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PRACTICAL MECHANICS

EDITOR : F. J. CAMM

MAY 1958

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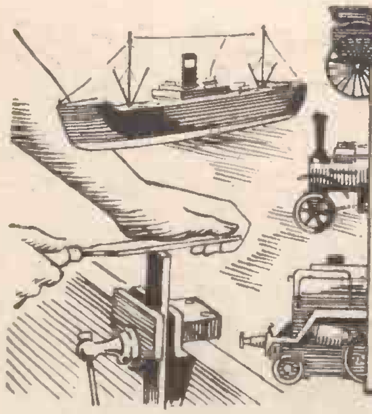

Practical Mechanics

Vol. XXV. No. 291 MAY, 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

A READER referring to our preliminary announcement concerning "The Practical Photographer" supplement, asks how it is possible for an editor to estimate with any reasonable degree of accuracy what his readers want. He says that editors obviously have this faculty, otherwise there would not be successful journals, and he pays us the compliment of saying that we have developed it to a fine art, judging by the large circulations of our associated group of practical journals. He says that the publication of the Photographic Supplement, as with our other ventures, was timely because there is a paucity of literature on modern photography and photographic apparatus. How is it done ?

The answer to that question is extremely simple. On an editor's desk each day and with every postal delivery during the day arrives a pile of letters of a heterogenous character. Most of them seek information on a wide variety of subjects and some of them make suggestions. In the course of time it is easy enough to assess, by the frequency with which particular questions recur, the tendencies of reader interest. Of course, the correspondence, though large, is but a small proportion of our total sales. There must be many tens of thousands of readers who have never written to us at all. And the fact that they continue to take the paper is an indication that they are satisfied with the contents. It would be easy to follow the line of least resistance and to produce each issue to a pattern as to editorial subject and content, but reader interest veers in the course of the years from one subject to another, and editorial policy must change to satisfy it.

It is therefore from the letters received from the sample cross-section of our readers that we are able to assess with a reasonable degree of accuracy what our readers want. It might at first be thought that this would only be possible if you took a referendum of the entire readership. You do not, however, have to devour the whole of the meal to discover whether it is properly cooked, nor does the cook have to drink the whole of the soup to ascertain whether it is properly seasoned. He takes a sample of it and sips it.

Readers' correspondence is always valuable and welcome from this point of view, and readers' queries are a special guide to the type of articles readers require, as well as indicating their special interests.

In most cases we are able to reply to readers' queries almost by return of post. On other occasions the preparation of the information would take a little time. In a small number of cases, it is not possible in the course of a letter to satisfy the reader's requirements, and a lengthy illustrated article or small textbook would be required. In such cases we endeavour to publish an article on this subject and in the meantime put the reader on to published sources of information, and by published sources of information we are, of course, including this journal. A glance through the index or indexes will often show that we have published the very information which the reader requires. Have your copies bound in one of our loose binders and purchase the annual index !

POWER FROM SEA WATER

SIR WILLIAM PENNEY is in charge of a team at Aldermaston, charged with the project of deriving energy from sea water. It is part of Britain's intention to produce power as cheap and almost as limitless as the sunlight which falls on the earth. One team of atom scientists have proved that the force of a hydrogen bomb can be bottled up in nothing stronger than a glass doughnut and exploded atom by atom. Everyone hopes that something tangible will evolve from all these atom experiments very soon. We have been promised that atom power has been practically round the corner for so long and we do not wish to wait until coal is £100 a ton !—F. J. C.

The June issue will be published on May 30th. Order it NOW!

Making a Swing-boat

Construction is Described by D. F. Seton

YOUR child's old perambulator can enter its second useful life in providing a safe, comfortable swing that will give many hours of happiness both to your child and her friends (see heading and Fig. 1).

First of all buy two wooden posts, 8ft. long × 4in. × 3in., and one 3ft. 6in. long × 4in. × 3in. (This shorter post, which forms the crossbar, should be 2ft. longer than the width of the pram.) With a wood chisel and saw cut the posts to form a simple but robust joint as shown in Fig. 2, and drill two holes in the short one to take swing hooks. The distance apart of these two holes should be made equal to the distance between the supporting rods by which the perambulator's body is slung—in other words equal to the width of the perambulator plus about 1in.

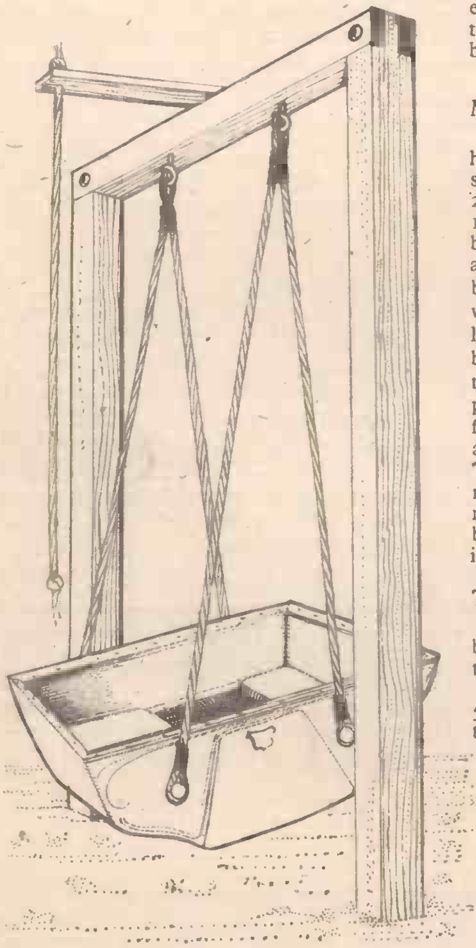


Fig. 1. — The completed swing-boat.

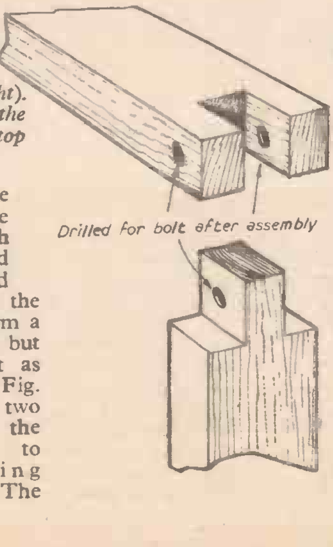


Fig. 2 (Right). — Jointing the posts to the top rail.

All three posts are now given a liberal coating of creosote, not forgetting the cut ends, and bolted together with two 5in. bolts.

Mounting the Posts

Dig two square holes at the chosen spot in the garden, 2ft. deep and about 1ft. wide, their centres being about 3ft. 3in. apart. The distance between the holes will vary, like the length of the crossbar, with the width of the pram. Into each put a few pieces of flat stone as a floor, and then stand the posts into the holes. The stones at the bottom of the holes may require moving, or a few more may have to be added, to make the crossbar *exactly* horizontal. This is most important!

The Concrete

The posts can be held absolutely vertical by lengths of lath and scrapwood nailed to them and to pegs in the ground.

Two hundredweight of ¾in. ballast and 56lb. of cement should be thoroughly mixed together and made into a firm sludge with water (be careful not to use too much water), and put into the holes around the posts to within about 2in. of ground level, then heaped up about 1in. above ground level immediately around the posts.

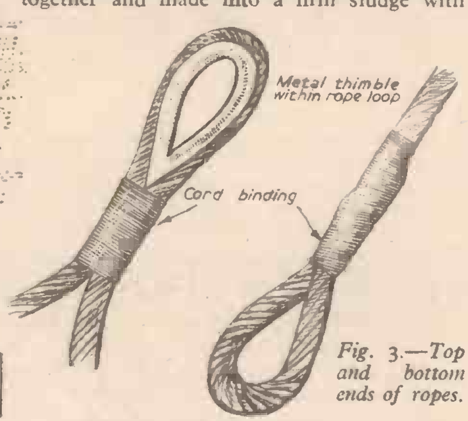


Fig. 3.—Top and bottom ends of ropes.

In the prototype, a week was allowed for complete setting and hardening, after which the cement was coverd with soil to ground level and the struts removed.

To make the slings, the centres of each of two 14ft. lengths of ¾in. rope were looped round a metal "thimble" to prevent wear of the rope in use and securely bound with strong cord (see Fig. 3). One of the swing hooks was put through each loop, pushed through a hole in the crossbar, and secured tightly with a washer and nut so that the rope could not jump off, as shown in Fig. 4.

Hanging

Next take the body of the perambulator off its chassis and stand it between the uprights, supported about 1ft. off the ground by a stool. The four ends of the rope are then each looped round one of the perambulator's suspension rods and secured by splicing (i.e., by threading the strands back through the rope) and binding with cord for strength and to prevent unravelling (Fig. 3). Great care must be taken at this stage to ensure that the ropes are all the same length, from crossbar to loop, so that the perambulator hangs straight and swings true.

Finally screw a piece of wood about 15in. long, 2in. wide, and ¾in. thick at right angles to the crossbar, drill a hole at the free end, and hang a rope from it for pulling.

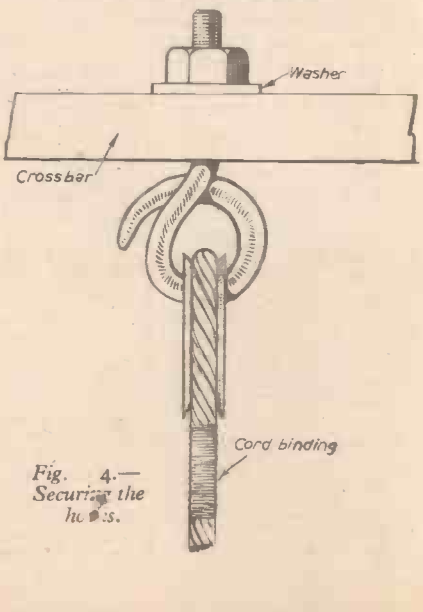
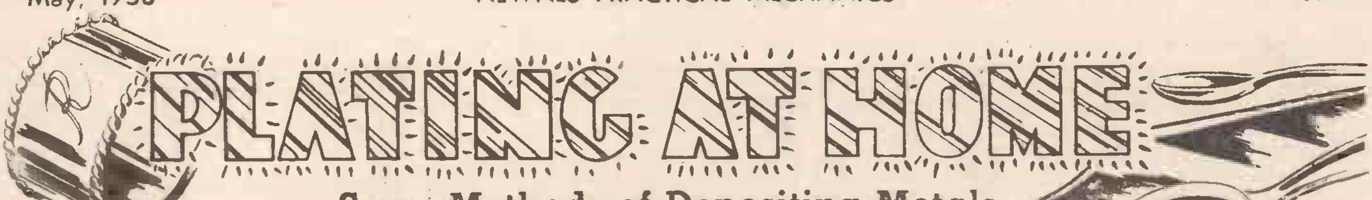


Fig. 4.— Securing the hooks.



PLATING AT HOME

Some Methods of Depositing Metals Chemically

By E. N. D.

DESPITE the acknowledged superiority of electrically-plated metals, there is no reason why the amateur should not try his hand at plating metals non-electrically. Quite a number of metals can be plated successfully by chemical means alone and, apart from the interest attached to such processes, these purely chemical methods of plating can sometimes serve a useful purpose for small-scale work.

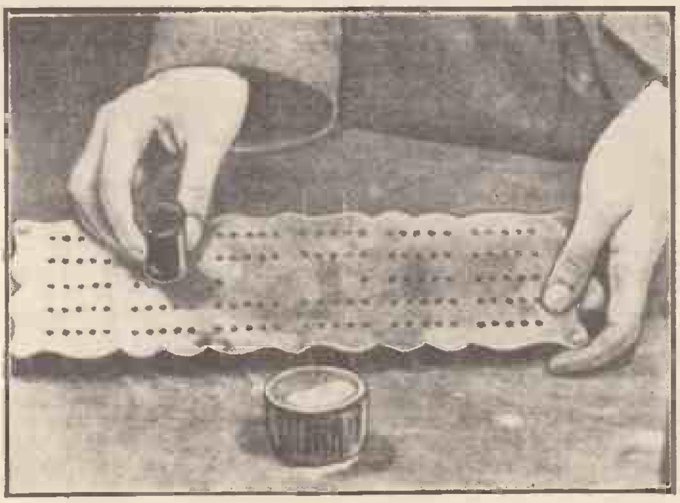
Simple Method of Plating

The very simplest chemical plating consists in the deposition of a layer of copper on an iron or steel article which is immersed in a bath of copper sulphate solution. The steel or iron article must be scrupulously clean and, preferably, its surface should be bright and polished. Do not have the copper sulphate solution too strong. A moderately weak solution is sufficient, for the copper deposited from such a solution will adhere much better to the steel object.

Making a mercury "silvering" solution. A small quantity of mercury and four or five times its volume of nitric acid.

Some consider that more effective copper plating may be attained by immersing the iron or steel articles in a bath consisting of equal volumes of moderately weak solutions of copper sulphate and cream of tartar. This bath precipitates the copper in a more golden - coloured form, but it does not work any better than the former simpler bath.

Zinc articles can be copper-plated in this manner.



Using plating powder. A brass article being silvered by means of mercury-chalk powder rubbed on its surface on the end of a cork.

Mix equal volumes of fairly weak solutions of copper sulphate and salammoniac (ammonium chloride)—the exact strength of the solutions, as in most of these chemical plating liquids, is immaterial. Clean and polish the zinc surface and then brush the above solution over it with a soft brush. A fine film of copper will be deposited upon the zinc. Do not use too much of the solution, otherwise the copper deposit will become flaky and drop off. Be content to employ the minimum amount of solution, wiping away all surplus solution after it has acted upon the zinc for a minute or two. This process can be repeated several times, thereby building up a fairly thick layer of copper upon the zinc.

Imitation Silvering

What we may term "imitation silvering" is very easily accomplished. There are two good methods of effecting this result, both of which are very easy to apply. The first of these we will call the "dry method." It gives on copper, brass, steel and other metals a very fine silvery film, which in the case of copper and brass, may be deposited so thinly that it only just modifies the characteristic colour of the underlying metal.

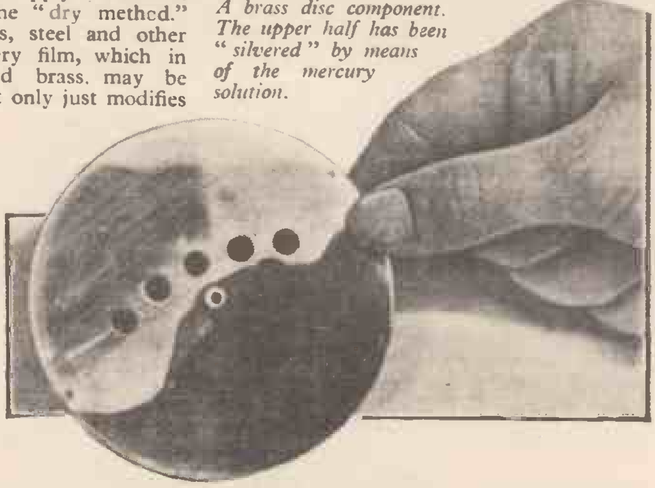
To carry out this "silvering" method, adopt the following procedure. Place a globule of mercury about the size of a pea in a mortar or other suitable grinding vessel and add, also, two teaspoonsful of powdered chalk. Grind the chalk and the mercury together. After about half an hour's grinding, the mercury will have entirely disappeared and the chalk will have acquired a grey colour. We have now prepared the well-known Hydrargyrum Cum Creta (Mercury-with-Chalk), or "grey powder," of the pharmacist, and it is this readily although somewhat tediously prepared material which constitutes our "dry silvering" powder.

Moisten the end of a soft rag with a little methylated spirit and then take upon the moistened area of rag a quantity of the "grey powder." Rub this over the clean surface of the article to be silvered. Within a few seconds a thin, shimmering silvery film will form on the metal surface, which film can be thickened by continuing the rubbing with a further quantity of the powder.

The "Wet" Method

The "wet" method of imitation silvering consists in dissolving a few globules of mercury in strong nitric acid, using about five times as much acid as mercury. When the mercury has all dissolved, add to the solution three times its volume of water and bottle for use. This "silvering liquid," when rubbed over the surface of clean copper, zinc, brass, iron and other metals, will almost immediately deposit a brilliant silvery film of considerable thickness. Only a small quantity of the liquid need be used, and thus it need not be made in a large amount. Bear in mind the fact that the liquid is poisonous and, therefore, that it should be kept under responsible control.

A brass disc component. The upper half has been "silvered" by means of the mercury solution.



The "silver film" obtained by the above methods is, of course, a film of metallic mercury. While being a very brilliant film and a closely adherent one, it is, unfortunately, not a permanent one. A little of the deposited mercury sinks into the body of the underlying metal, but the majority of the mercury deposit actually evaporates off the metal surface, leaving the latter, after the elapse of about two days, in its original unsilvered condition. If, however, we place a very light layer of varnish over the "silvered" metal, the evaporation of the mercury will be stopped and the "silvering" will be more or less permanent. Spirit or celluloid varnish is suitable for this purpose, but it must be perfectly clear and very thin, otherwise it will dull the silvery surface considerably.

Another silvering solution may be made by dissolving mercury in nitric acid, according to the instructions given above, but, instead of diluting it with water, by adding to it an equal volume of a 5 per cent. solution of silver nitrate. This solution, when rubbed over metal surfaces, will deposit an amalgam of mercury and silver and thus the deposited metal film will be more truly in the nature of a real silver film.

