-junction shown in Fig. 6. This spacer is

The trailer in the closed position.

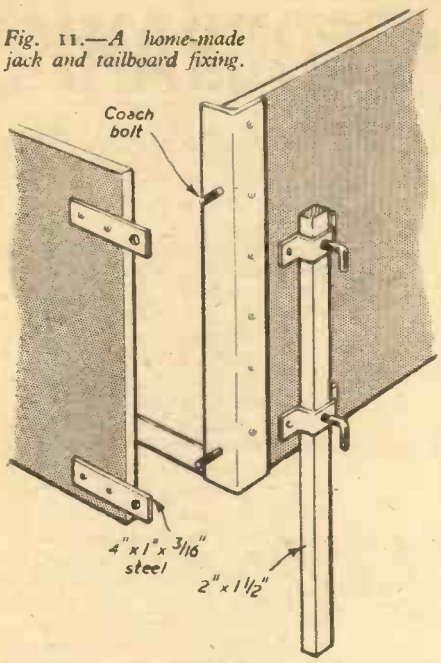

Fig. 11.—A home-made jack and tailboard fixing.

made from the same material as the brake lever. A piece of tinplate packing may be added so that the brake arm will move easily between the two pieces of angle iron.

The Coupling

Perhaps the reader who wishes to cut down metal constructional work could purchase a commercial coupling unit and fix it to the end of the draw bar.

On the other hand a simple design is shown in Fig. 9 which the reader could make for himself. Two short cross-members of 3in. × 3in. angle iron are bolted to the draw bar as shown. Two holes are drilled in them to take the coupling bar made from ⅜in. dia. steel bar to one end of which an eye is forged to hitch to the towing bracket on the car. A collar is fixed in the centre of the space between the two pieces of angle iron to take the pull and push of the two stout springs. The collar is secured with a high tensile steel bolt. Alternatively, the collar could be welded to the coupling bar.

Experiment will be necessary with the length of the brake lever so that sufficient movement is obtained at the lower end of the lever to give full application of the brakes, having regard to the amount of movement on the top end of the lever.

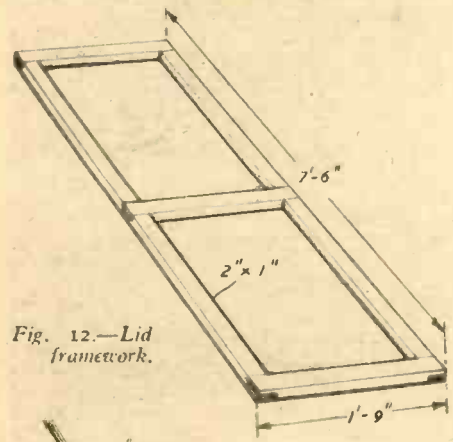

Fig. 12.—Lid framework.

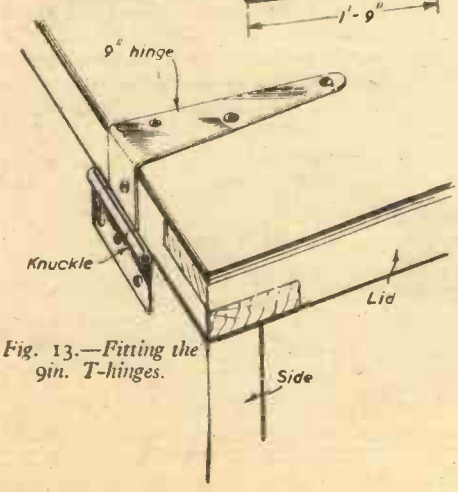

Fig. 13.—Fitting the 9in. T-hinges.

Floor Boards

The chassis is now completed and can be drawn behind a car in this state. Work must now proceed upon the body.

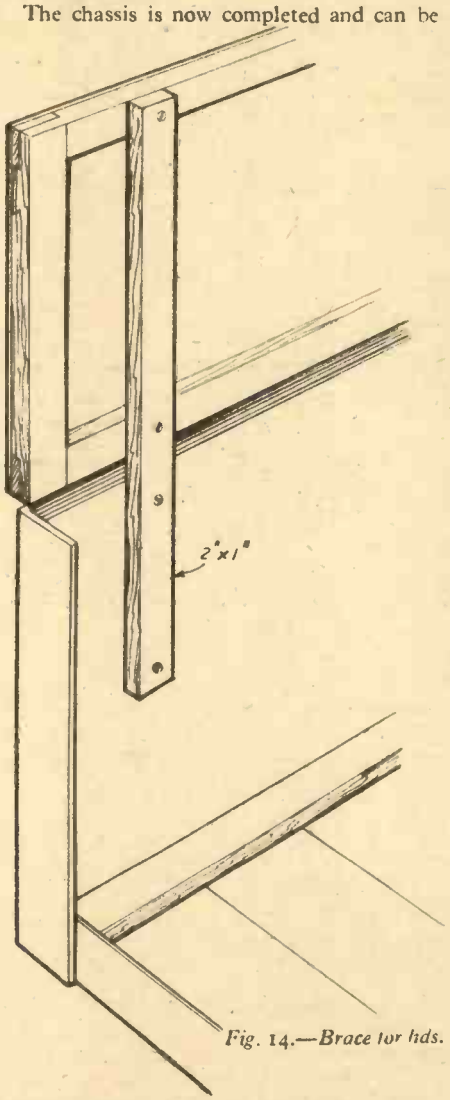

Fig. 14.—Brace for lids.

First of all prepare the timber for the floor. This is made from some 1in. × 6in. floorboards. The width of the floor is governed by the clearance between the two road wheels as shown in Fig. 6.

A wider floor space could be made overlapping the wheels as in the case of caravan construction. This would, of course, necessitate the construction of wheel arches which adds to the work. For simplicity the design shown was used.

The required number of 1in. × 6in. × 3ft. 5in. floorboards are screwed or bolted to the chassis. This will necessitate drilling through the angle iron so that the screws can take up in the wooden members secured on the underside.

Sides of the Trailer

At each end of the floor and secured to the ends of angle iron cross-members is a vertical piece of 1½in. × 1½in. angle iron 2ft. 3in. in length.

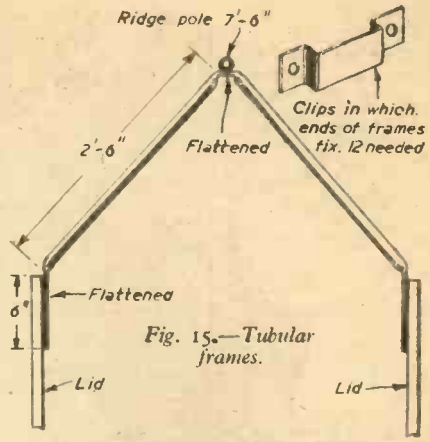

Fig. 15.—Tubular frames.

The sides and ends of the trailer are made from 5/16in. or ⅜in. resin-bonded plywood and bolted to these corner members. The lower edges of the sides overlap the ends of the floorboards as shown in Fig. 10 to which they are secured. Additional strength at these points can be obtained by fitting lengths of 2in. × 1in. deal.

The front end of the trailer is fixed whereas the rear end is made removable in the nature of a tailboard.

Jacking

At this juncture some thought should be given to methods of jacking the trailer. Here again, four commercial jacks could be bought and fitted. Alternatively, some simple home-made jacks can be made on the lines of those shown in Fig. 11, which

(Continued on page 474.)

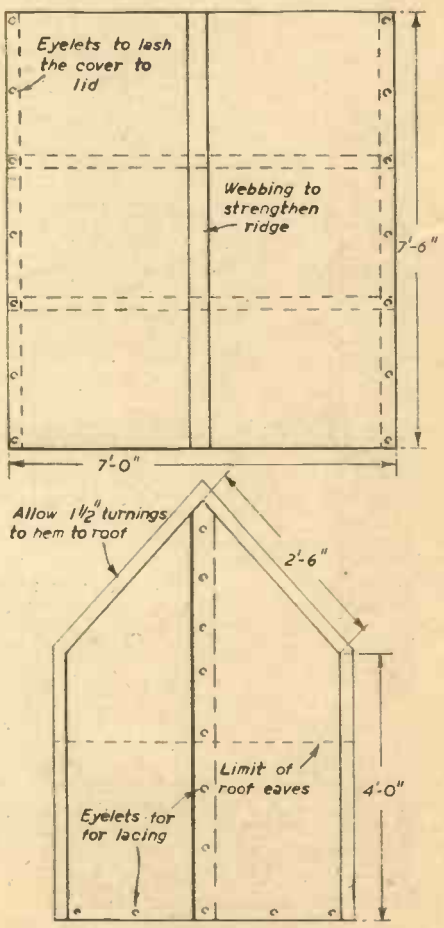

Fig. 16.—Details of the canvas covering.

THE U.S. SATELLITE PROGRAMME

Part 1—The Satellites, Details of Their Rockets, Launching and Instrumentation

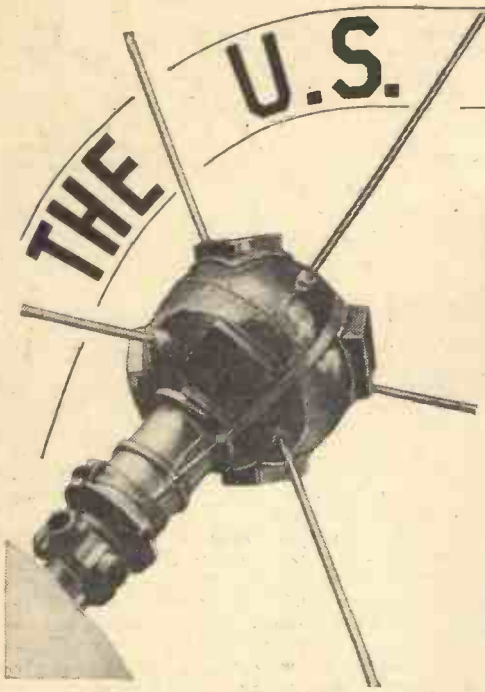

Fig. 1.—The 7in. diameter Vanguard I.

AMERICAN scientists planned to launch six fully-instrumented satellites during the International Geophysical Year and put into orbit several other "test vehicles."

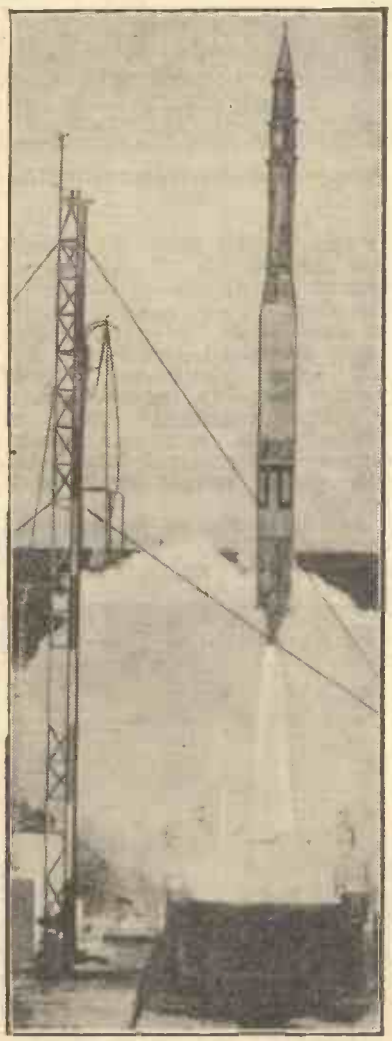

Fig. 2.—The Vanguard launching vehicle as it took off to put Vanguard I into orbit.

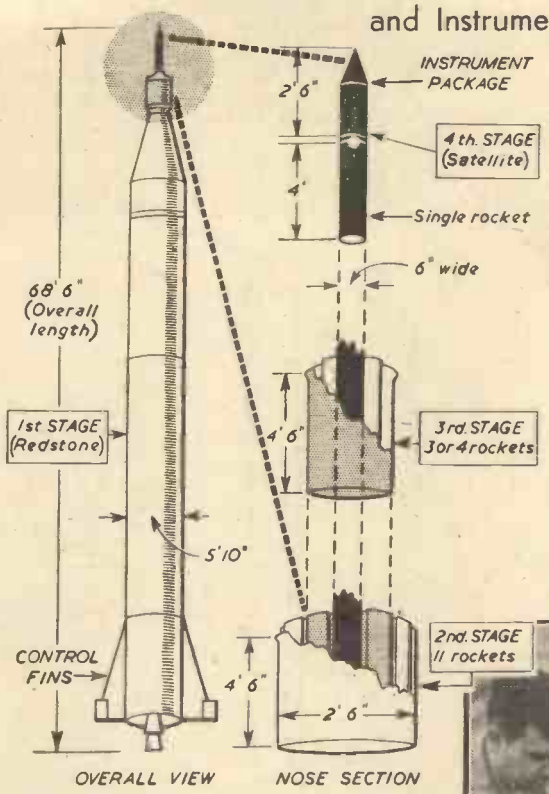

Fig. 3.—Details of the 70ft. Jupiter C launching vehicle.

By the end of March, 1958, the U.S. had three satellites in orbit, the first of these, Explorer I, being launched on January 31. The Vanguard I satellite (Explorer II) followed seven weeks later and a few days after this Explorer III was in orbit.

Explorer I (shown diagrammatically in Fig. 4) and Explorer III were rocket-shaped satellites with identical dimensions—80in. in length and 6in. in diameter. Both were launched by a Jupiter-C rocket. Explorer II was launched by a Vanguard rocket and its shape and general appearance may be seen in Fig. 1.

The Launching Vehicles

Details of the Jupiter-C rocket can be seen in Fig. 3. The first stage is a modified "Redstone" rocket modified to burn a hydrazine-based compound instead of alcohol. The three following stages are contained in a barrel-like cylinder. The second stage is a cluster of eleven solid-propellant rockets surrounding the third stage—a triangle of three similar rockets. Directly in the centre is the fourth stage—a single solid rocket with its instrumented section extending above the lower portion of the barrel. This boosts the speed to 18,000 m.p.h. and its casing remains attached to the satellite in orbit.

The Vanguard vehicle, shown in Fig. 2 taking off to put the first test sphere (Explorer II) into orbit, is a three-stage rocket. The first two stages are guided by internal controls, but the third stage is kept to a straight flight path by spinning it about its longitudinal axis prior to firing. It is 72ft. long and has a gross weight of 22,600 lb.

The first stage is a liquid propellant rocket; the second

Fig. 5.—Vanguard I being fixed into position on top of the third-stage rocket.

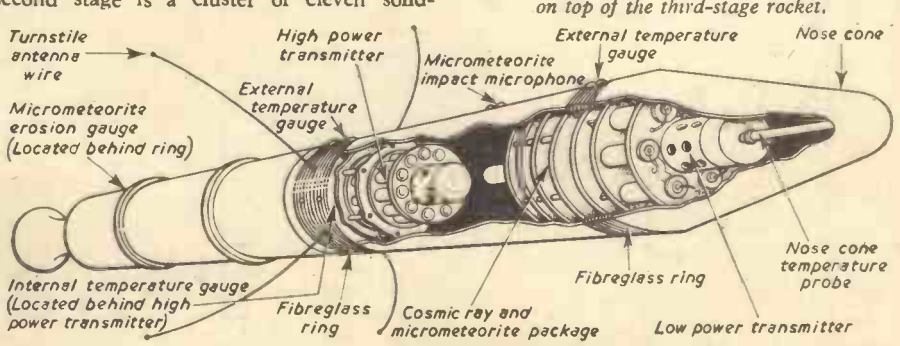

Fig. 4.—The instrument carrying section of Explorer I and the final stage rocket (rear) which went into orbit as a single unit. The antennae, fanning out from the centre section, are kept in position by the satellite's rotational spin.

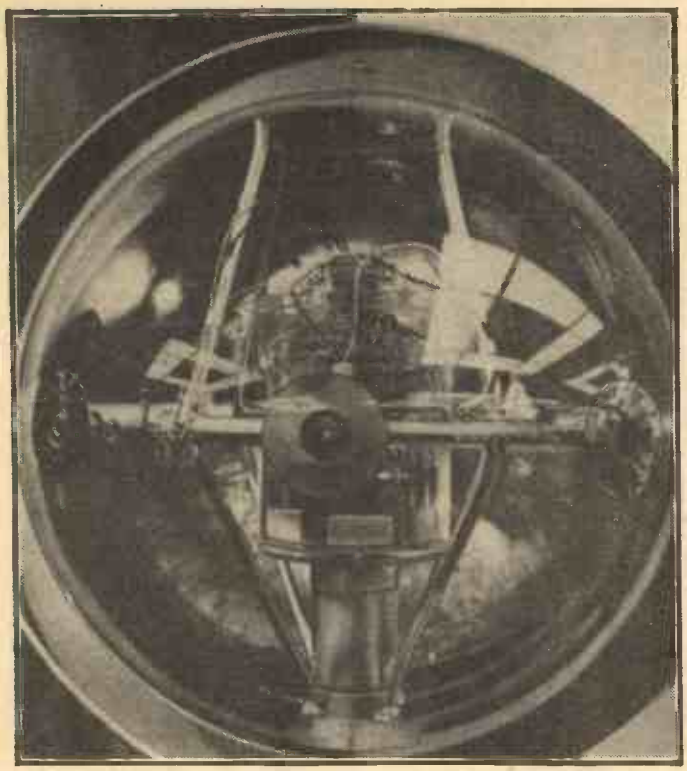

Fig. 6.—Model of the 20in. satellite. Instruments shown are: (A) Solar cell, current from which resets memory-playback unit. (B) Ion chamber which detects ultra-violet radiation. (C) Thermistor strip which measures outside skin temperature. (D) Erosion gauge. (1) The Minitrack transmitter. (2) Memory system for collisions with larger meteorite particles. (3) Telemetry coding system, feeding data from instruments to the transmitter. (4) This is below (3) and is the Lyman Alpha memory unit. (5) Meteoric collision amplifier. (6) Lyman Alpha amplifier. (7) Mercury battery power supply.

stage attaches to the forward end of the first stage and carries in its nose the third stage and the satellite (Fig. 5). This stage is the "brain" of the launching vehicle. The third stage is a solid-propellant rocket which delivers 2,300lb. of thrust at operating altitude. It is spun while it is in the second stage; then it separates and ignites.

Explorer I and III Satellites

Both these carried about 11lb. of instruments, designed to gather and transmit information on cosmic rays, meteorites and orbital temperatures. Explorer III had one important additional item of equipment—a tiny magnetic tape-recorder, which provided data on cosmic ray bombardment. The information was stored and released later while orbiting over ground receiving stations. Two hours' data—information covering a complete orbit—was transmitted in just five seconds.

Both Explorer I and III had elliptical orbits. The former at its closest point to earth was 220 miles at the outset and at its furthest point 1,590 miles. Explorer III came as close as 110 miles and swung out to as much as 1,700 miles during early circuits.

Vanguard I Satellite

Though less than 7in. in diameter, Vanguard I carried a good deal of delicate and complex apparatus. Included in this were six tiny solar batteries, energised by the sun's rays which will keep the radio transmitter working, possibly for years. Each solar battery is a sandwich of 18 extremely thin wafers of silicon. The negative and positive silicon wafers convert the sun's rays into electric power to feed a miniature transmitter broadcasting continuously on 108.03 Mc/s. In addition to providing tracking facilities the transmitter also reports on the sphere's inside temperature. Explorer II is expected to remain in orbit for several years. This satellite was launched as part of the "Test Sphere Programme," which is intended to provide reliable transmissions for radio tracking purposes.

The 20in. Satellite

It is proposed to launch a series of these satellites, which weigh 21lb. each and are designed to send back much more information than the previously launched test satellites.

Research in which they are planned to play a vital part includes measurement of the sun's ultra-violet radiation, determination of the arrival frequency of primary cosmic rays, measurement of the earth's magnetic field, and determination of the amount of radiation from the sun to the earth, and of solar energy reflected back from the earth. Additional information gathered will include data for the study of the changing patterns of the earth's cloud cover, surface and inside temperatures and surface erosion by meteoric dust, collisions and punctures by meteorites. Fig. 6 shows a model of the satellite and the positions of some of the instruments. Actual size can be seen in Figs. 7-10. The information gathered will aid the determination of inter-Continental distances and the shape of the earth; it will tell us more about the density of the upper atmosphere, cosmic rays, X-rays and other phenomena. Improved weather forecasting, improved radio and television transmission and new discoveries in medicine, chemistry, astronomy, physics and other sciences may all be brought about by this research.

Fig. 9.—The complete Minitrack transmitter unit.

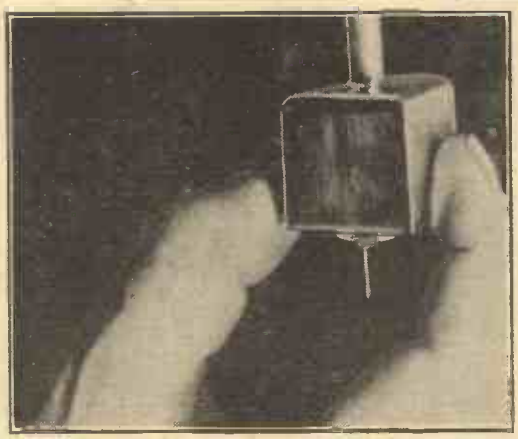

Fig. 8.—Miniature pressure-gauge which registers instantly if a meteorite punctures the satellite's shell.

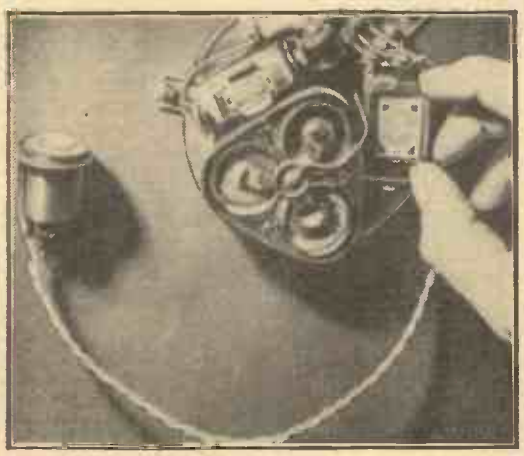

Fig. 7.—Lyman Alpha memory unit which memorises and later recites data on ultra-violet ray intensity.

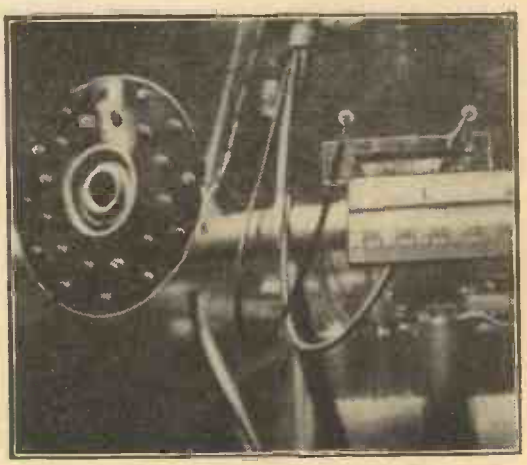

Fig. 10.—The solar cell, which will harness sun power to reset the memory unit.

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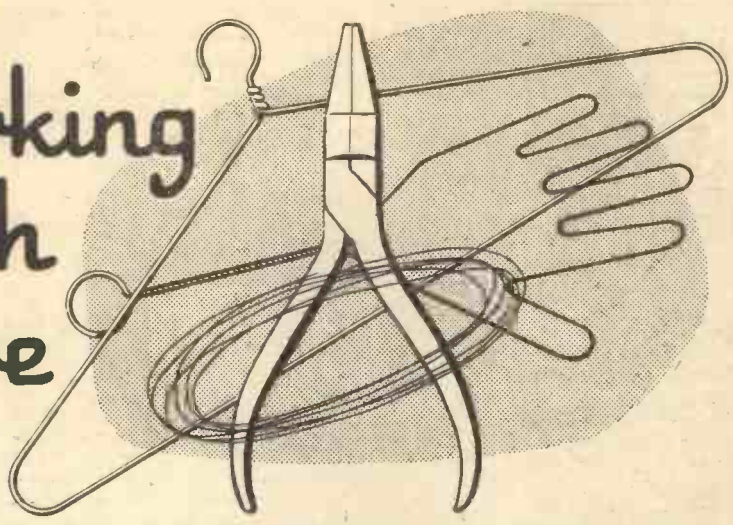
Working With Wire



Details for Making Some Handy Home Items

By Robin Sloan

SUITABLE wire can be bought at any ironmonger's by the pound, "gauge 14" brass or nickel covered being the best type for home items. Copper wire is too soft and lacks that slight "spring" which is a help to successful shaping.

The tools required for wire-work are a pair of square-nosed pliers, with a cutter incorporated, a small file and a block of wood having a spike in it, over which can be slipped cotton reels of various sizes. These latter have the lips trimmed off and are for use as formers for bending the wire round, the reels being of different sizes to give a range of curvatures. For quick work the block should be clamped to a table or held in a vice. Having something to work "against" or "round" is of the utmost value in most forms of wire fashioning. A glove to wear on the hand that will do the major part of the bending is an advantage.

The main question when making an item is that of how much wire it will take. Here is where a length of copper wire is handy to make a quick pattern, being easily shaped. When straightened out it is easy to measure the length needed. Points of bending can be measured off and indicated on the final material, so that they can be made with certainty.

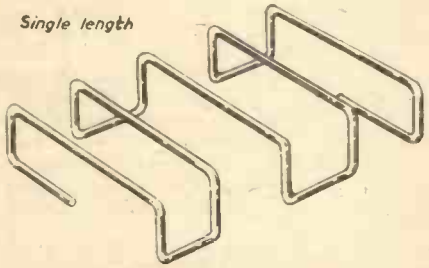


Fig. 1.—Cake stand.

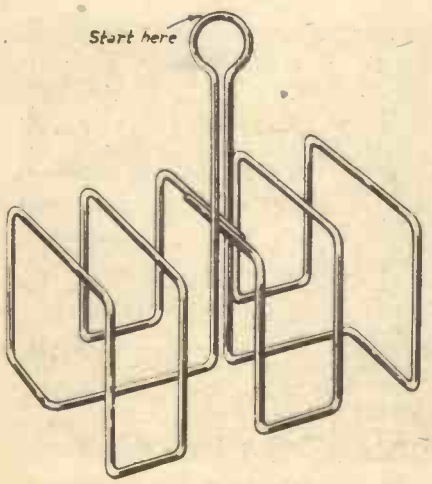


Fig. 2.—Toast rack.

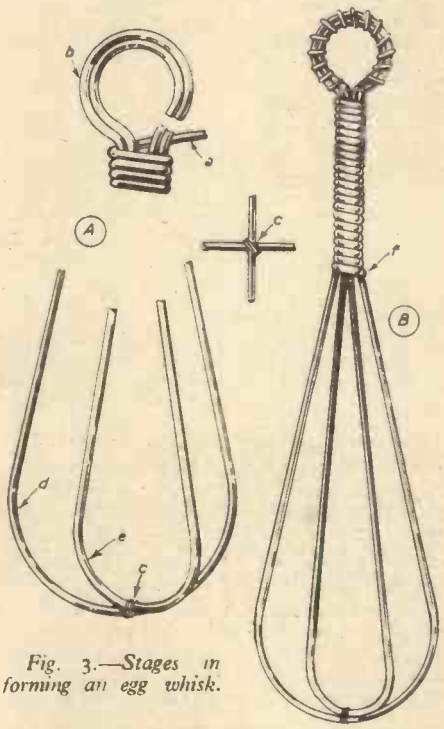


Fig. 3.—Stages in forming an egg whisk.

A Cake Cooling Stand

For a very simple piece of work, first try the stand shown in Fig. 1. This is but one length of wire and can be made from any material you have handy, but brass wire will look well. In making this article, success is mainly a question of careful measuring. The stand can, with advantage, be shaped over a rectangle of wood which just fits inside and is later pulled out.

A Toast Rack

Fig. 2 shows a toast rack, which is a little more complicated. Nickel-covered wire looks well, but a brass stand can be very neat; either square or round section material can be used. A first pattern should be made here with some care in the copper wire. Work starts at the loop and the wire follows down the upright, then out at right-angles along the base lengths and so on up to the squares. The track can be readily followed from the diagram. Finishing is effected by taking the two ends between the two strands of the upright.

As with the cake-cooling stand, the various corresponding lengths must be made the same and true right-angle bends formed, if the work is to be a success. It is all a question of careful measuring before working the final material.

An Egg Whisk

Fig. 3 shows a very useful kitchen item—an egg whisk. Two longish strips of wire are required (d) and (e), and a third length (a) of the same or smaller gauge for binding the shank and loop at the top—also a very thin piece is used to bind the two loops together where they cross.

First take the lengths (d) and (e) and bend them in the middle to two half circles of about 1½in. dia., using a round piece of wood to get a perfect curve. Now collect the wires together and temporarily bind them at a point about 5in. from the end. Continuing upwards, take two of the strands and curve them round to form the top loop (b), bringing them back on themselves till they meet the other two strands which must be cut off at just the right length. Bind now from the point where the strands were first brought together, up the entire length of the shank and round the loop, finishing at (f). At the other end the main loops are made to cross at right-angles, the intersection being bound tightly with the short piece of fine wire as (c). The completed whisk will appear as at (B). Nickel steel wire can be used with advantage for this item

A Glove Drier

The glove-drying

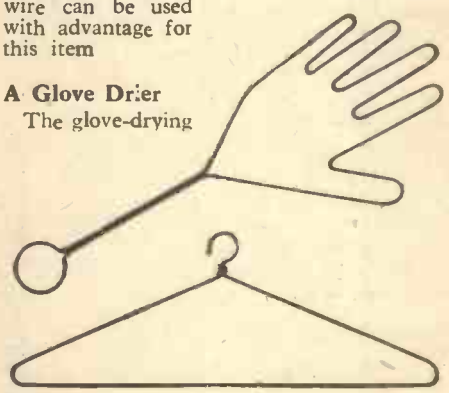
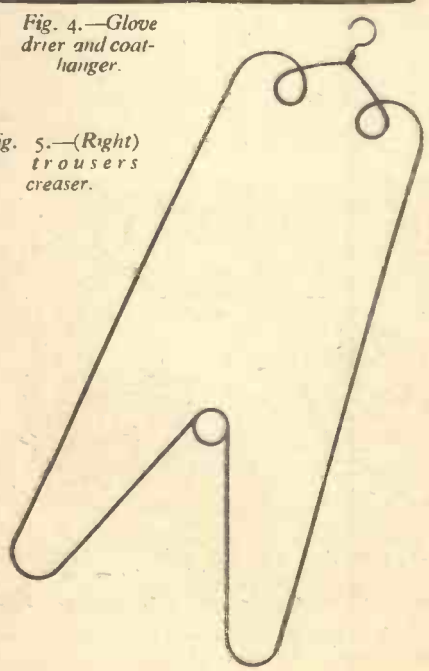


Fig. 4.—Glove drier and coat-hanger.

Fig. 5.—(Right) A trousers creaser.



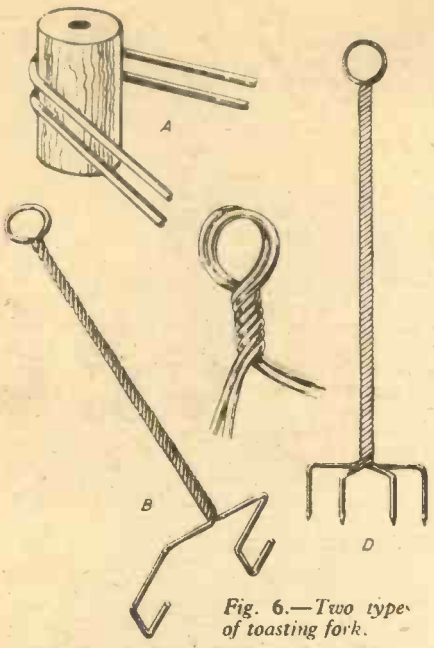


Fig. 6.—Two types of toasting fork.

frame shown in Fig. 4 is another very useful item. The part which goes inside the glove must be made of stiff wire but the binding can again be of fairly fine gauge. To obtain the correct shape lay an average-sized glove on a piece of paper and trace round it. Copy this shape in the soft wire again to get an idea of the length required, and then fashion in the stiffer material, seeing to it that the start and finish is about a third of the way down the shank. With the finer wire now bind the whole shank either tightly or in a regular spiral which will cover the ends and make the article rigid.

A Coat-hanger

This, as shown in Fig. 4, is fashioned from a single length of stiff wire. Starting with lower strand, the wire is bent back on itself at a normal shoulder width, the corners being rounded. At the mid-points the two ends are turned upwards and twisted together to form the upright piece, the hook at the top completing the article.

A Trousers Creaser

Fig. 5 shows a frame for keeping the crease in trousers. Two are needed and they are inserted one in each leg, there being sufficient spring in the wire to press well into the creases and retaining their shape. About 12-gauge wire is used and the various loops, made to give extra springiness, are shaped round the reels. The frames are supplied with hooks on top so that the trousers, with frames inside, can be hung.

Toasting Forks

Two are shown in Fig. 6. One is the usual pronged type and the other a more novel type. Two strands of wire are needed for the conventional type, but one only for the novel kind. A loop is first made at the mid-point of the single or double wire round the spike in the board as (A). With this firmly on the spike, twisting is continued for the desired lengh of fork. The strands are then divided, being taken out, down and up again for the novelty fork as (B), but finished with the orthodox prongs for the other. In the latter case file the ends of the prongs to a chisel edge to prevent the bread being broken. In the novel fork the bread is merely rested in the upturned ends.

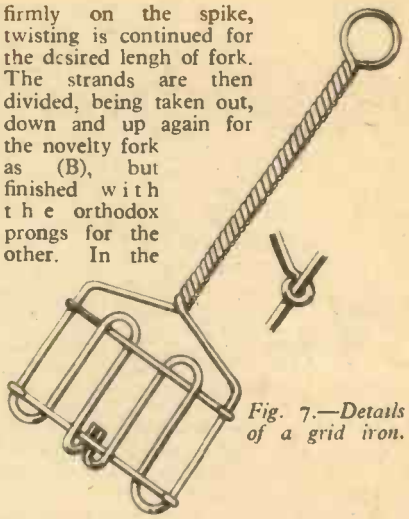


Fig. 7.—Details of a grid iron.

A Grid Iron

Details of this are given in Fig. 7. The method of construction is the same as for the toasting fork, using the spike as shown at (A) in Fig. 6. One piece of wire is used and the two ends are finally held firmly by one of the two horizontal pieces which are added afterwards as shown.

Fuel-less Plane

SMALL amounts of atomic oxygen present about 60 miles above the earth's surface could be used to power a satellite or an unmanned plane. The plane would gather in uncombined oxygen atoms, which when brought together would provide enough energy to propel the plane through the thin drag-free atmosphere. Such a craft could be built in the near future and it is thought that future developments of the idea could be used to gather and store fuel for space ships. These would be fired through the earth's atmosphere by conventional means to the height of the fuel store, where they could re-fuel and continue their flight into further space.

Longer Days

BY comparing the time kept by the earth as it turns on its axis with that kept by an atomic clock, British and American scientists have discovered that the length of a day has been increasing by half a thousandth of a second a year since 1955. The atomic clock at the National Physical Laboratory uses the natural frequency of vibration of cesium atoms. Accuracy is possible to 1 part in 10 billion. In the U.S., photographic zenith tubes were used for observations to establish Universal Time.

Drilling for Oil Below the Sea

IN the Gulf of Mexico a drilling platform with 175ft. long legs is being used. It is towed to its destination and the portability of this type of off shore platform is emphasised by the fact that it is cheaper to move one 1,000 miles than to shift a land based drilling operation 15 miles.

Metals from the Sea

SCIENTISTS at Plymouth have found quantities of niobium and vanadium in the bodies of sea animals of the skate family and this means that they must have been absorbed from the sea. If methods can be found of extracting it, the sea could be a valuable source of these metals, which have recently become important in the hardening of high quality steels and for making aircraft steels corrosion and temperature resistant.

Liquids like Powders

A METHOD of treating liquids so that they resemble powders has been evolved in America. The liquid is broken up into droplets of microscopic size and then each droplet is coated with gelatine. The millions of tiny capsules each only one millionth of an inch in diameter now closely resemble a powder. The liquid droplets are protected from air and from contamination and can be stored indefinitely.

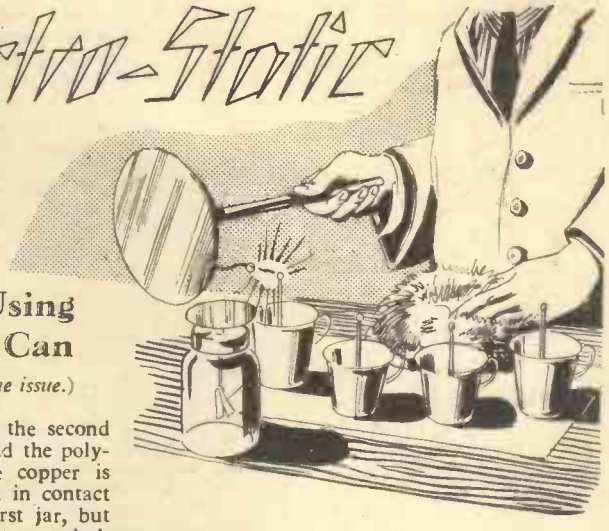
Chemicals, perfumes, drugs or dyes can be stored by this method until they are ready for use, when they are released by crushing the capsules.

Another use which has been evolved is to coat paper with a "powder" containing dye and when this is used behind a top sheet of typing paper, the imprint of the key on the front sheet releases dyes on the papers behind and so makes a carbon copy without carbon paper.

The "powders" are also being used as a permanent memory unit in an electronic computer.

One of the "Snocat" tractors used on the transantarctic expedition and now being exhibited in Trafalgar Square.

Apparatus for Electro-Static Experiments



K. G. Vine Describes its Construction Using Modern Materials and the Tests Which Can be Carried Out With it

(Concluded from the June issue.)

NOW place the plate on the table, press the metal disc on top of it, holding the disc by the insulated handle. Keeping it pressed down, touch it with a finger or earthed wire. Remove the finger or wire, then lift the metal disc by the handle. Hold it near the electroscope to make sure the metal disc is charged, then allow the metal solder blob to touch the blob of the Leyden jar. As the blobs get near, a small spark will jump. This process may then be repeated *ad lib.*; on a dry day it is not necessary to recharge the polythene plate more than once per half-hour. There is, of course, no need to check each time that the plate is charged with the electroscope.

After a number of charges have been transferred to the Leyden jar (say a score in the first instance) make a small discharging tool from some coaxial cable (Fig. 21). About 6in. of cable is stripped of the outer and metal cover, 2in. of the inner polythene is left in the centre for holding the tool in the fingers. If the wire is stranded run solder down it to give it strength and make solder blobs at each end. Bend it to a convenient radius.

If this tool is touched on to the outer cover of the jar and brought slowly towards the blob of the Leyden jar a fat spark will jump across. After a few seconds another smaller one can often be obtained. You may safely discharge the jar described with the fingers, the shock being harmless. Larger jars should be used in such a way with caution.

You may obtain a very high (and dangerous, so beware) voltage by wiring many of these jars in series (see Fig. 22). Each jar is warmed slightly in radiant heat to make sure it is dry and will hold a charge for an hour or so. It is then fully charged as described. One jar is placed on the table with the next jar standing on a polythene sheet or on two polythene rods (long playing records are probably suitable, too). A wire is placed under the second jar between the silver paper and the polythene. This wire (thin bare copper is suitable) is then gently placed in contact with the solder blob of the first jar, but the act must be done using two polythene rods or pieces of polythene sheet in lieu of your fingers or pliers. Insulated pliers will not do.

Further jars may be added in the same way, each on a piece of polythene and wired to the previous jar. The jars should be arranged in a circle so that the first and last are near together. Using the discharging tool held between two fingers at the centre of the insulator bring the tool in contact with the foil of the first jar and near the solder blob of the last. A large, vigorous spark will be obtained. Larger size jars should only be used with extreme caution. A large voltage on its own is not harmful except to people with very weak hearts, but a large current (as obtained from Leyden jars made with polythene buckets) can be very unpleasant and harmful.

Fig. 22. — Leyden jars in series.

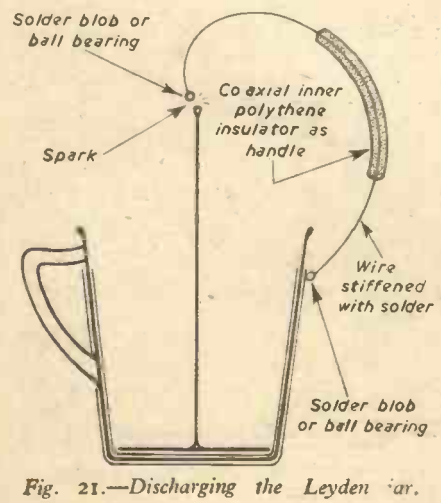


Fig. 21.—Discharging the Leyden jar.

The following are a few suggested experiments.

Aerial Static

A well insulated wireless aerial (especially the T.V. type) will often pick up static electricity and if it is disconnected from the receiver and the electroscope brought near the end, a deflection will be obtained.

Motor Car Static

On a hot summer's day after motoring through dusty atmosphere, or if the car is left where hot, dry sand from a dune will blow on to it, a charge may be detected in the metalwork. The author mounted his car on polythene blocks and ran the engine to gather information as to whether static was caused by the motor, the results obtained were negative.

Soundness of Insulators

If the electroscope is given a charge (it is best to use the negative one) the soundness of any insulator may be tested by touching the disc with the material. Dry wood will collapse the leaf at once and most glass will do so, too. Ebonite will do so slowly, but P.V.C. materials have hardly any effect. The soundness of the insulator of "sparking plugs" in a car may be judged, too. When new they are fairly good, but with age, even if cleaned throughly, they will discharge the electroscope at once.

Effectiveness of Tiny Picofarad Condensers

Small condensers may be held with one wire in the hand and the other touched on the charged electroscope. The leaves will drop a little as the condenser acquires a charge, but should then remain in that position with no further movement. If the leaves continue to subside the condenser has a faulty dielectric.

High Voltage D.C. Supplies for Radio or T.V.

If the supply is earthed on one side simply bring a wire from the other side of the supply to the plate of the electroscope. The type A electroscope (Fig. 3) will show a deflection of a few degrees with 150 volts. 250 volts gives an easily seen movement of the leaf. 3,000 volts (from the author's oscilloscope supply) takes the leaf up to 90 deg., 2,000 volts to about 45 deg. These figures can only be approximate as the conditions vary for each and every electroscope.

On the small headphone-type instrument full deflection may be obtained with little over 1,000 volts. These instruments are useful for detecting voltages which connect to the supply via high value (megohm) resistors as other instruments give a false

and erroneous impression of a low voltage.

Where one side of the supply is not earthed this must be done, or, in the case of the headphone-type instrument, connected to the casing. Due care is necessary in all cases to safeguard against accidental shock.

Effectiveness of Patent Gramophone Record Cleaners

If a gramophone record is cleaned with an ordinary camel hair brush or piece of soft fur it gets a charge. This may be detected with the electroscope. If it is rubbed with a treated brush it should not do so if the brush does its job properly.

Magneto or H.T. Supply Test on I/C Engines and Model Planes, etc.

If the spark is allowed to *jump* on to the electroscope the leaf should go up to the 90 deg. mark as the voltage should be well over 3,000, usually being 10,000 volts. A running motor engine may be tested in this way, too, but the operation is somewhat tricky. Direct contact between the electroscope and the plug terminal is useless, the disc must be within a few thousandths of an inch of the plug terminal.

Leakage from H.T. cables is easily detected. Put the electroscope in contact

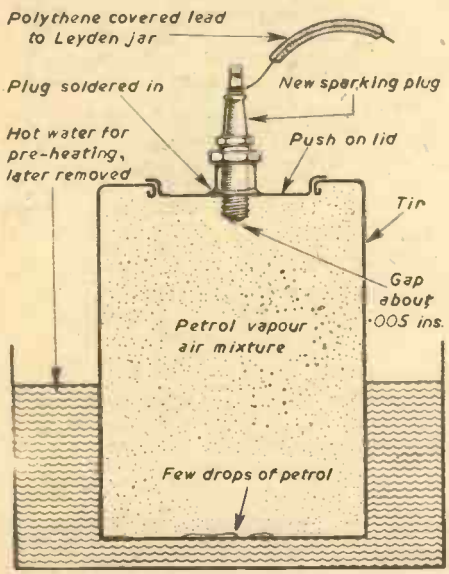


Fig. 23.—The explosion experiment.

with the metal part of the car. motor-cycle, etc. Connect a polythene-covered lead to the plate and run the end of the lead over the outside of the H.T. wires, distributor, etc.

Some Further Experiments

A gas burner with the gas turned low, especially if the air hole is closed, can be ignited with the spark from a Leyden jar. A few jars in series will do this very easily, but one is sufficient.

With care a small piece of cotton wool soaked in lighter fluid may be ignited in a similar way. Make sure none is on your hands when you do the experiment.

Methylated spirits, prewarmed by placing some in a bottle which has been kept in warm water for a few minutes, can also be used. Another way of using alcohol is to light the wool with a match, blow it out, and then it will easily be ignited with the spark.

A treacle tin or other similar container fitted with a *large push-on type lid* (no other type of lid will do, some could cause a dangerous explosion), has a sparking plug soldered into the lid (Fig. 24). It is possible with a detachable-type plug to fix it in with the help of some packing washers. The plug must be a new one and must be perfectly clean inside and out. The points are set at about five thousanths of an inch by bending the outer electrode(s). The plug may be fixed in the tin or lid, the author fixed the plug in the final experiment in the lid as he found the plug lead stopped the lid being blown violently against the ceiling. The tin is warmed by placing the bottom half in hot water and a few drops of petrol are placed in it. The lid is pressed home. Three Leyden jars, carefully charged and wired in series, are then wired with outer foil of first to the tin and the inner foil of last by a well insulated polythene-covered wire to the plug. Hold the wire about a foot away from the plug and bring it gently to the terminal. A loud explosion will result which, with the tin suggested, is quite harmless. The optimum amount of petrol is quite important, a 1lb. tin taking about five drops.

The experiment works, not quite so violently, using ordinary coal gas. The amount required is small, too much makes a mixture which the spark will not ignite. See Fig. 23 for diagram of apparatus.

An electroscope which is holding its charge well may be used to detect radio-active substances and radiation. Messrs. Griffin and George supply a radio-active source of radium quite cheaply and it may be used in various experiments. When the radium is brought up to the electroscope it will be seen to discharge much more rapidly, the more radio activity the quicker the discharge. If the radium is enclosed in various foils, etc., a rough measure of the effectiveness of the shield may be gained. The author tried using some luminous watches and found that some types caused the leaves to collapse over a period of some 20 minutes when placed a centimetre from the plate, the electroscope actually holding a charge on that day for over two hours. The radium source mentioned will discharge the electroscope in a matter of three minutes or so.

Make the apparatus exactly to the specifications given, as small deviations in this type of apparatus (especially in insulators) may cause complete failure. Dampness must be stressed as the curse of electro-static experiment and a red radiant source of heat is ideal for drying apparatus prior to experiment. Note that a gas flame itself produces water and is not to be recommended.

Apparatus Required for Experiments

A few yards of co-axial cable with outer covers removed. Various insulating materials such as china, ebonite, glass, etc. Gas supply and burner (or other source of heat); petrol or benzene; methylated spirit or industrial alcohol; cotton wool; a treacle tin or other tin with push-on lid, and a new sparking plug. Other apparatus which may or may not be used includes: motor-cycle or car engine, model plane with electric ignition, sparking plug (old), luminous watches, etc., small radio condensers, T.V. aerial.

Fig. 24.—Apparatus for the explosion experiment.

Radio-active source: (A89-900) 1 microgram of radium in protected container. Obtainable from Messrs. Griffin and George, E.C.1.

PUZZLE CORNER

Squaring the Circle

THIS is a classical geometrical problem of antiquity, in which we are asked to draw a square which has the same area as a given circle. The text books tell us that the area of a circle can be expressed by the formula πr^2, where r = the radius of the circle and π (the Greek letter pi) being either 3 1/7 for general working purposes, or 3.1416 if you want to be more exact. The snag is we can never get an exact value for pi (which symbol, of course, represents the ratio between the diameter of the circle and its circumference). It is, as we say, transcendental. It has been worked out to over 700 decimal places and, presumably could be worked out by electronic computers to 7,000 places or 7,000,000 places, but we should not, as far as is known, work out the matter exactly even then. Such a number which cannot be expressed in mere figures is called a "surd." Therefore, as we do not know the exact area of the circle, we cannot construct our square. In actual practice we can work out the problem to a very high degree of accuracy, but the ancient geometricians and their modern counterparts are not directly concerned with practical applications.

Suppose the earth were a perfect sphere and we knew its exact diameter, we could calculate (taking pi to 100 decimal places) the size of an iron hoop to encircle it so that the difference produced by a change of temperature equal to the millionth of a millionth part of a degree would not exceed the error arising from the difference between the true ratio and this figure.

What Are the Weights?

ON the old-fashioned type of scales, using separate weights, it is possible to weigh any number of pounds of a substance from one to forty. Only four weights are used; can you say what they are?

The Answer

The weights are 1lb., 3lb., 9lb. and 27lb. Of course, sometimes a weight has to be put into the same scale pan as the substance being weighed. Thus 2lb. is obtained by using the 1lb. weight against the 3lb. weight. To weigh 20lb., the 27lb. and the 3lb. weights would be used against the 9lb. and the 1lb. It is an interesting puzzle to work out the remaining weights.

A Small Table

Fig. 1.—The completed table.

By A. E. SMITH

This Table is Modern in Appearance, Light in Weight and Sturdy in Use

THE table shown in Fig. 1 consists of two end frames, each having two legs tenoned into a cross rail, screwed and glued to a top of ½in. plywood covered with Marleyfilm. The longitudinal rail prevents the top from bending.

The Legs

These are made from hardwood for strength and before commencing construction a full size drawing of one pair must be made from Fig. 2 so that measurements and angles may be taken from it. This drawing need not show all details; the outlines only will be sufficient. Fig. 3 shows the general construction of the underframing and Fig. 4 gives details of the joints used. The legs are tenoned into the rails so that they slope sideways, the slope towards the ends is obtained by planing the top of the rail after gluing, thus simplifying the mortising.

Cross Rails

Prepare the cross rails to 2in. by ⅞in. and mark them off to 16in. long. The legs are marked on the board side by side with alternate legs reversed and should be cut out 2⅛in. wide at one end tapering to 1⅛in. at the other. They are planed to ⅞in. thick and one edge is planed true. This is the outer edge from which all marking is done. Set a sliding bevel to the angle between the underside of the cross rail and the face of the legs and use this and a trysquare to mark the position of the mortises and the shoulder lines of the tenons. Note that the lines across the face of the legs are square with the outer edge, only the lines across the edges are marked at an angle. Set a mortise gauge to a ⅜in. chisel and use this to gauge the mortises and tenons, working from the outer edges of rails and legs. Saw the tenons and chop out the mortises. Saw cuts for wedges are made

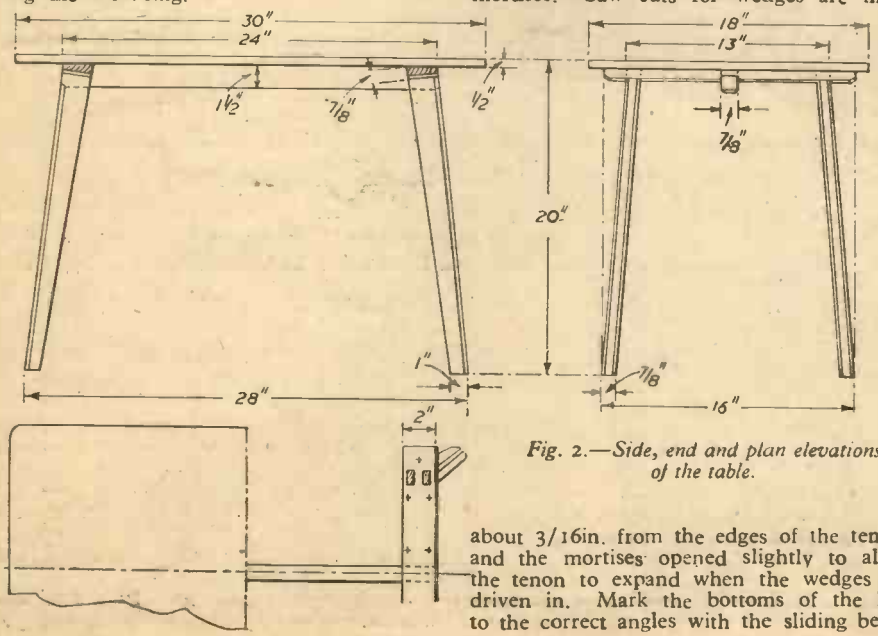


Fig. 2.—Side, end and plan elevations of the table.

about 3/16in. from the edges of the tenons and the mortises opened slightly to allow the tenon to expand when the wedges are driven in. Mark the bottoms of the legs to the correct angles with the sliding bevel, saw off the waste and cut the 3/16in. bevels down the outer edges, also those on the end of the cross rails. Clean up the sides of the legs and the underside of the rails with smoothing plane and glasspaper, glue together and insert the wedges. A cardboard template is used to ensure that the legs are at the correct angle. When the glue has set, plane the inside of the legs to the correct slope, complete the cleaning up, and plane the top of the rails to give the outward slope, testing with the sliding bevel. Holes are bored as in Fig. 2 to take the screws that fix the rails to the top.

The longitudinal rail is prepared to 1½in. × ⅞in. and is notched into the underside of the cross rails as in Fig. 4. Note that the housing in the rails is parallel to their top surfaces. The whole of the underframing can now be polished and assembled with two 1¼in. screws through the cross rails at each end.

The Top

The top is a piece of ½in. plywood, 30in. × 18in., covered with Marleyfilm. The

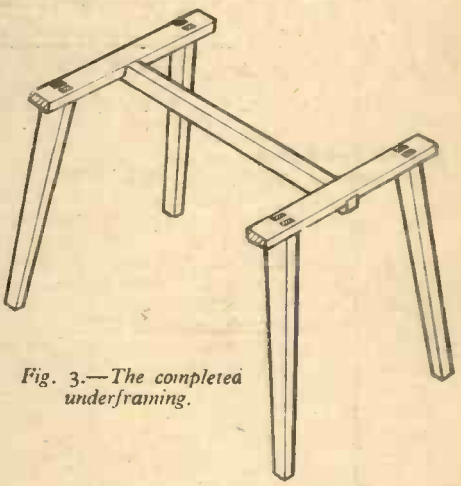


Fig. 3.—The completed underframing.

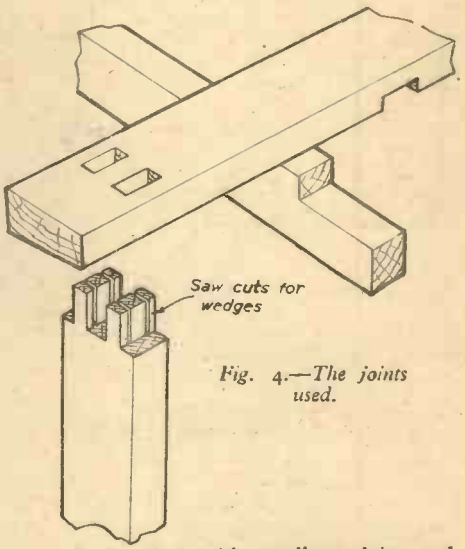


Fig. 4.—The joints used.

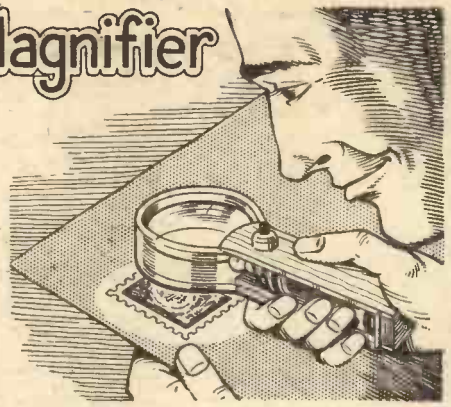
original was black with a yellow edging and was covered as follows:

Sand the plywood smooth and cover the top surface. The edges are then smoothed with a very fine-set plane and covered with strips of Marleyfilm just over ½in. wide. These are carefully trimmed with a chisel or sharp knife and finally smoothed with very fine glasspaper. If desired the Marleyfilm used for the top can be taken over the edges in the usual way but the use of a contrasting colour adds considerably to the appearance. The underframe is now screwed and glued in position and the table is finished.

An Illuminated Magnifier

Drawings and Instructions for Making a Device Which The Householder and Hobbyist Will Find Useful

By J. A. Logue



AN illuminated magnifier throws light on the subject to be magnified and is a useful gadget to have when examining stamps, maps, insects, woodwork for decay, metalwork for cracks or fractures, or in fact any minute object.

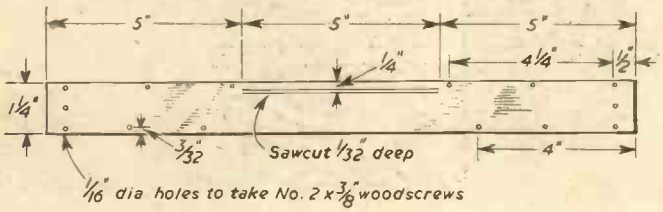


Fig. 1. — (Left) Cutting and drilling the Perspex.

Construction

A piece of coloured Perspex (cream, pink or white) 15in. × 1¼in. × ⅛in. is prepared as shown in Fig. 1. The 15in. dimension allows about ½in. at each end for fitting and also some latitude when bending. The ends are trimmed to size after assembly. The edge of the lens fits into the sawcut—a small circular saw (drill attachment saw) is ideal for making this groove. 1/16in. diameter holes are drilled to take No. 2 × ⅜in. wood screws and the holes are countersunk on the reverse side to the groove.

With the lens in position, this piece is fixed to the Perspex sides with No. 2 × ⅜in. wood screws; plated screws look best with the Perspex.

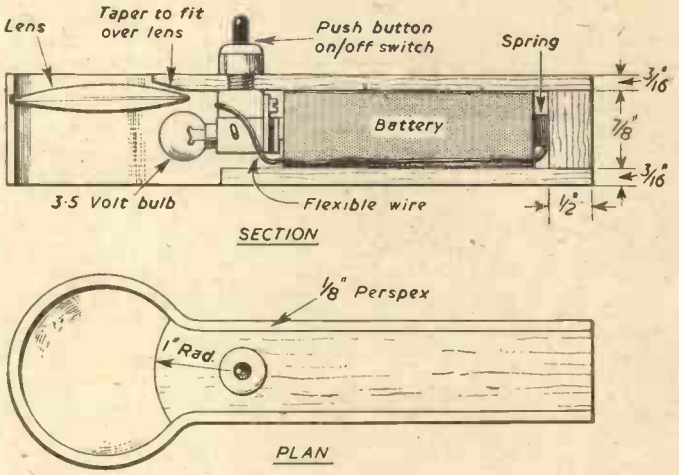


Fig. 3. — (Right) Section and plan views of the magnifier giving details of the switch and disposition of the other parts.

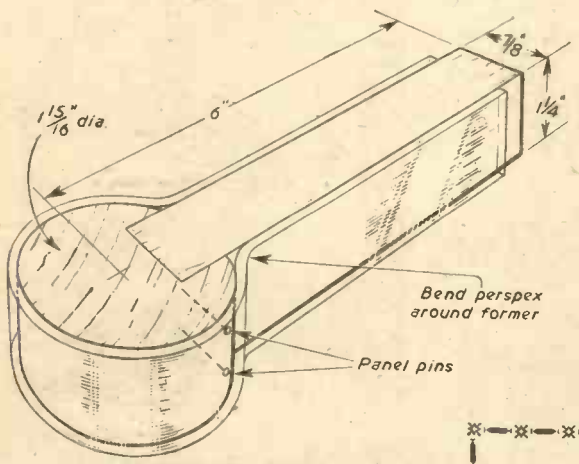


Fig. 2.—Bending the Perspex round the former.

Wooden Former

Fig. 2 shows the wooden former which is made for shaping the Perspex. A 1 15/16in. diameter × 1¼in. piece of timber has a ⅞in. × 1¼in. timber strip let into it, as shown, and held in place with panel pins. The strip of Perspex is heated in a domestic cooker oven for some minutes until pliable and then shaped around the former. Leather gloves should be worn when handling the warm Perspex to avoid burns. The Perspex is shown wrapped round the former in Fig. 2.

The Top

A piece of 3/16in. thick mahogany is shaped as shown in the plan, Fig. 3, and is drilled to take the push button on/off switch. The bulb will also be in its correct position, shielded as shown in the section Fig. 3.

The Bottom

A 4½in. × ⅞in. × 3/16in. strip of mahogany is now screwed into position along the bottom of the Perspex. An Ever Ready No. 8 battery or its equivalent will now fit snugly in the handle; the battery is in position in the section Fig. 3.

On a ⅞in. × ¼in. × ½in. block of timber a piece of compression spring about ½in. long is fitted. Before fitting the block in place a flexible wire is connected between the switch and the spring to complete the electrical circuit. A washer and wood screw are used to clamp the end of the wire and also to fix the spring to the wooden block. The block fits into the end of the handle and it is unscrewed for fitting a fresh battery when needed.

The materials mentioned for the construction of this magnifier are not, of course, obligatory and with suitable modification, tinplate could be used for the sides. The dimensions could also be changed to accommodate an alternative lens which the constructor may have.

Lampholder and Switch

The lampholder is the type with two tags attached and this type can be mounted directly on the switch by enlarging the hole in the inner tag to take the switch grub-screw. The remaining tag will now be correctly positioned for contact with the brass battery cap and

Materials Required

2in. dia. magnifying lens.
15in. × 1¼in. × ⅛in. coloured Perspex.
14—⅜in. × No. 2 plated wood screws.
Push button on/off switch.
Lampholder, bulb and battery.
1—5in. × 1½in. × 3/16in. mahogany strip.
1—4½in. × ⅞in. × 3/16in. mahogany strip.
1—⅞in. × ¾in. × ½in. mahogany block.
Flexible wire, spring and screw
Scraps of timber for former.

Repairing Tents

John Dee Tells You How to Correct Some Common Defects

ONE of the worst disasters that can befall is for a pole to break through the top. This can come about by the canvas rotting round the crown. It can also be caused by continually allowing the tent to become too taut during rain showers, which will eventually break stitches in the best of canvases; or the trouble may come about by a combination of both conditions.

Repairing the Crown

Repair is effected by renewing or refitting the existing crown "collar," which is quite within the scope of the practical man. A collar is a small circle of thick cord of a less diameter than the pole which is sewn under the fabric at the location where the spike on top of the pole passes through—see Fig. 1. Thickness of the cord depends entirely on the size of the tent, bell tents having quite a heavy ring while in light-weight equipment the collar may be little more than string.

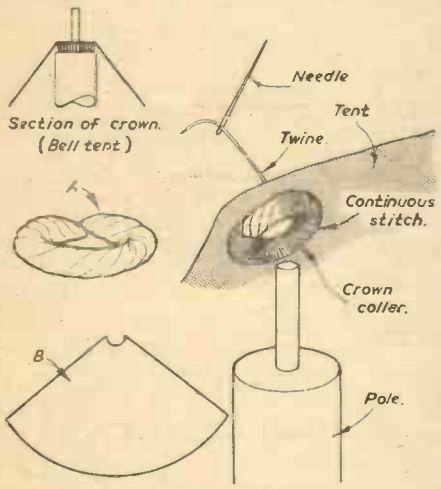


Fig. 1.—Repairing the crown.

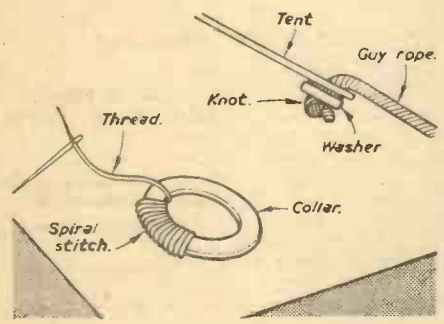


Fig. 2.—Repairing guyline eyelets.

Should the collar be intact and the crown only torn, the fabric is drawn together, using a packing needle and twine, and the original circle of cord set back underneath and refastened by a continuous stitch spiralled over it by taking the needle a little further along the canvas every time it comes round.

A new collar may of course be needed, if so make it as shown at (A) in Fig. 1 by cutting the cord to the right length, flattening the ends and joining up with a few stitches.

Should the crown canvas be very weak then a patch must be sewn in. This is a piece of strong canvas (or lighter material for light-weight tents) cut as (B) for a bell tent, or to suit other shapes of tent. Join up the edges experimentally till the piece agrees with the existing slope and sew it in by tacking stitches round the edges, and at any other place where a few stitches would be useful. The new, or old, collar is now sewn under this as described.

Working with heavy canvas a sail-maker's "palm" is needed. This is a leather pad held in the hand by the thumb going through a hole, and it is for pushing the needle with its load through the material. For light-weight material a darning needle with strong thread will often do all that is necessary. To wax the twine or thread first is good practice.

Crown failure as suggested is often brought about by the tent frequently being allowed to get too taut during rain, a tautness which should be relieved by slackening the guys. Some campers make a habit of putting a flat stone under the pole which can be taken away when the rain starts, so slackening the guys all round in one action—and without having to go outside.

Eyelets breaking where the guys pass through the eaves is a common tent trouble. Here the repair is very similar to that at the crown but with everything on a smaller scale.

Guylines

A guyline at its upper end is secured to the canvas as shown in Fig. 2, by passing through a reinforced opening with a washer behind to spread the pressure. A knot behind the washer again finishes off the arrangement.

Reinforcement is generally given to the opening by a cord ring on the underside, but some very light-weight tents rely on simply a binding of the edges. In any case, when an eyelet has broken it should be reinforced by a new ring, which in lighter equipment can actually be a circle of fairly strong string. For heavier material thin cord is necessary.

Eyelet holes generally have become too big, seldom having torn down to the edge seam. In repairing, the fringes of the hole are pulled together with fairly big stitches and the collar is sewn on as in Fig. 2 again (as with the crown) using a continuous spiral movement.

It should be remembered that broken eyelets are often caused by not slackening the guylines in rain, although they do tend to give way in the course of seasons by ordinary usage, as the whole weight and pull of the tent comes on them, especially in high winds.

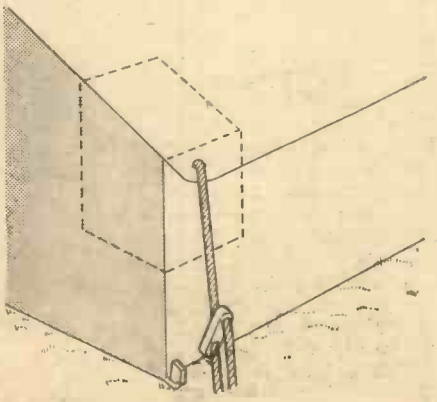


Fig. 3.—Sewing in a corner patch.

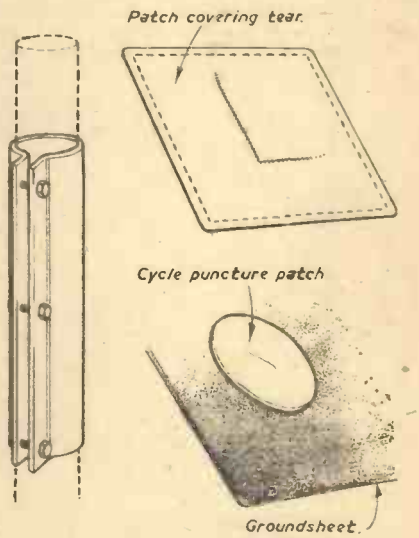


Fig. 4.—Pole repairs, patching a tear and repairing a groundsheet.

Corner Patches

A rather more difficult point of failure that comes at times in the "patrol" and other rectangular tents, and which should

be dealt with at once, is in the corner (Fig. 3) where the end panel, wall and roof meet.

The corner guy should be slackened and the broken seams drawn together, always working *from* an unbroken stretch *towards* the damaged part. Working this way the various sections of canvas can be slowly drawn together in correct relation to one another. Starting in the middle of a break, correct aligning is difficult.

If the corner is very weak then a strengthener must be put in the angle. This is sewn in slowly, folding the material over in a pleat where necessary to get good fitting.

Square tears in both heavy-weight canvas and light fabric are dealt with by pulling the edges together and then covering with a rectangular patch stitched round the outside (Fig. 4).

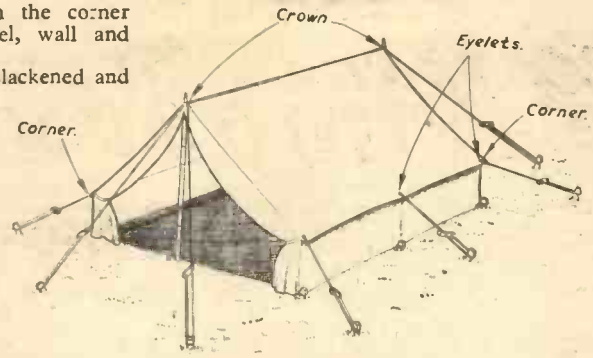


Fig. 5.—Parts of a tent which may require repairs.