Aluminium Articles

Liquids or powders containing mercury should not be allowed to come into contact with aluminium articles. If they do, the aluminium article will be ruined, for the mercury will attack the aluminium, causing it to undergo a very peculiar type of rapid oxidation. It is, indeed, possible to "burn" a hole in a thin sheet of aluminium by dropping one of the above mercury solutions on to it.

The real silvering of metals can be accomplished non-electrically and without much trouble and, in this case, the chemical-plated silver film is more of less permanent.

Dissolve a few unwanted pieces of scrap silver in the minimum amount of warm, moderately dilute nitric acid and, after all the metal has dissolved, add to the solution about an equal bulk of a strong solution of common salt. This will precipitate white silver chloride. The latter is filtered off, dried in a warm oven and bottled for use.

From the above we can make a rubbing paste which, when rubbed over the surface of copper, brass and other articles, will deposit a film of pure silver. The rubbing paste is composed of one part of silver chloride, two parts of cream of tartar, two parts of common salt and sufficient water to make the ingredients up into a thickish paste.

The following liquid will also deposit pure silver on metal objects which are immersed in it:

Silver	3 parts
Caustic Soda	3 parts
Water	10-12 parts

The metal articles are immersed for three or four minutes in the above solution and kept on the move all the time. Afterwards they are rinsed in hot water and dried in warm sawdust.

Sensitive to Light

Remember that all liquids and powders containing silver salts are sensitive to light. It is best, therefore, to carry out all work with them in artificial light and, also, to store such preparations in amber-coloured bottles which are kept in the dark. Do not allow silver solutions to come into contact with the skin in daylight, otherwise almost indelible black stains will be produced.

Non-electrical gold plating is, naturally, an expensive procedure these days, but provided one can obtain a small scrap of gold, such a process can be carried out very easily.

Dissolve a tiny scrap of gold in a

The end of this knife blade has been copper-plated by means of the simple process described in this article.

mixture of two parts of concentrated hydrochloric acid and one part of concentrated nitric acid, using as little of the acid mixture as possible. This acid mixture is known as aqua regia—"Royal Water," the name having been applied to it for centuries on account of its property of dissolving the "Royal Metal," gold.

When the gold has dissolved, add a few crystals of green iron sulphate (ferrous sulphate), and boil the liquid. This will precipitate all the gold in the pure form as a dark brown powder, and the copper and other metals admixed with the gold will be left in solution. Filter off the precipitate and re-dissolve it in the minimum amount of aqua regia. A yellow solution will result. This is a solution of pure gold chloride.

Now pour a little of this solution over a small piece of linen rag and afterwards burn the rag over a small saucer, carefully collecting the ash. The latter will comprise principally a mixture of finely-divided metallic gold and carbon. Now take a rag moistened with water or methylated spirit, dip one end of it in the above ash and then rub it vigorously upon the polished surface of the article to be gilded. A film of metallic gold will be deposited and it will increase in brilliance with rubbing.

Gilding

By shaking up pure gold chloride solution with ether, an ethereal solution of gold will be obtained.

It is not possible to deposit chromium by chemical methods alone, nor, for that matter, is the chemical deposition of nickel usually attended with reliable results. If, however, the amateur wishes to try his hand at non electrical nickel-plating, he may do so as follows:

Mix equal amounts of moderately strong solutions of zinc chloride and nickel sulphate. Place one or two small pieces of clean scrap zinc in this bath and heat it to near boiling-point. Now immerse in the bath the metal objects to be nickelled. After about a quarter of an hour, the reaction will be complete and the articles will be covered with a film of nickel.

Usually, however, this film tends to flake off. Hence, the amateur should not be too sanguine of the results of this process, for, even when electrically plated, nickel is one of the most difficult of metals to deposit satisfactorily.

Let us consider, finally, a very simple method of brass plating or "brassing," iron and steel objects.

A chemical brass-plating liquid can be made by dissolving in a pint of water approximately half an ounce each of stannous chloride and copper sulphate. Have the solution slightly warm, clean the iron or steel objects thoroughly and then drop them into the solution, stirring them round until they attain the colouring desired. Rinse the objects in hot water and dry them in warm sawdust.

Automatic Car Steering

RESEARCH is being made into a system of automatic steering for cars and already a demonstration has been given in America. A combined electronic computer and servo mechanism takes over from the driver and follows a magnetic path produced by low frequency power in an electrical cable under the road. Could this lead eventually to the solving of the road accident problem?

New Rocket Fuel Checking Technique

UNTIL recently the method of inspecting cast solid fuels involved the wrapping of X-ray film round the fuel and passing X-rays completely through. The new technique utilises a small electron tube inserted in the burning hole running through the centre of the fuel. As the X-rays start in the centre, they pass through only half the thickness and penetration requirements are halved. High voltages are transmitted from a large Van de Graaff X-ray generator via a small extension arm.

Transparent Aluminium Film

SCIENTISTS are using films of aluminium oxide only one millionth of an inch thick to support sensitive materials inside electronic tubes. The transparent film is prepared from aluminium foil which is dissolved to leave the aluminium oxide, which is but .1 per cent. of the whole. From this the film is prepared. The film is used because it does not obstruct the path of electrons directed at the materials supported in the electronic tubes.

The Martian Atmosphere

RECENT research has established that the Martian atmosphere contains less water vapour than was thought previously. A box of air from our earth 2ft. × 4ft. × 5ft. would contain the same amount of water vapour as the whole of the Martian atmosphere. Condensed to water, this vapour would form a film only one three-hundredth of an inch thick over the whole of the planet. The researches which established this are described fully in the article on page 393 entitled "The Martian Atmosphere Restudied."

Messages by Infra-red

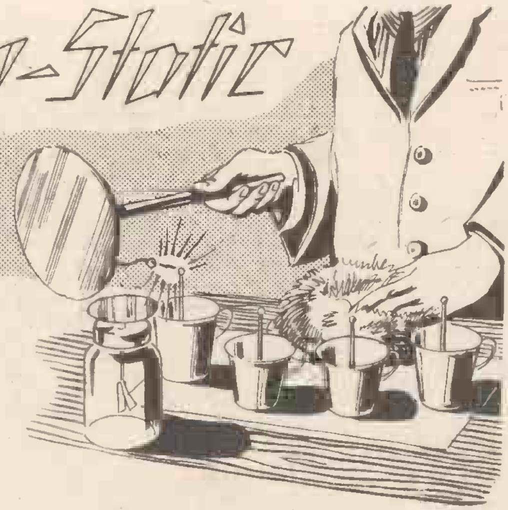
SUCCESSFUL experiments have been made in the use of infra-red rays to carry voice messages. A special infra-red transmitter is used and the receiver may be coupled to a loudspeaker or telephone as required.

Sun's Cosmic Halo

AS a direct result of studies carried out in Chicago University it is now thought that the sun has a magnetic corona for storing cosmic rays. Cosmic rays are ceaselessly bombarding the earth from space, and, although their origin is not known definitely, it is believed that they are produced by the huge explosions and leaping flames on the sun. These solar flares bear a direct relationship to cosmic ray activity on earth and when it was found that high energy cosmic rays arrived on earth some nine minutes before low energy rays, a magnetic corona which stores the rays was suggested as the reason.

It is thought too that the present high level of sunspot activity is now past its peak.

Apparatus for Electro-Static Experiments



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

EXPERIMENTS with frictional electricity often give disappointing results which are usually blamed on the humidity of the air. Most of the troubles, however, could be overcome by using more suitable insulators and dielectrics.

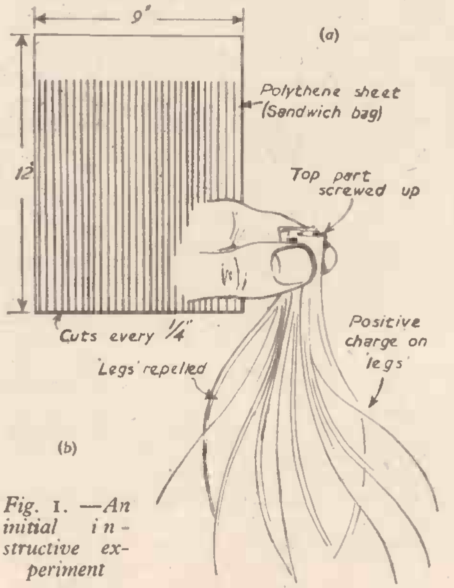


Fig. 1.—An initial instructive experiment

To-day the would-be experimenter has at his disposal a wonderful insulator called "Polythene" or "Alkathene." It is soft in nature and easily distinguished from the "Bakelite" type of material which is hard and brittle. The polythene items suggested in this article are those used in the prototypes, but there is no reason why the individual should not use other items of polythene.

When making and keeping electro-static apparatus in the past is has been the custom to "dry" out moisture in the glass insulators in a mild oven, this process must not of course be used with polythene as it will melt, although its properties do not appear to be changed by mild heat. No special care is necessary as it will not absorb water even when immersed in it for long periods. Glass absorbs many times more moisture under similar conditions. The apparatus should not, however, be made or used in a steamy place.

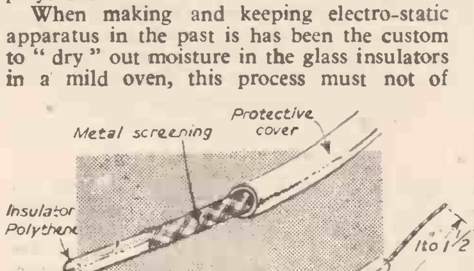


Fig. 2.—(a) Coaxial type cable. (b) Preparation of coaxial cable.

Initial Experiment

It is not intended to go into the theory of electro-statics, but it is well for the success of the would-be experimenter that he understands what causes the phenomena met in this article.

Take an ordinary polythene sandwich bag which should be clean and dry, cut it into a sheet of approximately the dimensions given in Fig. 1a. Place it flat on the table and cut long "filaments" as shown. When screwed up and held by the top part the filaments or legs all hang straight down.

Fig. 3.—A type "A" electroscope

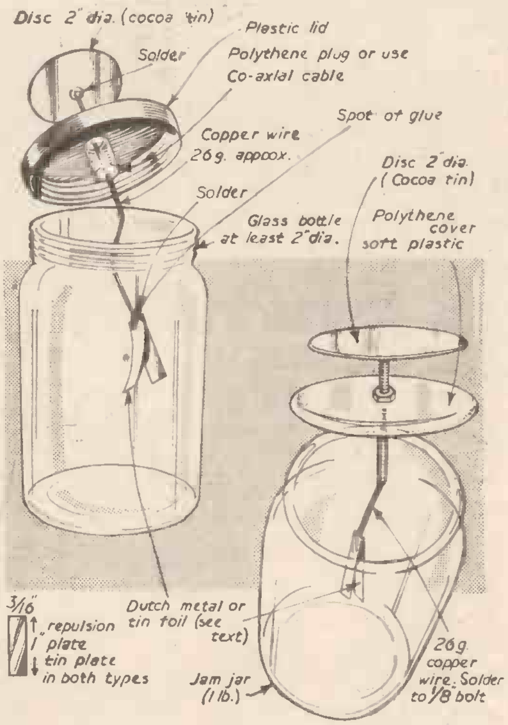


Fig. 4 (Left) Type "A" electroscope and Fig. 5 (Right) Type "B" electroscope.

Place the material flat again, this time use a blanket and rub it with a drawing motion holding the sheet by the top uncut part and "drawing away" to keep the "legs" straight. After a few minutes of this rubbing motion again screw up the uncut portion. The reader will observe that the "legs" no longer hang straight down but each repels the other as shown in Fig. 1 b.

If this is tried with paper it will not work unless it is perfectly dry (which is very difficult to attain). The blanket removed electrons holding negative charges from the surface of the polythene and as it is a perfect insulator electrons could not pass along it from your hand to replace the deficiency. Thus the polythene had on it what we call a "positive charge." As in magnetism where like poles repel, so in electro-statics like charges repel and, conversely, unlike ones attract. Usually both attraction and repulsion are present together. In the experiment the positive charges repelled, but also the "legs" were attracted by the negatively charged walls, etc.

The Electroscope Type "A"

An electroscope is a very sensitive detector of electric charges and is in a way an uncalibrated voltmeter. The voltage of the charge on the polythene in our experiment is probably over one thousand, but you could not get a shock from it as the current which would flow if you touched it would be very small. The most sensitive moving coil instrument (voltmeter) you could buy would hardly be capable of detecting the charge. The electroscope will do so easily.

Obtain a jar with a screw top, preferably a plastic one, and clean and dry it thoroughly, using a detergent in the water. Remember to clean the top too. Metal-topped honey jars will work but the extra insulating properties even of bakelite type plastics helps. The jar used should be at least 2½in. in dia., a suitable one being a medium-sized "Brylcreem" jar. A plastic jar is definitely *not suitable* and will not work.

Take some television or some ex-Government radar coaxial cable (not the air-spaced type), about 4in. long. With a razor blade carefully strip off the outer plastic layer (see Fig. 2a), when the metallic screening may be *pushed* off. Note that you cannot pull the metallic screen off as it tends to get tighter the more you pull. You then have a length of inner copper conductor surrounded by a polythene insulator. With the razor blade very carefully strip off the polythene to the dimensions in Fig. 2b. If the inner cable is stranded, tin it with solder using "Multi-core," on no account use ordinary solder and "Bakers" fluid. Do not take the iron quite up to the insulator or you will melt it.

Measure the diameter of the cable and drill a hole 1/32in. smaller in diameter than the cable insulator in the centre of the plastic jar top. If you have not exactly the right drill you can make the hole smaller and gently file it out with a fine round file.

Warm the prepared coaxial cable to soften the polythene and push it through the hole with the longest piece of wire pointing downwards until the lid is in the middle of the insulator. The coaxial cable will now be held firmly in position. If you make the hole too large cellulose cement should hold the cable. Do not on any account get the glue on the actual insulator other than where it touches the jar cover. The lid with the cable through it can be seen in position in Figs. 3 and 4.

Cut out a tinplate disc (cocoa tin), about 2in. in diameter, and round off the edges with emery paper so that there are no sharp projections. For a more professional looking instrument, use brass or even a large metal

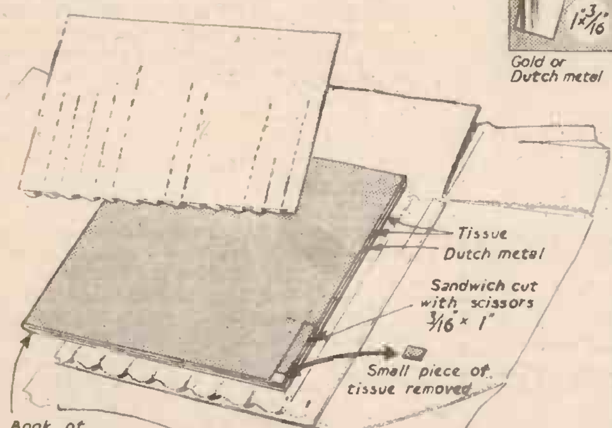


Fig. 6.—Preparing the Dutch metal leaf.

ball about ¾in. dia. Solder this plate to the top piece of wire projecting from the lid.


Fig. 8.—Type "B" electroscope.

Make a neat job with rounded appearance and no sharp solder points.

Cut a small piece of tinplate (or brass) 1in. by about 3/16in. and solder it to the end of the wire which is pointing downwards. You may have to shorten this wire according to the height of your jar. When the wire has been bent to the shape shown, make sure there is room for a 1in. piece of "foil" to rise without touching the glass, and that the foil will not be unduly near (say nearer than ½in.) to any glass around the sides, or the foil will be pulled sideways and possibly fractured by attraction. The shape of wire shown proved the best way of providing for the above points.

You now need some gold leaf, Dutch metal or tin foil from an old round wireless con-

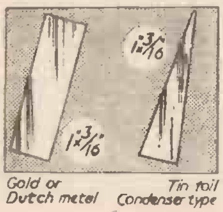


Fig. 7.—Shapes of completed leaves.

denser. These are given in order of sensitivity, but all of them are quite suitable. Gold leaf is very difficult to use and it is suggested that you do not try unless at a later date you want a much more delicate instrument.

Using Dutch Metal

This is obtained very cheaply in books from any laboratory supplier, it is an alloy of copper and zinc and is extremely thin. It is easily blown about by air currents or even the breath of the operator. When obtained it is interleaved with thin sheets of tissue paper, this should be left in position as you cut the metal to the desired shape. The piece you need is approximately 1in. × ¾in., so take a sandwich of tissue paper — Dutch metal—and tissue paper (Fig. 6) and cut it with sharp scissors. Hold it firmly and snip away about ⅛in. of tissue paper at one end. The exposed metal is then very gently applied to the top of the tinplate deflector plate on which is previously put the merest trace of cellulose cement. Let go of the "sandwich" and hold your breath, the tissue paper will fall away leaving the leaf of Dutch metal hanging straight down in front of the tinplate. Note:

(a) You must not have even one speck of adhesive on the tinplate proper, and the latter must be perfectly free from flux or the leaf will stick to it all over.

(b) If the tinplate is rough the leaf will stick to the roughness and fracture.

(c) If you are careless you will crinkle the leaf, and it will not bend easily (compare strip iron with angle iron).

(d) If the leaf looks all right, very slowly and carefully lift the assembly and screw it in place in the jar.

The apparatus is now more robust and can be carried about quickly, but not subjected to jerks.