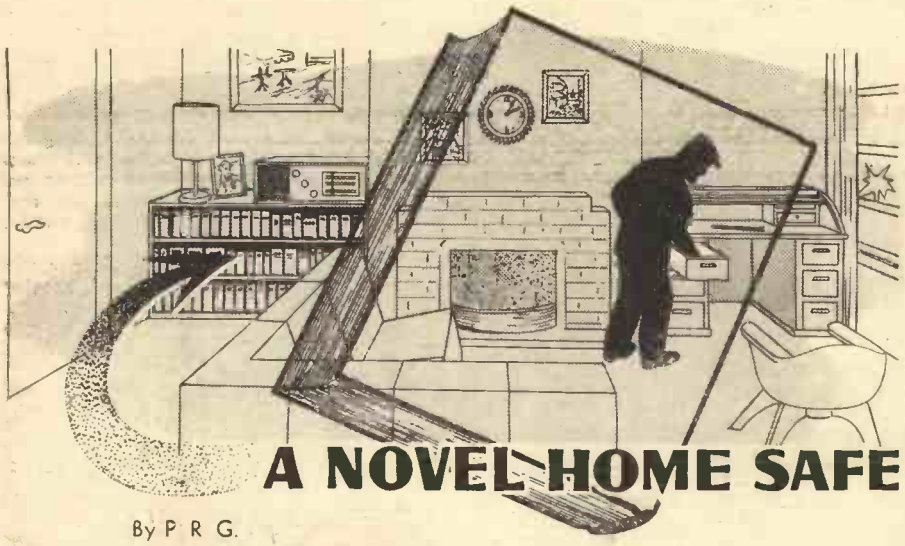
Pole Repairs

Should a pole have cracked along an extended sloping line a good repair can be effected by making a simple binder as shown in Fig. 4. This is shaped from tinplate, wrapped round the pole and lipped as shown. Holes are punched in the lips and small bolts inserted.

The tinplate must of course be so bent in the first wrap round that the lips are some little distance apart so that there is scope for the tightening effect of the bolts.

Groundsheets sometimes develop small holes. If not too large, such faults can be repaired with ordinary sticky cycle patching, this being put on the rubber side of the sheet with the usual solution as when mending a puncture (Fig. 4). Distinction must be made here between an accidental piercing of a groundsheet and one that is becoming badly perished. If the latter, scrap the sheet at once and get another.

Finally, with a view to effecting repairs, close examination should be made of all tapes, peg loops and brailing if the tent has this. Loops, etc., may seem small items, but a tent is a unified design and the giving away of one loop or tape may well impose an undue stress on some other part. The chief parts of a tent which may require attention are shown in Fig. 5.



A NOVEL HOME SAFE

By P R G.

Keep Your Valuables Safe from an Intruder

IT is always something of a problem to know where to deposit documents and small but fairly valuable items when going on a holiday or even when leaving the house empty for a short time. The "book safe" described here is one solution. To the average sneak thief, or even too curious a person, a book means nothing and passes unnoticed, this being the idea behind this form of hidden storage. There is no reason though why the book safe should not be locked away with other books in, say, a cupboard for greater security.

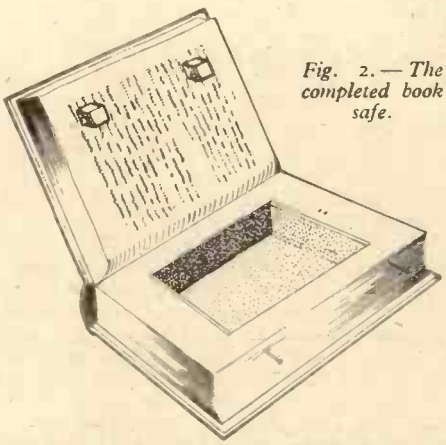


Fig. 2.—The completed book safe.

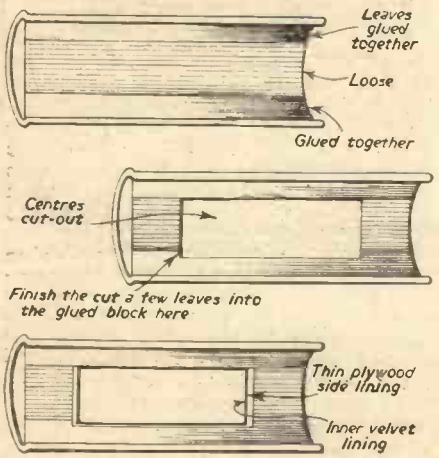


Fig. 1.—Three stages in making the safe.

Construction

Obtain a reasonably sized volume with a stiff back for which there is no further use. The volume should not in itself be too conspicuous or the purpose of the safe might well be defeated.

With a strong, but not too thick glue fasten together a fair number of the first and last pages (Fig. 1), putting the book under pressure as they harden into a solid mass; the glue must be spread right over each page but not on the very edges as it is wished to preserve the appearance of untouched leaves on the outside.

After hardening, place on something firm and opening the top cover with its attendant leaves mark out a rectangle on the first of the loose pages, leaving at the very least a half-inch margin all round.

Pressing down very heavily with a steel edge, and using a keen blade, cut out the rectangle right through the loose leaves, stopping a few leaves into the solid leaves below. Remove the unwanted paper.

Lining the Cavity

This has the effect of joining all the leaves into one block—but from the inside. It is done by cutting two strips of oilcloth to lie along the upper and lower walls, and then two strips of thin plywood for the sides.

The oilcloth is liberally smeared with glue and put in position first and then the wood strips are similarly treated and set in place. If correctly cut they will jam between the lino strips, so giving greater firmness. When dry it will be found that a very strong framework results.

A final lining of velvet is now given to the whole of the inside. This is firmly glued in and cut from one piece, as shown.

Secret Lock

Lastly, a secret locking device is supplied. This is by gluing two blocks of cork in position as indicated, so that when the top cover closes they fit into the corners of the cavity. The blocks (a) can be cut from any large cork.

The wire pins (b) are then prepared, these being pushed through the loose leaves and oilcloth (top and bottom) and into the corks. a hand pressing down firmly on the closed book while this is being done. The heads are hidden in the loose leaves. The purpose of the pins is to prevent the back falling accidentally open when the safe is being handled as a book. It is not intended in any way to form a true lock, the basis of the idea being that the book will be left unnoticed and untouched.

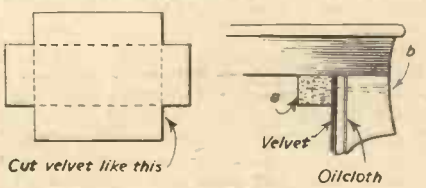
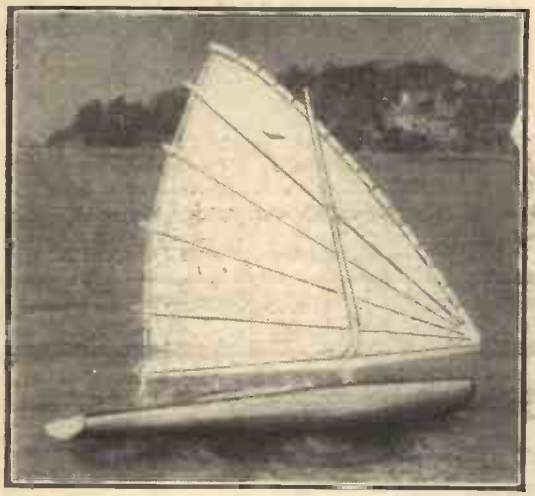


Fig. 3.—Cutting the lining and the lock



The completed yacht sailing under a 1 experimental rig.

Making a Fibreglass Yacht

C. E. Bowden Concludes His Description of This Modern Method of Model Hull Building

FOR this job an equal weave both ways to give all round strength is required. Tyglas Y.227, obtainable from Messrs. Fothergill and Harvey, Ltd., Harvester House, Peter Street, Manchester, is suitable, although there are a number of manufacturers and a wide variety of woven cloths to choose from.

Having noted that the scrim lamination has just set brush on a fairly thick coat of resin main mix after catalysing, the accelerator having already been mixed in. Now lay on the glass cloth (Tyglas Y.227), and working outwards from the centre with the fingers and stippling with a resin brush, see that the resin works up through the cloth and thoroughly wets out, *with absolutely no air-pockets anywhere.* Lay on the second lamination of glass cloth, whilst the first is still wet, after another coat of resin has been applied. Again work the resin well in with no air-pockets. Reinforce the transom, the bows, and where the load of the keel will be taken with pieces of extra cloth, well saturated. Stipple with short rapid strokes of the brush that do not pick up the cloth and admit air. I use a 2in. wide paint brush of good make. Do not use too much resin mix for a good laminate is one with only just adequate resin and plenty of well wetted-out glass cloth. Fig. 8, which was included in last month's instalment, shows the cloth-covered mould of the 5ft. 6in. model already seen in Fig. 1. The drip edges clearly seen in the photograph, are later removed when the resin reaches the plastic stage and before it becomes dead hard. This is best done by a "surfile," which is undoubtedly the best instrument for all cleaning up work with fibre-glass, as its openwork cutting surface does not clog like a file or rasp. A rasp or file is useful for local and final smoothing down work.

The glass laminate is now allowed to set hard during the night when it will be easily removed next day.

It should be remembered that fibre-glass contracts as it hardens and, therefore, a boat made in a female mould is always easier to remove than the female mould from the male form. Should there be difficulty in removal slightly ease all round the gunwale and pour hot water between glass laminate and form to break up the suction.

The Hardwood Surround

After removal wash the P.V.A. release agent from form and female mould. The mould is now cemented with a resin putty mix into a hardwood surround or "table." This resin putty is made from a stiff mix of china clay, a little thixotropic resin, and a little glass mat cloth chopped up with scissors. It is catalysed and allowed to set hard (see Fig. 9).

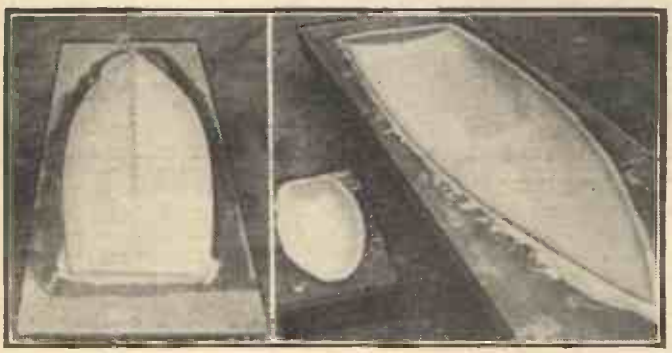


Fig. 9 (Left).—The female mould is now resined into its hardwood table surround, which keeps it rigid and of correct shape for the subsequent building of the boat hull inside.

Fig. 10 (Right).—The dark-coloured part in this photograph is where the blue-coloured P.V.A. release agent has started to be applied to the female mould. Note the dinghy mould on the left.

The operator now has a permanent and indestructible female mould in which to build one or any number of boats. Deck or cabin tops can be made in the same way. This particular hull was fitted with a light three-ply deck.

During all fibre-glass operations the hands should be protected by rubbing in a barrier cream which protects the skin against resin and cleansing acetone. Use rubber gloves for small operations but to mould laminates well bare fingers are necessary to obtain an adequate sense of touch. A large dish of acetone should be kept beside the work into which brushes, scissors and tools can be put between laminating operations, etc., in order to prevent the resin hardening on them. Acetone dissolves uncured resin and is therefore used for cleaning *before the resin hardens.*

At the end of the day's work all tools and equipment, including the hands, should be thoroughly cleaned in fresh acetone and the stickiness washed off in hot water and detergent.

The Fibreglass Hull

The operation of hull building is very similar in principle to the building of the female mould but is done inside the mould instead of on top of a form.

Proceed as follows:

Polish the female mould with silicone wax polish and then paint it carefully with blue P.V.A. release agent and allow to dry (see Fig. 10). Make up the jel coat mix and the main mix as before, not forgetting to add anti-star resin to the jel coat mix. The amounts and proportions of mixes are the same as for making the female mould. Stir in the accelerator to give a fast set for the jel coat and a slower set for the laminates main mix. When ready to start work stir in catalyst to the jel coat mix, and immediately brush this as before but inside the female mould surface. As the jel coat sets brush on the first coat of main mix after catalysing. Approximately 1½lb. are required for this boat. Lay in the scrim lamination, working out all air, so that the scrim backs up the jel outside resin coat of the hull (Fig. 11). As the scrim lamination just sets give a second coat of resin main mix, and work in the first glass cloth (Tyglas Y.227) laminate. Whilst still wet, work in the second glass cloth laminate after another coat of resin (Figs. 12 and 13).

Reinforce transom corners, bow vee and where keel loads occur with strips of extra cloth, making sure this is well wetted out.

Fig. 11 (Right).—The first layer of scrim to back up the "Jel coat" is put into the female mould with a coat of resin.

Fig. 12 (Right).—The first laminate of glass cloth is now wetted out with resin. Great care being taken to admit no air-pockets.

Fig. 13 (Right, below).—The second laminate of woven glass cloth is now wetted out, being worked into the first lamination (excluding glass scrim layer) whilst wet. A sample of the glass cloth Tyglas Y.227, can be seen on the right.

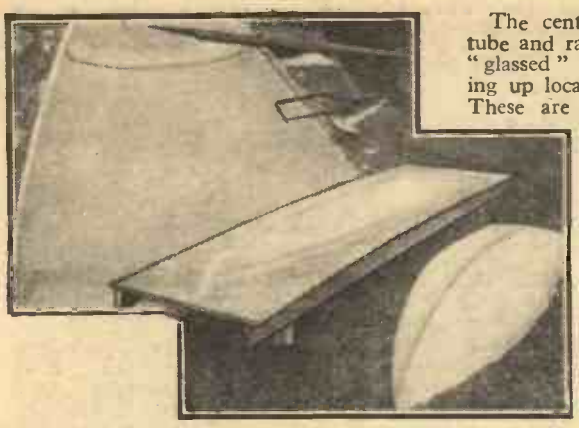


Fig. 14 (Top).—Clean the edges of the hull whilst the resin is hard, but slightly plastic, by "surfile" or rough rasp.

Fig. 16 (Right).—The three-ply "deckbeam" outline being cemented into position. Cramps are used until resin sets hard.

Give the whole hull inside a final careful stippling, adding a little resin where wanted, to give a fine finish inside the hull with no bare glass cloth showing. Remember not to put in too much resin, and that the best and strongest laminate is one with only just sufficient resin and plenty of glass.

Allow the edges to set to the plastic stage but firm, and then clean around the edge of the mould with the "surfile" (Fig. 14). Leave overnight to set hard, and on the following day remove the hull from the mould (Fig. 15).

Building in the Fittings

The hull shell now has its "deck beam" three-ply outline cemented into place by a resin putty mix with a little glass chopped up from mat or cloth to fill any gaps. The hull inside should be roughened up by sandpaper or rasp where the three-ply is to mate (see Fig 16).

The centreboard box, mast step, rubber tube and radio box hatch, are all fitted and "glassed" in where applicable, after roughing up locally where joints are to be made. These are shown in position in Fig. 17.

Fig. 15 (Left).—The finished hull is now removed from the female mould and the P.V.A. release agent, soluble in water, is washed off mould and hull.

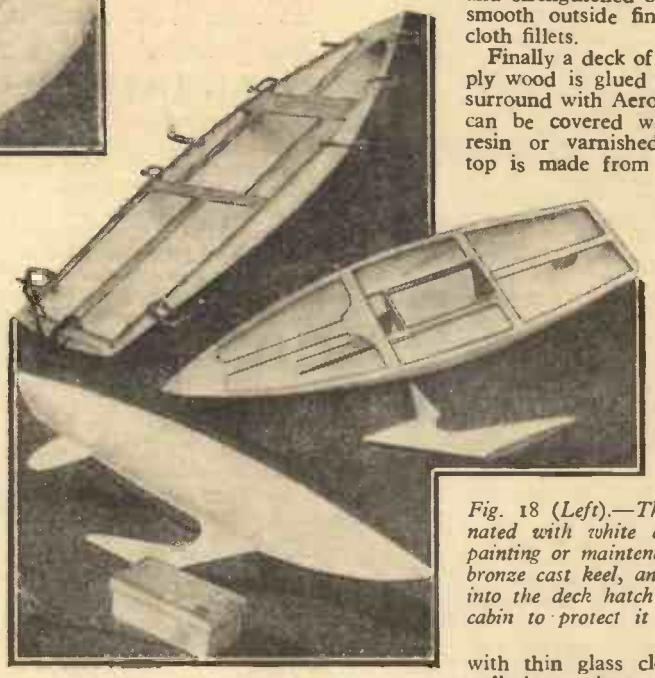


Fig. 17 (Left).—The "Centreboard" case, rudder tube, and radio hatch are placed into position and "glassed" up to the hull where applicable, using glass cloth strips and resin.

Fig. 18 (Left).—The completed hull, impregnated with white colouring now requires no painting or maintenance. Note the detachable bronze cast keel, and the radio box which fits into the deck hatch opening, with a fibreglass cabin to protect it from seawater spray.

An open weave glass cloth or scrim is used.

Note the bronze cast keel, which is detachable for easy transport and for experimental change purposes, has a tang which fits into the "centreboard" box, whilst a brass split pin goes through a hole at the top of the tang to retain the keel in position.

If a wooden pattern is made, any local foundry will cast a keel for a moderate fee or one can be made up from sheet steel with a lead bulb weight riveted to the foot.

The rudder skeg is made from wood and screwed through the hull from the inside. Fibre-glass can be drilled, tapped and filed. The base of the skeg is faired into the hull and strengthened by locally roughing up the smooth outside finish and then doping on cloth fillets.

Finally a deck of 1mm. resin bonded three-ply wood is glued on to the three-ply deck surround with Aerolite resin glue. The deck can be covered with thin glass cloth and resin or varnished. A streamlined cabin top is made from balsa sheet and covered with thin glass cloth, which fits over the radio box to keep sea-water spray and waves from the radio box, which, in turn, has a Perspex top. Fig. 18 shows the finished hull with detachable keel of bronze in position, and the rudder fitted. The detachable radio box is seen below the hull.

A Camping Trailer

(Concluded from page 462)

also shows the method of fitting the tail-board.

The Lids

Two lids are now required each 7ft. 6in. × 1ft. 9in. The frames for these are halved together and made from some 2in. × 1in. deal, and subsequently covered with 3/16in. resin-bonded plywood.

These lids are secured with 9in. T-hinges. The knuckle of the hinges is level with the top edges of the sides. The longer part of the hinge is bent at right angles along the top of the lid (Fig. 13).

When the lids are raised they are held in place by a simple brace at each end secured by wing nuts and bolts, as shown in Fig. 14.

The Roof

The canvas roof of 8oz. duck material is supported over a framework made of electric conduit tubing. The three lengths of tubing are first flattened in the middle for a distance of about 1½in. and then bent down at an angle as shown in Fig. 15. The lower ends are also flattened and bent so that they can pass vertically down through some clips screwed to the inside of the lids.

A ridge pole also of conduit tubing is held in place along the flattened top of the V-hoops with 3/16in. wing nuts and bolts.

The canvas covering is made up from some 8oz. duck material. The part covering the V-roof is made from three strips 7ft. long, sewn together to make an overall length of 7ft. 6in. as shown in Fig. 16. A wide hem is made along the two longer sides into which are fixed some eyelet holes. The cover is eventually lashed through these to cleats fixed along the bottom of the lids. Where the ridge pole comes in contact with the canvas a 2in. wide strip of webbing is sewn on to counteract chafing the duck.

The ends are made as also shown in the diagram which shows the rear end only.

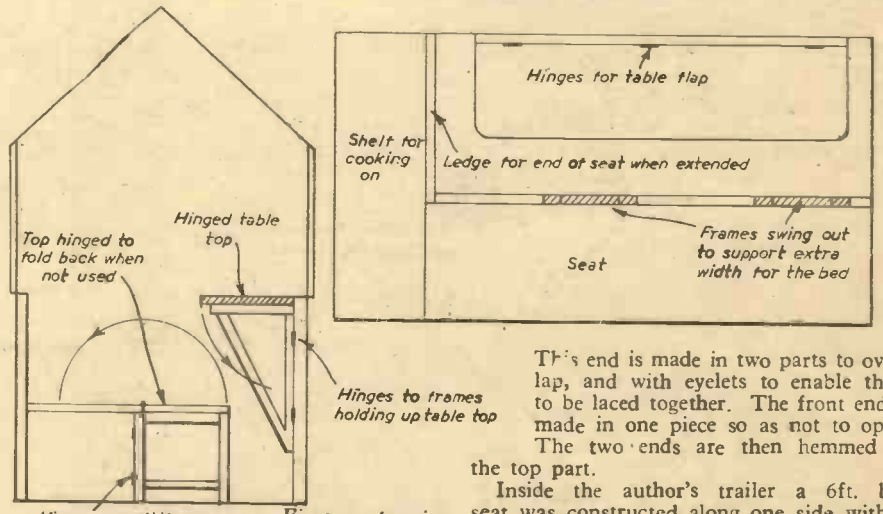


Fig. 17.—Interior fitments of the trailer.

This end is made in two parts to overlap, and with eyelets to enable them to be laced together. The front end is made in one piece so as not to open. The two ends are then hemmed to the top part.

Inside the author's trailer a 6ft. box seat was constructed along one side with a removable lid so that the seat could be used for storage purposes. Along the front end a low shelf was fitted on which the cooking, etc., could be performed. Along the other long side a table flap was hinged which was useful for mealtimes, etc.

A further modification incorporated was a flap fixed to the front of the box seat which could be raised and held horizontal by hinged legs to form a bed (see Fig. 17).

A NEW BRITISH INTERCEPTOR

This Aircraft is Fitted with Both Rocket and Jet Engines

The new British S-R.177 interceptor.

THE S-R.177 is being constructed by two aircraft firms, Saunders Roe and de Havillands. It has been designed to keep pace with all the developments in weapons and operational requirements which can be reasonably anticipated. At any stage of its development it will be completely operational and capable of offering our island continuous protection.

The Two Engines

The chief distinguishing feature of this plane is its unique combination of both rocket and jet engines in the same fuselage. The turbojet engine, which is a de Havilland Gyron Junior is capable of developing a thrust of 10,000 pounds. The rocket engine is also made by de Havillands; it is a "Spectre" and uses the same fuel as the turbojet, i.e., kerosine.

The advantage of the two types of engine will become obvious when it is considered that a turbojet engine is extremely efficient at low altitudes, but the same engine at 60,000 ft. would deliver only 4 per cent. of its sea-level thrust. When considered in terms of thrust to engine weight ratio, the rocket engine at low altitudes is even more efficient than the turbojet and—more important—its thrust increases with altitude. It is in the thin atmosphere of 20 miles up where the air battles of the future will be fought. To be set against this advantage is the rocket engine's very high consumption of fuel and oxidant.

The tremendous thrust of the rocket motor will be required only during combat and when a high speed bomber is being attacked at high altitude. Rocket fuel consumption will thus only need to be maintained for a few minutes. When the attack is over the interceptor will cut its rocket motor and cruise back to its base using the turbojet engine. When required, say, to climb and attack an enemy formation, both engines may be used at once, but when the warning is given far enough in advance the S-R.177 can cruise to the point of attack using only its turbojet.

Size and Versatility

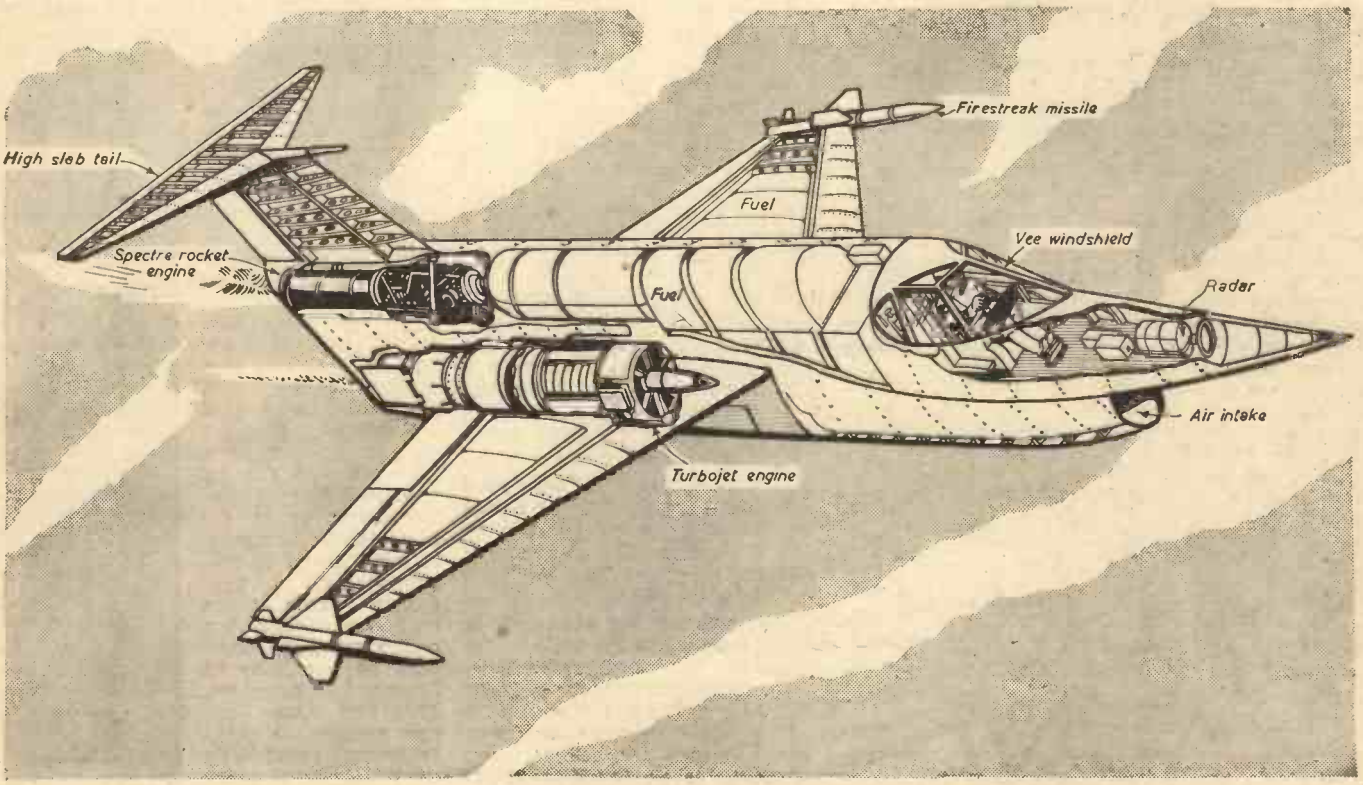
It has been found that by combining a single large jet engine with a rocket engine, a smaller and lighter craft can be obtained than by using two large jet engines. The aircraft also has the advantage of greater versatility. Although its engine weight is less than with the pure jet aircraft, the S-R.177 will have a somewhat larger percentage of its take-off weight consisting of fuel. When this fuel is consumed, the landing weight will be considerably lower and thus the plane can land on short runways. With the vast reserves of power available, take-off presents no problem at all.

Its climbing capabilities are very high indeed, heights of 60,000 or 70,000 feet being attained in only a few minutes. Aerodynamic drag does not limit the machine's performance and it is capable of outperforming even the best turbojet aircraft at present known.

Wide Range of Duties

The S-R.177, with its versatility and large fuel capacity, is suitable for performing a wide range of duties—long range strike support, photo reconnaissance and ground attack duties as an all-kerosine aircraft operating on its jet engine alone.

Our artist's impression of the layout of the S-R.177 below will give some idea of the new plane. The turbojet is housed in line with and behind the air intake and the rocket motor immediately above it.



An artist's impression of the layout of the S-R.177.

A CARNIVA

This Sideshow Cou

NAME-PLATES are sold to the public at 3d., 6d. or 1s. each and, when the twenty are disposed of, the arrow is spun. When it comes to rest the bearer of the name-plate corresponding to the town which remains illuminated is invited to select any prize on the table. The prizes should cost about half or a little under half the total amount which will be collected on each spin.

Choose Your Own Design

The design is, of course, entirely elastic. The names can be those associated with any particular movement, they can be christian names, Walt Disney characters, Members of Parliament (for political functions), or even plain numbers. Similarly, the dial can be designed to advertise the movement organising the fair, it can be symbolic of almost anything from an aeroplane to a Shakespearean comedy or drama. Names of towns and a railway engine were chosen for the model shown in Fig. 4 because they are of common appeal and it was intended to loan the spinner to other organisations when the association for which it was made was not using it.

Wheel Construction

A bicycle wheel is an ideal base on which to build up the mechanism of the spinner; the ball-bearings give it easy and continuous motion and the rim acts as a flywheel, regulating the speed and accumulating power. The size of the wheel is not critical, but a fairly long spindle is necessary—it is essential to have about 1½in. clear of the cone at one end. Thoroughly clean and re-oil the bearings and test for truth. Remove the free-wheel or sprocket and, of course, the tyre and inner tube. Figs. 1 and 6 show that a shaped contact strip of insulating material (hardwood will do quite well) is fastened to the hub by being force-threaded on to it and strengthened by two 4B.A. bolts passing through the strip and between the angles formed by the spokes. (It is best to mark the positions for these bolts from the inside of the hub to ensure that they will engage in spaces where the spokes cross each other at an acute angle—this will prevent the possibility of back-lash.) But do not try to fit the strip at this stage as it is necessary, before cutting out the hole, to use the centre to mark off the exact distances for the two springs.

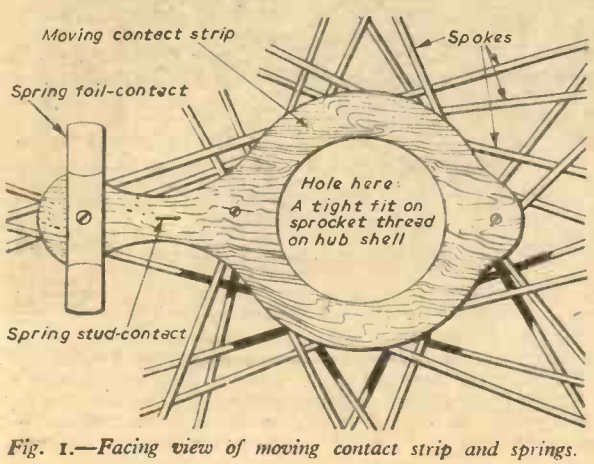


Fig. 1.—Facing view of moving contact strip and springs.

The Springs

The centre of the stud-contact spring (Fig. 6) is exactly 2in. from the sprocket hole centre, and the foil-contact spring 2⅛in. The first is a piece of very thin spring steel about 1½in. long × ¼in. wide. Fig. 3 explains the action of this spring and is an edge-on view. Presuming the spring is at "A" on the contact strip, it will be seen that it is unimpeded and therefore unbent but just making contact with stud No. 1. As the wheel is turned the spring advances towards "B" and its position at various stages during this movement is shown. As the fixed point moves along, the spring rides on top of the stud, bending as it does so. At point "B" it is just about to break contact with stud No. 1, and the moment it does so it straightens out and thus makes immediate contact with stud No. 2. This arrangement ensures that always one lamp, but *only* one lamp, is alight. With this mechanism there is no possibility of the arrow stopping between lights.

The second spring—the one which will make contact with the copper-foil circle—is, as Fig. 2 shows, a Terry tool clip opened out. This "opening out" is reasonably critical since the happy medium between assured contact and minimum friction must be attained. For the moment, however, open the spring so that its vertical height is ⅜in. and fasten it to the contact strip as shown in Figs. 1 and 6, first having sunk a very shallow groove in the strip into which the spring can settle down with no possibility of lateral movement. Note that when these two springs are fixed they must be electrically connected by inserting a small piece of copper foil (Fig. 6) at the back

Fig. 4.—The com

—Modifications to the Terry clip.

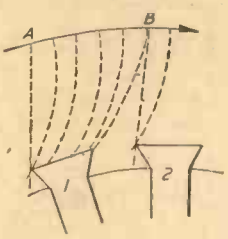


Fig. 3 (Left).—How the spring contact works.

and passing both bolts through it. The stud-contact spring will have to be bent at right-angles after it has passed through the strip. The slot through which it passes can best be made by a number of very fine drill holes and finished with a thin file. If there is too much play, wedge with a shaving or two of wood or fill with plastic wood or sealing wax, but be sure that the spring is fastened only by means of the bolt passing through it and the strip—you may have to replace it one day! The strip may now be placed on the wheel—springs outward—and fastened to the spokes by means of the two bolts.

The Contact Studs

Put the wheel aside for the present and work on the main strut and the circular base carrying the studs. The strut is 4ft. long, a universal adhesive, but it is best to be on the safe side and pin it as well. ¼in. fine brass pins should be used and placed very close to the outside and inside edges so that they do not foul the Terry spring. The top right of Fig. 5 shows an additional piece of copper foil soldered to the ring. Through this passes an ordinary wireless terminal with its head at the back of the plywood. This provides a means of connecting to the mains without interfering with the actual ring or the studs.

The twenty holes may now be enlarged to 3/16in. dia. and the plywood fastened to the main strut. This must be placed absolutely centrally, i.e., 2ft. from either end and in the middle of the board; use four screws as shown. It will now be found that several of the 3/16in. stud holes are blocked by the strut; drill these right through. The

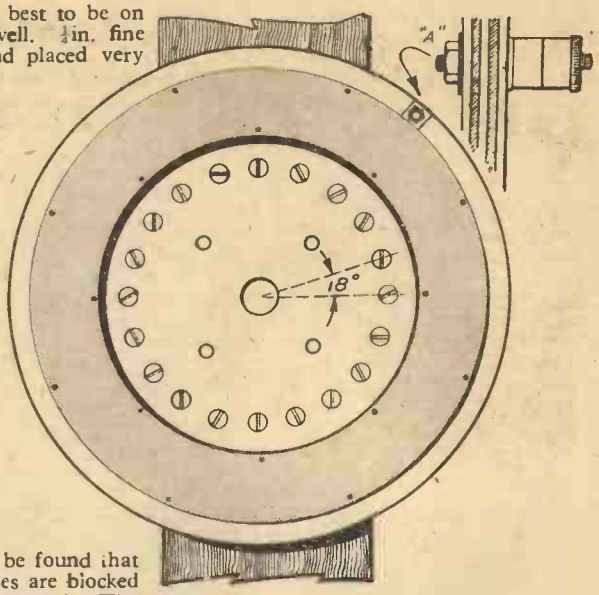


Fig. 5.—Face of contact side of the plywood dial carrying copper foil ring and stud contacts.

L★SPINNER

Designed and Built By Jameson Erroll

ıld Be a Money Spinner at Your Local Fête, Garden Party or Carnival

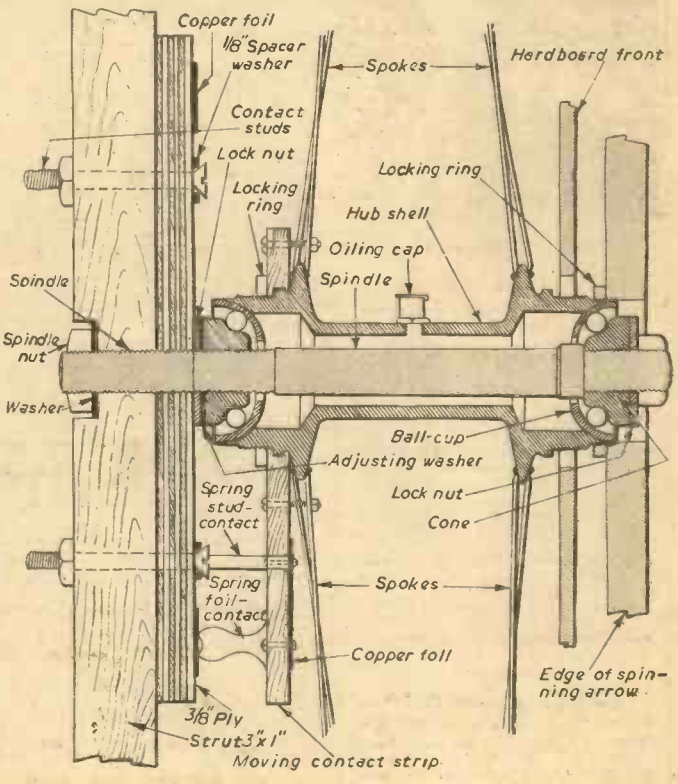
3in. wide and 1in. thick. The base is of good quality ¼in. ply and is a circle 7in. in diameter. From the centre of the ply describe an *exact* circle of 2in. radius. Use either an ink compass or steel dividers—a pencil line is too thick for the required degree of accuracy. Now place a protractor on the centre and mark spaces around half the circle exactly 18° apart—use compass point or steel scriber. With a steel ruler resting against each mark in turn and passing through the centre, mark off the remaining divisions on the other half of the circle. You should now have twenty marks on your circle each 18° from its neighbour; these will be the centres for the contact studs. The "studs" are 3/16in. countersunk-head Whitworth engineers' bolts and it will be found that their heads measure exactly 5/16in. across. Fig. 5 is a face view. Before drilling the 3/16in. holes it is advisable to drill 1/16in. pilot holes.

pleted spinner.

The Copper Foil

This is a ring ¾in. wide with an internal diameter of 5in. and an external diameter of 6½in. It is shown shaded in Fig. 5. It may be fastened to the plywood by means of Whitworth bolts may now be fitted, and some of these will need to be 1in. long (when they pass through the ply only) and the others 1¼in. long (when they pass through the ply and the strut). The heads should be kept ¼in. above the surface of the ply and ¼in. spacer washers, as used in old-time moving condenser construction, will ensure evenness. If care is taken, however, not to tighten the bolts too much, the countersunk heads will assist in correct alignment. Use steel washers between the back of the ply and strut and hexagon nuts. On the remaining length of these bolts the cable is later fitted and kept in place with another washer and nut.

The centre hole for the bicycle wheel spindle should now be drilled; this will probably be ¼in. dia., but do not let it be so tight a fit that it has to be "threaded" on as you will have to remove it many times before the job is complete. If there is an insufficient length of spindle protruding from the back of the strut to ensure a really firm fitting, sink a hole in the back of the strut large enough to allow the nut to turn (see Fig. 6). You should now be able to check that both springs are working correctly and will be able to make final adjustments to the tension of the Terry spring. Ensure that one or the other or both lugs of the spring make contact with the foil at all times, but guard against too much pressure. The wheel should run quite easily and come to a *gradual* stop. Given a fair spin to start with, it should make from 10



6.—Split section of working mechanism on 3in. × 1in. strut.

to 15 revolutions before stopping. Do not worry at this stage if it is so free from resistance that unbalanced weight tends to let it reverse slightly after it has stopped.

The Main Frame

This, as Fig. 9 shows, consists of a large, very shallow box. It is constructed of ex 5in. × 1in. deal and is 4ft. square. The front is of hardboard and is screwed to the edges of the frame with ⅜in. C/S No. 6 wood screws. Use round-head screws if preferred, but they are more difficult to drive. Before fixing, the front should be drilled to take the lampholders and have a central hole about 2½in. dia. cut in it to clear the sprocket thread and locking ring on the front of the wheel. It is better to err on the large side than to cut too small a hole as this hardboard front must in no way impede the freedom of the wheel hub. In any case, the hole is afterwards hidden by a circular piece of wood or hardboard fastened over the centre of the indicating arrow (see Fig. 6).

To locate the centres of the holes for the lampholders, scribe a circle 3ft. 4in. dia. and, using the protractor as before, mark out twenty centres at 18°; this will give a distance between centres of approximately 6½in. It is immaterial what this distance really is provided it is constant. If carelessly marked, the arrow will not true up with the lighting and it will be found, for example, that the Derby light is on, but the arrow has stopped near the end of "Hull" or the beginning of "Hove." Although this is provided for by stipulating to the public that the place name which remains illuminated is the winner (not necessarily where the arrow is pointing) it is better to have no discrepancies. The holes are drilled 1⅛in. dia. and the shade rings are used to fasten the lampholders to the board.

Notches are cut centrally in the top and bottom edges of the frame to take the wheel strut so that it falls level. This may now be screwed on (minus the wheel, which will only get in the way and be liable to damage) and the little backless box fitted around the contacts. This should be deep enough to cover the bolt ends and should have a hinged hardboard cover as shown in photograph Fig. 8.

Down the centre of the strut are pinned two hardboard strips 1in. wide. These carry four wooden turn-buttons for keeping the half-doors closed. They should be rounded slightly on their undersides.

The hardboard half-doors may now be cut and fitted. The box enclosing the contacts projects beyond the strut so gaps must be cut in the doors to enable them to close. Not less than three hinges should be used on each door; they can be screwed into the edges of the frame, but must be fixed to the hardboard with C/S bolts and nuts on the outside.

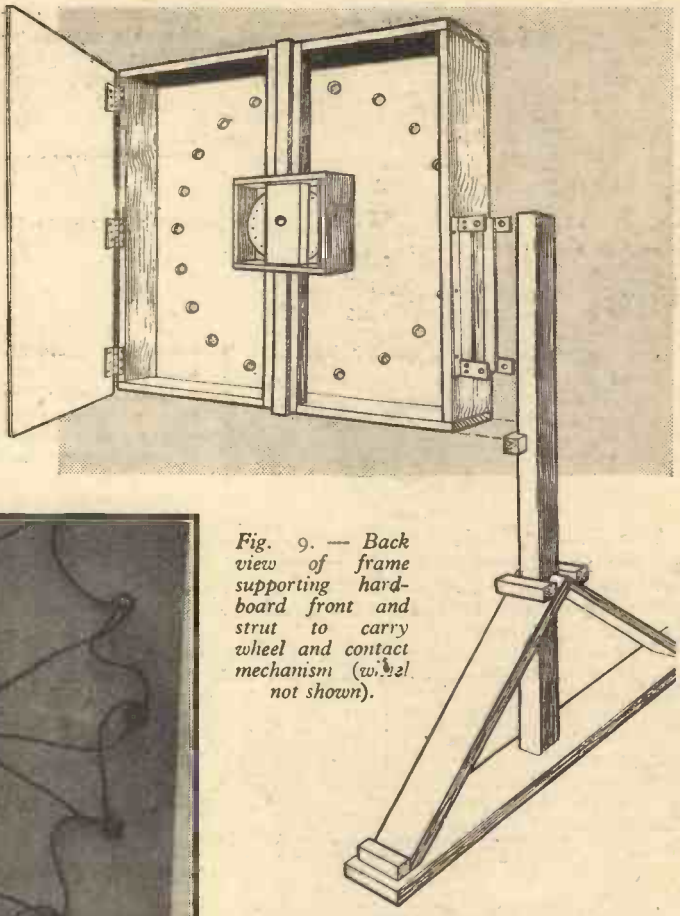


Fig. 9. — Back view of frame supporting hardboard front and strut to carry wheel and contact mechanism (wheel not shown).

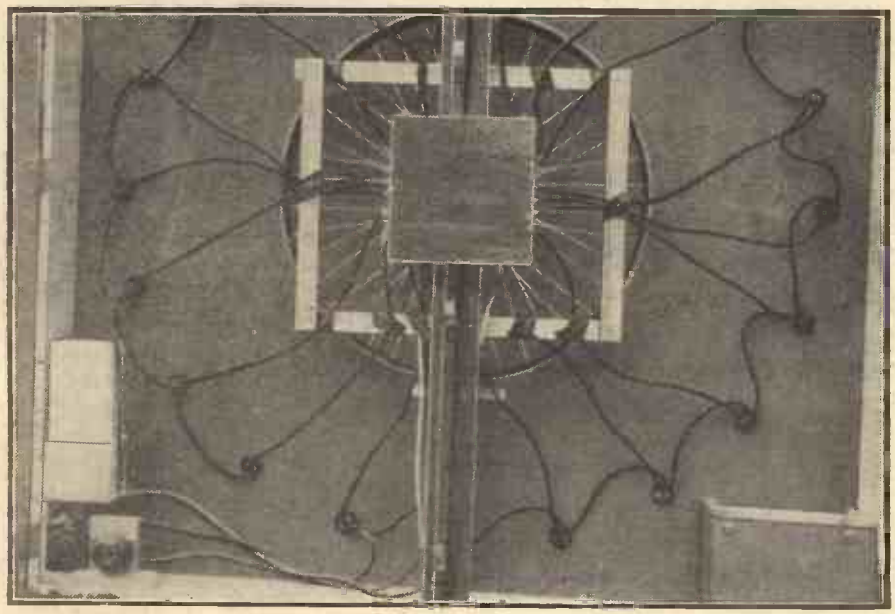


Fig. 8.—Interior view. On the left is a half box and strap holding the name plates. Bottom right is a box which holds the lamps when not in use. The centre box covers the live terminals of the 20 contact studs.

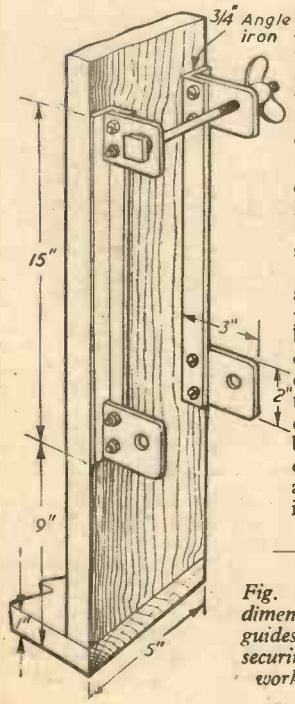


Fig. 7.—Details and dimensions of the guides and lugs for securing main framework to standards.

Guides and Lugs

These, as will be seen in Fig. 7, are made up of ¾in. angle iron, mild steel lugs 3in. × 2in. × ⅛in., and ⅜in. bolts 3in. long supplied with fly nuts. Reference to Fig. 9 will show that the standards run between the insides of the angle iron and are kept in position by the bolts, the main frame resting on the cross blocks let into the standards. First drill the angle iron to take three or four No. 8 screws to fasten them to the main frame.

(To be Concluded)

About Binoculars

Some Points Which May Guide the Prospective Purchaser

ALTHOUGH there are several types of glasses made for special classes of work the optical systems of all fall under one of two heads: non-prismatic and prismatic.

In the first, usually spoken of as just "field glasses," rays from the subject pass straight through to the eye, but in the second the path is diverted by small triangular prisms of glass. The telescope gets its tremendous magnification by virtue of the great length from the eye-piece to the "objective" lens (the one at the far end). Being short, binoculars can never, therefore, be as powerful, but "prismatic" glasses can

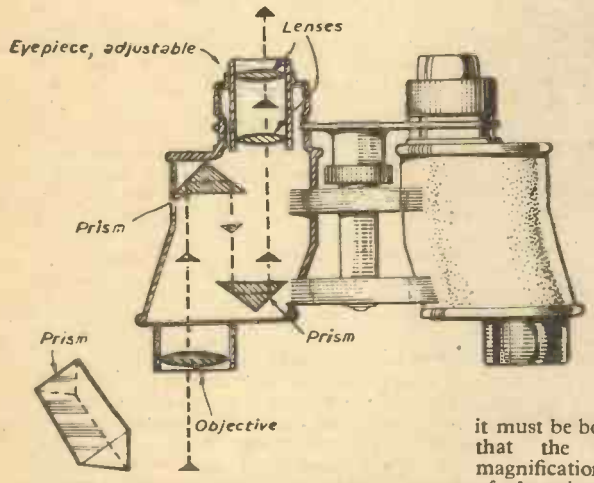


Fig. 1.—(Left) The principle of prismatic binoculars.

Fig. 2.—(Right) Details of non-prismatic binoculars.

give the greater magnification, as the prisms increase this all-important distance between eye-piece and objective.

The increased length is made possible, as shown in Fig. 1. The rays from the subject are collected by the "objective" and pass to the first prism. Here, by the simple laws of refraction they are bent to a right angle twice and pass on to the other prism. A reverse action takes place and the rays are bent back once more to the same direction they had when entering the objective. And so they reach the eye through the small lenses in the eye-piece.

With the other type of glass the rays travel straight from the entering lens to the eye-piece without any bending and, of course, by a shorter route. Hence there is less magnification. These glasses are shown in Fig. 2.

Magnification and Lens Diameter

Non-prismatics are generally vaguely advertised as "powerful," etc., but prismatic glasses are stamped with figures such as 8 × 30. The first number gives the magnification, thus 8 means that an object is seen through the glass eight times higher and eight times wider than it appears to the naked eye. The second figure, 30, gives in millimetres the diameter of the objective glass. It is a very important dimension, for on the size of this lens depends the brightness of the image and it gives some idea as to how useful the glasses will be in dull light.

The bigger the objective, the more light it collects, and certain binoculars known as "night glasses" have these end lenses very large indeed so that they give quite a good picture even when it is too dark to see the object with the unaided eye.

To compare the amount of light coming through two glasses, set them up a little distance away. A small circle will be seen, which will be bigger in the glass that passes the more light. In a well-designed glass the circle will be equal to the diameter of the objective divided by the magnification.

For general use a glass magnifying 8 times is considered ideal, but for specialist work they can be obtained up to × 25. When buying a glass it must be borne in mind that the bigger the magnification the less of the picture you see at any one time. Thus it would be no good going to a race meeting with binoculars so strong that, say, a jockey's cap filled the whole picture area. Very high-powered glasses, too, are more difficult to sight and to keep steady, for the slightest vibration causes a big movement of the image.

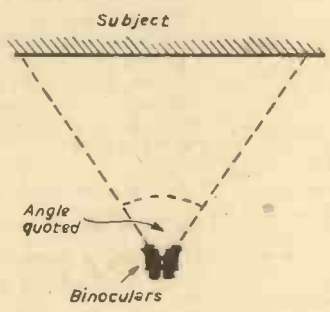


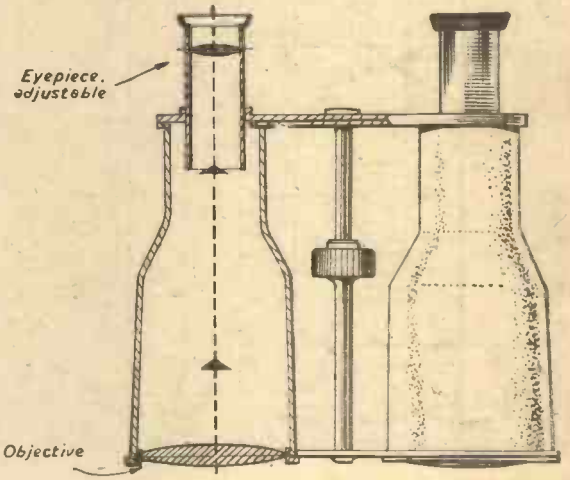
Fig. 3.—The binoculars' field.

General Purpose Glasses

A good compromise is obtained with × 7 or × 8 binoculars. They cover a good field, give fine detail and are easily held. The "field" is the width of view a glass gives, and it is either described as a certain width at a certain range, or in terms of the angle the outer edges of the field make at the objective lens. Thus an 8.5 deg. glass can be defined as giving 150 yards width at 1,000 yards range, see Fig. 3.

Focusing

High-grade prismatics have another advantage over plain "field glasses" in that they are made with a hinged bar in the centre which allows the two eye-pieces to be brought exactly before the pupils. This is really very important, for no two persons have the same between-eye distance and for perfect vision the eyes should look straight into the lens. If upon looking through a glass you see a shape as Fig. 4 you may know that the lenses are too far apart and



should be brought together till a perfect circle is seen.

Again, our two eyes never have quite the same strength, and to allow for this, good-quality binoculars have one eye-piece focusing independently of the other. This is very convenient and helps towards clear vision.

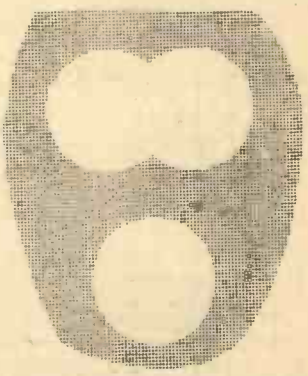
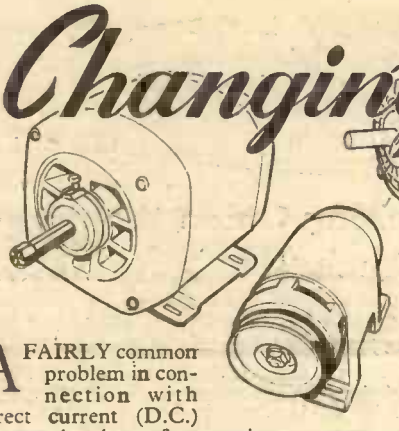


Fig. 4.—(Top) Glasses wrongly focused. (Below) The fault corrected.

An interesting development of the prism principle is the "Monocular." This is, in effect, one half of a pair of binoculars and is used like a telescope; indeed, it is, in fact, a shortened telescope. Magnification of × 8, × 12, × 16 and up to × 25 can be obtained with it.

Changing the Speed of D.C. Motors

J. L. Watts Discusses the Various Aspects of this Problem



A FAIRLY common problem in connection with direct current (D.C.) motors is that of operating a motor at a different speed from that for which it was designed. It may be required to run the machine at one speed, or variable-speed operation may be required. It may be that a given motor must be suitably controlled or modified, or it may be desired to select a motor which can be modified for some particular purpose. Fortunately D.C. motors can often be used on different speeds.

Power Requirements of Various Types of Loads

In all cases it is, however, necessary that the motor be large enough so that it can, without overheating, develop sufficient power to drive the load at whatever speed is required. Now the horse power developed by a motor is proportional to the product of its speed and torque, or turning moment. Thus a high-speed motor of given horse power has a lower, full-load torque than has a low-speed motor of the same horse power. The full-load torque of a motor is defined as the load torque which the motor can drive, without overheating, for the period of the motor rating.

The design of D.C. motors is such that, in general, a low-speed motor of given horse power has a larger physical size than that of a high-speed motor of the same horse power. This means that if a low-speed motor is modified to run at a higher speed it may be possible to increase its horse power; but if a high-speed motor is modified to run at a lower speed its horse power will be reduced. Thus, in general, a low-speed motor of given horse power is often a better proposition for modification than is a high-speed motor of the same horse power. If a high-speed motor is to be run at reduced speed it may be necessary to use a motor which, on its normal rated speed, has a greater horse power rating than is required on the lower speed. The relation between the full-load torque and the speed of motors will be discussed as the occasion arises.

In deciding upon the horse power required to drive a given load at a different speed, or at different speeds, it is necessary to consider the speed-torque characteristics of the load itself. Fig. 1 refers to various types of loads. Curve A shows the torque required to drive a simple rotating device in which the principal resistance to motion is friction, which may be somewhat higher at the instant of starting than after the drive has been started. Apart from the initial starting period, the horse power required to drive this type of load (proportional to torque × speed) will be proportional to the speed. This has been represented by A^1 in Fig. 1 in the case of a load which requires half the motor horse power at the rated speed of the motor. It will be noted that if the speed of the drive is doubled the drive will then require the full rated horse power of the motor. This characteristic is similar to that of a lifted weight.

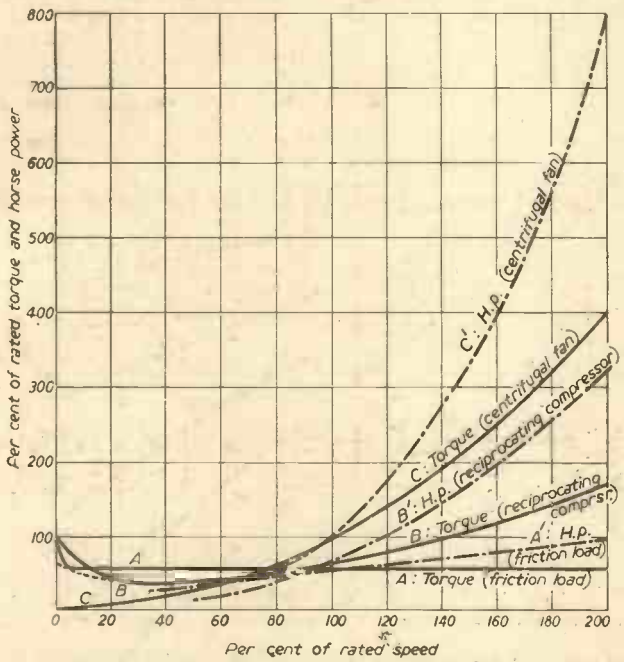


Fig. 1.—Torque and power requirements of various types of loads.

The curve B in Fig. 1 shows how the torque required to drive a reciprocating air compressor varies with the speed of the compressor. It will be noted that if no pressure release valve is fitted the torque required to start the compressor will depend somewhat on the position of the piston in the cylinder at the instant of starting, as indicated by the dotted line at the start of curve B. The curve B' shows that the horse power required to drive such a compressor at double speed may be about four and a half times the power required to drive it at rated speed. On the other hand the torque required to drive a centrifugal fan is approximately proportional to speed^2 as indicated in curve C, the horse power required being approximately proportional to speed^3, as in curve C'. Thus, if such a fan is to be driven at double its normal speed, about eight times the normal horse power may be required.

Series Motor with Armature Circuit Resistor

The simplest way of running a D.C. motor at a different speed is by connecting a resistor in the motor circuit and/or by altering the internal connections. Many small D.C. motors are series machines, having field coils F_1 and F_2 of comparatively thick wire which are connected in series with the armature A. Often the field coils are connected on either side of the armature, as shown in the inset in Fig. 2, which also shows a speed control resistor R connected in series with the motor. The effect of such a resistor is to reduce the voltage applied to the armature so that, on a given armature current and load resistance torque, the motor runs at a reduced speed.

On a given load torque the motor speed is roughly proportional to the voltage applied to its armature. Thus to reduce the speed from N to N_1 r.p.m. the voltage applied to the motor may be reduced from the rated value V to V_1 volts. In this calculation internal volt drops in the motor have been ignored for simplicity. The volt drop required across the series resistor is, therefore $V - V_1$ volt, this being equal to $I_A \times R$, where I_A is the motor current (amps), and R the ohmic value of the series resistor. Thus R is roughly equal to

$$\frac{N - N_1}{N} \times \frac{V}{I_A} \quad \ldots (1).$$

It will be noted that the volt drop across a given resistor is proportional to the current I_A which flows through it. As will be seen from Fig. 2 the current I_A taken by a series motor is automatically governed by the motor torque which, under all stable running conditions, is just equal to the resistance torque of the load. Thus if the load torque and motor current are reduced on reduced speed, the volt drop across a series resistor will fall, causing the motor to run at a higher speed than would otherwise be the case. If the field magnets of a series motor are magnetically saturated the motor torque may be practically proportional to the motor current

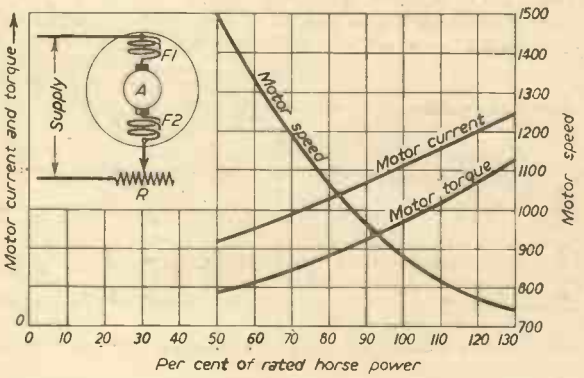


Fig. 2.—Characteristics of a series D.C. motor and method of speed reduction.

I_A; if the field magnets are unsaturated the motor torque of a series machine may be practically proportional to I_A^2. If, therefore, the load requires reduced torque, and thus reduced motor current I_A, to drive it at reduced speed, the value of series resistor required for a given speed reduction will

have to be increased, as will be understood from Formula (1).

Taking the extreme case where the load torque required is proportional to speed², as in curve C of Fig. 1. with an unsaturated series motor in which the torque is proportional to current², the actual motor current taken on changed speed will be practically proportional to the speed. Thus if I'_A is the motor current required to drive this load at the rated speed N, the current I_A required to drive the load at the reduced speed N_1, may be taken as equal to $\frac{N_1}{I'_A \times N}$. This little example will illustrate that an increased value of series resistance is required if the required torque is less on reduced load.

When a series motor is used with a series resistor the torque developed by the motor is equal to the resistance torque of the load at all steady speeds, provided the series resistance is not so excessive as to stall the motor. However, the torque which the motor is capable of developing without overheating is approximately constant; thus the horse power which the motor can develop without overheating is approximately proportional to the motor speed.

Field Diverter Control of a Series Motor

It is sometimes required to raise the speed of a series motor. It is often possible to do so by connecting a diverter resistor in parallel with the field windings. If the field coils are connected on opposite sides of the armature, as in Fig. 3a, it is best first to reconnect them on one side only of the armature, as in Fig. 3b. It is essential that the relative direction of the current through the field coils be unchanged, thus the ends X and Y which were connected to the brushes in Fig. 3a must be connected together as in Fig. 3b. With a given voltage applied to the motor the speed will be almost inversely proportional to the strength of the field flux. When full load current flows through the motor armature the torque will be practically proportional to the field flux, with speed inversely proportional to the field flux.

With unsaturated field magnets the speed would be doubled if the field current were halved, as could be done by connecting in parallel with the field coils a resistor of ohmic value equal to that of the field windings. The resistance R_f of the field windings can be calculated by measuring the volt drop V. across the ends of the series field windings whilst carrying a given field current, I_f. Then $R_f = \frac{V_f}{I_f}$. If the field magnets had a high degree of saturation a lower value of diverter resistance would be required for a given increase of speed. With the diverter method of speed control the torque which the motor can develop without overheating is practically inversely proportional to the speed, the permissible horse power loading being practically constant at all speeds. If this method of speed control is to be used with a load requiring a constant torque at all speeds the rated torque of the motor at its rated speed must be more than the torque required at the maximum speed, in the ratio $\frac{\text{Maximum speed}}{\text{Rated speed}}$. If the torque required increases on increased speed a still higher torque ratio will be required.

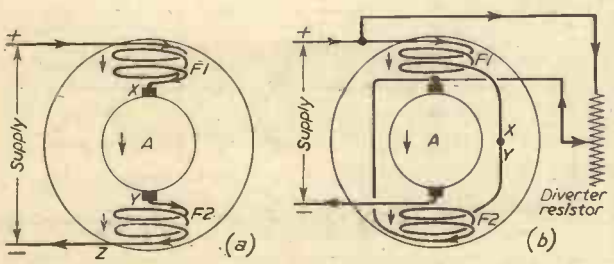


Fig. 3.—Use of a diverter resistor for raising the speed of a series D.C. motor.

Reconnection of Field Coils of a Series Motor

The speed of a series motor can also be raised by reconnecting the field coils into two parallel sets, in series with the armature, as in Fig. 4b. Care must be taken that the relative direction of the current through the field coils is unchanged. With unsaturated field magnets this system would double the speed of the motor on a given armature current but, in practice, the increase of speed is likely to be rather less than 100 per cent. due to saturation effect. The permissible load torque in either case will be roughly inversely proportional to the speed, with permissible horsepower loading practically unchanged.

Armature Circuit Control of a Shunt Motor

The field coils of a shunt motor are wound with relatively fine wire and are connected in parallel with the armature, as in the inset to Fig. 5, which also shows a resistor R in the armature circuit for speed control. This method can be used for reduction of motor speed. As in the case of a series motor the ohmic value of armature circuit resistor required to reduce the speed from N to N_1 r.p.m. on a supply of constant voltage V may be given by $R = \frac{N - N_1}{N} \times \frac{V}{I_A}$ ohms where I_A is the armature current required at the reduced speed. The armature current I_A taken by a shunt motor is approximately proportional to the torque, thus, if the torque is reduced at the lower speed, the reduced value of I_A will necessitate using an increased value of armature circuit resistance.

Take the extreme case where the torque required is proportional to speed², as in curve C of Fig. 1. If I'_A is the armature current required to drive the load at the rated speed N, the current I_A required to drive the load at the reduced speed N_1 may be taken as equal to $I'_A \times \left(\frac{N_1}{N}\right)^2$. This indicates the considerable increase of armature circuit resistance required if the load torque falls on reduced speed. If the torque is proportional to speed², the series resistance required to halve the speed may be about four times that required with a constant-load torque.

With armature circuit resistance control of a shunt motor speed the permissible torque is practically independent of the speed, the permissible horse power being almost proportional to the speed. Thus this method of speed control is satisfactory provided the motor can develop sufficient torque to drive the load at the maximum speed required. Fig. 5 shows the reduction of speed with increasing values of armature circuit resistance from R_1 to R_5. It will be noted that the use of such a series resistor allows the motor speed to vary considerably if the load torque varies. Also if a very high value of armature circuit resistance R_5 is used the motor may be unable to develop its rated full-load torque, even at standstill, due to the reduction of armature current.

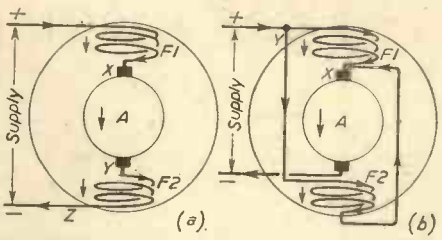


Fig. 4.—Re-connection of series field windings of a series motor for increased speed

Speed Control by Shunt Field Circuit Resistor

The speed of a shunt motor can be increased by connecting a resistor R in series with the shunt field windings alone, as in the inset to Fig. 6. The resistance R_f of the shunt field windings can be found by measuring the current I_f which flows through the shunt field windings when a voltage V is applied to the field windings. Then $R_f = \frac{V_f}{I_f}$. Due to saturation effect in the field magnets the field circuit resistance required to double the motor speed will be rather more than that of the field windings themselves. Fig. 6 shows how the speed of a particular shunt motor varies with the field current. It will be noted in this case that if a series resistor of ohmic value equal to that of the field windings is connected in the field circuit to halve the field current the speed will be increased from 1,420 to 1,940 r.p.m., an increase of 37 per cent.

The permissible torque obtainable with field circuit control is practically inversely proportional to the speed, as may be seen from Fig. 6, the permissible horsepower being practically constant. With this system of control, therefore, the rated full-load torque of the motor at rated speed must be greater than the torque required to drive the load at the maximum speed.

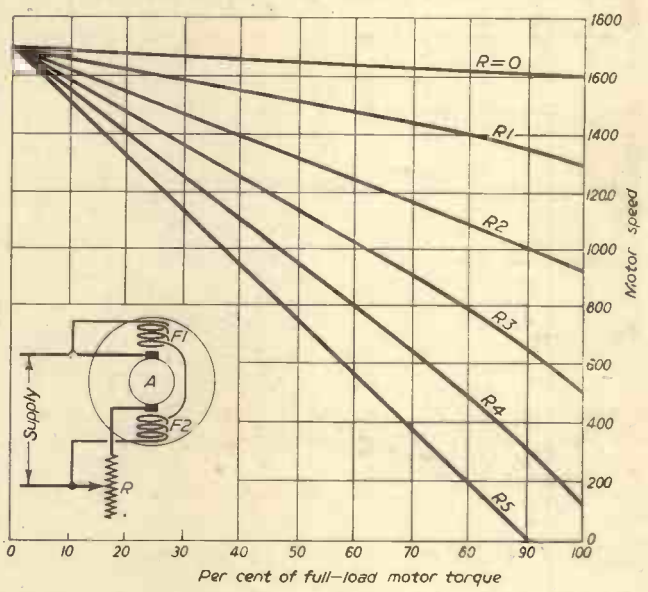


Fig. 5.—Effect of a series resistor in the armature circuit of a shunt motor.

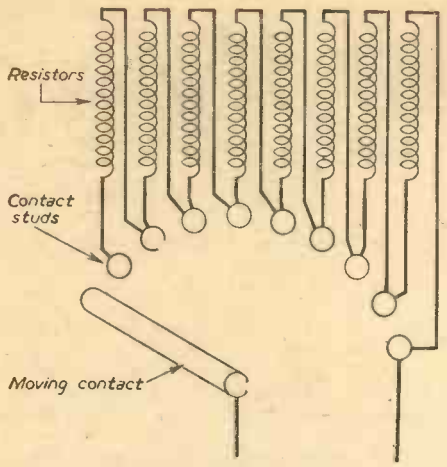


Fig. 7.—Arrangement of a variable resistor.

Construction of Resistors

Speed control resistors may be constructed by using resistance wire which is wound round into a spiral of about ½in. dia. and wrapped round, or secured to, a strip of asbestos board; or wound in a spiral of about ¼in. dia. fitted into the grooves of a steatite electric fire former. If a precise or a variable speed is required, it is best to use a variable resistor. The wire may then be looped to contact studs on a tapping switch, as indicated in Fig. 7. The contact studs could consist of 2 B.A. brass cheese-headed screws on a panel of asbestos board. The resistors should be fitted in a well-ventilated metal case which is efficiently earthed. The moving contact may be operated by a ½in. dia. bakelite rod passing through the metal case to an insulated knob outside. The size of resistance wire must be large enough to carry the required current without overheating. Table 1 gives suitable sizes of Eureka resistance wire, together with the resistance per yard of the wire. These values enable the length of wire required to be readily calculated.

Speed Alteration by Rewinding

The speed of a motor can also be altered by rewinding the armature. Before so doing it is necessary to ascertain the number of turns per armature coil, the number of coils per slot, the size of wire used, and the lead between the armature coils and commutator segments. It is assumed that only two-pole motors are concerned, such motors having two parallel circuits through the armature. The number of armature coils may be equal to, or a multiple of, the number of armature slots. The number of coils, or coil sections, will be equal to the number of commutator segments.

In order to count the number of conductors per armature slot it is best to cut through all the conductors at the back of one slot and to count the number of wire ends. The number of turns per slot will then be equal to half the number of conductors in the slot. The number of turns per coil, or per coil section, will then be equal to the turns per slot × number of armature slots divided by the number of commutator segments. If there are more commutator segments than slots, as is quite usual, there may be more than one coil per slot; or each coil may have two or more sections with loops brought out to the commutator segments. The gauge of the armature conductors must then be accurately measured by means of a standard wire gauge or micrometer and identified as in columns 1 or 2 of Table I.

If the present number of armature conductors per slot is C and it is required to alter the motor speed from N to N_1 r.p.m. the new number of armature conductors per slot will require to be made equal to $C_1 = \frac{N}{N_1} \times C$. Thus for increased speed the number of armature conductors must be reduced and vice versa. If the cross-sectional area of the present wire is A sq. in., the cross-sectional area A_1 of the new wire to be used should be approximately equal to $\frac{N_1}{N} \times A$ sq. in. In other words $C_1 \times A_1$ should be approximately equal to C × A. Thus, if it is required to double the speed of a motor which has 160 conductors of 36 s.w.g. (0.0000454 sq. in.) per armature slot, the armature should be rewound with 80 conductors per slot of 32 s.w.g. (0.0000916 sq. in.). The existing coil span, and the lead between the armature coils and commutator segments, must be carefully copied. When rewinding the armature of a series motor each field coil should be similarly rewound. However, if the number of armature turns is halved to double the motor speed the field coils could be reconnected in parallel, as in Fig. 4, without other alteration.