Using Condenser Foil

As a substitute for Dutch metal, the thinnest foil in everyday use was that used in ordinary "paper" type radio condensers of capacity between .01 and .1 μF. An old one will easily be obtained from any radio servicing shop. The outer paper card is stripped off and the condenser will be seen to be made up rather like a roll of camera film (Fig. 9). To strip off the foil without tearing or creating crinkles, the condenser, with cover removed, was placed in front of an ordinary fire for 30 minutes so that it was

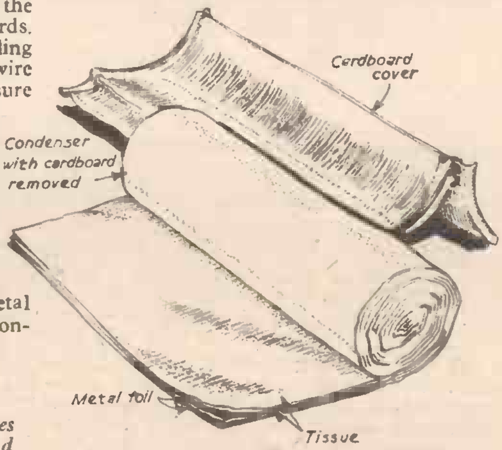


Fig. 9.—Obtaining condenser foil.

warm right to the centre. It was then held about 2ft. above the gas stove with a flame ¾in. high from one burner. The foil, with the wax thus melted on the paper interleaves, came away easily and in large unblemished sheets which were immediately placed between the pages of an old book. Care had to be taken to see that the waxed tissue did not fall into the gas stove flame, for it burnt readily.

Another method tried, which worked well, was to put the condenser in boiling water for a time and then to undo it in the hottest water the hands could bear.

The salvaged foil was rather stiff and would not hang nicely like the softer Dutch metal, so instead of cutting the metal to a rectangular shape to match the deflector plate is was cut to a triangular shape shown in Fig. 7. It was then stuck in the same way by the "apex." The small amount of metal doing the suspending was then easily bent by gravity acting on the larger mass of the base of the triangle.

Using a Polythene Plug in Lieu of Coaxial Cable

Slightly better results can be obtained by making a plug of ½in. dia. polythene to fit a slightly smaller hole in the lid. The polythene is then drilled with a small hole through which is pushed a piece of 26g copper wire. It is unnecessary to stick the wire in place, as if a few bends are made in it as it is pulled through it will grip well.

Polythene rod ½in. dia. can be obtained very cheaply from most laboratory suppliers and is extremely useful for many insulating purposes.

It is also possible to use a plug made up of a spiral of the plastic sheet from a "Sqezy" container, this appears to be polythene and certainly has its electrical properties. The printing should first be removed with fine sandpaper. It is not so easy to fix the wire using this method but cellulose cement may be used as long as it is confined to the wire and the adjacent polythene.

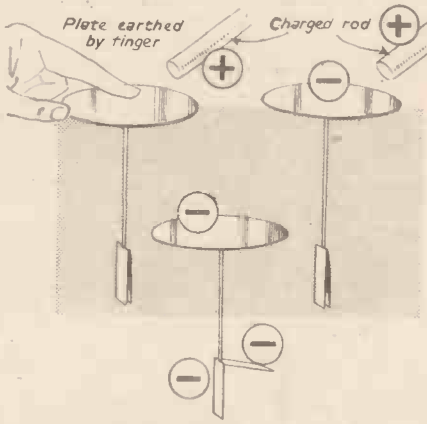


Fig. 10.—How to give a negative charge.

APPARATUS REQUIRED

Initial Experiment.

Polythene sandwich bag, clean and dry.

The Electroscopes, Electrophorus and Leyden Jars.

Harris tweed or woollen blanket. Animal fur will do if clean.

Old "Sqezy Carton" from household store.

Plywood, solder, nuts, bolts, jam jars, bottles, etc.

Polythene rod, ½in. dia.; 1ft. will make two handles or many insulators for electroscopes. Obtainable from Messrs. Griffin & George, 20, Britton Street, E.C.1.

Polystyrene is a suitable substitute (probably the same chemically), and may be obtained from Messrs. Denco (Clacton), Ltd., 357/9, Old Road, Clacton-on-Sea, Essex.

Dutch metal (or gold leaf) in books, obtainable from Messrs. Griffin & George (address above).

Coaxial cable, non-airspaced, from any radio dealer or Radio Supply Co., Leeds.

Polythene beakers.

Polythene jam jar covers.

Knitting needles or bicycle spokes.

An old or good .01 Mfd. paper radio condenser. Radio Supply Co., Leeds.

An old earphone with metal casing. A second-hand shop is the most likely source of supply, otherwise use ex-Govt. earpiece available for 1s. 9d. from Duke & Co., Romford, and cover inside with tin foil.

Polythene bottles can be used in some cases in lieu of rods.

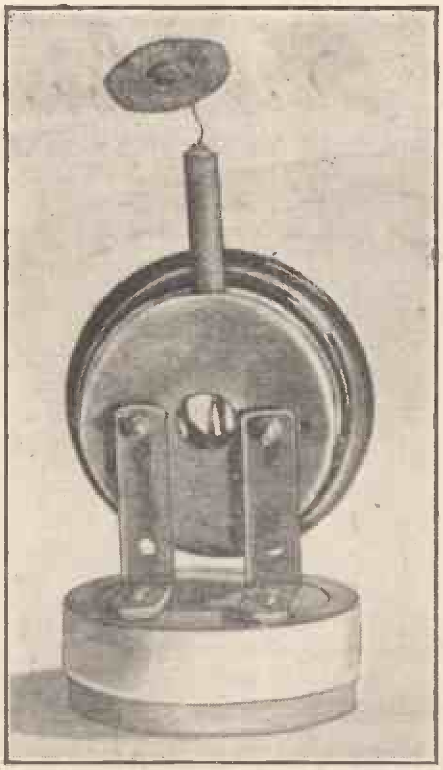


Fig. 11.—Rear view of type "C" electroscope.

Testing the Electroscope

Rub a piece of polythene sheet, a polythene bottle, dustpan, washing up bowl, beaker or even an ordinary comb on some cloth. Bring it near the electroscope disc. At a distance of 1ft. the leaf should commence to move getting to right angles with the exciter 1in. from the disc.

If the leaf rises slowly as the exciter is

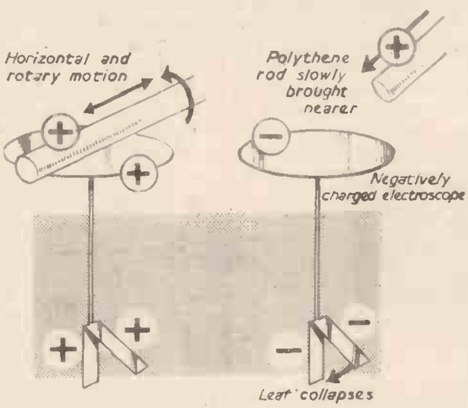


Fig. 12.—Giving a positive charge and checking it.

brought near and suddenly flicks up and then settles down again you have brought the exciter too near the disc and a spark has jumped. In that case touch the disc with the hand and start again.

A good electroscope will give a movement at least 1ft. away from a charged polythene rod (or bottle). On removal of the rod the leaf will collapse to the vertical position.

The factors governing the operation are insulation of the copper wire, stiffness of the Dutch metal, and the charge on the polythene. (Harris tweed acts as a good rubber.)

How to Charge the Electroscope

The electroscope may be charged negatively or positively. Use a sheet of polythene container, polythene bottle, rod, dustpan, etc., and having rubbed it on fur or wool bring it near to the disc until a good repulsion is obtained on the leaf. Keep the polythene there and touch the disc with the finger. Remove the finger. Then remove the polythene. The leaf will diverge as you do so. It will hold a negative charge. If the charged polythene is actually rubbed into contact with the disc it is possible to give the electroscope a positive charge; this procedure is not quite so easily done.

To make quite sure how yours is charged proceed as follows:

1. Refer to Fig. 12 and excite a polythene or ebonite rod.
2. From a distance of 2ft. bring it closer, little by little to the electroscope until you see the leaf moving.
3. If the leaf moves up (diverges) the charge on the leaf is positive, or if down it is negative.

The electroscope should hold its charge for many hours. Some experiments and uses of this electroscope will be given later.

The Electroscope Type "B"

This is very similar in construction to Type "A." A jam jar is used for the container and a polythene jam jar cover for the insulator.

Refer to Figs. 5 and 8. A few inches of 26g copper wire is soldered to the head of a small nut and bolt (⅛in. Whit. × 1½in.). A washer is slid on the bolt and it is then pushed through a hole in the cover, another washer and a nut are then screwed on top. The tin disc is soldered to the end of the bolt. The copper wire is bent and attached to the repulsion plate as in Type "A."

This method of construction gives an instrument every bit as good as the previous one but the cost of the covers is much more than short off-cuts of coaxial cable. A charge can be held all night, as with the other type.

The Electroscope Type "C"

This is a more ambitious instrument which will give an appreciable deflection with only 200 volts applied to it. It is small, robust and quite novel in construction. It is housed in an old earphone which is mounted by brackets on a wooden or other stand. The electroscope leaves are viewed sideways on by looking through the hole where sound used to come from, the background being a white illuminated window against which even the smallest movement of the leaf may be seen. It is also possible to project a light beam through the instrument if the back window is made clear and to obtain a shadow of the leaf on a screen. This is not very simple to set up as the leaf is so thin and the light beam has to be at an angle to the plane of the leaf. The author's prototypes were fitted with Dutch metal leaves; if the experimenter uses gold leaf he will get even better results.

The construction of this type of electroscope, which is shown in Fig. 11, will be described next month.

(To be continued)

An Artist's Sketching Device

R. F. Johnson Describes a Device for Drawing Accurate Perspective Sketches, Portraits, etc.

EVERY mechanic, whether amateur or professional, takes a keen interest in drawing, and many are either skilful draughtsmen or adept at making understandable sketches.

Not so many, however, can make a good free-hand perspective drawing from an object, a building or a landscape, or can even copy pictures that involve a knowledge of perspective. Still more rarely is it possible for one not trained in art work to make a good, recognisable portrait sketch. Yet it is easy to do all of this with the aid of the device described here. This instrument enables the object to be drawn as if projected right on to the paper. All that has to be done is to trace the outlines of the various parts with a pencil in order to draw everything just as it should be—the shape, proportions, perspective, details, and light and shade.

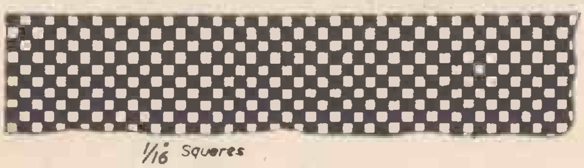


Fig. 1.—Part of the chequered mirror.

Construction

The construction of the device is explained in the drawings. The operation of the device depends on the two mirrors A and B (Fig. 2), placed in their box-like container at the angles indicated, with their reflecting surfaces facing each other so that light will be reflected from one to the other.

The Mirrors

The silvered coating of mirror A is continuous and unbroken, but part of the silver on mirror B has been scratched out in a pattern of tiny chequer-board squares as shown in Fig. 1. This removes approximately half of the mirror surface and allows the eye to see an object placed behind the mirror and, at the same time, the image of another object reflected from the tiny squares of silver that remain on the glass.

The application of this to sketching is shown in the heading sketch. The course of a ray of light from the subject to be drawn is indicated by the line of heavy dashes. This ray meets the surface of mirror A, is reflected to one of the silvered squares on mirror B, and thence to the eye. The course of a ray of light from the drawing-board to the eye is shown by a similar dotted line. This ray goes straight through the clear glass of one of the scratched-out squares of mirror B. As a result, the pencil point can be seen through the mirror image of the subject, and the outlines of the image can be traced easily on the paper. Later, the drawing can be finished in any way desired, e.g., in pen and ink or water-colours.

To ensure accurate proportions, take care to place the drawing-board in a slanting position with its surface parallel to that of mirror A. When sketching by artificial light, illuminate the pencil sufficiently to enable it to be seen as distinctly as the subject to be drawn.

The box is made of hardboard except the two side linings in which the slots for the mirrors are cut. In the front piece are cut the eyeholes and the nose "bridge" (see Fig. 3).

Mirror B is ruled in 1/16in. squares. This is easy to do with a drawing-board, T-square, and any sharp-pointed tool. Every alternate square can be scratched out with a penknife while the mirror is pressed against a window pane.

Since successful sketching depends upon keeping the image of the subject immovable, it is necessary to guard against moving the head and eyes while sketching. This is accomplished by making a "bridge" for the nose and keeping the nose in contact with it. The box is, of course, pivoted to the standard and the latter is clamped to the table.

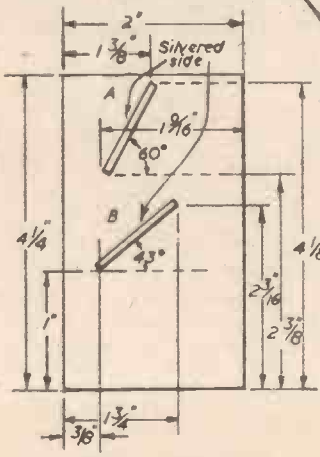


Fig. 2.—Positioning the mirrors.

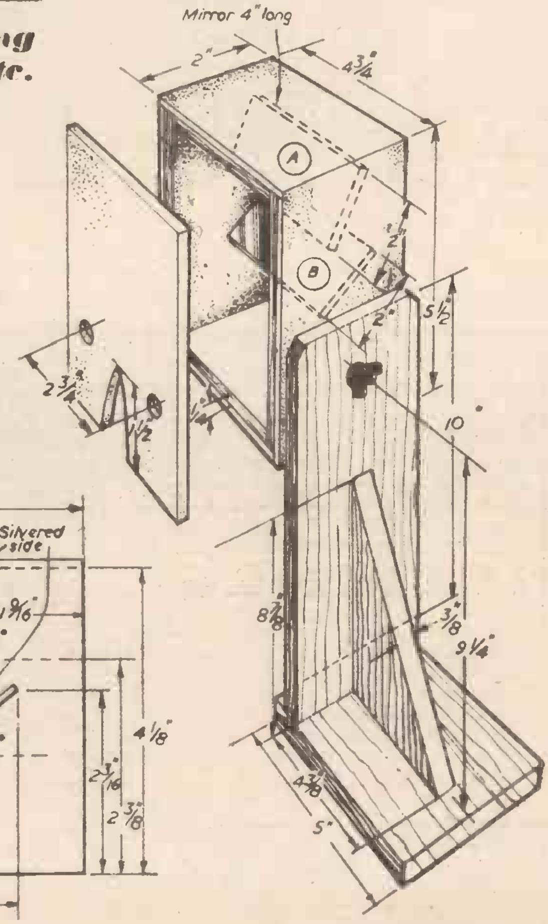


Fig. 3.—General constructional view.

MODELLING A TUDOR SHIP

A Decorative Ornament

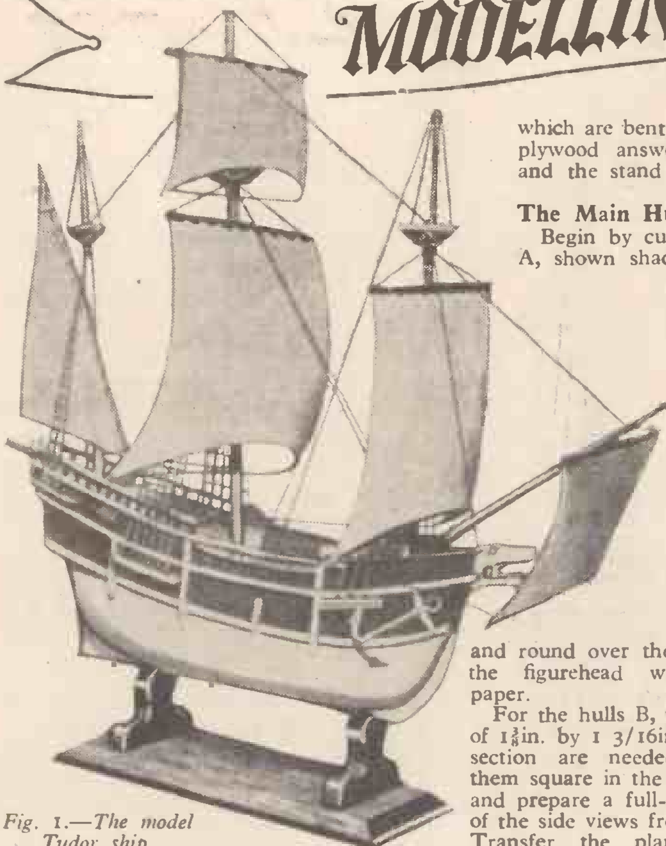


Fig. 1.—The model Tudor ship.

THIS model represents the type of ship that was used for carrying merchandise during the time of Henry VIII. It is founded on a drawing made by Holbein in 1532, in which the crew are shown going about their various duties. Amongst them are several soldiers carrying pikes, suggesting that the ship, even when engaged peacefully as a merchantman, would be prepared against attack. In emergency she would be pressed into service as a fighting ship.

As was invariably the case with Tudor ships, that shown in Fig. 1 is brightly finished with gay colours, thus making it a splendid subject for a model because it has such decorative value. The hull is built up, rather in the form of bread and butter, this being simpler than making it in a single piece, and it is just as satisfactory.