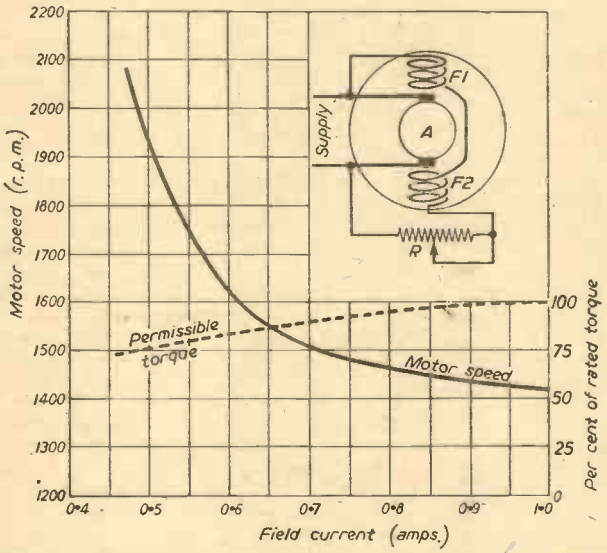


Fig. 6.—Effect of reducing the field current of a shunt motor.

CHANGING THE SPEED OF A D.C. MOTOR

Gauge of wire (s.w.g.)	Diam. of wire (inch)	Cross sectional area of wire (sq. inch)	Current (amps)	Resistance (ohms per yard)
13	0.092	0.006648	12.7	0.101
14	0.080	0.005027	9.5	0.134
15	0.072	0.004072	7.4	0.165
16	0.064	0.003217	6	0.209
17	0.056	0.002463	5.3	0.273
18	0.048	0.001810	4.3	0.372
19	0.040	0.001257	3.7	0.536
20	0.036	0.001018	3	0.661
21	0.032	0.000804	2.8	0.837
22	0.028	0.000616	2.2	1.093
23	0.024	0.000452	1.8	1.487
24	0.022	0.000380	1.5	1.77
25	0.020	0.000314	1.25	2.142
26	0.018	0.000254	1.05	2.645
27	0.0164	0.000211	0.9	3.186
28	0.0148	0.000172	0.76	3.914
29	0.0136	0.000145	0.68	4.634
30	0.0124	0.000121	0.59	5.575
31	0.0116	0.000106	0.52	6.37
32	0.0108	0.0000916	0.47	7.35
33	0.010	0.0000785	0.42	8.571
34	0.0092	0.0000665	0.37	10.128
35	0.0084	0.0000554	0.33	12.149
36	0.0076	0.0000454	0.28	14.840
37	0.0068	0.0000363	0.26	18.536

Table 1.—Details of Eureka Resistance Wires.

In order to change the speed of a shunt motor the armature may be similarly rewound, no alteration of the field windings being necessary.

When thus rewound the permissible full-load torque may be practically unchanged, the permissible horse power loading being practically proportional to the speed. It should be noted that the running speed of a series motor will still depend on the resistance torque of the load, the speed of a shunt motor being almost independent of the load. Care should be taken not to operate a motor at such a high speed that there is a risk of damage to the rotating windings and other parts due to the high centrifugal forces set up, these forces being proportional to speed². If the speed of a motor is very much reduced it may be advisable to reduce the load torque t avoid overheating due to reduced cooling. On changed speed there may be slight sparking at the brushes. If the brushes are adjustable it may be advisable to set them slightly backwards in the opposite direction to rotation otherwise brushes of higher resistance may be desirable. If a motor is rewound for increased speed and horse power it will, of course, take an increased current. This may not affect the commutation of a very small motor but, in the case of a big alteration to a larger motor, larger brushes may be advisable.

A Powerful Lifting Magnet

The Magnet Described Will Carry a Current From an 8-volt Accumulator With No Other Resistance in Circuit and Will Easily Lift a Weight of 25lb.

Fig. 1.—The completed magnet.

A LIFTING magnet is an electro-magnet which is specially designed to support heavy weights by the application of a comparatively small electric current. The model described is capable of carrying a current from an 8-volt accumulator, with no other resistance in circuit, without undue heating up of the coil, and it is easily capable of supporting a load of 25lb. weight, or even more. The materials used are inexpensive, and the work involved is not beyond the skill of the young amateur constructor.

Fig. 1 shows the finished magnet, and Fig. 2 a vertical section. The dimensions given can, of course, be varied to suit individual requirements, and are merely intended as a general guide. The main portions of the body of the magnet are shown separated in Fig. 6.

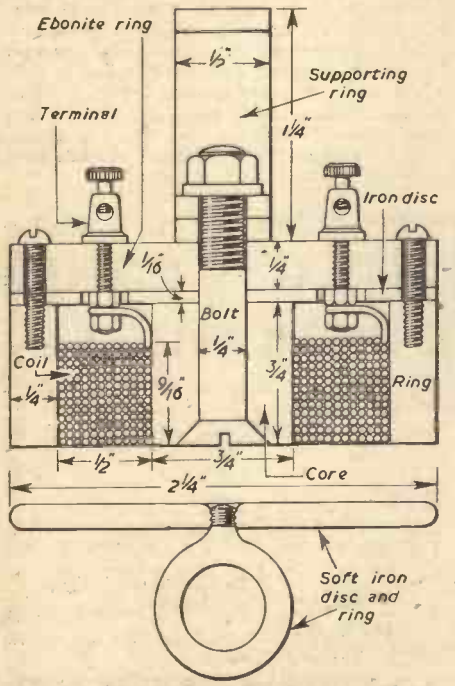


Fig. 2.—A sectional view.

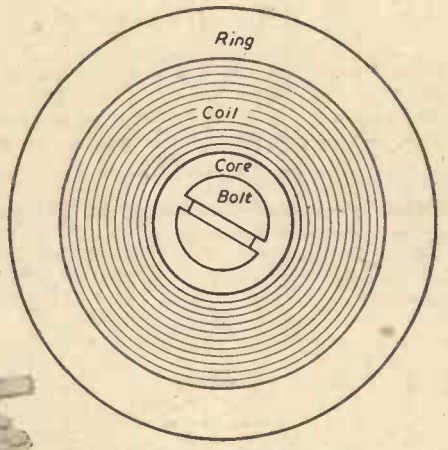


Fig. 3.—Plan view.

Magnet Construction

Obtain a piece of iron piping 1¾in. internal diameter and about ¼in. in thickness. Cut off a short length, about 13/16in., and file and polish the ends until they are square, flat and smooth and the finished length is ¾in. Of course, the appearance is improved if the outside surface of the piping is also finished off smoothly or even enamelled. This portion will afterwards be referred to as the "ring" in all diagrams and description.

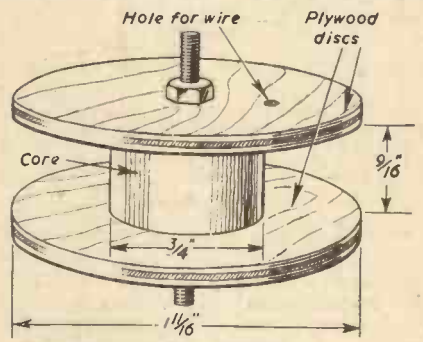


Fig. 4.—The coil former.

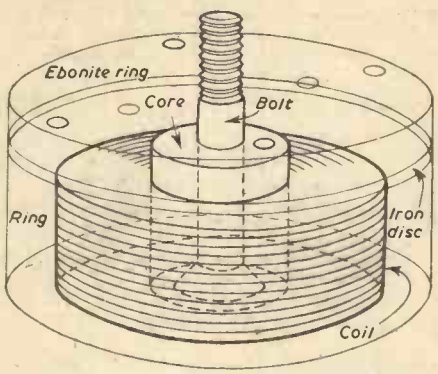


Fig. 5.—The ring, core, discs and bolt in position.

The "core" is made from a piece of ¾in. soft iron rod, ¾in. long, with the ends worked smooth and square. Through the centre, drill and countersink a hole to take a ¼in. countersunk bolt (B.S.F. thread) fitted with a nut. This hole is, of course, drilled more easily on a lathe. A further disc of 1/16in. sheet iron of the same diameter as the outside of the ring is also drilled in the centre to allow the bolt to pass through it. The purpose of this disc is not only to add strength, but also to close the magnetic circuit. A similar disc of ebonite or other insulating material, ¼in. thick, is also drilled in the centre to allow the bolt to pass through it easily. A supporting ring is made by turning a strip of 1/16in. sheet iron into a ring of about 1¾in. dia. with the ends overlapping and drilled to take the bolt, as shown in Fig. 1.

It is advantageous to construct from a piece of ⅛in. soft sheet iron another disc of the same diameter as the iron and ebonite discs already mentioned, although this disc is not actually a portion of the magnet itself. Drill and tap it to take a stout eye. If the top of the hole is slightly countersunk and the eye screwed a little way through, riveted and then filed down level with the disc, there is no danger of the eye pulling through under strain.

Drill and tap the ring and the iron and ebonite discs all together so that later on they may be held together by four round-head 2B.A. ⅜in. screws (see Figs. 2 and 6). Also drill together the discs, iron and ebonite, to allow the legs of two terminals to pass through the holes later.

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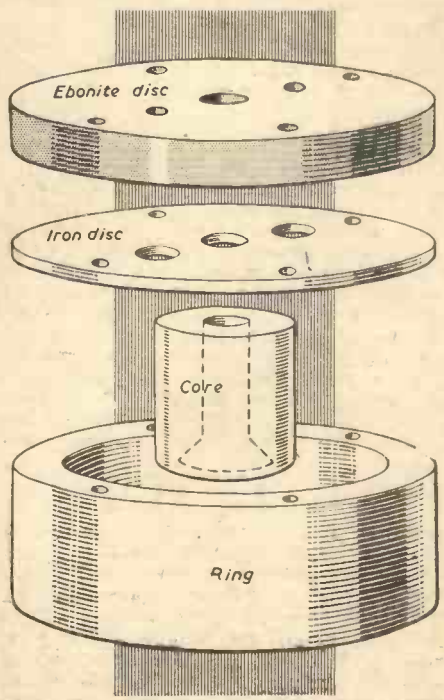

Fig. 6.—The main parts of the magnet.

Making Rafts

By "Aqua"

Try One of These Craft On Your Holiday This Year!

THE easiest way to make a passenger-carrying craft is to follow the practice of the early, and not so early, tribesman and secure a log with sufficient buoyancy to carry your weight and then supply it with an outrigger to prevent it rolling over.

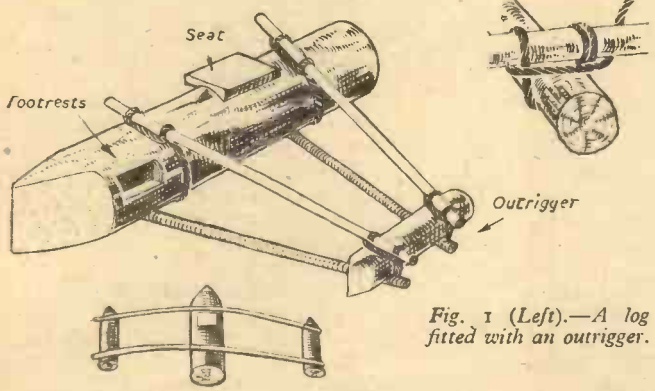

Fig. 1 (Left).—A log fitted with an outrigger.

Fig. 1 shows how this can be done by attaching a small log by means of four spars. The parts are secured together by cord lashings, the method of joining being shown in the inset. The cord is started by a clove-hitch. It is then taken under the lower spar and up and over the one at right-angles. This is repeated several times and a finish off made by taking the cord horizontally between the two members, where it will automatically bind; but the lashing should be completed by pushing the end under an existing turn. This lashing is more or less standard for all this class of work. A seat on top and foot rests can finally be added. Greater manœuvrability is given by roughly pointing what will be the leading ends of the logs. Craft where transverse stability is given by outriggers fall into the catamaran category.

Using a Barrel

If a barrel can be procured this can be used in place of the log. The safe load a closed barrel will carry can be found by multiplying its capacity in gallons by nine, which gives the required figure in lbs. The outrigging can be done with the log in front or at the side, as shown in Fig. 2. The log in front gives a more manageable craft, but not the same anti-rolling properties.

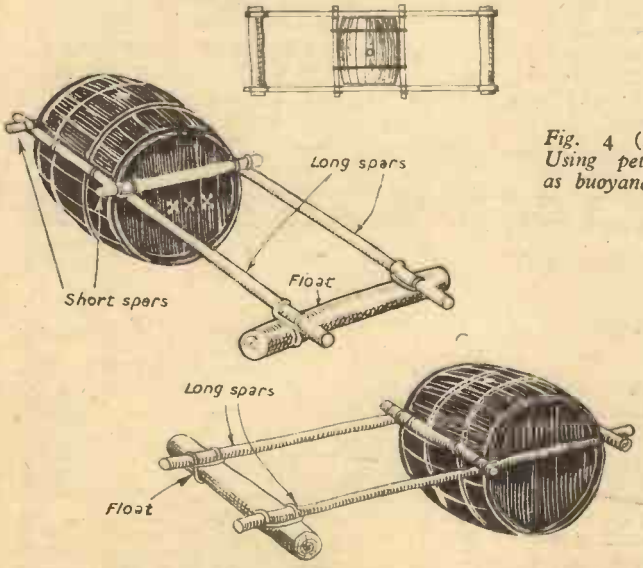

Fig. 2.—Using a barrel to make a raft.

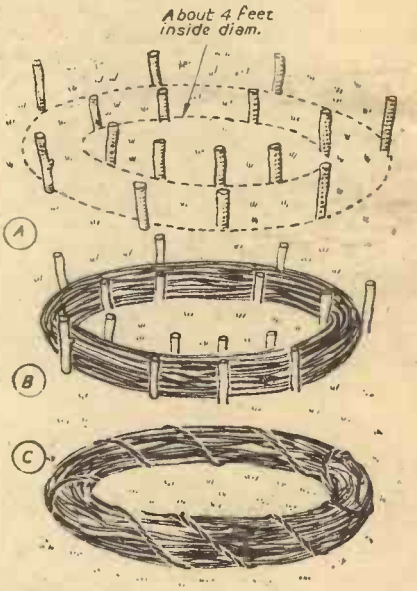

Fig. 3.—Three stages in making a coracle.

Two fairly long spars are needed in either case, two smaller cross-bars and a heavier piece of timber for the float. The two main spars, cross-pieces and float are made into the frame as shown, which must sit on the barrel *above* its halfway line so that the upward thrust of its buoyancy does not tend to push it out, but rather makes things firmer. The barrel is held in position by two lashings, which go right round and take in the horizontal strips also.

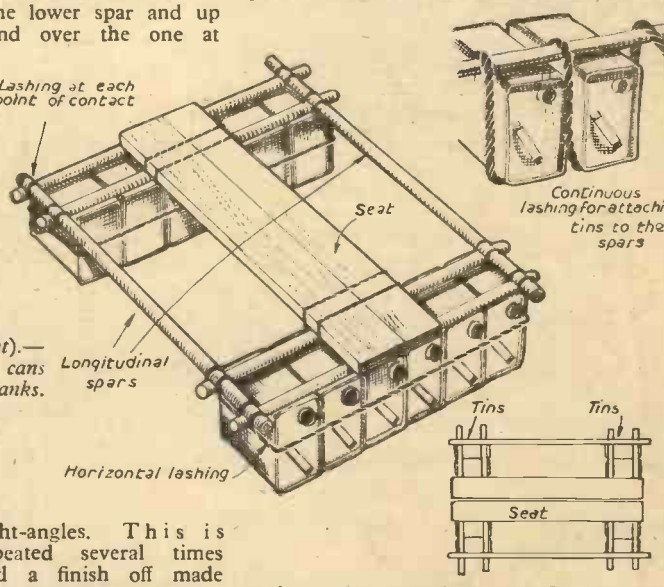

Fig. 4 (Right).—Using petrol cans as buoyancy tanks.

As with the log, a more truly balanced craft is produced by laying the spars right

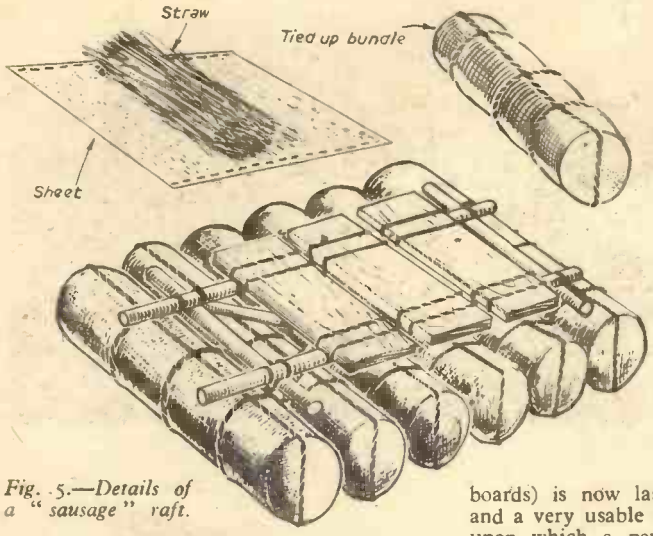

Fig. 5.—Details of a "sausage" raft.

across and having a float at each side, but one float gives the barrel—with careful navigating—all the anti-roll it needs.

A Coracle

This kind of craft can be made if a tarpaulin is available. First drive stakes into the ground as shown in Fig. 3, making a circle of approximately 4ft. inside diameter. Now work brushwood between the stakes till a thick wad has been obtained, and then bind together into a solid band by winding round pliable pieces or using cord. Lift the "fascine," as it is called, on to the tarpaulin and wrap the sides over, making good watertight pleats. Lash firmly across the top and lay on some more brushwood for a floor and the raft is ready for use.

Using Petrol Cans

A dozen cans are required. These might be borrowed locally and returned after use. Two rows of six are made, with the tins narrow side up. Two spars are placed on the top of the one row and two more on the other. The tins are now attached to the spars by a continuous lashing as shown in Fig. 4. Care must be taken to see that each row forms a solid block, and to ensure this a final lashing can be taken horizontally round everything, if this seems desirable. See to it that all the caps are screwed well down.

The two "floats" thus produced are now joined up by two longitudinal strips, lashing at all the points of contact with the transverse spars. A seat made of a board (or boards) is now lashed firmly in the centre and a very usable craft has been constructed upon which a person can ride out of the water.

The "Sausage" Raft

With six groundsheets an arrangement called the "sausage raft" can be made (Fig. 5). This, incidentally, has found favour in the eyes of the armed forces and it is stated that one 18ft. × 15ft. will carry 24 cwt.

The groundsheets are laid out and on each is placed a long truss of straw or soft brushwood. The ends and sides of the sheets are then taken over and the bundles so made lashed at intervals down their lengths. A simple frame is now made from four spars with, if possible, diagonals. A plank seat should go on top.

With a lashing similar to that used for the petrol tins the bundles, or "sausages," are lashed to the frame and all is ready for a launching. This raft is suitable for construction by Boy Scouts or similar organisations at summer camps.

The Log Raft

No article on improvised craft would be complete without some reference to the ordinary "log raft." This is the traditional raft of stories and is made by simply lashing together as many fairly straight pieces of wood as possible (Fig. 6). A raft like this might well be started and added to as the holiday near water continues. The logs are laid side by side and secured to two cross-members by the continuous and very elementary lashing shown. The weight-carrying capacity depends entirely on the number and size of the timbers used.

The ideal thing is to have logs perfectly straight and of equal diameter, but this is seldom feasible and quite a good raft can be put together with logs of various sizes.

Warning

As much fun can be had in shallow water as deep, so play safe and do not do anything risky, even if you are a proficient swimmer. Rafts are good sport, but they are not streamlined boats and the best can become very unwieldy if caught in a current. To launch any raft built on the bank, have as many helpers as possible, lifting all round. Many lashings that will do their job well when the craft is uniformly supported by water may well become disturbed by unequal lifting or pulling about on land.

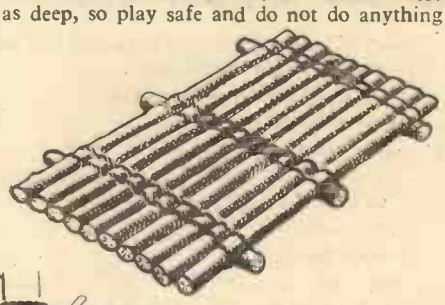

Fig. 6.—A completed log raft and details of a simple continuous lashing.

A Powerful Lifting Magnet

(*Concluded from page 483*)

The Coil

The next job is to wind the coil. This is carried out on a former (Fig. 4), which must first be constructed. The dimensions of the former are such that the finished coil will afterwards fit snugly into its proper position, as shown in Fig. 5, which is a transparent view of the ring, core, discs and bolt in position.

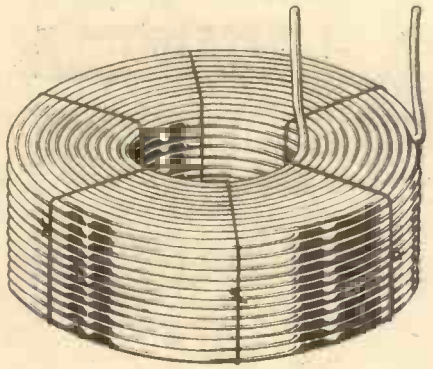

Fig. 7.—The completed coil.

The centre of the former is a piece of ¾in. wood dowelling 9/16in. long with the ends truly squared. The discs are made of plywood and are 1 11/16in. in dia. Drill a hole through the centre of the discs and dowelling and pass through them a piece of threaded brass rod so that the whole can be held firmly together by a nut at the top and another at the bottom. A hole to take one end of the wire should be drilled as shown at the edge of the dowelling. Wrap a piece of paper round the dowelling to facilitate the removal of the finished coil. The wire required is about 1¾oz. of No. 28 D.C.C. copper.

To wind the coil, fix the former on a lathe or in a hand-drill clamped in a vice. Pass one end of the wire from the inside to the outside of the former through the hole at the edge of the dowelling. Secure it and begin to wind the rest of the wire on the former. Arrange between the paper and the first layer of wire several pieces of cotton thread to allow the coil to be tied up after completion, as shown in Fig. 7. After winding each layer of wire, apply with a brush a strong solution of shellac in methylated spirit, which, when it dries, will improve insulation and bind the coil together. When the former is completely filled, allow the coil to stand as long as possible so that the shellac solution may dry off thoroughly, then tie up the threads of cotton to secure the coil. Unscrew the nuts on the former, remove the discs and slip the coil off.

Assembling the Magnet

First pass the bolt through the core and the iron and ebonite discs. Place the ring on the top of the bolt and secure the whole in position by the nut at the top of the bolt. The grip will be improved by a washer below the nut. Pass the terminals through the holes prepared for them in the discs, fasten the ends of the coil to them by small nuts and slip the coil over the core. Now fasten the ring in position by the screws. Set the coil back from the bottom face of the magnet about 1/100in. and pour round it melted paraffin wax to improve the insulation and to maintain the coil in position. Remove the excess of wax, level it up, and the magnet is ready for use. Suspend the magnet by the ring on top. Connect the terminals of a 2-, 4-, 6- or 8-volt accumulator to the terminals of the magnet. Bring the soft sheet iron disc near it, when it will be strongly attracted. Hang weights on the eye which is screwed into it, when the lifting power of the magnet may be ascertained.

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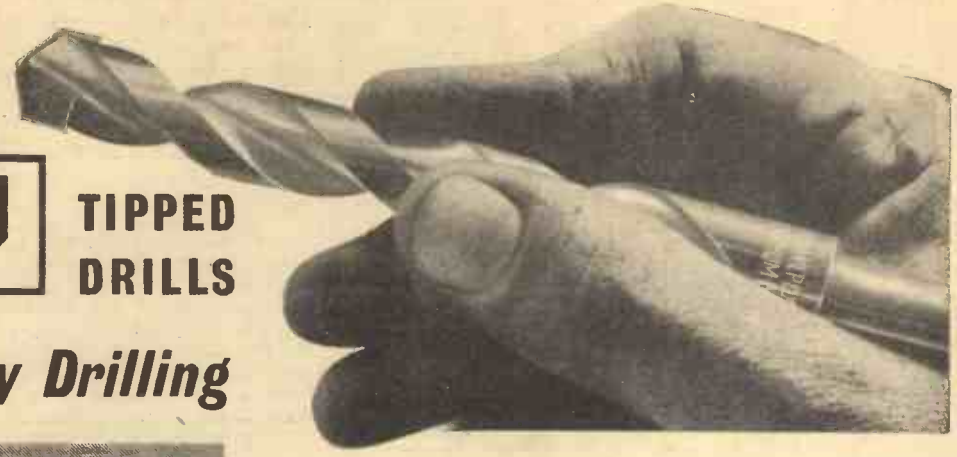

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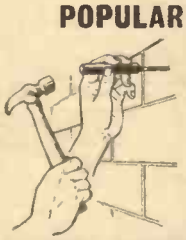

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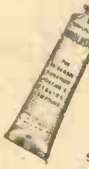

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Letters to the Editor

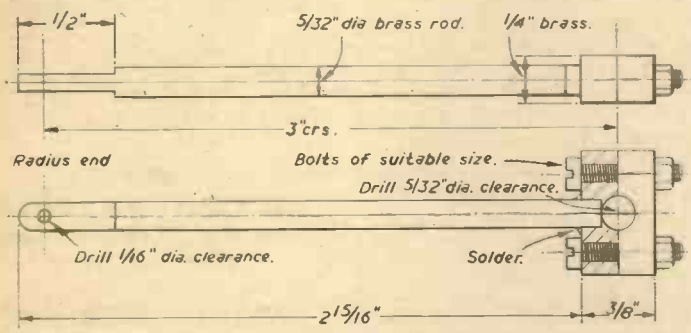
The Editor Does Not Necessarily Agree with the Views of his Correspondents

Address your letters to The Editor, "Practical Mechanics," Geo. Newnes, Tower House, Southampton Street, London, W.C.2

Connecting Rod for Electric S.V. Engine

SIR,—I have made the electric slide valve engine described in your March, 1958, issue. The article is an excellent one, but I notice no details are given of the connecting rod. I devised my own, and perhaps other readers may be interested in the method I used:—

It is made in two halves, i.e., the connecting rod shaft which is 5/32in. dia., and the big end bearing block made from ¼in. brass. The brass is cut and filed to shape as shown on the plan. It is then drilled 5/32in. clearance for the crank. This should be a running fit. Another hole is drilled for the connecting rod shaft and this should be a push or forced fit. Two smaller holes are drilled to suit the bolts to be used on the big end bearing. The bearing block is next cut in half along the line on the plan. The small end is then filed to shape. One 1/16in. dia. clearance hole is drilled. The distance between centres is 3in. Note that all bearings must be running fits.—D. B. (Raynes Park).



Connecting rod details.

Moulding the Human Foot

SIR,—Re "Moulding Human Foot" (page 405, May, 1958, issue), your contributor's method in reply to G. Kendall (Watford) seems to me, a plaster caster for 50 years, rather long drawn out. I suggest the use of a waste mould to be the best way. A model tires quickly, so prepare beforehand two pieces of plaster, any shape, ⅜in. thick, but no wider than foot and heel, to be used as rests, and kept wet. Pare a little toilet soap and boil with water to make a paste. Obtain a 2ft. length of thin, strong twine or thread, a little ochre powder and solution of soft soap.

Prepare the 1in. deep fence next; this is best done with modelling clay, with foot on plaster rests, leaving a margin ¾in. clear of foot. Soap the foot lightly with paste, then place centre of twine under heel, bringing both ends upwards over the ankle, soaping into position to height of leg required. Tint sufficient water with ochre and mix plaster for sole piece; pour into prepared fence, well covering rests, sink foot into plaster, keeping plaster as level as possible, but raise a little at arch. Now, before the plaster is really hard, hold a dinner knife vertically and revolve, making button-like depressions all round. This done, remove fence.

Clay wash or soap this joint right up to the foot. Quickly mix tinted plaster and cover the rest of foot, concentrating on getting at least ½in. of plaster over the twine and the heel. There is a right moment now, when plaster is starting to set, to pull downwards on both ends of the twine, thus obtaining three pieces of mould. While still wet, lather vigorously and wash in running water. When the water runs off, the mould is ready for assembly. Wire the sole to top of the foot, but plaster the vertical joint. When set, wire this joint also.

Cast in white plaster. Before removing the wire chip or carve the mould from under and above the toes, the rest will fall away with a few light taps from a mallet.—G. WELLS (Kent).

Congratulations

SIR,—I have to-day re-read my February copy of PRACTICAL MECHANICS and would like to congratulate you—if I may—on your leading article headed "The Satellite Era." It can be no light task to keep in one's mind all the close practical details of mechanical engineering necessary for the many journals and books which you write or edit, and at the same time be able to move one's outlook to the more distant viewpoint.

If I may say so, your article shows that you are able to focus your viewpoint with remarkable success. This mental "focusing" from inches to many miles requires not only knowledge of the relevant facts, but a great deal of mental discipline.

Again, congratulations, for there is material for several chapters condensed into your article.—ANTONY AVENEL (Scarborough).

Green Fire-balls

SIR,—Radio-active decay is a natural process which cannot be accelerated in any way! So if strontium-90 is absorbed by any substance it would still take 30 years to decay to half its primary activity. I therefore disagree with Mr. H. E. Ford's view on green fire-balls as they would not be able to carry out the job for which they were designed. However, other points mentioned in Mr. Ford's letter in PRACTICAL MECHANICS, May, 1958, are definitely worth further thought, particularly if one believes in "Flying Saucers."—H. LECHNER (Worcs.).

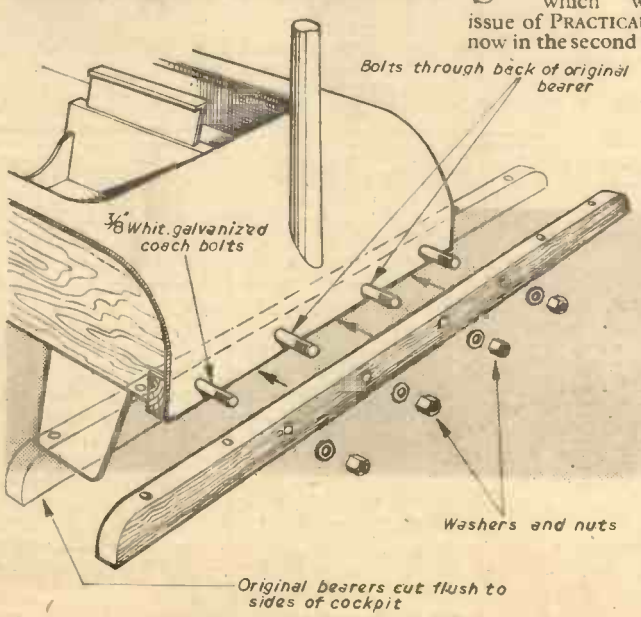
Change of Address

SIR,—May I draw your attention to the fact that the Aethenius Society has changed its address to: The Aethenius Society, 15, Fulham High Street, Fulham, London, S.W.6.—H. E. FORD (Herts).

Catamaran Modification

SIR,—While building the catamaran, which was described in a past issue of PRACTICAL MECHANICS, and which is now in the second PRACTICAL MECHANICS How-to-Make It Book, it occured to me that it would be easier to carry the craft on top of a car if the 6ft. 8in. cockpit bearers could be modified so as not to protrude beyond the width of the car. Accordingly, the main 4in. × 2in. bearers were cut off flush with the cockpit sides and separate bearers made to bolt along their faces, as shown in the sketch.

This, of course, necessitated moving one main fixing frame in each of the two hulls. The hatches follow standard practice and are a fast fit and secured from loss by short lengths of chain.—R. W. B. (Kent).



Details of the modified design.

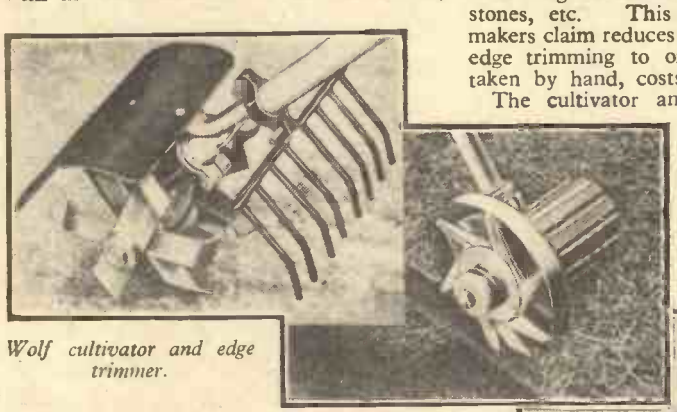
TRADE NOTES

A Review of New Tools, Equipment, etc.

WOLF GARDENING ATTACHMENTS

THE already extensive range of Wolf Home Power Equipment has now had a new item added to it—a verge trimming attachment. This is intended to be used with the cultivator and weeder attachment, both pieces of equipment being shown in the photograph. The bronze alloy rotary cutting blade of the verge trimmer is self-sharpening and the spring loading allows a floating action to avoid damage from stones, etc. This attachment which the makers claim reduces the time taken for lawn edge trimming to only a fraction of that taken by hand, costs 58s. 6d.

The cultivator and weeder which can furrow, hoe, earth-up, work in fertilisers, etc., is run from either the Wolf Cub or Quartermaster power unit. The price is £5 19s. 6d. excluding power unit.



Wolf cultivator and edge trimmer.

★ ★ ★ ★ ★

Bench Crosscutting Machine

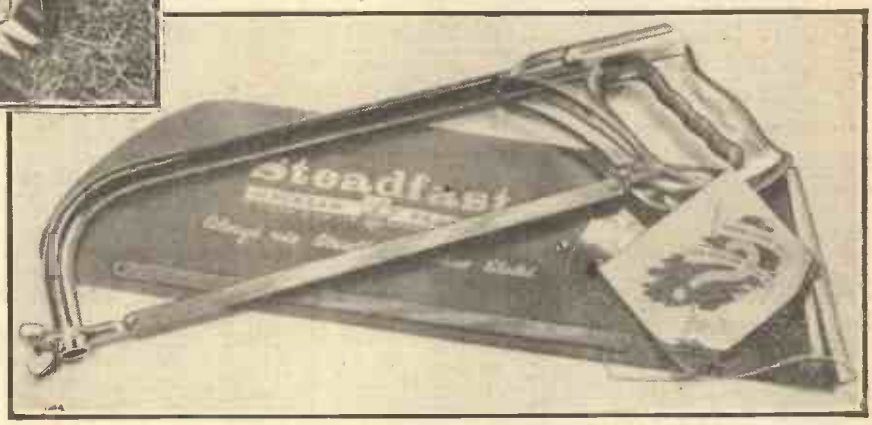
THE Dominion Machinery Co. Ltd., of Hipperholme, Halifax, are adding to their list of small machines a bench cross-cutting machine. This takes up little space and can undertake all cutting work across the grain. The table is fixed so that an extension table can be built around it if required, but the top rail and the carriage on which the saw in mounted, rises and falls and is controlled by a hand wheel.

Bench crosscutting machine.

The machine will carry a wobble saw or grooving head and it is possible, therefore, to groove across the grain or to do stair strings or half tenons. The price is £70 complete.

Steadfast Hacksaw Frame

A NEW product is announced by J. Stead and Co., Ltd., of Manor Works, Cricket Inn Road, Sheffield. This is the Steadfast Hacksaw Frame in a plastic wallet, as shown. It incorporates an entirely new type of translucent amber plastic handle, which, it is claimed, gives a better grip and in conjunction with the adjustable oval tube frame forms a balanced tool of robust manufacture. The frame is sold complete with a 12in. × 24T Steadfast regular tungsten blade, the wallet also containing an additional 12in. × 18T blade, and a booklet describing the correct use of a hacksaw. The method of holding and tensioning the blades, as can be seen from the photograph, is unchanged from that of previous saws produced by this firm. Blade changing is effected merely by a few turns of a butterfly nut. The kit costs 19s. 6d., and is obtainable from ironmongers, tool merchants, garages, etc.



The Steadfast hacksaw frame.

Flexible Drive "One Man Workshop"

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A single flexible drive, with a handpiece which can be adapted to be either of the collet or straight type, can be used with all the attachments provided. These include the "Kennedy" light hacksaw machine, which can cut 2in. square or 2⅛in. round steel bar; the well-proved "Burgess" light bandsaw, capable of sawing timber up to 3¼in. thick and plastics, hardboard and light alloys in addition; a nibbling shear, a pneumatic drum sander, a drill chuck, sanding heads, burs and the whole host of small tools and accessories used for fettling, sanding, grinding, rasping and polishing of metals and softer materials.

It will appeal to the man working alone on small scale production, or in carrying out light repair work of all kinds. It will be valuable in many toolrooms, and very suitable for educational and rehabilitation institutions.

Further information can be obtained from Flexible Drives (Gilmans) Limited, of 195, High Street, Smethwick, Staffs.

The flexible drive power unit.

READERS' SALES AND WANTS

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

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5IN Tru-Plane, £18/15/- ; 9in. Tru-Plane, £37 ; Mortise Attachments, £12/18/- ; h.p. terms. Wragg Bros., Chapel Street Leabrooks, Derbyshire.

S.G.S. Woodworking Machinery.—Saw Bench Units: "Empire" (for saws to 12in.), £3/6/-; "Royal" (16in.), £5/3/- ; "Empress" (20in.), £5/15/- ; "Monarch" (30in.), £11/18/6 ; ½in. Drill Chucks, 14/- extra. Planer Units, fitted with high-speed ball bearings: 4½in. £4/15/-, 6in. £6/15/-, 8in. £8/10/-. Wood Turning Combination Lathes: 18½in., 24in. or 30in. centres from £9/19/6. Obtainable from ironmongers, tool shops, etc., or write direct to: S.G.S. Engineers, Dept. 14, Old Costessey, Norwich, Norfolk.

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(Continued on next page)

(Continued from previous page)

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ALL TYPES OF ELECTRICAL GOODS at extremely competitive prices, e.g., 5 amp. Twin Cable, 48/- 100 yards; Lampholders, 7/- doz.; 5ft. Battens, 51/6; quality and immediate despatch guaranteed. Request list. Jaylow Supplies, 93, Fairholt Road, London, N.16. (Telephone: Stamford Hill 4384.)

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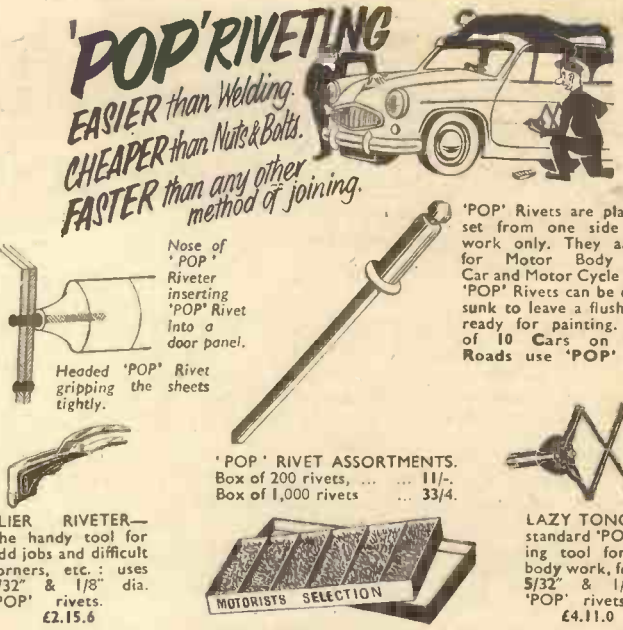

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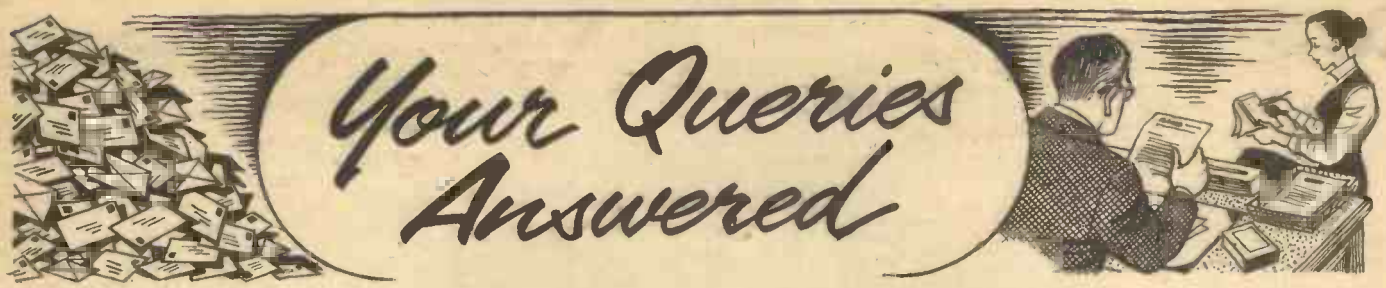


A Tellurion

COULD you give me any practical advice on the making of a Tellurion? The model I should like to make is for practical demonstrations before geography students.—R. Evans (N. Wales).

A TELLURION is an instrument for illustrating the day and night effects on the earth. It may also demonstrate the seasons. Obviously the most simple way in which this can be done is either to obtain a globe, complete with continents and oceans, or to make one with a ball turned in hardwood. In either case it must be mounted on pivots in a half circular brass frame, the pivots making an angle of 23 deg. 27 min. with the vertical, so that it shall be capable of revolving at that angle. The best plan will be to buy a finished globe already mounted and on a stand. 10in. or 12in. diameter should suit your purpose.

In addition you will require a short standard lamp holder of about the same height as the globe. The lamp will require to be powerful so that it can be placed some distance away and perhaps screened to avoid glare in the eyes of the students. The lamp will represent the sun.

Waterproofing Concrete Garage Roof

I HAVE a pre-cast concrete garage which has developed several hair cracks. The roof consists of reinforced concrete panels with a black bituminous compound sealing the joints.

When it rains the water seeps through the hair cracks in the roof and makes the garage damp on the inside. How can I waterproof it?—F. C. Abbott (Sutton).

THERE are various bituminous compounds on the market which have been specially prepared for waterproofing concrete roofs. One such compound is marketed by Messrs. Tretol of Tretol House, The Hyde, London, N.W.9. The fibrous compound is applied in two coats, coverage 8-10 sq. yards per gallon. We suggest you approach this firm, asking for their leaflet No. 32 on which full instructions are given.

Heating a Village Hall

I HAVE a problem concerning Space Heating for a local village hall. Being an electrician I have estimated that 57.25 kW. would be needed to heat the place electrically. The size of the hall is 60ft. × 35ft. × 12ft. rising to 18ft. which would be 31,500 cu. ft. I have allowed 1,500 watts per 1,000 cu. ft. of air space.

Could you please tell me.

1. Are the figures I have quoted correct?

2. How would this compare in cost of installation and running with any other form of heat?—M. Ackin (Lincoln).

IN order to make an exact estimate of the heating requirements of the hall it is necessary to take into account various factors, such as the changes of air required per hour, and the construction of the buildings, size of windows, etc., which govern the heat loss. About 1,500 watts per 1,000 cubic feet is a good average figure for continuous heating, but if you wish to go into the matter in more detail we suggest that you obtain a copy of the "Mechanical World Electrical Year Book," price 3s. 6d. from Emmott & Co. Ltd., 31, King Street West, Manchester, 3. This book contains a few useful notes on electric space heating, including an example in which the various factors are taken into account.

If the heat losses from the hall with the doors closed, and at the required temperature, are 45kW., the average heat loss during the warming up period might be taken as 22.5 kW. In this case if 57.25 kW. of heating is used, the heat available for warming up would be 35.25 kW. If the heat absorbed by the air, walls, etc., at the required temperature could then be found, in kWh. the time required for warming up (in hours) could be estimated by dividing this figure by 35.25 in the case in question. However this calculation involves the weight and specific heat of the walls, etc., the construction of which is unknown. For buildings which are warmed daily it is advisable to allow 50 per cent. extra heater rating (over that necessary to make good the heat loss at the required temperature) if the hall is to be heated in one hour, or 20 per cent. extra if the hall is to be heated in three hours. For a building which is heated weekly 60 per cent. extra heater rating is advised if two hours can be allowed for pre-heating, or 50 per cent. extra if three hours can be allowed.

We are inclined to think that gas heaters would be less expensive than electric, but this depends on the local charges for electricity and gas for such heating.

QUERY SERVICE 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.

3-phase Motors on Single-phase Mains

I HAVE been given several ½ h.p. and 1 h.p. 3-phase motors. Can I work these on single-phase mains? What are the ways of doing this without having to rewind the coils, etc?—J. W. Richards (St. Austell).

A THREE-PHASE motor can be run from single-phase mains if given a spin by hand before switching two of its three terminals on to the supply. However, even if the single-phase voltage is the same as the three-phase voltage for which the motors were designed, the possible horsepower output on single-phase will be no more than about half the rated value. If, as is usually the case, the single-phase voltage is much less than the three-phase voltage for which the motor was designed, the possible horsepower output on single-phase may be no more than about one quarter of the designed horsepower. In some cases a three-phase motor can be made self-starting on single-phase mains by connecting the third terminal of the motor to one pole of the supply through a suitable capacitor during starting only, but the starting torque is not likely to be very high, and the power developed during running is in no way increased. Up to ⅓ of the rated horsepower could probably be obtained if the stators were rewound for single-phase

Making Polish

CAN you give me a formula for the preparation of a spray- or brush-on polish which could be applied to linoleum or tiled floors? I find the application of normal polish before using an electric polisher is almost as hard as polishing by hand.—C. H. Moore (Stroud).

GENERALLY speaking, it does not usually pay to attempt to make up one's own polish. We would urge you to take up the matter with the manufacturers of the electric polisher or with the makers of the linoleum. However, the following formulæ may prove of interest to you:

Linoleum Polish

Carnauba wax	1lb.
Paraffin wax	10z.
Yellow wax	70z.
Turpentine	1 gal.

Tiles and Marble Polish

Sodium silicate	1 part
Linseed oil	1 part
Precipitated chalk	1 part
Magnesium chloride	0.2 part
Water	10 parts
Gelatin	0.1 part

Tarnishing Silver

I WISH to tarnish silver and E.P.N.S. articles in the quickest possible manner. Can I do this in a closed container with acid fumes or can you suggest a more efficient way? The method must be quick and the equipment (if any) portable.—J. R. Yeates (Liverpool).

SULPHURETTED hydrogen is probably the quickest method of tarnishing silver. It has, as you know, an unpleasant smell of rotten eggs. But a small quantity evolved from the addition of dilute hydrochloric acid to ferrous sulphide should prove effective.

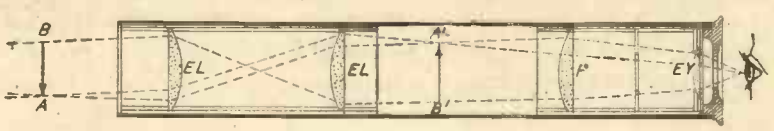
More conveniently you could carry a bottle of ammoniacal solution of hydrogen sulphide and dab the metal objects with a pad of cotton wool soaked in this solution.

Another alternative is to purchase a small tin of "Veet," which is a dipilatory. This should also tarnish silver and would be less messy than the first two methods.

Refractor Telescope

I AM anxious to build myself a telescope, and as I have an ex-govt. camera lens I wondered if it would be suitable for conversion. It is a 36in. f6.3 telephoto (dia. 6in.). If it is suitable, what eyepieces would it need?—B. J. Douglas (Northampton).

THE 36in. focus, f6.3 telephoto lens would be suitable for the telescope. The eyepieces used will depend on whether the image projected is required to be erect or inverted. If erect, for terrestrial observation, you will require four lenses and if inverted two. A terrestrial eyepiece is illustrated below. The two lenses F and EY, at the



The terrestrial eyepiece.

eye end, will be all that are needed to make an astronomical eyepiece. The other two lenses can be separate and mounted in another tube which can be of such diameter as will slide into the main or first tube. You will thus have two eyepieces which are quickly convertible. Let the lens F and the two converting or erecting lenses be all three exactly alike, say ¾in. diameter × 1in. focus. The eye lens EY can be ½in. or ⅝in. dia. × ½in. or ¾in. focus. They are to be all of Plano-convex form.

H. W. English, Rayleigh Road, Hutton, Brentwood, Essex, can supply ex-service eyepieces.

Radio-controlled Models

I HAVE followed your series on radio control and have built the necessary apparatus. I have, however, encountered difficulty with the multivibrator (January 1956). I am using a 12AU7 valve but whichever way I wire the circuit (i.e., changing the two halves of the valve over) it stubbornly refuses to function efficiently. A steady pulse is obtained which is not varied by the .5Ω pot. However, when the key switch is pushed to "Mark" the relay buzzes, indicating that there is not enough current to "hold" it. This relay has a resistance of 2KΩ and making the anode resistance up to 3K and 3.4K has no effect. I have also tried changing the capacitors from anode to grid over and this worsens the situation. Can you help?—M. Newbery (S.W.15).

PROBABLY your difficulty is due to parasitic oscillation in the 12AU7 valve. This effect was not encountered until after the article was written, but the performance of existing units has been improved by the simple expedient of including grid stopping resistors in the grid of each triode of the valve. A value of about 10,000Ω is suitable but not at all critical. The resistors should be soldered by the shortest possible wires directly to the grids of the valves (i.e. pins 2 and 7) and the other ends will then go to the respective junctions of the 56KΩ resistors and .1μF condensers.

The fact that the relay is buzzing when the key switch is pushed to "Mark" indicates that the multivibrator is still operating and has not been immobilised as required by cutting off one half of the valve. It is possible that the grid stoppers will clear the trouble but if not check the values of the 100KΩ and 270KΩ resistors which form the potential dividers to the cathode circuits. A voltage check at these points (with a high-resistance meter) should indicate a voltage of about a quarter of the H.T. line voltage when the key switch is pushed to "Mark" and "Space" alternately. The points should be at earth potential when a "Mark"/"Space" signal is being transmitted.

Dry Rot

WE live in a fairly old house. Below the wooden floor (about 18in. down) is the bare earth, which the builder left covered with a layer of shavings.

Quite recently this layer of shavings has become covered by a thick, yellow, furry fungus, which looks like a yellow carpet with a few orange or reddish brown blotches. It also has an unpleasant smell. The floor boards have been attacked from below and are beginning to break in. I would like to know:

(a) If there is anything which could be sprayed on the fungus to kill it.

(b) If we scrape it up would there be danger from breathing in the tiny spores?—R. Williams (Oxford).

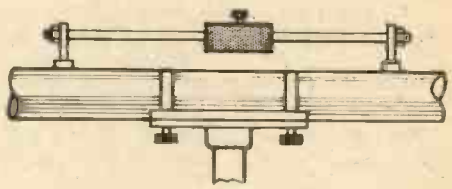
TO answer the second part there will be no danger to humans or animals in breathing the evil-smelling fungus.

From your description it would appear to be a severe attack of dry rot and to eradicate this the first thing to do is to carefully remove all timber which has been attacked and is unsound and in the open air burn it to a cinder. Scrape up all the shavings and remove them in a bucket and likewise burn. Take care when carrying the affected material that you do not drop one particle or get any stuck to your clothes. The spores can lie dormant for years and then without cause or reason commence to grow. Saturate the earth and all timber left in position and also any brickwork with "Rentokil." All the new timber to be put in position must also be treated. At regular intervals of, say, six weeks check that the attack has not broken out in another place.

Telescope Balance

I RECENTLY purchased a 4½in. dia. telescope but find that it is out of balance on its stand, as the two thumbscrews which hold the barrel to the palm are set well forward, causing it to fall with the eyepiece downwards. Can I bore and tap new holes in the barrel for the setscrews? Have you any other suggestions?—J. Heron (Co. Down).

YES, to get your telescope perfectly balanced drill and tap fresh holes for the thumbscrews, although it must be borne in mind that this may not allow for any changes in the weights of various eyepieces



Movable balance weight.

or micrometers or other apparatus you may add at the eye end of the instrument. A better way would be to fit a movable balance weight to slide and clamp on a fixed bar. This is the usual way in which balance is achieved.

Another way would be to slot the holes either in the telescope barrel or in the palm. This is not so good because the screws go into solid plates or if they do not the slotted tube would be weak.

Preventing Resin Penetration

I AM constructing a linen cupboard, the framework of which is white pine and the slats for the shelves are the same material.

As the timber is inclined to be resinous in places, would you kindly advise me how I could treat it so that nothing will stain the linen?—M. A. Lawson (Scotland).

THERE are two methods by which you can make your cupboard resin proof. The first and most simple will be to cover the shelves with a good quality white paper, which may be stuck down with glue or preferably a good, strong paste, either all over or only at the edges, the latter preferably. The other will be to give each shelf a coat of shellac varnish (flake shellac dissolved in methylated spirit). Then on top of this put on a couple of coats of good quality flat white paint. The two methods could be combined: paste paper down first, pasting all over, then shellac this and finally paint it. No resin will come through this. Of course the sides and top of each compartment could be so treated if you think it necessary

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WHAT I THINK By F. J. C.

THE MERIDEN PILGRIMAGE

THE Meriden Memorial Service this year attracted only about 1,000 cyclists, and the time has come to consider whether the excellent reasons which prompted this annual service have not now sufficiently lapsed into the limbo of the past to make the service unnecessary. As it stands, the service is giving undue prominence to the cyclists who fell in the 1914-18 war and ignores those who fell in the last war. Meriden is approximately the centre of England and it was considered therefore to be easily accessible to cyclists from every part of the country. Whilst it cannot be considered that a crowd of a thousand is small, nevertheless year by year the crowds have been declining in numbers.

TOO MUCH RACING ?

A READER takes me to task for my recent criticism of sporting cyclists whom I labelled as the "noisy minority." I said that they were small in numbers compared with the total number of cyclists and that too much attention was devoted in the press to racing results of events organised by comparatively small and nondescript clubs, that is to say, clubs with a membership of 20 or less.

The publication of the results of a club handicap held by such clubs can be of no possible interest whatever except to the 20 or so members of each of those clubs. Understandably, they like to see their names in print. Many of the events only attract an entry of 10 or less, and it is my view that it is a waste of space to publish such results—space which could be more profitably employed on other subjects. Such reports make dull reading, especially when set in small type. I suggest that in order to get into print, so to speak, the club should first of all distinguish itself in the field of sport, and that cannot be done in five minutes. Many of the clubs are of the "kerbstone wheeler" variety—mushroom clubs which start and flounder within a period of a few months.

Another point—touring articles should be the work of several men. Some of the touring articles, we fear, have been written from guide books, and not from personal experience. The technical side of the bicycle is almost entirely neglected. Cycling literature should be directed mainly at the large majority of cyclists, if it is to achieve wide circulation. Altogether too much prominence is being given to the sporting side. One might almost imagine that other forms of cycling do not exist. The sporting element has shown over a long period of years that it cannot and does not support periodicals. Cycling literature, as I have said, should be devoted to the multitude and space accorded to sport should bear a relationship to the whole, comparable to their numbers. Several clubs I know with large memberships take one copy of a periodical and pass it round.

I do not, therefore, withdraw anything from what I have written over a long period of years and I repeat that altogether too much attention is devoted to this noisy minority.

In view of the paucity of their support of the cycling press, cycling clubs do not deserve a periodical at all. Their demands on publishers for free notepaper, advertisements in programmes, prizes and donations, are not only unreasonable but impertinent. Let us forget the 50,000 or so noisy ones and concentrate on the 10 million or so.

My correspondent also criticises my comments on the conduct of tourists at tea houses. He says he has never seen a bun fight at one of the recommended C.T.C. or N.C.U. houses, from which I must conclude that he has not been cycling for many years nor very far. For what other reason is it that hundreds of such houses have given up their official appointments and have notices outside stating "no cyclists"? The conduct of many of these cyclists is deplorable and a bad advertisement for the organisations to which they belong.

The organisations themselves do not sufficiently impress upon their local centres the importance of good conduct on the road and in their recommended establishments, and I have yet to learn of any member guilty of conduct prejudicial to the movement being expelled. It is unfortunately true that cyclists who join the associations are trained to become militant cyclists, always fighting for their rights and against imaginary grievances, manufactured for them by head office. Militant cyclists become offensive cyclists

THE BUS STRIKE

THE public, confronted with the bus strike, rapidly adjusted itself to the stoppage of this form of public transport by using alternative vehicles. The sale of motorised bicycles and mopeds as well as bicycles rose sharply during the strike, still unsettled as we go to press. That accounts for the apparent calm amongst members of the public. There was no outcry by the public asking the Government to intervene in the dispute, and the public took the absence of buses calmly and prosaically. The strike has made people tend to be independent of public transport, with all the risks of stoppages due to strikes, official and unofficial. Many users of public service vehicles have deserted it forever and find that they are healthier for travelling under their own steam. The public has, indeed, become tired of the "stand and deliver" tactics, the methods of Dick Turpin presented in a new form.

AGREEMENT AT LAST !

THE three-man committee charged with the duty of finding a formula which would be equally agreeable to the three national bodies has produced a plan to which the three bodies now subscribe. A definition of categories has been agreed on and the various sides of the sport to be controlled by each has been agreed. A joint committee will act for all bodies ; there will be no reclassification of riders and the N.C.U. retains its position as the representative of Great Britain in International Cycling Events. The agreement makes the best of a bad job ; for the R.T.T.C. and the N.C.U. it has been a face-saving solution and for the B.L.R.C. a distinct victory. They have forced the older bodies to recognise them, and whilst neither of them has submerged its identity to the B.L.R.C., there can be no doubt that the latter will from now on exercise a major influence on cycling sport.

PURCHASE TAX

THE President of the British Cycle and Motor Cycle Association has issued a statement on bicycles and purchase tax. He says that the cycle industry was amazed and dismayed by Mr. Maudling's reply in the House of Commons to the excellent case for a reduction in Purchase Tax on bicycles, as was sought in an amendment to the Finance Bill and which was sympathetically supported by so many Members of Parliament.

When Mr. Maudling stated that industries facing difficult times may have to adapt themselves to their changed conditions rather than expect help from the Government, it is difficult to believe that he was speaking of an industry which in 1951 produced over 4 million units and employed 26,000 people, but today is reduced to little more than half that production with the number of people employed suffering proportionately. The industry's concern is well known to the Government, for repeated representations on this subject have been made by the industry's association. What does Mr. Maudling expect the highly specialised cycle industry to do?

The cycle industry which has such a magnificent export record could, one would think, expect some sympathy and assistance from the Government to help it in its difficulty, more particularly when what is asked for is to help it to recover home market volume which is so much below pre-war figures. Such assistance would have put the industry in better shape to fight its grim battle in overseas markets.

This attitude of the British Government is in strong contrast to the advice given by President Eisenhower, who quite recently strongly recommended cycling to the American nation and exampled the benefits to Great Britain that come from it.

For Mr. Maudling to say that purchase tax would only relieve the buyer by a matter of 10s. a week and to insinuate that it would make little difference is, in the view of the president, a misleading device and one denounced by the Government itself when used in commercial circles. The tax is the rate applicable on the cash sale and those who are experienced in the trade know that the present rate is a great deterrent to sales.

It is not a valid argument either to suggest that it would be inappropriate to apply the low rate of purchase tax to a bicycle as compared with what he describes as competitive transport. The bicycle cannot be compared with any other form of transport and therefore does not compete with it. Motor scooters, which Mr. Maudling instances, are in an entirely different category, being power driven and about ten times the price of the bicycle. It is unfortunate that Mr. Maudling should have selected for comparison a product supplied by foreign makers.

Detecting Wear

How to Find it in Time to Avoid Unnecessary Damage

ALL the moving parts on the bicycle will wear in time, but if deterioration is discovered early replacements can be made and further damage, caused by the worn part affecting other associated parts, may be avoided.

The Bearings

Perhaps the most important bearing on the cycle is the bottom bracket. This has to stand up to considerable strain and if not properly adjusted and oiled wear will soon be present. To test this bearing for wear, remove the chain, make sure that there is no side play and then spin the cranks. If the bottom bracket spindle binds in one position and is free in another it is almost certainly worn. When the bearing has been dismantled, inspect both the balls and cups for pitting. The cup will almost certainly have a polished track where the balls have run, but this is quite harmless unless the surface has been so badly worn as to be

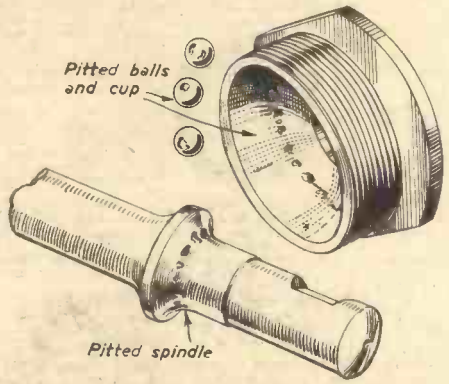

Fig. 1.—A pitted bottom bracket spindle and cup.

pitted. When the balls have been cleaned they should be smooth and shiny. If one or two are worn do not replace those only, but renew the whole set. Pitted cups should, of course, be replaced and the spindle also if the bearing surface is damaged (see Fig. 1).

The head bearing should be checked in the same way and wear will be indicated when it is found impossible to adjust the bearing satisfactorily; i.e., when bearing is tightened sufficiently to eliminate side play it is not free to rotate and when loosened so as to allow free rotation side play is present. Replacement of worn cups and balls will usually cure the trouble, but check also with cups which are a drive-fit in the head tube that they have not become "sloppy" and so require "packing" or replacement.

Wheel bearings and pedal bearings should be tested in exactly the same way as the bottom bracket for wear, and cones and balls replaced where necessary. Check also that the wheel and pedal spindles have not become bent.

Chainwheels and Chains

Wear on the chainwheel and driving sprocket is indicated by the shape of the teeth and a very old and worn sprocket will appear as shown at B in Fig. 2. This is known as "hooked" teeth, and replacement is called for. On the three- or five-pin type of chainwheel the pins or bolts sometimes become loose and the resulting movement between the ring and the spider causes wear to the threads. The cure is to replace the pins by slightly longer bolts which pass right through and can be secured by means of a nut.

The easiest method of testing a chain for wear is to fit it in position on the chainwheel and sprocket, pull the upper and lower strands towards one another until the chain is tight and then see if the chain will pull away from the front of the chainwheel. If it can be pulled clear of the teeth it is badly stretched and needs replacement. Check also for side play in the rollers by seeing if the chain will bend out of line sideways. Chain wear often does not need tests to be detected as it can make itself felt (or rather heard) by an irregular cracking sound when in use. If the cracking is regular a new chain may not be necessary—perhaps only the spring link needs renewal.

The Cotter Pins

A worn cotter pin will be felt in the pedalling action as soon as it occurs and reveals itself as a slight slip at the top of each rotation of the cranks. Whichever crank is loose, the slip is usually noticed in the left one, due to the fact that when the right-hand one is loose it is held firm by the chain wheel and the chain and instead the bottom bracket spindle (attached to the left-hand crank) slips inside the right-hand crank. A close visual inspection, however, will soon disclose the fault. Replacement is not always necessary. Sometimes a tap or two with a light hammer and a tightening of the nut will be all that is required, but if this treatment is of no avail remove the cotter (which will probably appear as in Fig. 3) and file and fit a new one.

Brakes

Here the chief site of wear is, of course, the brake blocks. Much can be done, how-

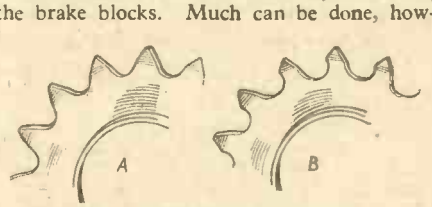

Fig. 2.—Worn sprocket teeth.

ever, to minimise this by correct fitting and using the correct type. Never let the blocks become as worn as the one in Fig. 3 or some distance from home you may find that the brake shoe is wearing on the rim. The main pivot of cable brakes is susceptible not so much to actual wear but to bending. This is a point worth checking from time to time.

Brake cables, although frequent replacement should not be necessary, are prone to wear. Usually the cable rusts and frays near the nipple in the lever or perhaps where it is fitted to the actual brake mechanism. Replacement should be made immediately fraying is noticed. The pivot in the brake lever is another place to watch, particularly with the modern alloy levers.

Tyres

Tyres these days seldom succumb to plain ordinary wear. Usually a particularly severe puncture, "blow out" or other accidental damage necessitates their replacement. Sometimes, however, wear can end the life of a tyre and the wear is almost always due to causes other than road wear. When you

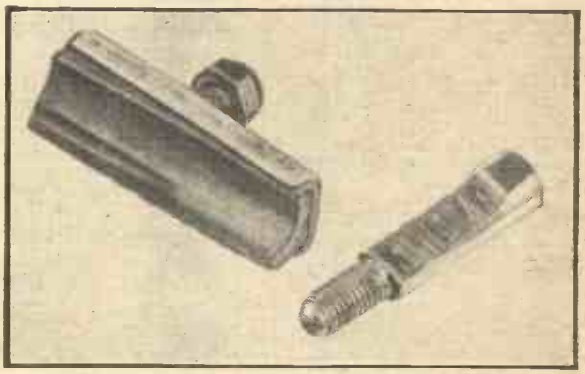

Fig. 3.—Badly worn brake block and cotter pin.

inspect your tyres look out for worn patches on the walls where the tyre could rub on the forks and look on the tread for any one spot which is badly worn due to frequent savage braking, resulting in a locked wheel and skidding. It is usually a rear tyre that suffers in this way, so remove it and fit it to the front wheel instead. When the former front tyre is in place on the rear wheel, remove the cause of the skidding.

Worn Threads

Due to frequent wheel changing, sprocket changing or perhaps to the fitting of the wrong type of nuts, screwthreads can become worn. This can sometimes be seen by the shiny state of the thread and perhaps by the looseness of the nuts or perhaps their excessive tightness in parts of the thread. A close inspection of a suspected thread will show it to be flattened on the top of each pitch, giving a smooth effect. It is wise to renew a component with such a worn thread before it strips completely.

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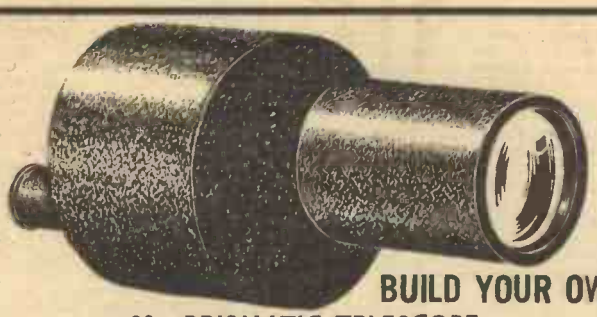

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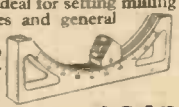

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50-0-40 ,,	2in.	MC/SF	12/6
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The Practical Photographer

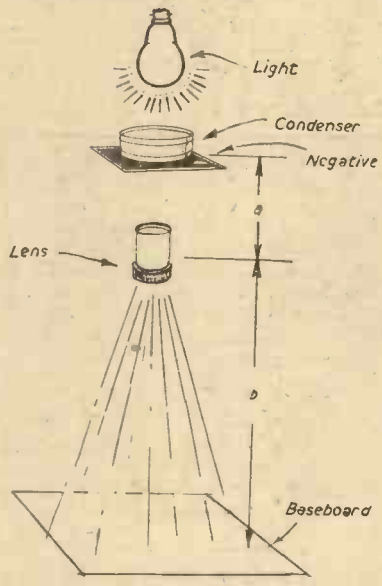
No. 4. JULY, 1958

Monthly Supplement to "Practical Mechanics"

Before Building Your Enlarger

A Few Pointers Which Will Help Your Planning

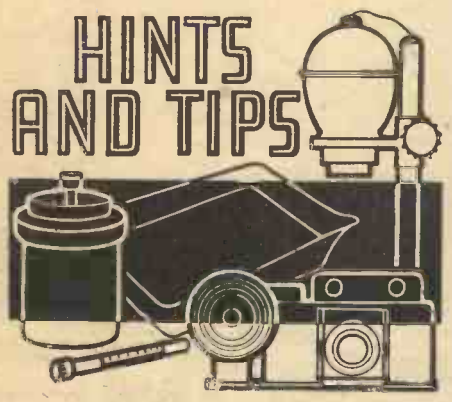
FIRST, the enlarging lens should have the same focal length as the lens used in the camera and in the popular 120 size this would be 10cm. or just over 4in. The focal length must also be greater than the diagonal measurement of the negative. It is measured when the camera is focused at infinity, but as the camera is focused most often at distances less than infinity, when the lens will be farther away from the negative, it must be realised that the working focal length is greater than the figure marked on the lens. Actually, for the purpose of enlarging, the increase is about a quarter and the working focal length of a 4in. lens would be about 5in. This would be the dimension (a) in the sketch. Dimension (b) is obtained by multiplying the working focal length by the number of times enlargement required. For instance, a 4x enlargement would mean a lens to baseboard distance of 4in. × 5in. = 20in. These distances will be varied considerably according to the size of negative to be enlarged and the focal length of the lens used. Smaller negatives than those for which the lens is designed may be enlarged but not larger negatives. For instance, a 4in. focal length enlarging lens can be used to enlarge 127 or 35mm. negatives but not quarter plates. With the smaller sizes, of course, the lens carrier must be suitably masked.



The negative to lens and lens to baseboard distances mentioned are only approximate.

The condenser used must also have a diameter greater than the diagonal measurement of the negative and the 120 size enlarger usually has 4½in. condenser lenses.

Distance between the lamp and the condenser is best found by experiment.



A REFLEX ADVANTAGE

WHEN photographing children who are almost always self-conscious in front of the camera the twin-lens reflex is particularly useful. Turn sideways, keeping the camera in the direction of the subject, and carry on focusing. Then, while the child thinks your attention is elsewhere and has resumed a natural expression, press the shutter release.

By pointing the camera behind you under your arm it is still possible to focus perfectly and then take a photograph of someone who is standing behind you and completely unsuspecting.