Practically any close-grained wood can be used. Satin walnut is quite satisfactory, or a good grade of pine. Common deal has the disadvantage of having hard and soft grain, and this is liable to show in the form of ridges, as shrinkage takes place. Some hardwoods, such as sycamore, are certainly close grained, but they are so hard that the carving out is made difficult. For the keel ⅛in. plywood is used, and for the bulwarks, which are bent around the hull, 1/16in. plywood answers well. Masts, spars and the stand can be of oak.

The Main Hull

Begin by cutting out the keel piece A, shown shaded in Fig. 5. It is in ⅛in. plywood and will eventually be sandwiched between the two hull pieces. Cut out with the fretsaw, and round over the edges of the figurehead with glasspaper.

For the hulls B, two pieces of 1⅜in. by 1 3/16in. finished section are needed. Plane them square in the first place and prepare a full-sized plan of the side views from Fig. 5. Transfer the plan on to opposite sides of each block and the side view to the inner surface only. Take care that the bows of both tracings are always at the same end and are level. Note that the two hulls are right- and left-hand.

The plan shaping is done in its entirety first. The fact that the shape has been marked out on two sides enables the correct line to be maintained at both edges. Much of the waste can be sawn away. This is followed by vertical paring with the chisel and the entire curve is finished off either with the spokeshave or wood file.

Now follows the elevation shaping. Put the hull in the vice and cut across with the chisel, keeping the latter square, and complete the whole curve. This will produce a shape which is correct in both plan and elevation, but the outer corner needs to be taken off to give the true shape when viewed from the front. The left-hand piece in Fig. 2 is shown at this squared up stage and that on the right shows the rounded shape partly produced and being tested with a template.

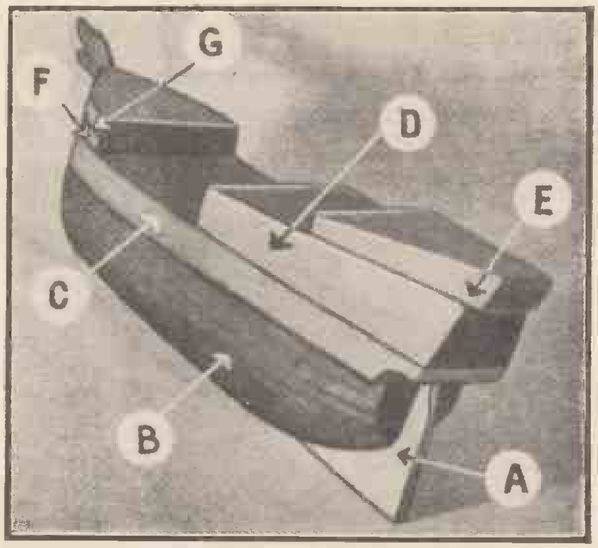


Fig. 4.—The superstructures glued to the hull.

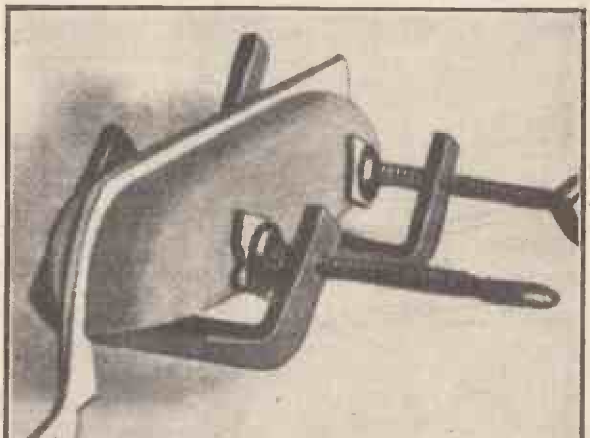


Fig. 3 (Left).—How the hull is glued to the keel.

Fig. 2 (Left).—Testing the shape of the hull with a template.

This template is the reverse of the correct section amidships, and the line can be traced from the stern view. Form this centre shape first. The chisel can be used to remove the majority of the waste, the hull being held in the vice during the operation. Test frequently with the template, remembering that wood can always be removed easily but cannot be replaced if too much is taken off.

Finishing the Hull

The shape towards bow and stern can continue in a gentle curve without bumps. View the hull from all directions and take off a shaving where required. The wood file can follow. This should be worked with a sliding movement both along and across the shape so that all chisel marks are taken out. A thorough glasspapering follows. The portion immediately adjoining the keel must be finished off true, because after gluing up, it would be extremely difficulty to touch this portion. Towards the deck it is not so important because a further smoothing down has to follow after the bulwarks are added.

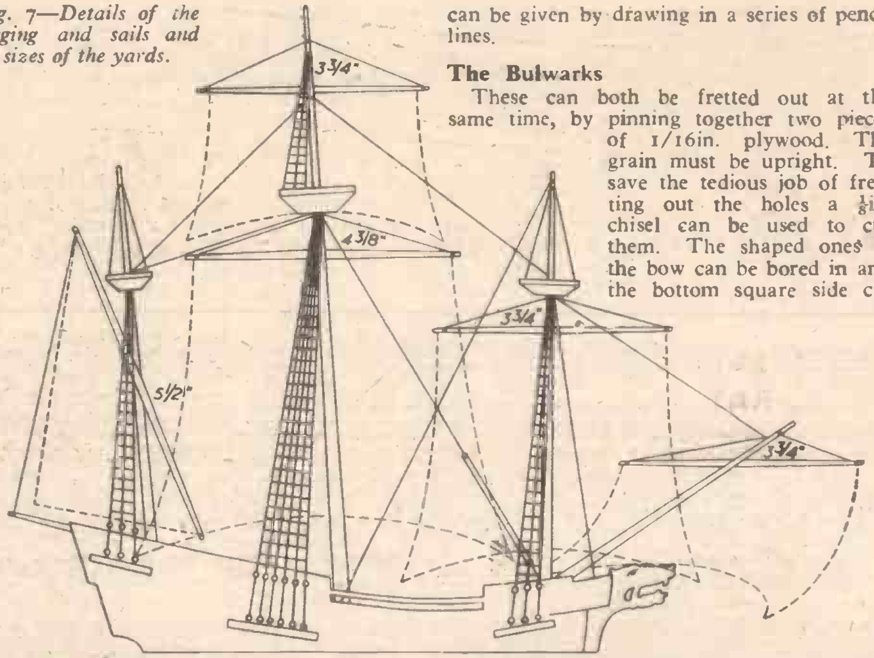
It is now ready for gluing up. One or two nails can be driven through the keel into one hull piece, but this is not possible in the other. Instead, a nail can be driven in at an angle through the thin part of the hull. These nails serve to hold the parts in position so that thrumbscrews can be put on as in Fig. 3. Note the little blocks of wood under the cramps to prevent damage to the surface.

The Superstructures

Begin with deck C, one-half of which is given in Fig. 5. Fold a piece of tracing paper and trace the shape, keeping the fold on the centre line. The opposite half of the shape is then traced directly from this. Transfer on to the wood (⅛in.) and cut out. It will be found that it stands in at the bow and right round until near the stern, where it projects. This is shown by the dotted line in plan shape of the hull. This standing in forms a rebate in which the bulwarks can be fitted. The bulwarks project at the stern. On the underside of the deck a hollowed out shape is cut at the stern so that it fits over the projecting rudder portion of the keel. The side shaping (see dotted line), is not cut until later. Fig. 5 shows the deck in position.

The various other superstructures are now cut out and glued on as also shown in Fig. 5. Certain of these have to be tapped in section (see side view in full size design)

Fig. 7—Details of the rigging and sails and sizes of the yards.



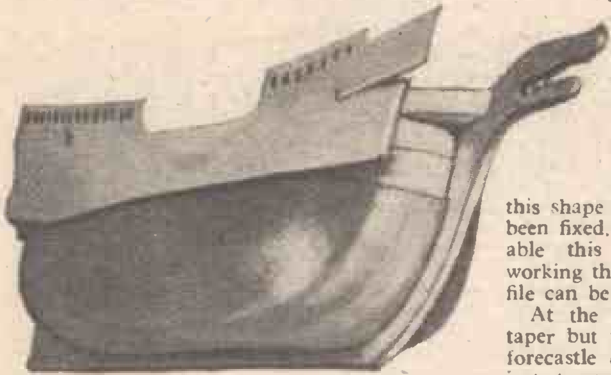


Fig. 6.—Fitting the bulwarks.

and both the quarter deck and poop are taken off at an angle at the rear. If the stern view is examined it will be seen that both quarter deck and poop taper inwards towards the top (tumble home) as it is called, and this shape is best worked after they have been fixed. If a bull nose plane is available this will prove very handy in working the shape. Alternatively, a wood file can be used.

At the bows, the forecastle does not taper but rises vertically. Note that the forecastle deck is pointed and thus projects towards the beak. Before proceeding further an imitation of the deck planking can be given by drawing in a series of pencil lines.

The Bulwarks

These can both be fretted out at the same time, by pinning together two pieces of 1/16in. plywood. The grain must be upright. To save the tedious job of fretting out the holes a ⅛in. chisel can be used to cut them. The shaped ones at the bow can be bored in and the bottom square side cut with the chisel. If this method is adopted, the holes must be cut before the main outline is fretted otherwise the grain may split away.

Fig. 6 shows the fixing. The cut at the bow enables the top part to bend along the forecastle deck, whilst the lower part can fit to the hull. Glue is used and a few fine nails which are afterwards punched in, will hold down the plywood whilst it sets. Afterwards the poop back can be added.

It is inevitable that a certain amount of unevenness will occur at the joint and this can now be smoothed down. Where the bulwarks slope toward the stern, the deck C can be cut away so that it is level with the hull. This is shown in the stern view, and half plan of the deck.

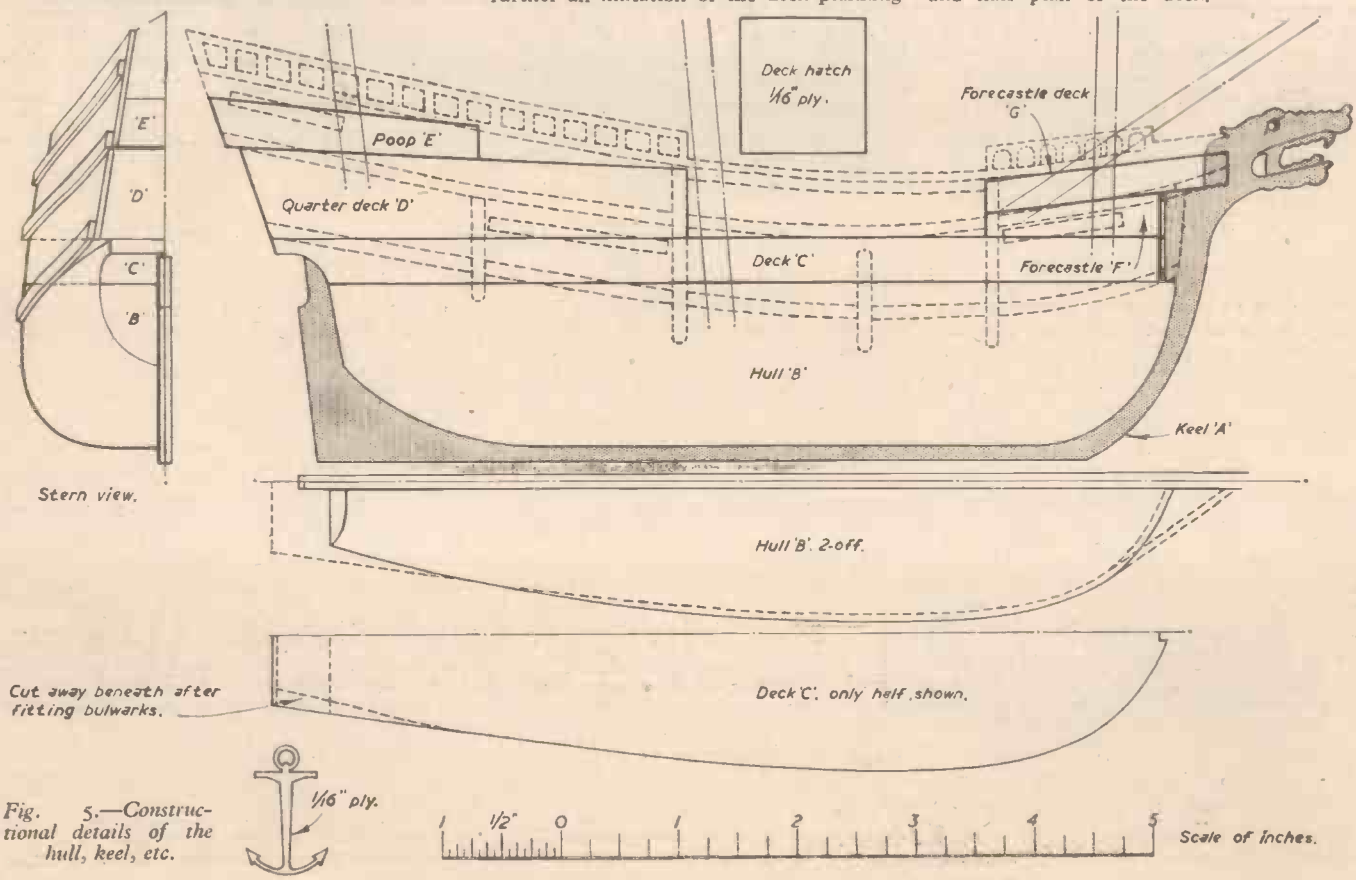


Fig. 5.—Constructional details of the hull, keel, etc.

Wales and Channels

For the wales cut six pieces to the shape shown in Fig. 8, and fit them in the positions indicated by the dotted lines in the side view. The exact length can be measured from the actual hull and they will bend easily one way or the other. The top wale is a trifle narrower than the others. Upright wales are also fixed in the position shown, these again being in 1/16in. plywood. They can be bent right over the horizontal wales and be fixed with glue and nails. The channels are also shown in Fig. 8 and fine holes are drilled through these to take the shrouds and at the end, rather large holes are made through the width to take the fixing screws (see dotted lines). The channels with curved edges are fixed at the bow end.

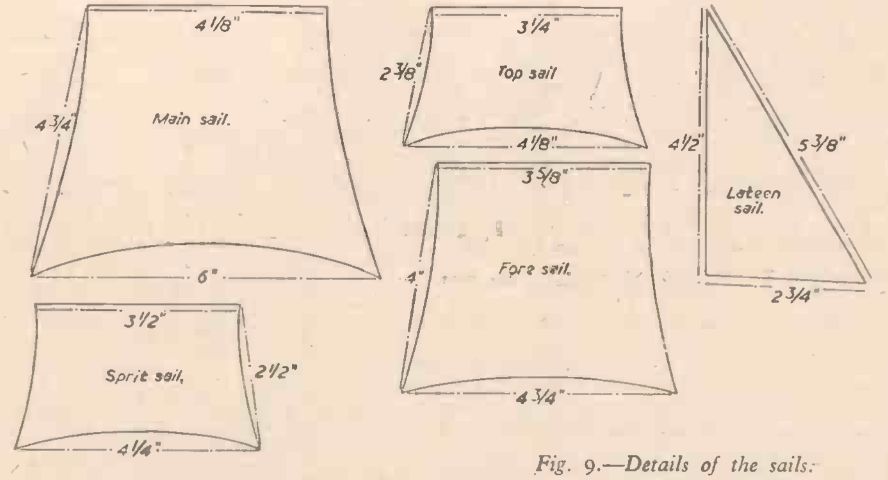


Fig. 9.—Details of the sails.

Masts and Yards

These are cut in oak. Plane the wood square, take off the corners to form an octagonal shape and then round over. Afterwards, taper the ends where required. The foremast rises 7in. above the deck, the mainmast 9¾in., the mizzenmast 6½in. and the bowsprit 4¼in. An extra length of about ¾in. is needed in each for recessing into the deck. Bore holes to take them, sloping the brace to give the required tilt to the masts, but do not glue till later. Sizes of the yards are given in Fig. 7. These can be fixed either with a fine pin driven into the masts or they can be bound on with fine thread. The crows' nests are fretted out, and the underside bevelled away. The centre holes are drilled before fretting out, their size being made to fit the masts.

Painting

Poster or showcard colours are excellent for the purpose as they are opaque and cover well. Two coats are advisable. The lower hull is white or cream and the bulwarks a mid brown, wales are picked out in yellow, and red and green are used to colour the hand-railing, break detail and crows' nest. When dry (this is important), the whole is given a coat of clear cellulose lacquer.

Rigging and Sails

Begin with the main shrouds. Dealing with the mainmast, cut off 12 pieces of carpet thread (brown shade No. 50), each long enough to stretch from beneath the crows' nests to well below the channels and lay the shrouds six to each side. When set, a piece of fine thread can be wound tightly round. Glue in the mast and, threading two small glass beads on each shroud to form the dead eyes, pass the shrouds through their holes in the channels. Now fix the main stay from under the crows' nest to the base of the bowsprit, draw the shrouds taut and tie them in pairs under the channels. A touch of glue on each knot prevents them from becoming undone. To hold the dead eyes in position, put a small dab of glue on each shroud, and raise the dead eyes to the required position.

Fig. 7 shows the remaining rigging and sail positions. The sails can be cut in lampshade vellum, to the sizes given in Fig. 9. The edges to be attached to the masts can be scolloped out with a gouge or scissors as in Fig. 9. Fine thread laced through the ends will hold them to the yards and dabs of glue along the edge will hold them in the centre. The free ends are taped to the bulwarks.