BACK PORTRAITS

IF you have taken the portraits of your family and friends many times before and have grown somewhat tired at looking at them in your album, why not try something different? Photograph them from behind. You will be surprised at the amount of character a good picture taken in this way will reveal. Take them without the subject knowing and, if possible, in some characteristic position, such as working at a desk, gardening, washing up or, perhaps, just leaning on the front gate. The subjects themselves will probably be interested, it's a view of themselves they never see!

A TRIPOD TIP

THE modern lightweight tripod, considering how very light and compact it is, is a fairly rigid structure, but when mounted on uneven ground, and particularly if the camera has a "sticky" shutter release, pictures showing traces of camera shake are apt to result. One very simple method of avoiding this is, of course, to use a cable release, but on the day this is forgotten "shake" can be avoided by using the delayed action device. An obvious tip? Maybe, but many photographers wouldn't think of it.

GET UP EARLY!

When you are holidaying at some picturesque town, either in this country or abroad, a drawback to picture making is that quaint old streets and buildings lose their charm for the photographer when it becomes necessary to include hundreds of fellow sightseers. The best way to avoid them is to take your pictures before they get up. The above photograph was taken in this way and the old town seen in its true character.

Photography Abroad

By A. E. BENSUSAN

How to Take Care of Your Equipment and How to Use It to the Best Advantage

THE selection of the various items of equipment needed for the holiday, and various other matters appertaining to holidays in general, have been dealt with in a previous article. The requirements for a holiday abroad are identical with, perhaps, added emphasis on the desirability for taking along all the film stock likely to be needed during the visit. Far better to bring back a small quantity of material unused than to need extra supplies and be unable to obtain the correct type of film in a small Continental village or town. In general terms, the prices of ordinary monochrome films vary very little from those ruling in Great Britain, but the supply situation is often rather unsatisfactory. In certain countries which import little foreign photographic material, and manufacture no reliable brands themselves, the prices of good quality films are out of all proportion to those asked here.

The possible exception to the rule for taking all the material necessary with you applies to colour film. In a number of Continental countries, well-known brands of colour film can be obtained at quite reasonable cost.

Fig. 1.—The station makes a good "record" photograph.

The Customs

When taking photographic equipment abroad it is a wise policy to carry the receipts for the various items, particularly if they are of foreign origin. Rarely is one asked for these papers by a Customs official but, should this occur, any doubts will be alleviated right away. Check your equipment insurance policy well before leaving to see that all the items are correctly listed and valued, and that the policy is valid in the country or countries you are to visit and through which you pass. Temporary extension of the cover afforded by a policy for Great Britain only can be effected at a small cost to include most other countries.

Photographic gear is best carried on the person while travelling for, in this way, it is under constant supervision. It must, however, be adequately protected from salt water spray if the Channel crossing is to be made by steamer. Even a light breeze picks up considerable moisture which, by virtue of its corrosive nature, should always be kept from coming into contact with the camera and other equipment. If you do have to pack the photographic kit with your ordinary luggage, make sure that every item is well wrapped with clothing so as to afford the maximum protection against damage by shock.

Fig. 2.—Look out for pictures of people in natural settings.

Arriving at your destination, the railway station itself brings a contact with a totally different world and, if you are planning to take a series of pictures illustrating your entire holiday, this must come quite early on the list (Fig. 1). Right away, enter the subject, date and photographic data in your record book so that you can check back at any time to ascertain whether you have taken that shot.

Be very careful to take a meter reading for every picture as, in the bright light and clean air of many Continental areas, exposures need to be rather short and guesswork could lead to drastic over-exposure.

Always Take the Camera

It is wise to carry your camera wherever you go while on holiday abroad. On a morning or evening stroll, a picture might be seen with the light perfect, and no fellow-tourists to spoil the view but, without the camera, it could be lost for ever. This is particularly true where local customs are concerned; not the type of entertainment usually provided for the tourists but the normal and general activities of the people. Carrying a camera you might well be invited to take pictures of the local craft industries, but the opportunities for this sort of photography will generally be presented quite early in the day. Certainly before the average visitor is out and about. Catch the people as they really are if you wish to obtain a faithful record of the country. (Fig. 2).

Whatever you do, avoid giving offence to the local inhabitants. Where possible ask whether you may take photographs and, in most cases, instant agreement and much valuable help will be forthcoming. Keep an eye open for the back streets, off the usual tourists routes for these often have remarkable photographic possibilities. Here, too, it is possible to photograph buildings and other items as they really are, and without the doubtful false fronts and artificially aged features sometimes seen in the more frequently used thoroughfares (Fig. 3). Photograph everything which appeals to you and seems strange at first sight. Film is relatively inexpensive, and complete coverage is the only way to build up a truly comprehensive collection of pictures.

Processing

It is inadvisable to have the films processed locally. For one thing the quality of the developing services available outside the large cities is not all that it might be and, for another, any delay in delivering the finished work might mean leaving the negatives to be posted to your home address. Either way, the best course is to bring all exposed material home in your luggage, and attend to the processing yourself.

Fig. 3.—A quaint corner of a small Continental town.

A Table-Top Tripod

The Construction of This Unit is Described, Together With an Adjustable Head

By M. Katers

THE table tripod described is collapsible and, yet, when assembled is perfectly rigid. The measurements need not be strictly adhered to but can serve as a guide to any model similarly constructed. The adjustable head is indispensable wherever a tripod is used, either indoors or outside. The tripod was constructed entirely of mild steel and the head of brass. The materials can be obtained through any reputable ironmonger.

The Tripod Plate

This is the part to which the legs are attached. Fig. 1 shows the general dimensions. The only real point to watch here is the thickness. If the plate is too thin, then there is a centre pillar wobble which is photographically undesirable.

Legs and Centre Pillar

These are made of 5/16in. mild steel rod

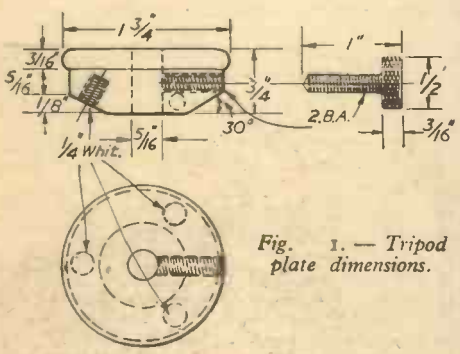
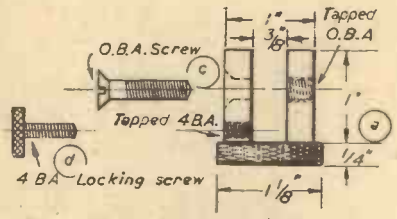
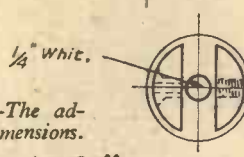


Fig. 1. — Tripod plate dimensions.

with a ¼in. Whitworth thread at one end. This gives a shoulder to the legs when screwing them into the plate on assembling the tripod. The legs can be knurled if required but it is an unnecessary refinement.

The centre pillar should not be too long, or otherwise there will be camera sway which would be noticeable on exposures; a maximum of 12in. is suggested. The end of the pillar can either have a locknut or a camera screw adaptor. British cameras have a ¼in. Whitworth bush and so the centre pillar can be screwed similarly and a locknut used. If, on the other hand, you have a continental camera then an adaptor is required as shown in Fig. 3. The Continental bush has a ⅜in. Whitworth thread





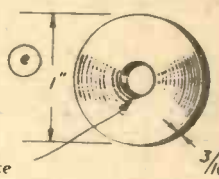


Fig. 4 (Right).—The adjustable head dimensions.

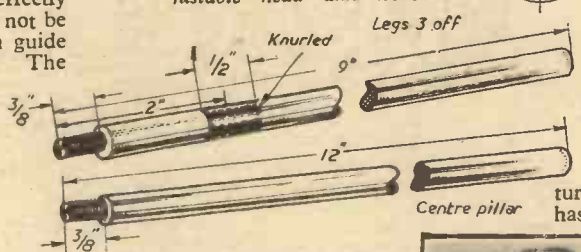


Fig. 2.—The legs and centre pillar.

Finish

Mild steel when heated in a clean flame to a cherry red will, when dropped into a tray of oil, give a blue-black finish. This gives a rustproof layer which is pleasing to the eye. The oil can be any car engine oil which is about to be discarded after use.

The Adjustable Head

The components are shown in Fig. 4. The photographs show how the parts are assembled. The barrel which is turned to the dimensions shown in Fig. 4a has the swivel (b) held in the slot. It is a neat smooth fit and rotates round the screw (c) which is countersunk into the barrel The locking screw (d) holds the swivel in any desired position by jamming it against the barrel wall. The locking ring (e) locks the camera on to the head when ready for use.

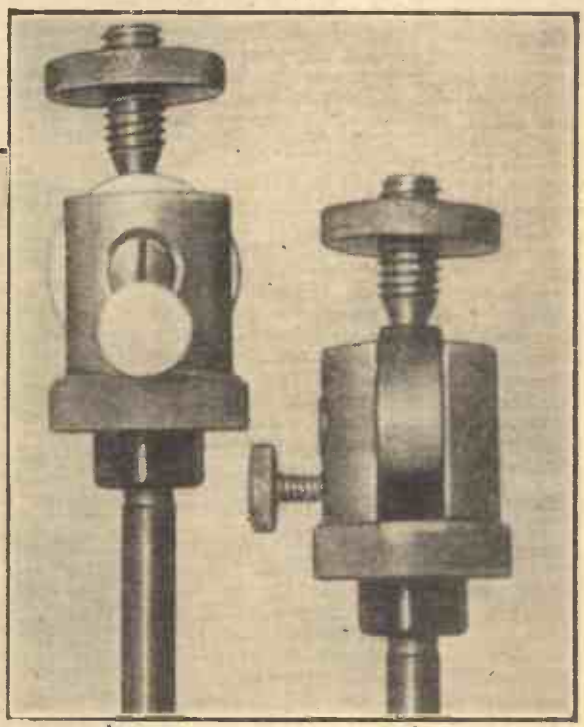


Fig. 5.—Two close-up views of the adjustable head.

If a continental camera is used, then the ¼in. screwed Whitworth rod in the swivel (b) should be replaced by a ⅜in. screwed Whitworth rod.

When finished the brass was polished and lacquered.

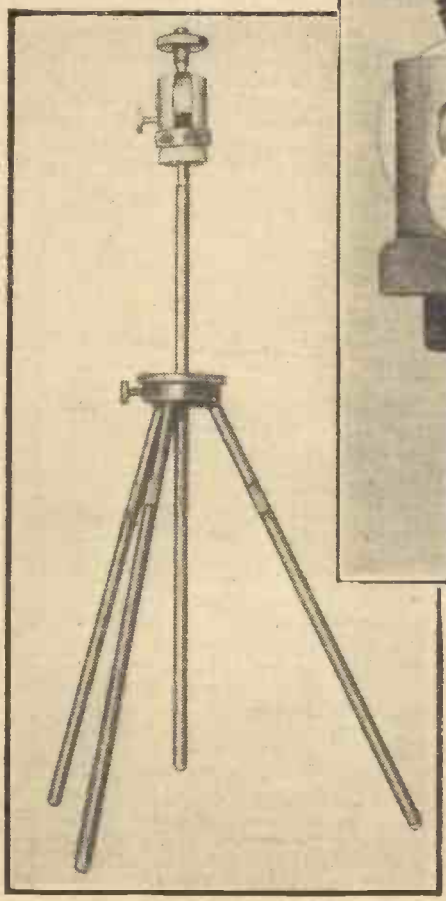


Fig. 3.—The completed tripod and adjustable head.

Out of the ordinary with Infra-Red

E. Clements Explains the Technique and Gives Some Examples

ROLL films as normally supplied only record as far as the visible red, and in order to utilise the infra-red radiation have to be further treated with special dyes; 120 films so treated are now available.

Using Infra-red Film

An infra-red film, although handled in exactly the same manner as an ordinary one, must be used in conjunction with an infra-red filter. If gelatine, the filter may be placed between the lens components where it will be less liable to damage, but failing this, it may be accommodated either in front of or behind the lens. It is necessary, however, to ensure that the filter excludes all but the infra-red rays; if the filter is omitted, the image will be a normal panchromatic one. Exposures are a matter for practical experience; without the filter the film may be rated as a fast panchromatic, but with the filter, exposures in the region of 1/50 sec. at f8 are required in bright sunlight. It is not possible to give a definite speed to the film for infra-red exposure as no means are available to measure the infra-red content of the light. No ratio between visible and invisible light is possible in daylight; it should, nevertheless, be possible to establish such a ratio in artificial illumination.

Picture Characteristics

The photographs on the next page will convey a better impression of the characteristics of infra-red photography than the written word can hope to do. It will be seen that the main characteristic of such pictures is in the rendition of green foliage and grass which, as they reflect infra-red strongly, are rendered as practically white. Coniferous foliage, however, photographs somewhat darker than deciduous. A blue sky and, of course, water reflecting the blue, are rendered as completely black, although on a dull day a more normal sky will be obtained. The angle of camera to sun does affect the tone of the sky which reaches maximum depth as the camera is turned away from it. If the sky is clear, shadows will be quite black, as they are then illuminated by reflected sky light. As the drops of moisture in the air, which produce haze in a distant scene by scattering visible light, have far less effect on infra-red rays, these may be utilised to cut through the atmosphere and record details invisible to the eye.

Focusing

Infra-red rays do not come to a focus in exactly the same plane as that formed by visible light and, in theory, therefore, focusing carried out by the latter will not provide accurate focusing for photography by infra-red. For the shorter focal length lenses, however, unless working at very close distances, the difference involved of approximately 1/50 of the focal length is insufficient to cause any appreciable inaccuracy In fact, it would be difficult to make so minute a correction. For larger cameras and longer focal lengths the visual focusing usually employed may be carried out with the aid of a deep red filter which is the nearest one can get to the infra-red end of the spectrum.

Infra-red photography has not so far received very much attention from the pictorial photographer; but if one discards the normally accepted necessity to record all colours with absolute fidelity in monochrome and concentrate upon the purely visual effect of the picture, looking rather for strength and generally imposing results, there is in infra-red radiation the means of obtaining some very individual pictures. It is, of course, possible with a little experience to visualise the infra-red effect in a given scene so that one does not need to expose haphazardly in the hope of obtaining a striking result.

Although infra-red photography in the pictorial field has not as yet received very much attention a considerable amount of film has been used in the scientific and technical spheres.

Infra-red Flash

With the advent of flashbulbs coated to emit only infra-red rays, it has become possible to make instantaneous exposures in total darkness for as no light, apart from a very dull red glow, is seen the flash can be used in circumstances where a normal flash would be inadvisable. For instance, a very graphic series was recently made showing the reaction of a child audience to certain types of film. Many other uses for the infra-red flash will suggest themselves as the photographer explores this fascinating field, in fact on any occasion where the subject should not be aware of a flash or where a flash would not be permitted, the coated bulb could be used. It can, for example, be used in busy thoroughfares as a fill-in for night shots where contrasts are often difficult to handle; in these instances no filter should be used as it is necessary to record both infra-red light from the bulb together with the general illumination. A filter is unnecessary when exposing in total darkness.

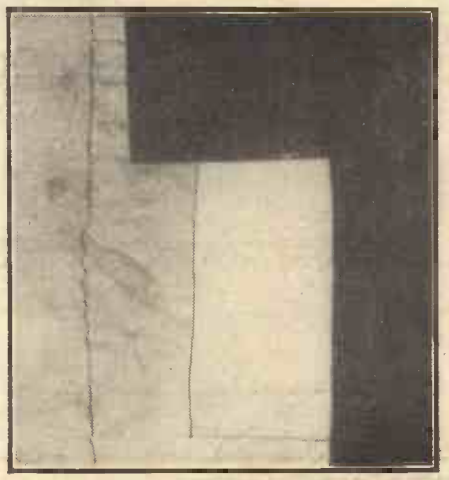


Fig. 1.—Several black materials photographed by infra-red.

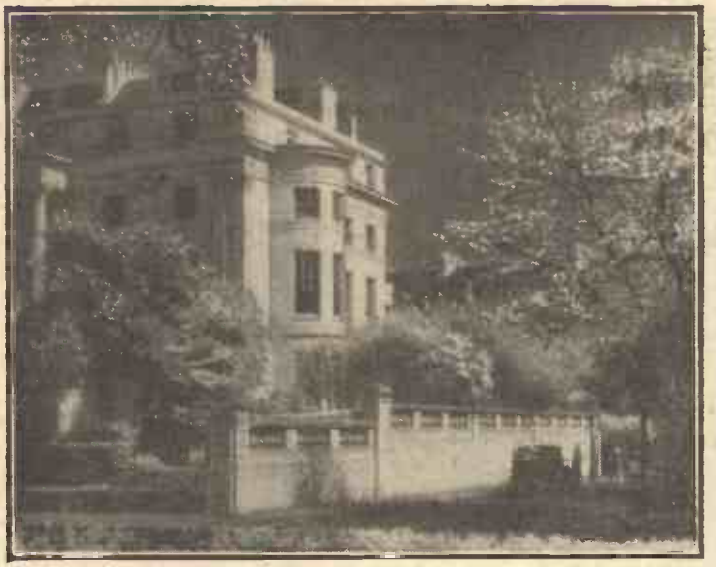
Night shots with a close-up subject in the foreground and where it is necessary to obtain detail in background, need much the same consideration as synchro-sunlight pictures. The exposure required for the background should first be determined and this exposure used in conjunction with a bulb calculated to adequately illuminate the foreground at the given aperture. For instance a well illuminated background might require 1/25 sec. at f4.5 on HP3; bearing in mind that an infra-red bulb requires about two stops more than a clear bulb it is possible to choose from the wide variety of bulbs now available one which will give the desired balance. It is probably simpler, however, to standardise on one fairly strong bulb and cut the light by means of one or more diffusers.

Unsuitable for Portraits

Although infra-red is receiving ever greater attention from scientists and technologists it is not suitable for all subjects; a portrait taken by infra-red will show to-morrow's beard in male sitters, skin tones appear as a deathly white and eyes reproduce as black beads. Wrinkles are accentuated and a negroid skin reflecting infra-red almost as much as a white one will therefore be rendered quite light in tone.

In the specialised fields of criminology, plant pathology, textile investigation, etc., infra-red is invaluable. Fig. 1, for instance, illustrates the difference in rendering of several black dyes by infra-red; five pieces of black cloth which on panchromatic stock would all be reproduced as quite black have been photographed by infra-red with results varying from black to light grey. This result is a key to the uses of infra-red in textile investigation and other fields.

In camouflage detection, greens which are visually similar will probably show light and dark patches indicating that the object has been camouflaged and is not reflecting equally as would natural vegetation. The same principles are used in showing writing on a burnt document; the diseased section of a leaf against the healthy part, etc. It



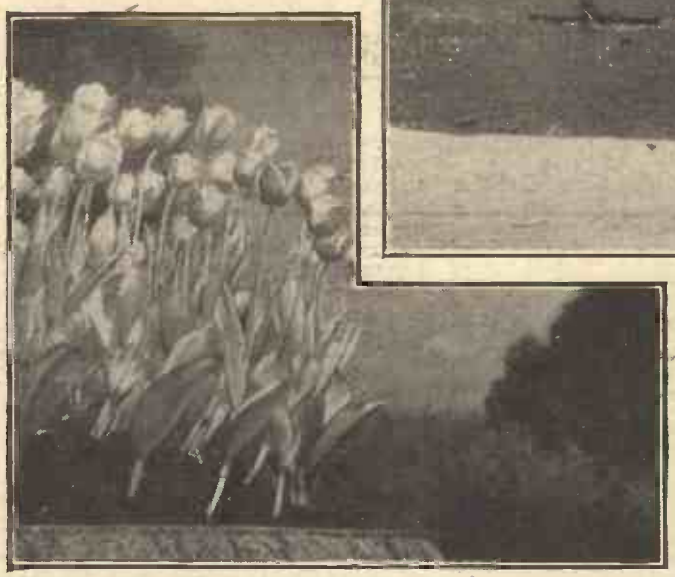
(*Above*) *Nash architecture in Regents Park, London.*

Exposure 1/12 sec. at f8. Note the contrast between buildings and sky.

(*Below*) *Tulips, taken from a low viewpoint. Exposure 1/50 sec. at f8.*

(*Above*) *The Serpentine, Hyde Park. Exposure 1/50 sec. at f8. Note the darkened sky and water.*

(*Left*) *The lake. Exposure 1/50 sec. at f5.6. Note the almost white rendition of the foliage.*



(*Above*) *In the shadow of Eros. 1/50 sec. at f4.5, coated PF 25.*

(*Left*) *Counting the take. 1/25 sec. at f8, PF 25 coated bulb.*

would be incorrect, however, to say that infra-red is always superior to panchromatic material in these fields; for most diseases which are visible the latter is often to be preferred. It is only when any penetration has to be made or a possible differentiation between visually equal tones has to be found that infra-red is superior.

Dish Developing a Film

MATERIALS REQUIRED, SAFELIGHT PRECAUTIONS AND STEP-BY-STEP INSTRUCTIONS

THE dish method of developing is used less to-day than in the past, most amateurs having decided that the modern developing tank makes the process both simpler and more convenient. However, for those who do not possess a tank, the method is described here.

35mm. films, owing to their length, are not suitable for dish development, but any of the "popular" sizes can be processed by this method.

Equipment Required

This is almost the same as for the tank method described in the April issue, except, of course, dishes will be required instead of the tank. Three will be required, one for developer, one for the fixer and the other for a stop bath solution (water). Some workers prefer to use bowls instead of dishes, which, as the film cannot scrape along the botttom, helps to prevent scratching.

The developer used can be one of the simple concentrated solution types which merely require dilution before use. Make sure when mixing the developer that the dilution instructions for *dish development* are followed and similarly that the correct developing times are noted. These, as will be seen, are shorter than for tank development owing to the stronger developer used. Fixer is mixed up the usual way.

Fig. 1.—How the dishes are set out.

Two stainless steel film clips will be needed to hold the ends of the film; do not use either the bare fingers or ordinary paper clips.

The final item of equipment required is a darkroom safelight. If the film being processed is orthochromatic, i.e., not sensitive to red, a dark red or ruby safelight can be used. If the film is panchromatic, only a dark green safelight can be employed; it is important, too, to use only the bulb specified by the makers, even though this gives a very dim light. The safelight must be used with discretion and the film must not be exposed to its light for any length of time. If the simpler routine processes can be carried out in darkness, it is best to switch the lamp off for as long as possible.

The Darkroom

The room used to carry out the developing will depend upon individual circumstances and preference, but in any case the dishes with their various solutions should be arranged in order, as shown in Fig. 1. A kitchen is shown here, as it is most probably the first choice of the beginner. It has the advantages of plenty of running hot and cold water and an adequate level working top, which the bathroom lacks. To prevent any accidents, spread newspapers over the table for the dishes to be placed on. Make certain that the windows are entirely blacked out—it would probably be better to work after dark.

Temperature

All the solutions should be used as near to the recommended temperature as possible. If the solutions are freshly mixed the correct temperatures may be obtained by the careful admixture of hot water in the dilution process. If stock solutions are used, the bottle containing them can be immersed in hot water or cold water, according to whether it is required to raise or lower the temperature. As the developer will be used first, it is a simple matter to ensure that this is at the right temperature, but it may be better to have the stop bath and fixing solution a few degrees warmer than required, so that when used they will have cooled to approximately the correct temperature.

Removing the Backing Paper

When the lamp has been switched off and the darkroom lamp switched on, start unrolling the backing paper from the film. When a short length of this has been unravelled the end of the film will appear. Attach one of the film clips to it and continue unravelling until the other end of the film (attached to the backing paper with adhesive tape) comes into view. Tear this free and attach the other film clip. During this operation, handle the film by its edges only wherever possible.

If the film has a strong tendency to curl, it is a good idea to immerse it for a minute or two in a bowl of water which has previously been brought to the working temperature. The washing water which has been got ready for the final washing is clean and quite suitable for this. Many workers give this initial immersion whether the film has a tendency to curl or not.

Development

The actual development is done as shown in Fig. 2. The hands, holding the ends of the film, are raised and lowered alternately, keeping the fold of the film under the solution. The film should be run through the solution from end to end, slowly, smoothly and regularly.

Fig. 2.—Developing in progress.

The negatives will appear faintly at first and then gradually becoming darker. They will probably look too dark before the correct developing period has elapsed, but make sure they stay in the developer for the correct time.

When the development time has elapsed, transfer the film, using the same see-saw action, to the stop bath and rinse for at least one minute. Finally, transfer to the fixer. As you continue the see-saw action, the film becomes patchy due to the partly dissolved emulsion. After several minutes of this, the light may be switched on and the rest of the fixing process carried out under it. Fixing must be continued for about five minutes after the emulsion has completely cleared. Finally, wash the film in running water for half an hour. You can use a washing-up bowl in the kitchen or the hand-basin in the bathroom for this, completely emptying the bowl or basin two or three times during the half hour. Clip the two ends of the film together while the washing is carried out.

Finally, hang the film up by one of the film clips in a dust-free room to dry. The other film clip can be hung on the other end as a weight to hold the film straight.

Cut Film and Plates

These are not so likely to be met with by the beginner, but if someone gives you a camera using this type of negative material the procedure adopted for development is approximately the same as for dish developing a film. Usually plates are dealt with one at a time. When placing the plate in the dish, make sure it is emulsion side upwards and, during the process, rock the dish. When development and fixing are completed the plates can be washed in a dish into which the tap is allowed to run gently. Finally, plates must be drained and dried on edge, while cut film can be attached by a corner to a line of some sort by means of film clips. If a number of plates is to be dealt with, it may be thought advisable to purchase special plate tanks and drying racks, which will greatly facilitate the process.

Freelance Photography

TAKE PHOTOGRAPHS FOR YOUR LOCAL PRESS AS A PAYING SIDELINE

By H. CULL

SOME local newspapers have their own photographers, but can often use prints taken at events which they are too busy to attend. Other papers rely entirely on amateur photographers, and the work can be very rewarding.

Fig. 1.—A local horse show picture.

It is not a job for the rabid specialist in any particular field. You will have to be quick and sure of what you are doing, with half an eye open for the unrehearsed surprise. You will be asked to take a wide variety of subjects, from Lady So-and-So presenting a challenge cup, to action shots at football or athletics (see Fig. 5).

Anticipation

Whilst luck plays a large part in getting out-of-the-rut pictures, a lot can be done by intelligent anticipation. For example, in Fig. 3, the boys were ambling round making no attempt to compete seriously in the walking race.

Fig. 2.—The photograph with a story.

I saw what was happening and got round the track to take up a position where I thought the competitor would pass them. As he did so, they were making "curious" remarks, and shortly afterwards were disqualified.

When working alongside other Press men I have noticed that they concentrate on posing the subjects they are to photograph. I like to work differently, however, to obtain more natural results and, using a 35 mm. Retina exclusively, I take the action as it occurs. To this end I put a lot of forethought into estimating where the action will take place, then take up the best position, which I defend against all comers.

Posed Pictures

If you have to pose your subject, it can be done without making the result look too stilted. For instance, I was assigned to take a picture of the roller-skating queen opening a fête. Instead of the hackneyed picture you get tired of looking at, I paid a shilling for her to go on the swingboats. The photograph in Fig. 4 was the result, which made the front page.

Many are the subjects for local news items. You can read about forthcoming events on posters—such things as flower shows, horse shows (Fig. 1), dog shows, rock 'n' roll contests (Fig. 6) and, of course, Lady So-and-So opening a bazaar, to mention only a few.

Fig. 3.—An example of anticipation.

When there is no news, you can sometimes make your own by photographing such subjects as the steam-roller in Fig. 2. If the editor thinks it worth while he will send a reporter to interview the subject. In this case the driver had been driving steamrollers man and boy for 46 years.

On the whole, picture editors like to see numbers of potential newspaper buyers in their pictures, so the more you can get in the merrier. At times you will have difficulty in preventing too many from creeping in. Be firm, but remember *people* buy newspapers, inanimate objects do not, so that your picture of the log shaped like a sea-horse doesn't stand much chance of being accepted unless, of course, it has bitten someone!

Finally, if your pictures are very good, so that the newspaper reproduction is clear, do not expect to sell many prints privately. For some unaccountable reason people prefer to pay fourpence for a newspaper picture of themselves rather than half-a-crown for the superb picture you will, no doubt, make for them.

Fig. 4 (Top).—An example of intelligent posing.

Fig. 5.—A typical action shot.

Fig. 6.—Local rock 'n 'roll contest.

An Electro

JOHN HUCKLEBRIDGE GIVES FULL

Fig. 1.—The electronic flash unit and two reflectors.

THIS electronic flash outfit is the third in a series of flash outfits made by the author during the last few years. The previous models used 1,000-volt flash tubes and radio-type electrolytic condensers in series-parallel arrangements. Although these worked quite well, they were heavy, and because of their leakage current radio-type electrolytic condensers took too long to charge when using batteries. Also, due to the short duration of the flash, there was need for 50 per cent. extra development of the film. Finally, reflectors made from car headlamps tended to "beam" the light too much. The unit described here and shown completed in Fig. 1 was designed to overcome some of the above snags as cheaply as possible.

The Circuit

This provides for two lamps of 100 joules each using internal 4-volt accumulator with built-in charger or mains (A.C.) all housed in a box measuring 8in. × 5½in. × 6½in. The theoretical circuit is shown in Fig. 4 and in Fig. 8 a point-to point wiring diagram is shown.

The closing of switch S2 completes the battery circuit, and the vibrator sets up an A.C. current in the vibrator winding of the transformer where it is stepped up and applied across the metal rectifier MR1 resulting in a D.C. voltage of about 270 volts charging the flash capacitors C1, C2, C3, C4, through their charge limiting resistors R2 and R3. These two resistors also prevent the full 200 joules lighting up one flash tube. When the lamps are plugged into the box (which should be done before switching on) there is a potential of 270 volts across the tube. This is not enough to start a discharge. Condensers C6 and C7 are charged to approximately 150 volts by the potential dividers R5 and R6. When the camera flash contacts or the open flash button S3 are closed, C6 is discharged through the primary of the trigger transformer TC causing a short pulse of several thousand volts to appear at the trigger electrode. This starts a discharge in the tube between the trigger electrode and the cathode, and then the 270 volts is high enough to keep the discharge going. Once the discharge has started the internal resistance of the tube is almost zero so the 100 joules stored in the main condensers are discharged in a few milli-seconds, giving a brief but bright flash.

The potentiometer R5 should be adjusted so that the neon stops flashing when the voltage across it reaches maximum (in about ten seconds when using one lamp). C5 makes the neon flicker instead of just glowing on reaching working voltage. Discharging the main lamp automatically flashes the extension lamp so that no synchronising leads are required in the extension lamp.

Switches S1A and S1B connect the battery either to the vibrator or the charger and S1C opens the secondary of the transformer circuit so that the main condensers are not being charged all the time the battery is being recharged. When the battery switch S2 is off this completes the mains primary side of the transformer and the flash may then be run off the mains or the battery charged. Do not forget to adjust the voltage adjuster as this is important with a small transformer.

S4 is the half-power switch. Closing S4

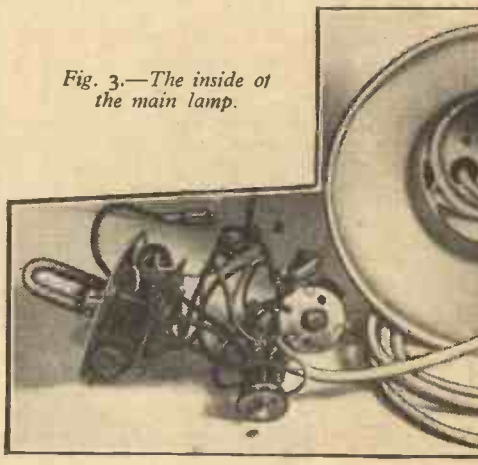


Fig. 3.—The inside of the main lamp.

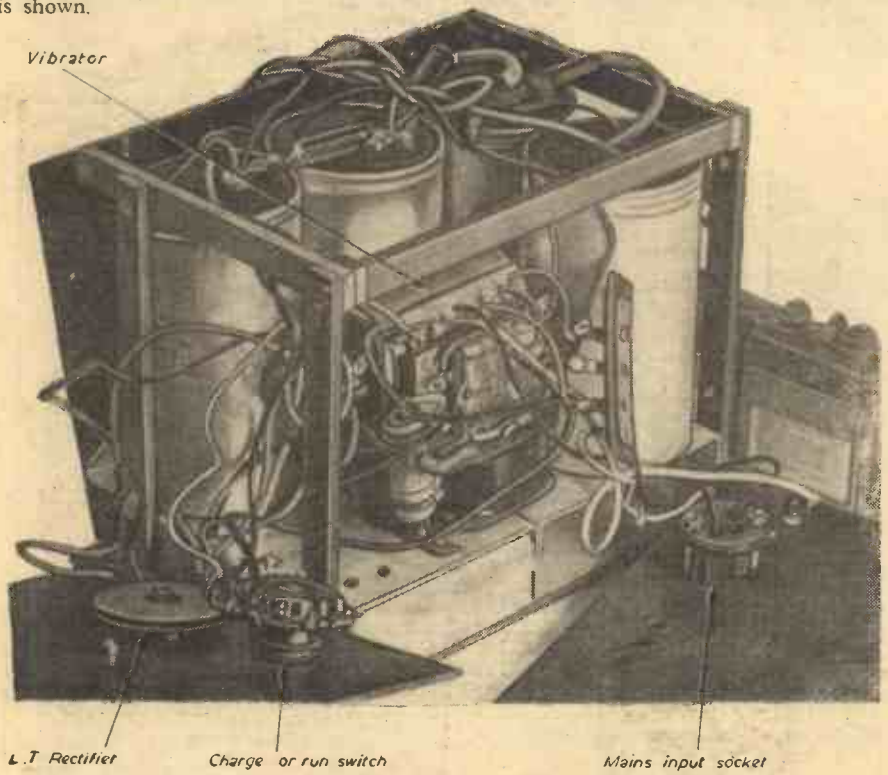


Fig. 2.—The unit with one end and one side removed.

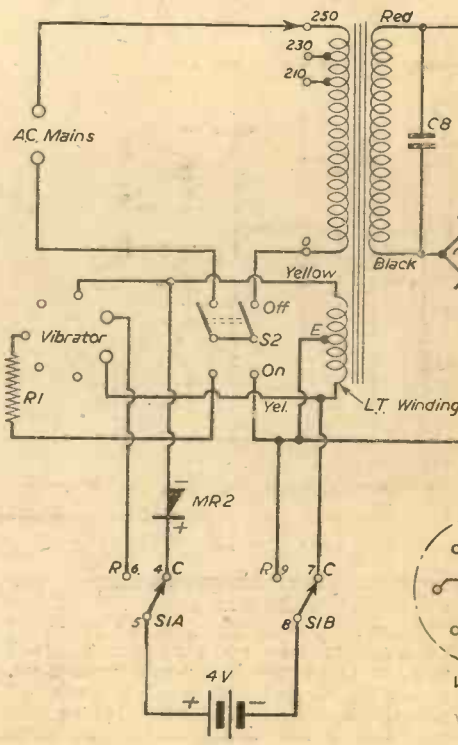


Fig. 4.—

nic Flash Outfit

CIRCUIT DETAILS AND NOTES ON CONSTRUCTION

shorts out R4, thus allowing the charge on C1 to combine with the charge on C2 and flow through the tube. Half-power is not required on the extension lamp, as if it is too bright it can be moved farther away from the subject.