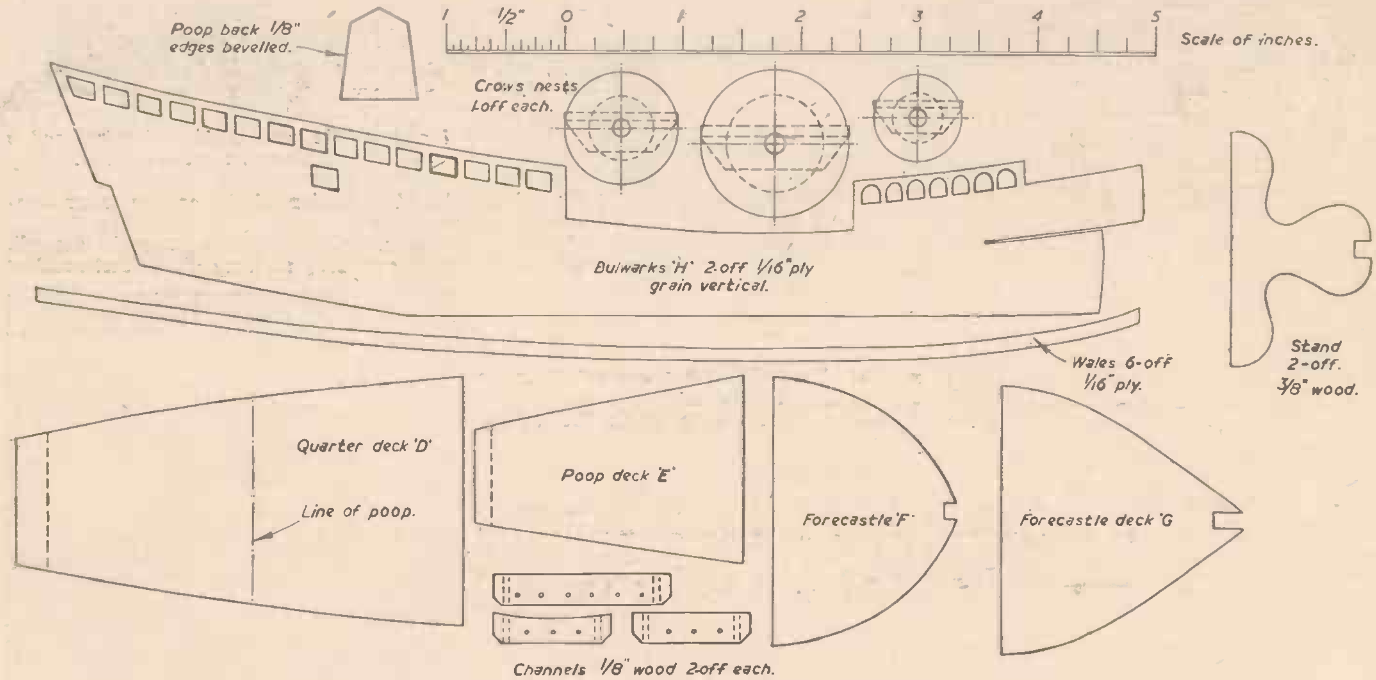


Fig. 8.—Constructional details of the bulwarks, superstructures, etc.

Make Your Own Thermometers

Part 3.—Descriptions of Various Types Including Wet and Dry Bulb and Bimetal Thermometers

By E. V. KING

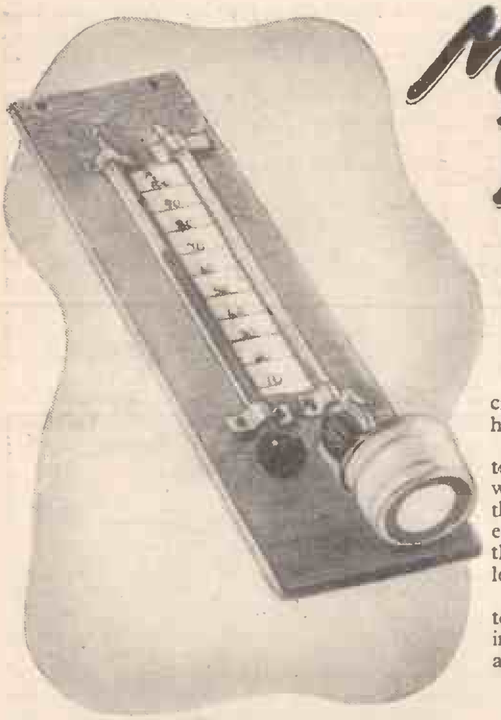


Fig. 22.—A prototype wet and dry bulb thermometer.

This Article Concludes the Series by Describing a Number of Special Purpose Instruments

A WHITE paint backing on part of the tube will show up the liquid in the dark room. With a red light a green fluid shows up well and *vice versa*. Carbon paper (Banda) solution shows up quite well in either light.

A convenient stand which can actually hold the thermometer in a dish of solution is shown at A in Fig. 23. It is made by cutting off the bottom half of a medicine bottle. To cut the bottle wrap it once with 1ft. of 22g. Eureka or Constantin resistance wire, do not cut excess wire. Twist on flex leads to the ends and wire to a 6-volt car battery or heavy duty transformer (use 2ft. of wire on 12 volts). Hold the wire taut with pliers. It will get red hot. After 45 seconds remove the wire and immediately plunge the bottle into cold water. It will crack round the mark where the glass was heated by the wire (Fig. 23C).

Another method of cutting the bottle is to place it in cold water up to the mark where it is required to cut it off. Fill it to the same mark with about 30 grade motor engine oil. Now plunge a red hot poker into the oil. The glass will snap along the liquid level (D, Fig. 23).

Use a cork with a hole burnt through it to fix the thermometer in the manner shown in Fig. 23A; note the nick necessary to allow air to pass.

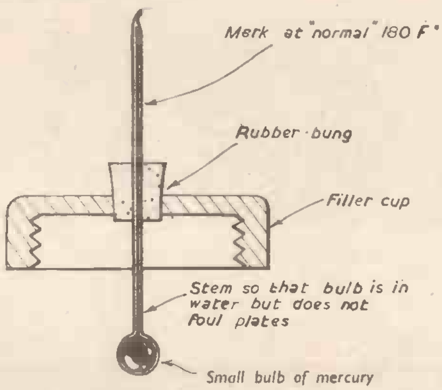


Fig. 24.—Motor vehicle thermometer.

Sick Room Thermometer

The best temperature for a sick room is recognised as between 60° and 65°F. Make an ordinary thermometer and make some special marks to show where the correct range lies.

Motor Vehicle Thermometers

It is not possible for the amateur to make the capillary type themometers used for dash board indication of the cooling water temperature.

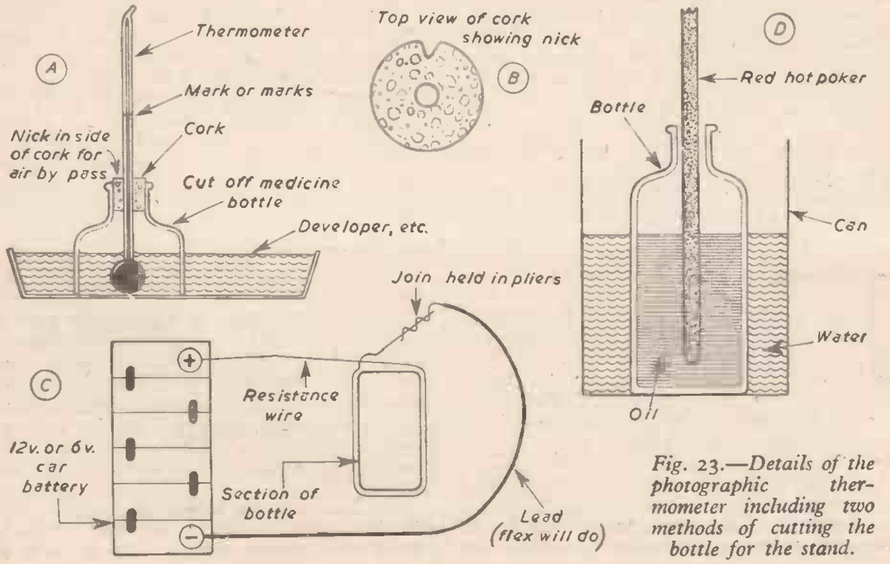


Fig. 23.—Details of the photographic thermometer including two methods of cutting the bottle for the stand.

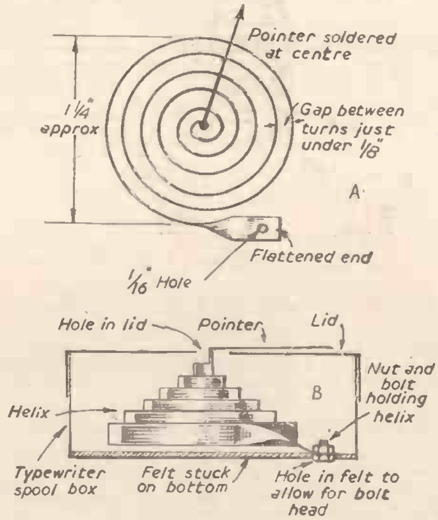


Fig. 25.—The six-turn bimetal spiral and a section through the thermometer.

It is, however, possible to make a small, non sensitive, mercury filled thermometer which may be mounted in the filler cap of older type vehicles by fitting a rubber bung into a hole drilled in the cap (see Fig. 24). The author had one of these fitted to a 1932 model Austin Seven for many years.

Fig. 26.—The prototype desk thermometer.

The proper temperature for a motor engine (water cooled) is 180°F. and if no anti-freeze is used then a watch must be kept for freezing point at 32°. In order to get freezing and boiling point within a few inches the bulb of the thermometer will have to be quite small.

Jam-making Thermometers

The thermometer must be calibrated to

cover the range 100 to about 350°F. It must be filled with mercury and have a good strong bulb. It is best mounted on aluminium or brass (stainless steel is good but hard to work). Scribe the scale on to the metal. It can be used for sweet-making also.

Very Sensitive Thermometers

These are best filled with mercury which expands equally for equal increments of temperature. They should have large bulbs and fine bore tubing. They usually have to be very long. One the author has read of was over 50ft. in length; this, of course,

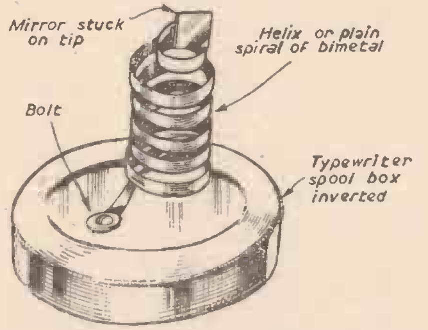


Fig. 28.—Bimetal assembly for the heat ray detector.

would not only be sensitive but would cover a large range as well.

Wet and Dry Bulb Thermometers

These are easily constructed and will give an indication of the humidity of the atmosphere. The housewife could for instance tell if the day is a good drying one or otherwise for the washing. The greenhouse owner can tell if his house is "dry" or "wet." The meteorologist has other uses for this type of thermometer. Fig. 22 shows a prototype. Two thermometers are made with the same size bulbs. The best method is to make up half a dozen bulbs and pick out the two which give the nearest identical liquid rise for a certain increase in temperature. The thermometers are mounted side by side and would normally give the same readings.

One is covered in flannel (old flannel trousers are ideal) or lamp wick which dips into a small container for water. A tomato ketchup top forms a good container. It may be attached by a band of metal or by drilling a hole for a panel pin near the top.

The bulb with the damp cloth on it is cooled as heat is extracted in order to turn the water to vapour as the cloth dries. The drier the air the more evaporation takes place and the more the temperature drops. When the readings are wide apart the air is dry, when they are the same it is wet (i.e., in misty or foggy weather). Readers requiring more information should consult any standard text-book on heat, looking up "dew point" and "hygrometry."

Fig. 27.—A selection of the parts required for the desk thermometer.

Bimetal Type Thermometers

These are easily made by the amateur. The bimetal is obtainable from Technical Services Ltd. and is very cheap. When heated it bends, due to unequal expansion of the metal (probably Invar and brass).

A neat and convenient desk type thermometer may be made in a typewriter ribbon container; the plastic type looks best, but a metal one could be used. Details are given in Figs. 25, 26 and 27.

Making the Desk Thermometer

Take between 10in. and 12in. of bimetal

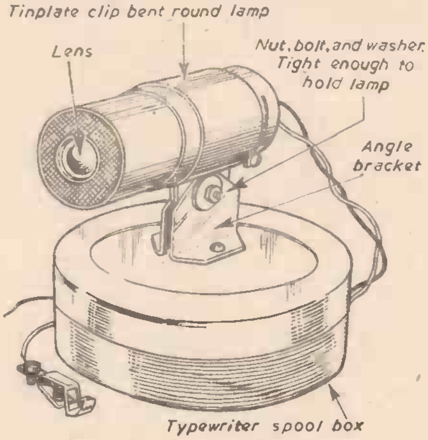


Fig. 29.—Details of the lamp.

and carefully coil it, using round-pointed pliers, until it takes the form of a clock spring. The internal diameter should be ¼in. and the external about 1¼in. Thus there is about ⅛in. gap between all the six turns (Fig. 25A).

The last ½in. of the outer end is now twisted so that it will rest flat on the table, and a small hole is drilled through it for fixing purposes. The other inside end of the bimetal is now gently pulled out until the spiral extends to a height of just 1/16in. less than the tin being used. On the author's model the height of the helix was exactly ¾in. (see Fig. 25B).

Tin the inside end of the helix with solder, using Baker's fluid and washing it off afterwards. Now solder on a short length of black iron florist's wire to extend upwards for ¼in. and then bend it horizontally at right angles. Now hold the helix to the table by pressing the thumb on the flattened end. Play a small flame near the helix, the pointer should very vigorously move round. Make the helix with the expanding metal (brass) on the outside. You can soon tell by heating a small piece first. Then, on heating, the

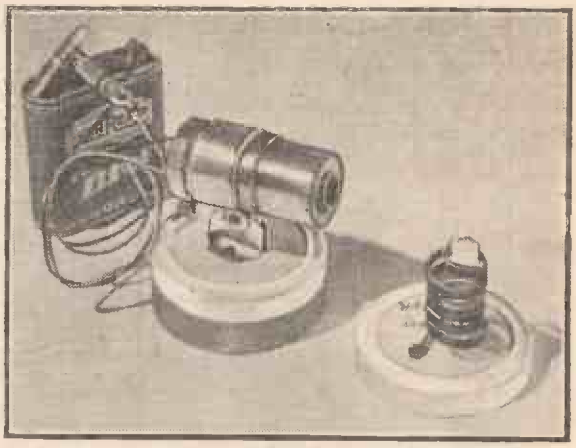


Fig. 30.—Heat ray detector complete (less screen).

coil tends to tighten up and on cooling to unwind.

A ¼in. hole is now drilled in the lid. This fits over the pointer, when the helix is bolted to the bottom tin by a nut and bolt through the flat end of the bimetal. A little nail varnish on the nut and bolt will stop them shaking loose.

The scale is now either stuck on the tin or written directly on the plastic type with India ink. Roughen the surface if the ink will not "grip." It is scaled by comparison with another thermometer or it can be done in water as before. Make sure you dry it quickly afterwards.

It may be used in any position and prototypes are working both horizontally and at an angle of 45°. This type may be adapted to read oven temperatures in the kitchen or workshop.

An Infra-red Ray Detector or Heat Ray Detector

The above method of measuring heat may be put to use in detecting electro-magnetic heat rays (which are not heat, but which heat objects up when they come upon them). A helix is made as above and it is mounted on an inverted typewriter spool tin (see Fig. 28).

The helix need not converge to a point this time as it does not have to be cramped into a tin. A cellulose cement or nail varnish is used to fix a small piece of mirror about ½in. square to the top portion (in lieu of the pointer). The mirror may be broken from a small thin hand-bag mirror and its shape is not important. The author found the mirror from the view-finder of an old camera suitable. The mirror from an old galvanometer would suit even better.

A lamp is now made up to project parallel rays of light from a flash lamp-bulb on to the mirror and then by reflection on to a white paper screen (see Figs. 29 and 30.)

The Lamp Housing

A miniature type Edison screw lampholder is purchased from a well-known department store for 7d. This is fitted to the bottom of a tube of metal or cardboard, either with screws or glue. Another tube is made or found which will slide easily into the other. In this one is mounted a small lens. Any magnifying, projection or viewfinder lens will do. The author used one from the viewfinder of an old quarter plate camera.

The best way to attach the lens to the tube is to cut a disc of hardboard with a fret-saw to fit the tube. A hole is then cut in this to fit the lens. It may be cemented if necessary.

The length of tube required is important. Make a rough calculation of the length as follows. Wire up the lamp to a 4½-volt battery and hold the lens in front of the lamp so as to project a line (filament) on to a screen placed about two yards in front of the lens. Note the distance between the lens and the lamp (Fig. 31).

This distance should be that aimed at when the two tubes are fitted together.

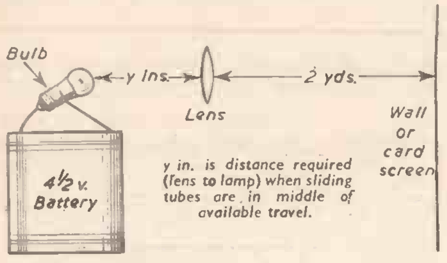


Fig. 31.—Checking position of lamp relative to the lens.

Allow for the tubes to overlap about 1in. for adjustment.

The author used some old vacuum cleaner tubing for the tubes as they are made ready to slide one into the other. Details can be seen in Figs. 29 and 32.

The Lamp House Stand

Any suitable stand will do so long as the lamp may be swivelled in any direction. The lamp can be raised or lowered by putting the stand on small pieces of plywood, it can be swivelled sideways by moving the stand. All the stand must be capable of doing is to hold the lamp rigidly and allow it to alter its angle with regard to the horizontal.

If a typewriter spool box lid is used, as in the prototype, make two small angle brackets and mount them with nuts and bolts at the centre of the lid with about 1/16in. gap between the two vertical plates.

The lampholder clip is cut from tin plate and will be made of such a length that it grips the lampholder firmly when the ends, which are bent at right angles over the last ½in. or so, come together.

These ends fit inside the gap between the

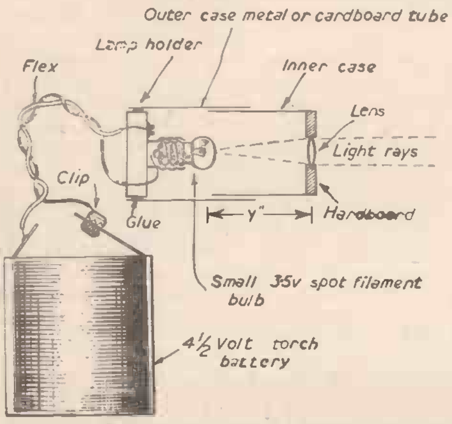


Fig. 32.—Section through the lamp body and connections to battery.

angle brackets, a hole is drilled through the four thicknesses and a bolt fitted with washers passed through. A nut and lock nut are then fitted. The nuts are adjusted so that the lamp can be moved up or down and yet will stay in position as required. Details are given in Fig. 29.

Using the Heat Ray Detector

When this is put in any room the strip soon gets to room temperature and the position of the mirror becomes static.

Now place the lampholder about a foot away from the mirror (see Fig. 33) at an angle of about 45° to it when viewed from on top, and level with the mirror when viewed from the side.

Place a white paper screen (or use the wall) about two yards away on the other side of the spiral (Fig. 33). The reflected ray from the mirror will also come away at 45° and by carefully adjusting both the lamp position and the focusing of the lens you can obtain a spot (or line according to the filament of the lamp) on the screen. If everything is still this spot will be still. The slightest vibration of the table will cause it to move. You have a weightless pointer and a very sensitive "thermometer."

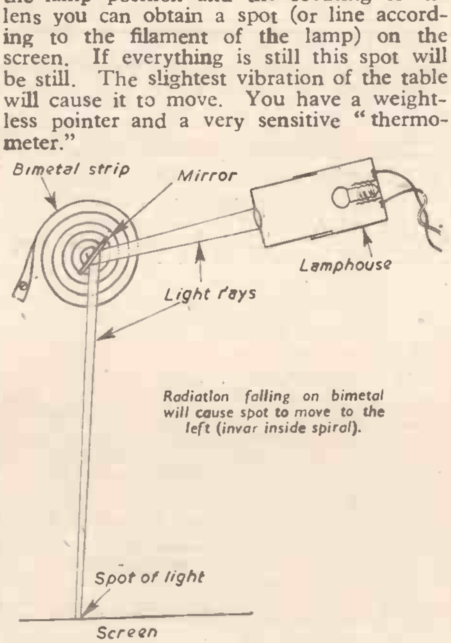


Fig. 33.—Plan of detector ready for use.

Now any heat rays falling on the bimetal will be changed to heat in the metal and thus it will be warmed, the bimetal bends, moves the mirror a tiny bit, this is magnified by the light beam so that it can be seen on the screen.

For experimental work in the first instance use an ordinary electric bowl fire. Hold it two yards from the spiral and rotate it slowly. As the rays are focused on to the spiral the spot will move rapidly across the screen. The author tried with good results a motor car headlamp fitted with a 36-watt lamp focused to a spot. Deflection of the spot was obtained at a distance of 12ft. using a highly polished reflector and fully charged battery. In this last case, of course, light rays as well as heat rays are emitted, both types being turned to thermal agitation (of molecules) on reaching the spiral. However, this would not be sensitive enough to act purely as a light detector.

Apparatus Required

Apparatus required (in addition to that already listed). Bimetal Strip. "Hi-Flex 45," .010in. × 3/16in. × any length. 6d. per foot from Technical Services Ltd., Shrubland Works, Banstead, Surrey. Cocoa-tin or similar tin plate. Various nuts, bolts, flex wire, typewriter spool tins or plastic boxes, Indian ink, gum, varnish, bottles, corks, tubes, solder, etc. 1ft. or 2ft. 22 gauge resistance wire (Post Radio Supplies) or a piece of electric fire element. Ice, from nature or refrigerator, butcher or fishmonger. 3.5v. flash-lamp bulb and holder. Crocodile clips. 4½-v. torch battery.

TABLE OF FIXED THERMOMETER POINTS

Melting point of Glauber Salts, Sodium Sulphate	=	32.38° C.
Boiling point of Sulphur ...	=	444.5° C.
Melting point of Mercury ...	=	—39° C.
Alcohol boiling point	=	78° C.
Boiling point of Mercury ...	=	357° C.
Beeswax melting point	=	63° C.
Ice melting point	=	0° C.
Alcohol melting point	=	—118° C.
No movement, no heat, everything solid. Absolute Zero... ...	=	—273° C.

BOOKS Received

Other Worlds in Space. By Terry Maloney. 128 pages. 12s. 6d. net. Published by John Calder (Publishers) Ltd.

WHILE being broadly classified under the heading of "Space Travel," this book deals with the subject chiefly from the point of view of the astronomer and what information he will be able to pass on to the prospective space explorer. Descriptions of all the planets are given, together with the methods used to obtain this information.

The numerous illustrations, both in colour and black and white, are drawn by the author, showing the planets with startling realism. An appendix explains the meaning of the various technical terms used.

"Engines for Small Power Craft," by P. N. Barnard. 215 pages. 100 illustrations. Price 16s. net. Published by George Newnes Limited.

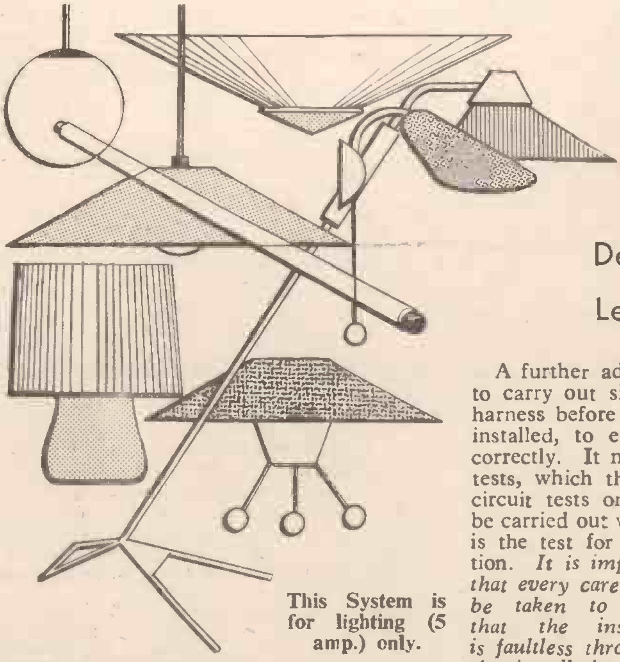
THIS is a book intended to cater for the rapidly increasing interest in small boats and whether interest is primarily centred on sailing or motorboating, it is bound to be concerned to a certain extent on the marine engine. This volume summarises the characteristics of all the main types of engine and the applications for which they are best suited. The first chapters deal with three main types of engine, i.e. diesel; petrol, paraffin and vaporising oil engines; and outboard motors. Other chapters deal respectively with engine installation and operation and maintenance of diesel and petrol engines. Summaries of the Thames Launch Byelaws, the Recommendations of the Ship and Boat Builders' National Federation and the Motor Lifeboat Regulations are given at the end of the book.

"Making Pottery and Glassware in Britain." 81 pages. Over 100 illustrations. 6s. 6d. net. Published by Scott Greenwood & Son, Ltd.

THE contents of this book were originally intended for sales-people concerned with pottery and glassware, but they will undoubtedly interest every amateur potter and everyone who likes to read how things are made. All the methods of making and decorating pottery and glassware are simply explained and illustrated.

"Learning Metalwork with Aluminium," by J. C. Older. 183 pages. 128 illustrations. Price 12s. 6d. Published by Temple Press Ltd., Bowling Green Lane, London, E.C.2.

BECAUSE of its ease of working and its pleasing appearance, aluminium is an ideal metal for the beginner in metalwork. The author of this book is a well-known teacher of this subject and he has provided a number of excellent examples of how this metal may be worked up into a number of attractive articles. This book will appeal to all amateurs and all technical schools for its authoritativeness. The information is backed by the Aluminium Development Association. The chapters include: Sheet-metal work; Scroll Work; Piercing; Decorative Punch Work; Repoussé; Beaten Work; Spinning; Etching; Fabricated Work; Moulding and Casting; Turning (Parts I and II); Anodising and Dyeing; Welding and Flame Brazing. Technical Data and List of Suppliers are also included.



How to Wire Your House for Electric Light

Details of a Prefabricated Wiring System Costing Less Than £10

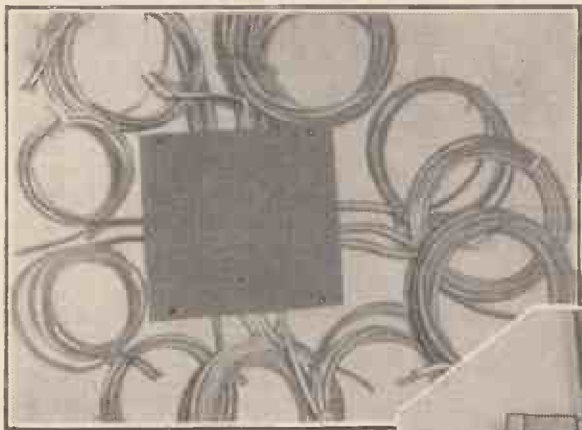
By JAMES VOSE

This System is for lighting (5 amp.) only.

THE installation of electric light wiring, using rubber or P.V.C. covered cable, is a comparatively simple project, well within the scope of the handyman. The main difficulty is the time it takes to do it. Conventional wiring, carried out in spare time, might take weeks to complete, and the domestic upheaval, caused by lifted floor coverings and loose floorboards for this period cannot be lightly dismissed.

The prefabricated system to be described has been specially devised to enable a great deal of work to be carried out before any actual installation work is commenced. Then, after any necessary floorboards have been lifted, the wiring, completely assembled, jointed and tested, can be threaded into place in a few hours.

One of the features of this system of wiring is its extreme simplicity. A novice could carry out the work without undue difficulty. It would be advisable, however, under these circumstances, to have the work checked over by some person with a knowledge of electrical circuits to guard against the possibility of a mistake occurring. But a mistake is very unlikely because all circuit connections are made in the junction boxes before the installation work is commenced. This very important part of the work can be carried out in comfort, in full light, on the work bench or the kitchen table.



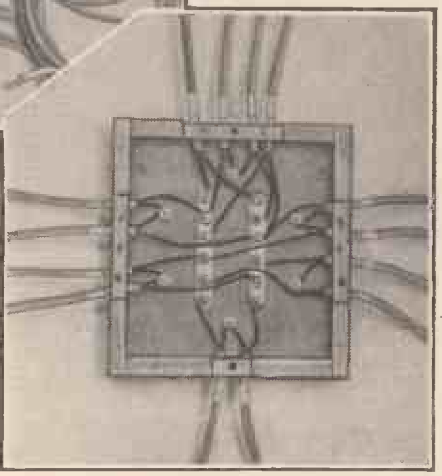


Fig. 1.—One of the junction boxes with the cables connected ready for installation. Fig. 2. (Right)—The internal wiring of junction box for upstairs. Plan in Fig. 4.

A further advantage is that it is possible to carry out simple tests of the completed harness before any of the wiring is actually installed, to ensure that everything works correctly. It must be understood that these tests, which the reader can carry out, are circuit tests only. One test which cannot be carried out without expensive instruments is the test for insulation. *It is imperative that every care should be taken to ensure that the insulation is faultless throughout the installation.* The Electricity Authority will, before connecting up, test the installation and, if the insulation is found to be below standard, will refuse to connect to their mains. It is appropriate to mention here that the Electricity Authority cannot refuse to supply current merely on the grounds that the installation has not been carried out by a qualified electrician. Provided the insulation passes the prescribed tests, the authority is bound, by statute, to provide a supply of current when requested to do so.

Description of the System

A study of the photographs Figs. 1 and 2, and the diagram Fig. 3, will show that the main feature of the system consists of a central junction box, specially built for the job, one to each floor of the building. In the case of a single storey bungalow, one box only is required, to be located in the roof space, although for an extensive installation it would be preferable to use two boxes, and to split the wiring into two circuits, thus avoiding congestion of wiring in each box.

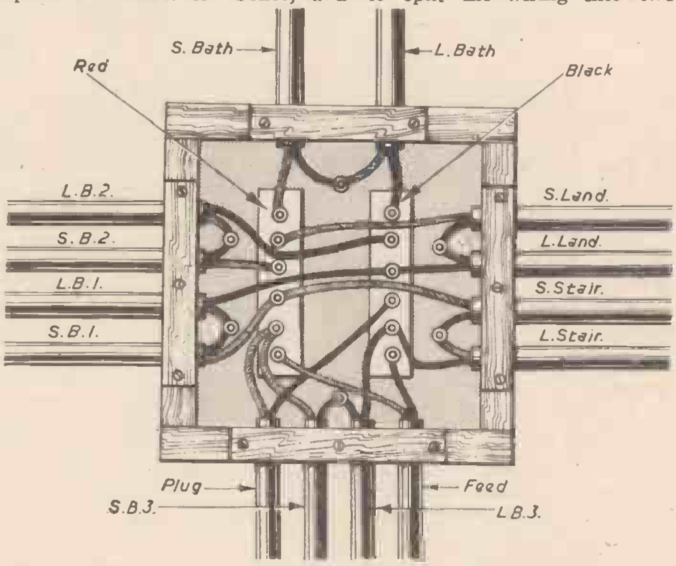


Fig. 3.—Internal wiring of junction box. Black wires are shown black and red wires shaded.

To these boxes the various cables, cut to predetermined lengths, are connected according to requirements, the circuit connections made by simply looping the wires under the terminals provided inside the boxes, and the cable ends anchored by screwing down thin wood strips over them. Each cable is labelled, both at the anchored end and the free end, with a simple code for identification purposes. For instance, S.B.2 means the cable running to the switch in bedroom No. 2. L.Bath means the cable to the bathroom light, and so on. As it may be necessary to refer to these labels in the future, in the event of modifications or additions to the installation, it is a good plan to write the labels with Indian ink on white paper, and to bind them in position with transparent adhesive tape.

Each cable is coiled up separately and tied with string. A typical box, with all the cables connected and coiled is shown in Fig. 1. After testing, the cables are piled up over the lid of the box, on top of each other, and tied with two crossed loops of string, so as to enable the complete assembly to be carried up into the roof space and placed in the position as determined. All that now requires to be done is for the various cables to be threaded through to their respective positions, the lampholders and switches connected to them, the main feed cable connected to the fuse box, and the installation is complete.

Preliminary Work

The best way to commence the work is to prepare accurate scale plans of each floor of the house. These plans need not be elaborate—pencil drawings on the back of spare pieces of wallpaper are quite sufficient—but it is essential that sizes of rooms, thicknesses of walls and positions and hangings of doors are correctly indicated. Plenty of time should be taken over this plotting, as it is much easier to make corrections on paper than it is to alter wiring because a mistake has been made through lack of foresight. If these plans are made to a large scale—one inch to one foot is very suitable—the cable lengths can be measured from the plans, thus saving the trouble of going all over the house measuring up each cable with a rule.

Typical plans are shown in Figs. 4 and 5, and it will be noted that, as the wiring for the bedrooms is above the ceilings, the various cables can run directly to their respective points, but the wiring for the ground floor rooms must be run in straight lines, either under a floorboard, or between the joists. A little forethought will show that it is often possible to run several of the cables, for some part of their length at any rate, under the same floorboard, thus minimising the work of taking up the boards. This is well worth while, even if it means, in some cases, using a little more cable than would otherwise be necessary.

The positions for the junction boxes should be chosen with some care, and marked on the plans. The box in the ceiling, serving the bedrooms, should be fairly central, and preferably near to the access manhole. The box serving the ground floor rooms should be placed in such a position that the various cables can be run out from it in straight lines, as far as is possible. Fig. 5 shows the idea. It should be possible also to gain access to this box, if and when necessary, without having to move furniture about. A landing is usually the most suitable position.

A suitable position for the meter and fuse box must now be chosen. This should really be done in consultation with the supply authority, as they like to fix their meter at the nearest point to their underground cable. This point may be in the hall, as shown on the typical plans illustrating this article, or it may be in the front room. Wherever it is fixed, the meter, together with the main switch and fuse box, can be covered in at completion with a neat cupboard.

The positions of every lighting point and every switch point should now be marked on the plans. Coloured crayon is useful for marking all the electrical work, as this avoids confusion with the plan lines. A single line, to represent the cable, which is, of course, really twin cable, must be drawn from every lighting point to the junction box, and from every switch to the junction box. Another line must be drawn to represent the feed cable from the meter point to the junction box. It is necessary to make a survey of the attic space over the bedroom ceilings to see if there are any walls or chimneys or other obstructions, and if so the lines must be drawn to avoid them. Cables can, if necessary, be passed through holes drilled through partition walls, but they must not, on any account, be passed through chimneys or flues.