The Box

The box is made from an aluminium base, which is the battery container, and a skeleton of ½ × 3/16in. Paxolin strip (see Figs. 2 and 6). These strips are held together by 6B.A. ¼in. c/s brass screws—the Paxolin takes a thread quite well. The side and top and bottom panels are of ⅛in. black Perspex-like material. Each panel is held on only by four screws. The switch S1 and the L.T. rectifier are fixed to the end panel, S2, mains input socket and voltage adjustment panel are fixed to one side panel and two output sockets and S4 are on the top panel. A 1½in. plastic carrying strap completes the box. These details may be seen plainly in Figs. 2 and 6.

Reflectors

The two reflectors, which can be seen in Figs. 1, 3 and 5, are "surplus" from C. B. Miller & Co., 337, Brighton Road, South Croydon, Surrey, at 12s. 6d. each. They have a 1¼in. hole drilled in the side. A two-pin 2-amp. socket is mounted on the back of the metal plate supplied and clearing holes drilled in the metal so that the flash tube may be plugged in. A small hole is drilled between the flash tube holes and the trigger lead is brought out through this

Fig. 5.—Camera cradle and main and extension lamps.

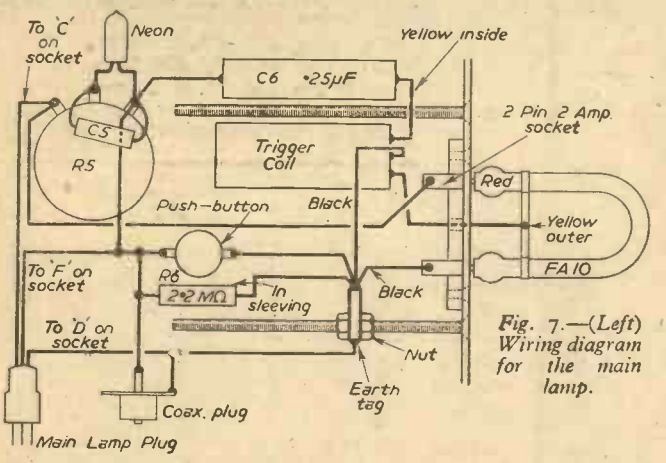
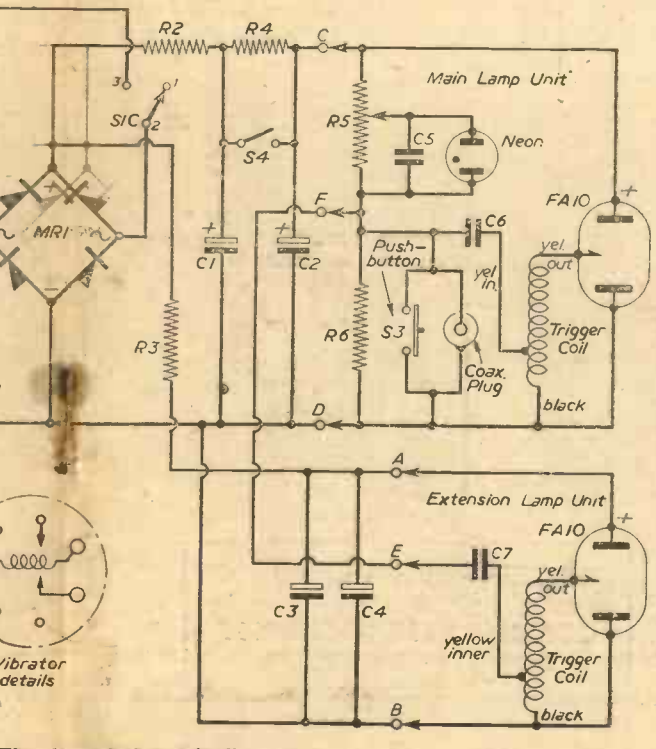
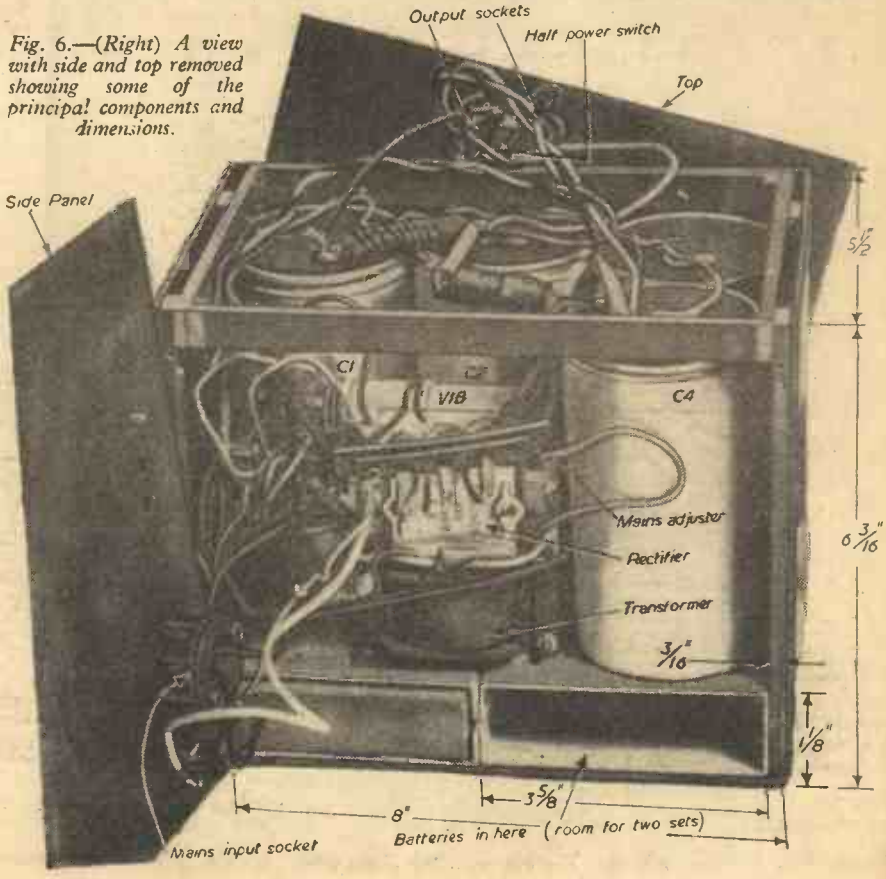


Fig. 7.—(Left) Wiring diagram for the main lamp.

Fig. 6.—(Right) A view with side and top removed showing some of the principal components and dimensions.



The theoretical circuit diagram.



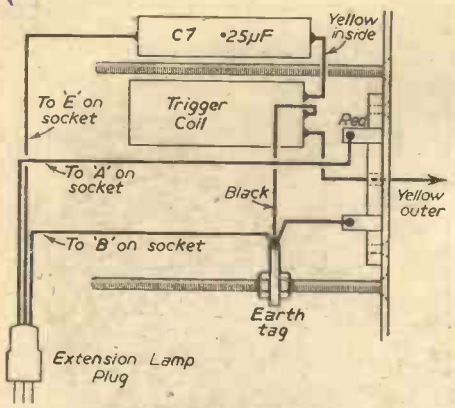


Fig. 9.—The extension lamp.

hole and joined to the metal strap between the flash tube legs. Two holes, 1¼in. apart, are made in this metal plate, and two 2½in. 4B.A. bolts are screwed through these holes for fixing in the reflector. The trigger coil and condensers C5 and C6 are strapped to the Paxolin disc supplied, and the disc is then pushed on the 4B.A. bolts and held in place with a nut either side. The neon is pushed through a rubber grommet with its head just protruding, and the potentiometer is fixed to the inside. The wiring for the main lamp and the extension lamp is shown in Figs. 7 and 9. The power lead is anchored on the inside and brought out through a grommet. The main lamp has 2 yards and the extension has 6 yards of three-core P.V.C. cable.

LIST OF COMPONENTS

Mains battery transformer assembly (includes vibrator, vibrator socket, coil resistance R1, buffer capacitor C8 and Westalite rectifier-16RD 2-2-8-1, wired ready for mounting), £2.19.6, from General Electronics, 129, Portobello Road, London, W.11.

3 2-pin 2-amp sockets (1 for mains, 2 for flash tube holders).

S2 battery toggle switch, double pole change-over.

S1 A.B.C. 3-pole 2-way switch.

S4 on/off single-pole toggle switch.

M.R.2 L.T. charging rectifier, ½ amp.

L.T. battery, 2 Exide Gel-Cel type PRA-3S.

R1 (already in transformer assembly).

R2, R3, 500 Ω 1 watt (charging resistors).

R4 200 Ω wirewound.

R5 2.2 MΩ ½ watt midget pot.

R6 2.2 MΩ ½ watt.

C1, C2, C3, C4, Daly photoflash capacitors 1,600 μF each 270 volts wkg. Type PFM 99/18 from Daly Condensers, Ltd., West Lodge Works, The Green, Ealing, London, W.5. 41/3 each.

C5 .05 μF 200 volts wkg. midget type.

C6, C7 .25 μF 250 volts wkg. midget type.

C8 .05 μF (supplied in transformer assembly).

TC 2 trigger coils 12/6 each (General Electronics or C. B. Miller).

2 reflectors 12/6 each (C. B. Miller & Co., 337, Brighton Road, South Croydon, Surrey).

1 neon, miniature pattern, 2/-. C. B. Miller.

2 miniature 3-pin plugs and sockets.

8 yards of 3-core P.V.C. connecting cable.

2 flash tubes Mazda type F.A.10, £2.10.0 each. (Tube is marked with red dot on the positive leg.)

1 mains voltage adjustment panel.

1 synchronising lead with suitable type plug on the end; the type of plug depends on the camera with which it is to be used.

4ft. 2in. of ⅛in. × 3/16in. Paxolin strip.

Case comprising of 2 pieces 5½in. × 8in., 2 pieces 6¼in. × 8in., 2 pieces 6¼in. × 5 5/16in. of ⅛in. Perspex, Paxolin or other suitable material.

Approx. 2ft. of 6in. wide 3mm. aluminium sheet.

Five dozen 6B.A. ⅜in. long brass c/s headed screws.

4ft. of 1½in. wide plastic strap.

Red and black P.V.C. flex for wiring.

Components not specially mentioned can be purchased from any radio dealer or from General Electronics.

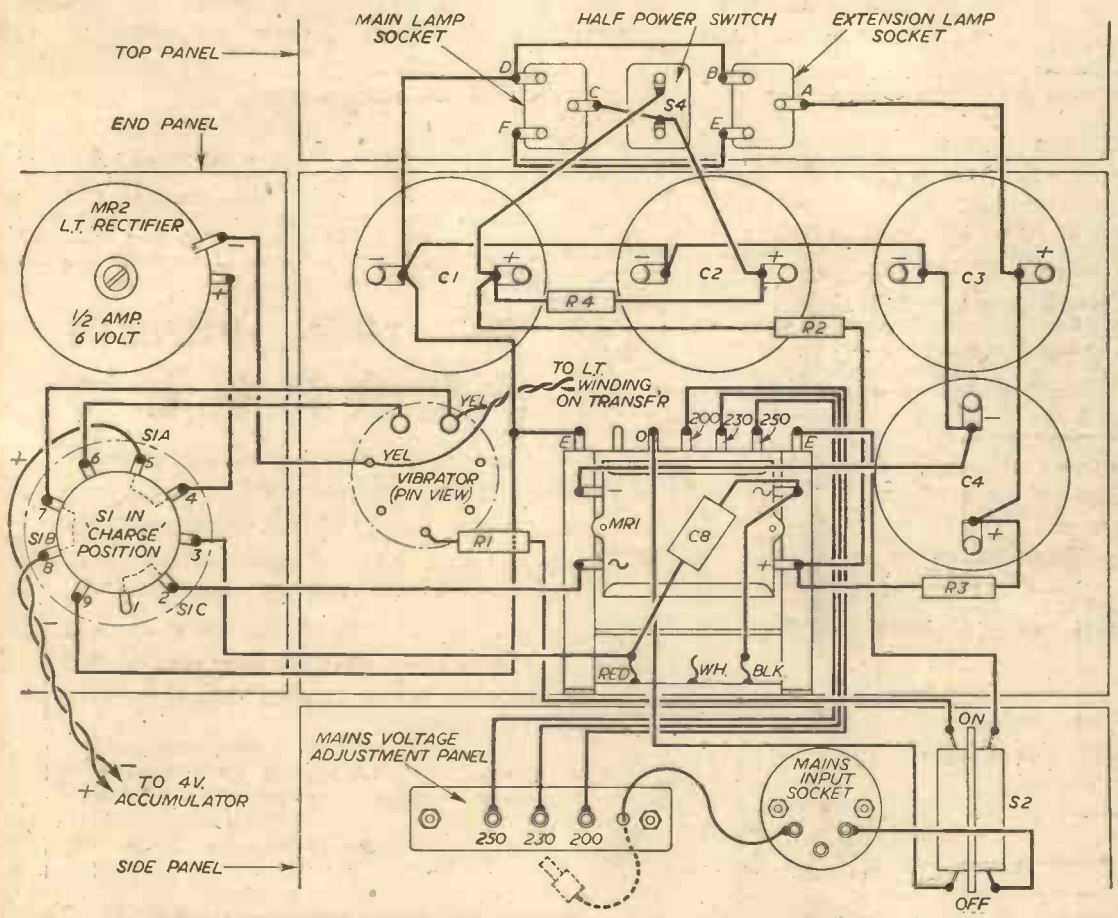


Fig. 8.—Wiring diagram of the power unit.

Warning

Do not make any alterations to the circuit without first making sure that the main condensers are discharged. This can be done by flashing the tubes or shorting the condensers with a 500Ω resistor. Do not short them with a screwdriver as this is detrimental to the condensers. Use only one hand and keep the other in your pocket.

To charge the batteries, take off the panel opposite the mains socket, pull out the batteries and stand them upright. Always take the batteries out before charging them.

In use, the main lamp is attached to the camera, and the extension screwed to the pan-and-tilt head of a tripod which is placed nearer and to one side of the subject. The author's arrangement is shown in Fig. 5. About three seconds after the neon lights the lamps are ready to flash. During waiting periods the box should only be switched on in short bursts—just long enough to keep the neon alight and so conserve the batteries. With two lamps, the flash number is not as critical as with only one lamp.

Exposure

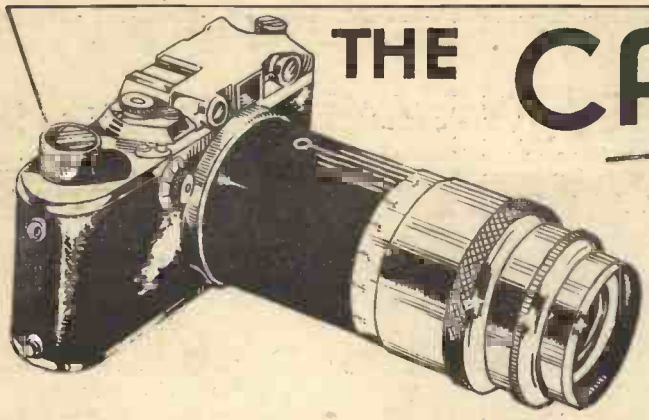
For head and shoulder portraits—

light subjects ... f22
dark subjects ... f16
Full lengths ... f11

all others f8 or f5.6 depending on size.

This is using Verichrome Panchromatic film.

These exposures have been found by the author to give the best results, but it may be advisable for the individual user to establish his own standards by trial and error. Not every photographer will wish to use the same procedure and technique, but the outfit described is quite versatile.



THE CAMERA LENS...

Part 2 of a Short Series Which Explains in Simple Language How the Camera Lens Works

By J. C. Lowden

(*Continued from the June issue*)

The Focal Length

THE focal length may be most simply defined as the precise distance behind a lens at which the rays of light reflected from an object "viewed" by the lens converge to form a clearly defined, inverted image.

This property is simply observed in the following manner. Take any simple lens—a small magnifying or burning glass is adequate. Hold it under any bright source of light. The sun is the ideal, but a pendant lamp will suffice (Fig. 6). Place a sheet of

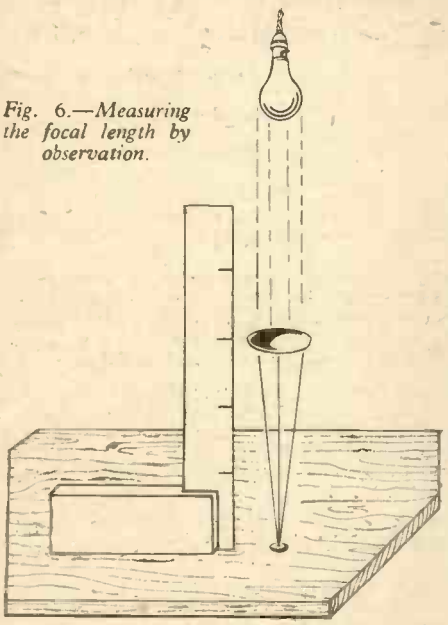


Fig. 6.—Measuring the focal length by observation.

paper on a flat surface under the lens. Raise or lower (focus) the lens until a clear image of the lamp or sun is resolved. (Beware of heat if you are using the sun.) Measure the distance between the centre of the disc and the paper. There, to the limit of accuracy of your measuring, is the focal length of the lens. The focal length of the lens can be manipulated within wide limits by the design. Once the lens is finished, however, it is a fixed quantity.

The focal length of a compound lens, i.e., one made up of more than one "element," can be determined by the focal lengths of the elements used. As a simple example, if two lenses of, say, 10in. focal length were mounted in a short cell the lens would be a simple "doublet" (Fig. 7) and the focal length of that doublet would be roughly half of the focal lengths of its elements, i.e., 5in.

(For the mathematically minded, the exact focal length of the doublet could be calculated by the use of the Gauss equation:

$$\text{Focal length of doublet} = \frac{F/L.1 \times F/L.2}{F/L.1 + F/L.2 - D}$$

D is the distance between the two elements and is a variable quantity.)

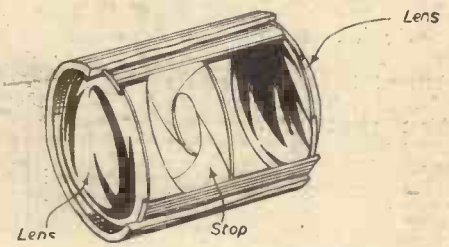


Fig. 7.—A simple doublet.

Since the good-quality photographic lens is made up of a multiplicity of glasses and sealed into a single unit it would be a formidable task to work out for oneself the focal length. The "direct observation" method would afford only an approximation, since the measurements of a compound lens must be taken from the nodal points, which would be difficult for the non-technician to locate.

Fortunately for the amateur, every good-quality lens has the focal length clearly engraved upon the lens mount. This is a fixed quantity, and (except for a special purpose, which comes under the heading of focusing) it cannot be controlled by the user.

Convertible lenses, in which the focal length could be varied by the removal or substitution of various components, were at one time essential items to a serious worker. Many of these excellent objectives are still giving yeoman service.

Among the many important considerations of the focal length of the lens is that it more or less determines the maximum size of the negative to be used. In a camera using a lens of "normal" (40-60 deg.) angle of acceptance the focal length of the lens fitted will be equal to, or somewhat larger than, the diagonal of the largest negative used in that camera.

TABLE OF FOCAL LENGTH/FILM SIZES

Negative	Focal length	
35mm. (Leica size)	5cm.	2in.
2¼in. sq.	7.5-9cm.	3-3½in.
2¼ × 3¼in.	10-11cm.	4-4½in.
¼ plate	13.5cm.	5¼-6in.

This table is not complete, and individual cameras may vary slightly. The metric equivalents are approximate.

The F Number

The f number is the most important symbol in photography, for it denotes the working efficiency of the lens. The smaller the f number, the more efficient the lens—a fact which may puzzle the tyro until it is realised that the number is really the denominator of a fraction.

The f No. is resolved in the following way:—

$$\frac{\text{Focal length}}{\text{Diameter of lens}}$$

Thus, a lens of 10in. focal length, with a diameter of 1in., would be rated at f/10, while a lens of the same focal length with a diameter of 2in. would be rated at f/5. Another term for the f ratio of a lens is the "aperture."

Lenses of long focal length are not made with such large apertures as lenses of shorter focal length. Referring to the previous example of a 10in. f/1 lens: to make this lens with a working aperture of f/2 (by no means unreasonable in modern usage) would require a disc of glass of a minimum diameter of 5in. This would introduce a great many difficulties, both in design and manufacture, and would increase the cost to an unreasonable degree. The same objections would be present, and probably intensified, if the designer set out to do the job with a multiplicity of compound lenses.

In a simple fixed-focus camera the aperture is fixed at the comparatively "slow" rating of f/11. This represents a lens of sufficient power to transmit the correct quantity of light to give adequate exposure to normal "amateur" film under reasonable lighting conditions.

Fig. 8.—The iris diaphragm "stopping down."

Fig. 9.—Chromatic aberration. A—point of focus of blue rays. B—point of focus of yellow rays.

Variable "Stops"

Even quite unambitious cameras to-day, however, have lenses with maximum apertures of the order of f/4.5, and it will be clear that if sufficient light can be transmitted by an aperture of f/11, that passed by f/4.5 will be greatly excessive. The wide aperture, then, must be controlled by a "stop." In simple cameras this stop may be merely a blackened metal strip, pierced with holes. The strip is moved over the lens until the correct hole is selected.

In better equipment the aperture is controlled by the "Iris Diaphragm" (shown in

Fig. 8). This is a beautiful mechanism, consisting of a series of fine metal leaves. Each of these is pivoted at one end to a common "travel," and as this travel is moved the blades open or close. The degree of closure, within the limits of the travel, is unrestricted, save that it is not usual for complete closure to be made. The travel is usually actuated by a "setting ring" or lever.

The Setting Scale

For accurate exposure it is necessary to know precisely the size of the aperture, so the iris has a scale graduated in a series of closures. Each of these "steps" is so arranged that the larger aperture passes exactly twice as much light as that preceding it, e.g., f/4 passes twice as much light as f/5.6, while f/5.6 passes twice as much as f/8.

The British Standard Scale is as follows, the typical Continental Scale being given below it.

British: f/2, f/2.8, f/4, f/5.6, f/8, f/16, f/22, f/32.

Continental: f/2.3, f/3.2, f/4.5, f/6.3, f/9, f/12.5, f/18, f/25, f/36.

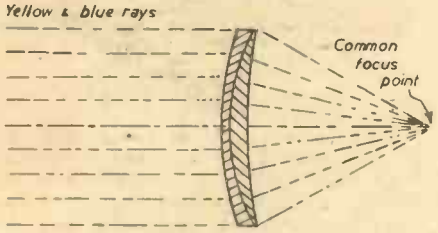


Fig. 10.—Achromatic lens.

Although these do not exactly correspond they may, for practical purposes, be regarded as equivalents.

A scale now obsolete, but still to be encountered in perfectly serviceable "vintage" models, is the Universal Scale (U.S.). In this scale the aperture f/4, then considered almost unapproachably "fast" was taken as unity. Thus:

	f/4	f/5.6	f/8	f/11	f/16	f/22
U.S.:	1	2	4	8	16	32

Lenses are always specified by their maximum working apertures. In some lenses this maximum may not fit in the standard scale. As an example, the Skopar lens fitted to the writer's Vito has a maximum aperture of f/3.5. This is the widest aperture on the scale, which then follows on with the normal British scale. For practical purposes it is reckoned that the "extra" stop of f/3.5 is equivalent to doubling the value of the next stop.

When buying a camera, especially a moderately priced miniature, it is as well to be careful of a cheap lens with a huge aperture. Even with colour film exposures of the order of f/2.8 or so are rarely called for, and a well-designed lens of a maximum of f/4.5 or so may well be a better "buy" than one with a super-wide aperture but the resolving powers of which, even when closely stopped down, may be suspect. To design and build a really wide aperture lens which will give first-rate performance can never be cheap.

Referring to the original definition of a lens, the simplest form of lens to fulfil these basic conditions is a meniscus lens, in section a "crescent" or "meniscus." This lens, unfortunately, cannot be regarded as a serviceable camera objective. The first and really insuperable objection is as follows.

Chromatic Aberration

Anyone who has observed the effect of passing light through a prism is aware that so-called "white" light is really a blend of light rays of differing colours, among which the blues and the yellows are the most important for photographic purposes. The simple meniscus bends the rays of light of different colours to different extents. Thus the yellow rays do not focus in the same plane as the blue rays, and it is not possible to reconcile these two planes of focus (see Fig. 9). This failing is known as "chromatic aberration." It is best observed by looking at the coloured fringes around an object viewed through the lenses fitted to cheap optical toys.

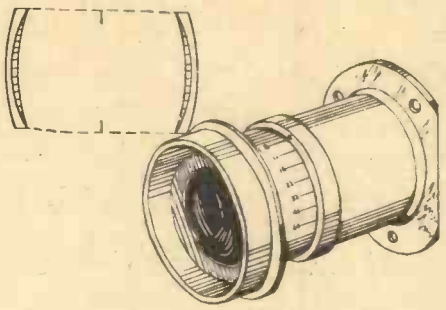


Fig. 11.—The rapid rectilinear lens.

Meniscus lenses have been fitted to fixed-focus cameras of the toy quality, but their best use in photography is as supplementary lenses.

The Achromatic Lens

The problem of chromatic aberration was solved by Dollond, the English scientist, in the mid-Eighteenth century. By compounding two lenses of varying refractive indices and differing focal lengths he was able to produce a lens which focused the different coloured rays in the same plane (Fig. 10). This lens, not subject to chromatic aberration, was termed achromatic. In its most efficient form the achromat is of meniscus section, and is usually termed a meniscus achromat. This type of lens, while eliminating the main bogy of chromatic aberration, is subject to other aberrations which preclude its use at apertures wider than f/11 or thereabouts. It is, however, perfectly adequate for simple fixed-focus cameras using a large negative which will not normally be subjected to the searching process of enlargement. It is, therefore, practically standard equipment on good quality box cameras.

The rapid progress of the other branches of photography greatly hastened the development of the lens. Various workers used different combinations of achromats, perhaps the best known of which was the famous Rapid Rectilinear (R.R.).

This was a combination of, basically, a pair of symmetrical achromatics with a stop in between, as shown in Fig. 11. This combination eliminated the worst aberration, linear distortion, to which the simple achromat was subject. Linear distortion implies an inability to render an accurate image of a straight line. While linear distortion was tolerable in portrait work, and in landscape, to some extent, it was quite unacceptable in architectural photography (see Fig. 12). The R.R. remedied this grave defect, and it was termed "rapid" because it could be made at an aperture corresponding to f/8—still a useful size.

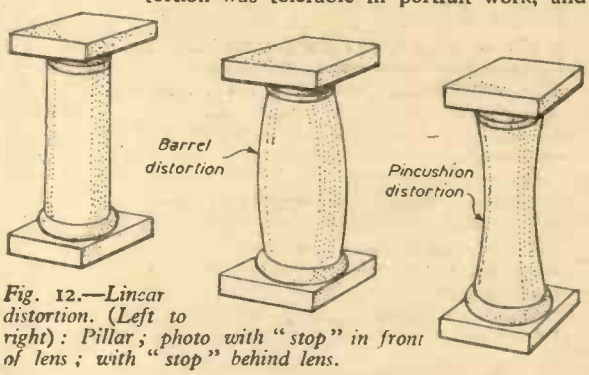


Fig. 12.—Linear distortion. (Left to right): Pillar; photo with "stop" in front of lens; with "stop" behind lens.

Large negative cameras (film sizes 116-118) are still to be seen in use with R.R. lenses, and they give good service so long as the negatives are not over-enlarged.

While the rapid rectilinear and similar compound lenses represented a great advance in lens performance, they were still subject to a number of aberrations, and the two most obstinate of these were curvature of field and astigmatism. These two aberrations are closely allied.

Curvature of Field

The two glasses used together in compounding an achromat must be made to certain specifications if they are to focus blue and yellow rays together. They must also fulfil certain other conditions if the image to be focused is to be formed on an absolutely flat field. Unfortunately, these two factors are different, and irreconcilable, and the simple achromat is unable to bring the image to focus on a plane surface.

Curvature of field can best be observed in an enlarger, or projector, when one of the inexpensive achromat doublets is being used. At its widest aperture the lens "projects" an image which may well be perfectly defined in the centre, but which is blurred at the edges. If the lens is refocused so that the edges of the image are clear, then the centre is blurred. Fortunately, this defect can often be cured by "stopping down" the lens.

(To be concluded)

Camera Collections

Why Not Start One of Your Own?

MOST people have at some time or other in their lives been a collector. Schoolboys collect the most amazing variety of things, ranging from the more usual stamps and cigarette cards to things like matchbox tops, orange wrappers, cheese labels and door knockers; why not, now you are a photographer, collect photographs of one particular subject? Once the collection is in full swing, you may rediscover the enthusiasm of the true collector. Your collection may easily be allied to a subject in which you are already interested—the architect can make a collection of freak buildings, the motorist a collection of vintage cars, the horologist a collection of unique clocks, etc., etc. Those with no particular interest have the whole field of photo-collecting open to them, such things as windmills, sundials, signposts, gargoyles, bridges, wells, and one of the most popular subjects of all (although perhaps not for the reasons usually ascribed to the true collector) pub signs.

A photographer who collects pictures of one subject for any length of time, is bound to gain considerable knowledge of his subject and might possibly, in time, become an expert!

Replies to Readers' Letters

Roller Blind Shutter Repair

I HAVE a T. P. Reflex camera and the substance with which the inside of the roller blind shutter is coated has perished and cracked and is no longer light-proof, although the fabric and tapes are in good condition.

The cost of having new blinds fitted is prohibitive, bearing in mind the limited use to which the camera will be put.

Can you suggest a suitable substance with which the blinds may be coated to render them opaque? Or, alternatively, is the fitting of new blinds by the owner a practical proposition?—L. C. W. (Sheffield).

IF a limited number of pinholes exists, they may be filled with a sparing application of Bostik or rubber solution. If the blinds are in bad condition, new ones are really required. Thornton Pickard, Woodfield Road, Altrincham, would fit these. It is also possible that they would provide you with new blinds to fit yourself, if supplied with details of the camera.

Whether or not you could do this successfully depends upon your ability to note exactly how the shutter components operate, and upon replacing everything exactly as originally. It is necessary to mark the gears in the shutter mechanism, so that they may be replaced with the same teeth meshing, and if this is done, timing will be correct.

If you study the shutter drive before taking to pieces, this will become clear to you.

It does not seem very likely that the existing material could be made light-proof, if in bad condition.

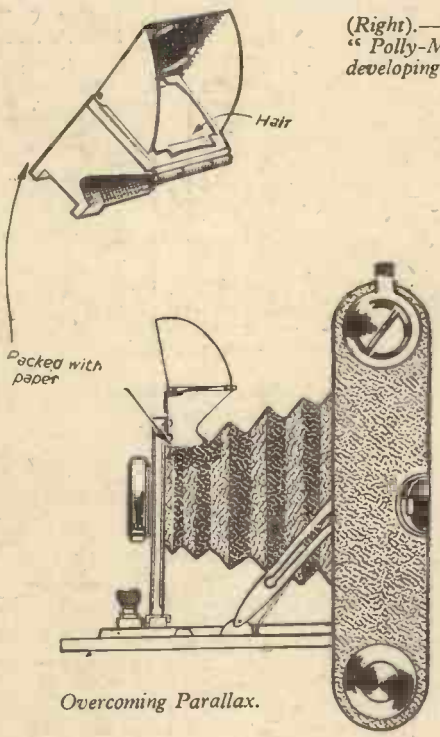
Overcoming Parallax

THE camera I possess is a folding one; with the usual type of viewfinder fixed on the side and I am experiencing parallax" when using the viewfinder on close-distance objects, e.g., portraits. Is there any way I can correct this?—W. Grant (Yorks).

THIS problem of parallax correction can, theoretically, only be overcome by having a viewfinder which is fully adjustable for every distance. In practice, however, it is generally sufficient to bear in mind that a little more space must be left at one side of the viewfinder when taking close-up photographs.

A hair, stuck to the finder at the required place, is an improvement on memory and will still not affect the scope of the viewfinder for longer distance work.

If you take large numbers of close-up pictures, and the viewfinder is attached to the camera with two screws—as is often the case—it may be thought worth



Overcoming Parallax.

while to pack up the base of the eyepiece side of the finder with thin card, until the area viewed coincides with the negative produced. In this event, you will still need to allow for correction but, this time, when the camera is used for longer distance work.

The amount to be allowed for correction in any of the schemes outlined above can only be found by experiment.

Improving the Negative

RE the article in the April issue, "Improving the Negative," under what light is intensification carried out when the negative is re-developed in a non-staining developer?—F. Sturgess (S.E.9).

WITH chromium, and certain other intensifying agents of a more specialised nature, it is necessary to remove the *colour* from the negative without destroying the image, before the actual intensification can take place. This is done in the manner stated in the article.

Now, in order to build up a more heavily coloured, or intensified negative, the film or plate is immersed in a non-staining developer, such as a standard M.Q. solution packaged by all the leading photographic manufacturers. This is done by ordinary lighting, and the process is far more rapid than the initial development given to the film. The process is complete when no further change occurs.

As you will see, if you try this method, a slight increase in negative density is obtained.

TRADE NOTE

THIS tank is made entirely of chemical resistant polystyrene and by a system of stops in the transparent flanges, not only can films of all the popular sizes be loaded, but a second film of the same size also.

(Right).—The "Polly-Max" developing tank.

"Second-exposure" of colour films without removal from the spiral; automatic "two-way" agitation; "Roto-Feed" easy loading; a "quick positive lock to the lid; clean filling and emptying (a full tank with lid on can be emptied in 20 seconds); a stirring rod in which a thermometer can be inserted; a practice loading film and very full instructions are other points worth noticing.

The retail price of the Polly-Max is 32s. 6d. Distribution to the trade is jointly by Johnsons of Hendon, Ltd., and Neville Brown and Co., Ltd.

YOUR OPINION

SIR,—I have been reading with interest your new "Practical Photographer" supplement and would like to express the hope that it will live up to its name and fill a long-felt want by supplying the amateur with real down-to-earth practical information.

Too much time is given these days, I feel, to the finer points of photography at the expense of the basic fundamentals, which, after all, occupy the minds of the majority of amateurs. Typical of this attitude is the emphasis laid on picture composition. I have seen a so-called expert criticise a photograph, which I would have been proud to have taken, for some reasons which can only have been based on personal preference and for others which were merely hair-splitting. I refuse to believe that trimming half an inch from the bottom of a half-plate print will turn it from a mediocre picture into a masterpiece! Even the generally accepted basic rules of composition—picture thirds, cone-shapes, diagonals, etc., have been frequently violated by the world's greatest painters, and yet in some schools of thought a photograph, unless it conforms rigidly to a set of rules, is termed bad composition. Personally I would rather take a badly composed picture of an attractive subject than a perfectly composed picture of an ugly one, but then perhaps that is another matter.—"REBEL" (Kent).

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