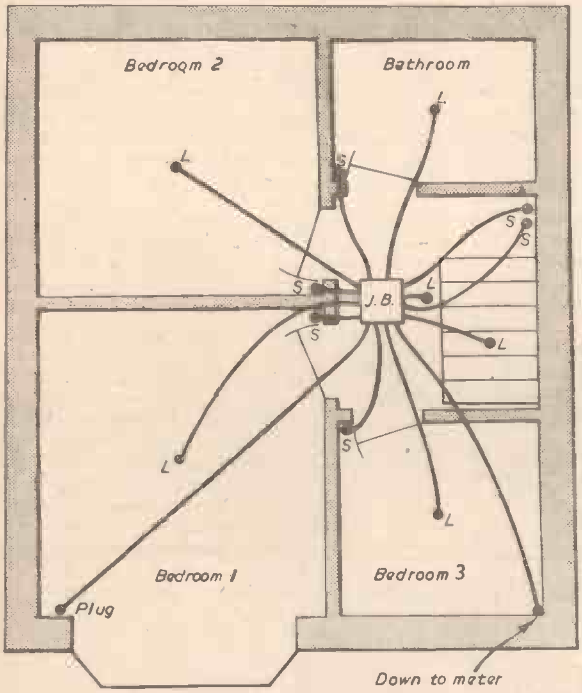


Fig. 4. (Left)—Plan of bedrooms showing cables above ceiling.

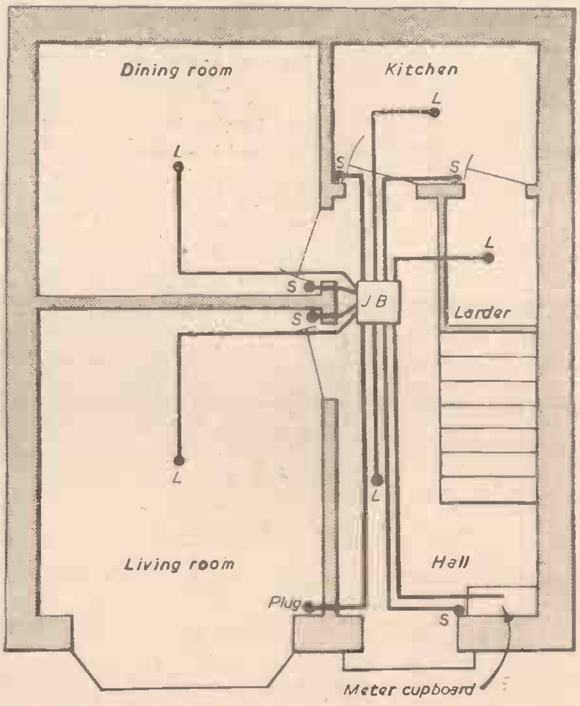


Fig. 5. (Right)—Plan of ground floor rooms showing cables under bedroom floors.

The Junction Boxes

The junction boxes have to be "tailor made" to suit each individual installation. The general construction is shown in Fig. 6. One box is needed for each floor, and a suitable size is 7in. square inside × 2½in. deep. The four sides, of 2½in. × ¾in. should be of teak or other fire-resisting hardwood. The bottom, of asbestos cement, can be screwed or nailed in position, and a similar piece of asbestos provided for the lid, to be screwed down at completion of the work. Strips of 1in. × ½in. hardwood tacked to the sides of the box form a ledge to support the terminal panel. The sides of the box may be lined with asbestos millboard, if desired. This must be done if softwood is used in the construction, to make it fire resisting. This is only to comply with regulations. The actual danger from fire is extremely remote.

The terminal panel, 7in. square and ⅛in. or so, thick, should be of ebonite or bakelite, or other good insulating material. A suitable panel can possibly be purchased cheaply from a war surplus stores.

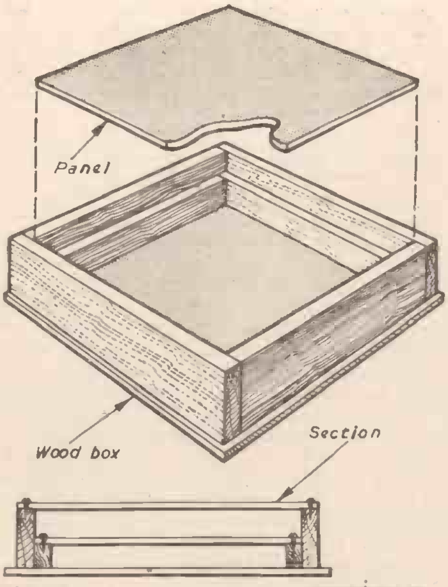
For the purpose of connecting the various wires, the panel must be provided with two busbars and, in addition, a number of separate terminals, one for each lighting point to be served from the box. It is a good plan to allow for one or two extra terminals so that any future extensions can be dealt with without a lot of trouble. The box shown in Fig. 3 has six terminals spaced conveniently around the panel to suit the wiring of the typical bedroom plan, Fig. 4, but the terminals should be arranged to suit the particular house being wired. It is convenient, however, to place the single terminals between the switch and light cables, as shown, as this enables the internal wiring of the box to be kept tidy and free from unnecessary crossovers.

The busbars are thin strips of copper or brass, and the terminals securing them, as well as the individual terminals, may be brass bolts with two nuts to each; ¾in. long brass bolts, No. 4 B.A., are suitable Washers under the nuts are advisable to enable a secure fixing to be made to the cable ends. To enable the cables to enter the box, slots cut in the sides, ½in. deep, in appropriate positions as determined by the cable runs on the plan. When the cables are in position, thin strips of hardwood are screwed down over them to anchor them in the slots. The screws must be clear of the cables, and only tightened sufficiently to grip the cables without deforming them.

Wiring up the Harness

The cable recommended to be used with this system of wiring is size 3/029 twin flat. It may be either tough rubber-covered, known as C.T.S. (cab tyre sheathed) or P.V.C. covered. One hundred yards of this cable should be sufficient for the average house. In addition, a quantity of heavier cable is required for the feed cables from the meter position to the junction boxes. The amount of this cable required depends on the distance from the meter to the two or more junction boxes. This can be measured up from the plans, and the exact amount ordered. The size of this cable is 7/029.

Having obtained the necessary materials, a start can be made on wiring up the harness. The required number of lengths of the cable are cut off from the roll ready for connecting to the junction box. The lengths are determined by measuring up from the plan, and adding an extra foot or so for slack and for connecting purposes. Extra length must be allowed on the switch cables to allow for the drop from the ceiling to the switch point on the wall. Normal switch height is 4ft. 6in. from the *floor*. As each



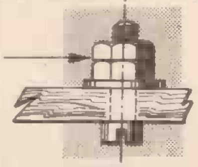


Fig. 6.—Construction of one of the specially made junction boxes.

length is cut off it should be labelled immediately at each end, coiled up again and tied with string, leaving about 12in. of free end for connecting purposes. Care must be taken to avoid kinks when unrolling and re-coiling the cable.

The wiring inside the box (Figs. 2 and 3) may appear to be complicated at first sight, but in fact, if the job is done methodically, the task is quite simple. The two metal strip busbars must first be identified by writing the word "RED" alongside one of them, and the word "BLACK" alongside the other one. It is immaterial which is red and which is black. These busbars are fed from the 7/029 feed cable, which must have its red and black wires connected to the red and black busbars respectively. The other wires are connected as follows. Every *light* cable must have its black wire connected to the black busbar. Every *switch* cable must have its red wire connected to the red busbar. The red wire from the light cable and the black wire from the appro-prite switch cable controlling that light, must be connected together at one of the single terminals.

In the case of a point which is not controlled by a switch, such as the one at the lower left-hand of the box (Fig. 3), the red and black wires are connected directly to the red and black busbars. Note that any number of connections can be made to a busbar terminal, but the single terminals spaced around the panel can only be used for connecting pairs of wires. Two-way switching, used for controlling a light from two positions, such as at the top and the bottom of the stairs, can be accommodated in this system, but to prevent any confusion this will be described separately later.

The wiring being completed, the cable ends can now be anchored by lightly screwing down the thin hardwood strip over them. A turn or two of electrician's insulating tape round the cable ends before screwing down the strips helps to make the anchorage more secure without excessive tightening.

Testing the Harness

The wiring of the box is so simple that it is very unlikely that a mistake can occur. But to guard against this remote possibility, and also ensure that good electrical connections have been made, the following simple tests should be carried out before commencing the installation work. As illustrated in Fig. 7, an ordinary 4½ volt flashlamp battery is used to represent the mains current, and this is connected to the free ends of the feed cable by twisting the wire ends round the brass connecting strips of the battery. A 4½ volt flashlamp bulb is connected across the free ends of the light wires, and this can be switched on by touching together the free ends of the appropriate switch cable. If desired, the actual switch can be temporarily connected to the free ends of the switch cable, and the light can then be switched on and off by manipulating the switch. This procedure enables the switch to be tested as well as the wiring.

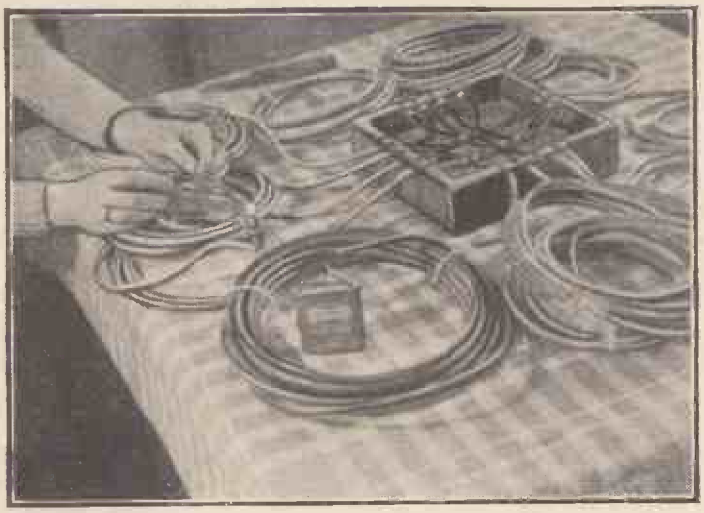


Fig. 7.—Testing one of the junction boxes with a battery and bulb.

Each light cable should be tested in turn with its own switch cable.

To test a plug cable, which has no controlling switch, the bulb is simply touched to the two wires of the cable, when the bulb should light up. Two-way switching has not been shown on the typical box to avoid complicating the wiring diagram. This will be described later, but it is appropriate to mention here that the testing of two-way switching is done by connecting the flashlamp bulb to the light cable, as before, but the two two-way switches should be connected to the free ends of both the switch cables, so that the correct action of both switches can be checked.

Installing the Harness

The wiring having been fully tested and found correct, the actual installation work can now be carried out with every confidence. The junction box serving the bedrooms is taken up into the attic and placed in its predetermined position. The various cables are run out to their respective positions, and passed through holes carefully bored through the ceiling. There is no need to cut off any surplus length, as this can easily be disposed of by a little coiling or snaking above the ceiling.

A number of floorboards require to be taken up to accommodate the cables and the junction box serving the ground floor. This should be carefully done so that the boards can be afterwards replaced without damage. The correct way to take up a short board, as is required immediately over a lighting point, is as shown in Fig. 8. First a small hole is bored at the edge of the floorboard, close up to the joist, sufficient to insert the point of a padsaw blade. The board is then sawn across, with an angled or splayed cut, so that the joint is not so obvious when the board is replaced. Before the board is replaced short ends of batten are nailed to each joist to give a bearing for the board ends.

In some cases the cables will run parallel with the joists, and they can then be pushed, of "fished," through in between the joists, but where the cable runs at right angles to the joists, parallel with the floorboards, it is necessary to take up a long board and cut shallow slots in the joists to take the cable. To remove a long board the ends must be sawn through as before, and then the nails should be punched right through the board and into the joists with a nail punch. The board can then be levered up from the saw cut with a strong chisel. A tongued and grooved board must have its tongue cut off with a knife or saw before it can be removed.

The slots in the joists to take the cable should be as shallow as possible so as to avoid weakening the joists; ½in. deep is sufficient to give clearance to the size of cable recommended, and this should not be exceeded. When two or more cables run in the same direction, they should be fitted in the slots side by side for the same reason. The slots should also be kept in the centre of the gap in the floorboards so that when the board is replaced it can be screwed down at the edges without risk of damaging the cable.

It is not necessary to chase the switch cables into the plaster. It is permissible to fasten them with buckle clips on the surface. But in cases where it is desired to chase them in, it is recommended that a short length of oval conduit be inserted into the chase and cemented in.

(To be concluded)

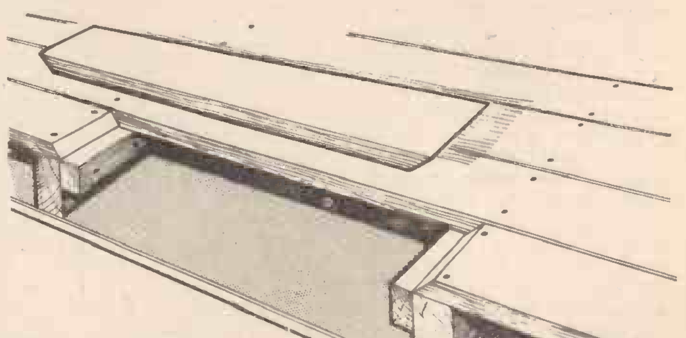


Fig. 8. — Method of forming access holes in floorboards.

MAKING A TA
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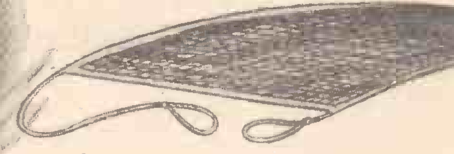


THE construction of a table tennis table follows normal procedure but special care must be taken to ensure that the top is perfectly smooth and flat and that the framework is rigid. The top is best made of ⅜in. or ½in. plywood; no other material offers the same fine finish combined with rigidity and freedom from warping. True, an alternative is a grooved and tongued boarding covered with Formica or similar material, but not only will this method prove more expensive and be much more difficult to fix to the framework, but there is also the constant threat that the boards will warp. It may also be desirable, if not actually essential, that the table should be capable of being dismantled for easy storage.

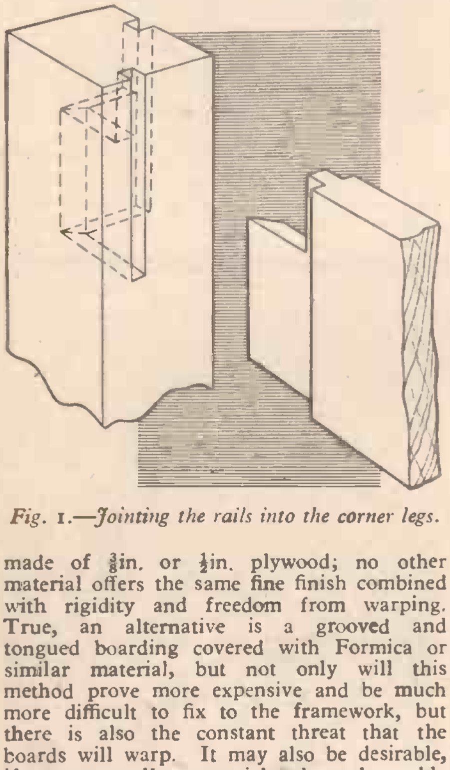


Fig. 1.—Jointing the rails into the corner legs.

The English match-regulation size for a table tennis table is 9ft. × 5ft., a size which is very convenient for plywood construction, since standard boards are 60in. × 60in.; ⅜in. ply costs about 1s. 6d. per sq. ft. and ½in. about 2s. The height must be 2ft. 6in.

A Permanent Table

Presuming the table is for use in a club or institution where it is intended it shall be permanent, then construction should be carried out on the lines suggested in Figs. 1, 2, 4 and 6. The legs should be 3in. × 3in. and, if a ½in. plywood top is used, 2ft. 5½in. long, i.e., the top must be 30in. from the floor. The turned leg, similar to that used for sturdy kitchen and dining tables, would look quite well and give a more finished effect than square or tapered legs. The top rails should be of 6in. × 1in. timber and the bottom rails of 4in. × 1in. It will be seen that these rails should be of such lengths as will allow the table top to overhang about 1½in. all round. To strengthen the ply edges and to give the top a suggestion of extra thickness, a border of 1½in. × 1in. or 1in. × 1in. should be run around the underside and preferably screwed from the bottom.

The Joints

At the four corners, the rails are shouldered and tenoned into the legs as shown in Fig. 1. The thickness of the tenon should be ⅜in. Note that if the

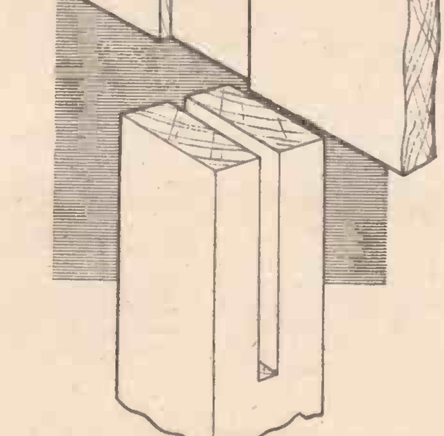


Fig. 2.—Jointing the rails into the centre legs.

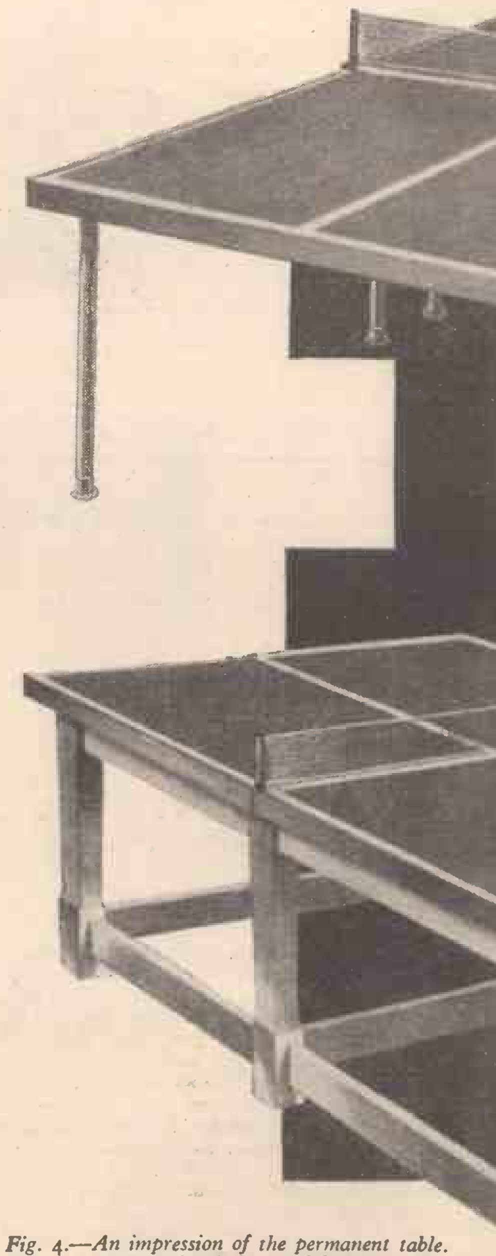
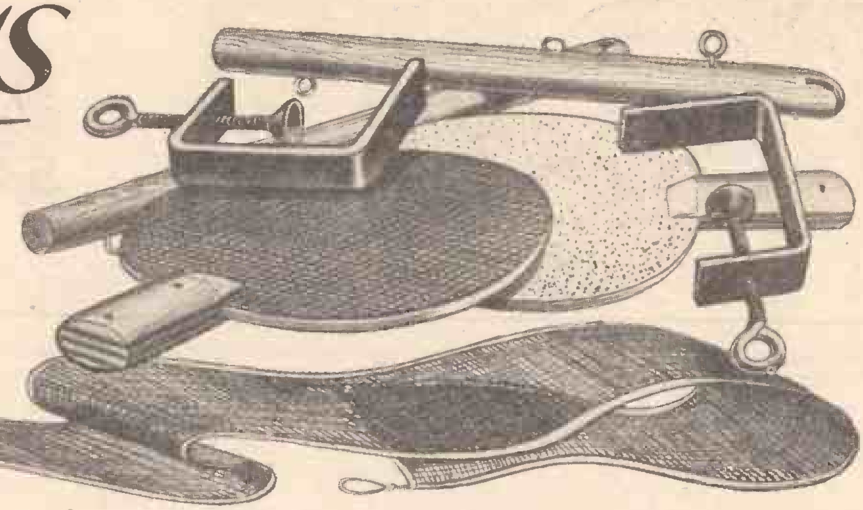


Fig. 4.—An impression of the permanent table. This structure is ideal for a club or institute where there is a permanent games room and where the table does not have to be disturbed.

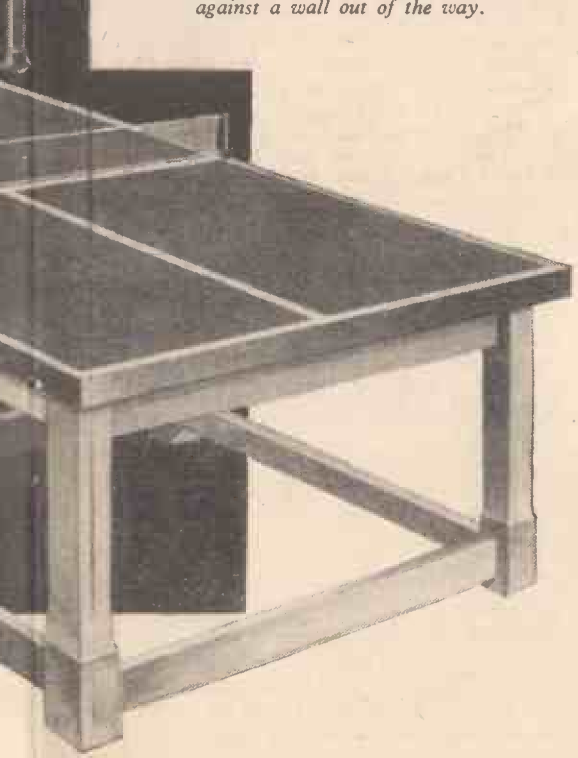
BLE TENNIS EQUIPMENT



n of Two Types of Table.
d the Bats are Described

JAMESON ERROLL

Fig. 3.—An impression of the collapsible table. To dismantle unscrew the legs from the top flanges and the plywood table top can be stood against a wall out of the way.



mortices meet in the centre of the leg, the tenon ends should be mitred. If this is not done they will jam when cramped up.

The centre top joints are as shown in Fig. 2 and may be pegged with a couple of $\frac{3}{8}$in. dowels entering the inside of the legs, passing through the tenon and continuing for a further $\frac{1}{2}$in. into the legs. The bottom rails are all shouldered and tenoned, including the centre cross-rail. The framework may now be glued and cramped up, care being taken to ensure that the structure is perfectly square.

The Plywood Top

This will be in two pieces and may be fastened to the rails by either method shown in Fig. 6. The wooden button is by far the better since it obviates interference with the playing surface, but if the screw method is used the screwheads must either be sunk *exactly* to table-top level or sunk below it and afterwards filled in with plastic wood and glasspapered. Where the two pieces of ply meet in the centre of the table, alternate struts are screwed on the undersides as shown in Fig. 8. These will give extra support to the ply and ensure a perfectly level join. The hook shown in Fig. 8 will only be necessary if the table is made to dismantle.

Painting

Two undercoats should be applied, each being rubbed over with fine glasspaper when dry and, finally, the top should be given a coat of good quality dark green *matt* paint. The white edging around the table and running up the centre should be 1in. wide, also matt. A glossy finish on the top is not desirable since it tends to produce glare and to reflect the lights. The legs and framework may have a gloss finish in any desired colour, but it is better to stick to green for them also—a slightly lighter shade than the top would look well.

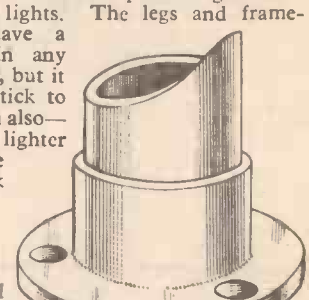


Fig. 7.—A view of one of the flanges.

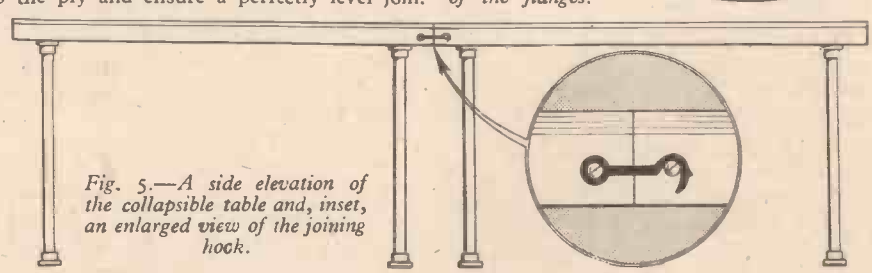


Fig. 5.—A side elevation of the collapsible table and, inset, an enlarged view of the joining hook.

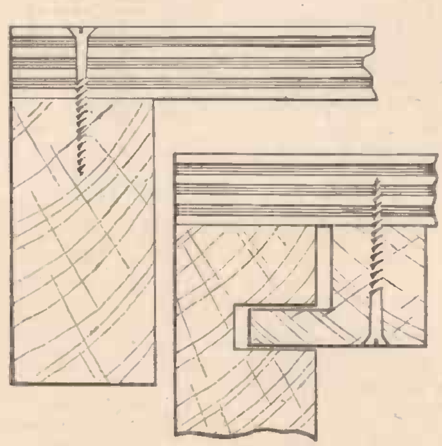


Fig. 6.—Two methods of fastening the top to the rails.

A Collapsible Model

If the table is not required to be a permanent fixture and has to be taken to pieces and stored in as small a space as possible, it is better to do away entirely with wooden legs and substitute iron piping about 1in. in diameter. It will be found that disused short lengths of old gas or water pipe —or even welded electric conduit—can be purchased quite reasonably. Eight pieces will be required (threaded at both ends), and 16 threaded flanges. The legs should be about 2ft. $3\frac{3}{8}$in. long, but this may vary slightly as it is governed by the type of flange used. The point to bear in mind is that the total height of the table must be 30in. A table of this type is shown in Fig. 3.

Construction

First prepare the two pieces of ply by strengthening them on the three outer edges

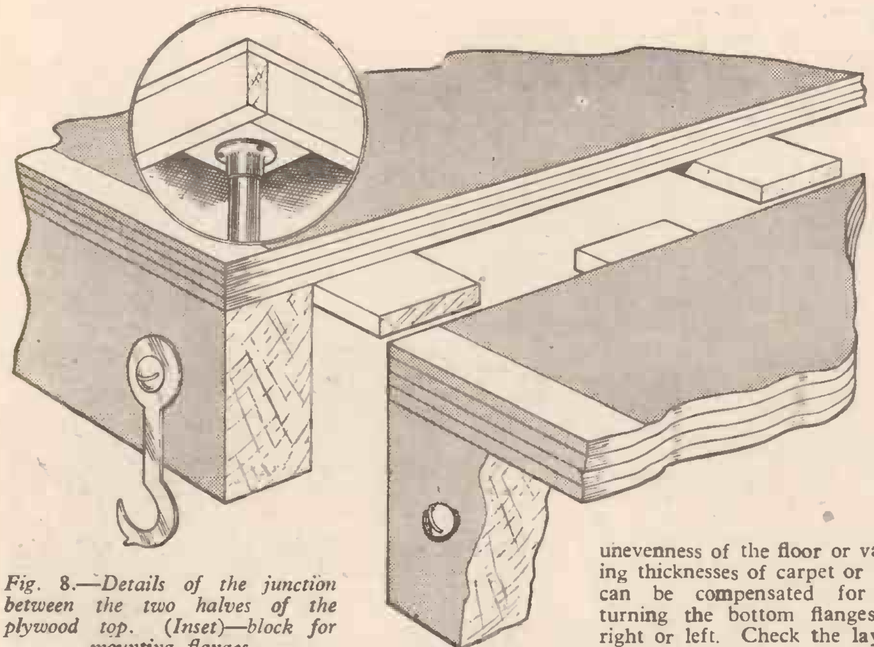


Fig. 8.—Details of the junction between the two halves of the plywood top. (Inset)—block for mounting flanges.

with lengths of 2in. × 1in. and on the inner edge, where they meet, with alternate struts as already explained and shown in Fig. 8. The corners of the 2in. × 1in. framework can well be mitred, but there is no objection to their being butted. At the four corners and at about 3in. from the ends where the table meets in the centre, blocks of 2in. × 2in. wood should be fastened to the frame (see inset, Fig. 8). These serve as supports for the top flanges.

Screw a flange on to each of the eight blocks on the frame and screw a leg into each. To allow for slight inaccuracies in the surface of the wooden blocks, it is advisable to see that the legs run at an exact right-angle to the table top. A slope of 1/64in. becomes greatly exaggerated throughout the length of the leg and will be visible. These minor surface faults can be remedied by inserting one or two pieces of veneer or thin card between the wood and the flange.

The bottom flanges can now be screwed on and the table assembled, the centre being brought up tight by the use of two strong hooks as shown in Figs. 5 and 8. Any unevenness of the floor or varying thicknesses of carpet or lino can be compensated for by turning the bottom flanges to right or left. Check the lay of the table with a spirit level. The whole structure may now be painted as already described.

To dismantle, unscrew the legs from the top flanges, and the complete table can be stood against a wall and will take up very little room.

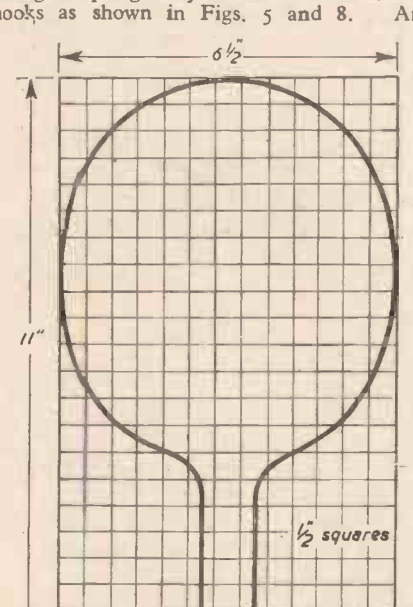


Fig. 9.—The table-tennis bat shape.

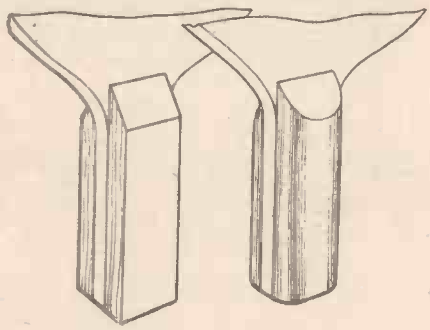


Fig. 10.—Shaping the handle.

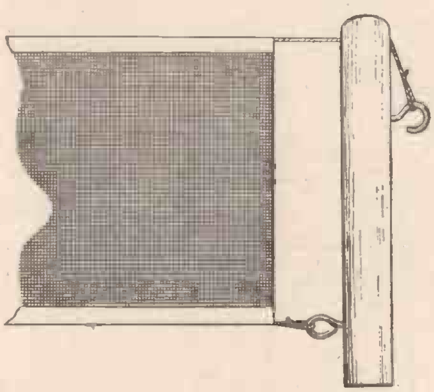


Fig. 11.—Details of the net and post.

Details of the Bat

There is no restriction on the size or shape of the table tennis bats and many unorthodox types are used by expert players. The shape shown in Fig. 9 is quite average. The shape must be laid out on a piece of 3/16in. plywood and the best way of doing this is to draw one half of the shape on a piece of card to form a template, transfer it to the plywood, turn the template over and draw the other half. This method makes sure that both halves are identical. Cut the shape out with a fretsaw and lightly clean the edges with a spokeshave. By marking out two bats the opposite way round, they may both be cut from a piece of plywood 10in. wide.

The Handle

This is formed by gluing on two thicker pieces of wood and shaping round to be comfortable. Each piece is 3in. long and ¾in. thick, chamfered at the ends. Glue to each side of the plywood with the edges flush and, when the glue has set, round the sides off with sandpaper to form a comfortable shape as shown in Fig. 10. After the edges of the bat have been sandpapered, they may be painted with a gloss enamel if desired. Finally cover the playing surface of both sides of the bat with the special embossed rubber sheet which is available for the purpose from a sports dealer. Great care should be exercised both in cutting and gluing this rubber, as the final appearance of the bats depends on these operations being accomplished neatly.

The Net

Close-meshed netting is used for this and the top and bottom edges are sewn round with tape to prevent them fraying. Sew a piece of string into each hem, leaving it loose for adjustment. The finished net should be 6in. high and 5ft. long.

The posts are cut from ¾in. dowel rod and should be 7in. long. The top of each is rounded off and a sawcut made across it to form a grip for the string and a small hook is positioned about 2in. down the outside of the post to make a suitable fastener. At the bottom end another small hook or eyelet is screwed in 1in. upwards and in line with the saw cut, but on the opposite side to the other hook. A completed post is seen in Fig. 11.

The Cramps

These are obtainable from any woodworking shop (Fig. 12). Cut a recess in the bottom of each post the same depth and width as the metal of the cramp, so that it lies flat and flush when put into place. Drill a hole through the cramp to take the screw and countersink on the underside so that the head is below the surface of the metal and will not scratch the table. Lay the cramp in the recess and drive the screw up into the base of the post (see Fig. 13).

The handles of the bats and the posts can be varnished if desired. Also, if preferred, thin sheets of cork or sandpaper may be used as a playing surface on the bats.

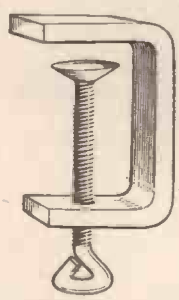
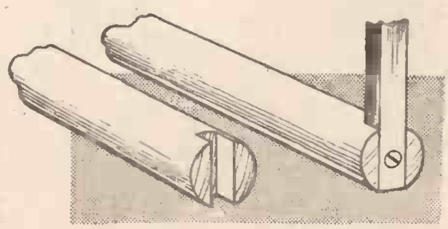


Fig. 12 (left).—The cramp.

Fig. 13 (below).—Attaching the cramp to the post.



A Tapestry Frame

A Home-made Portable Unit

By B. PARKER

THE tapestry canvas frame shown in the drawings has several advantages over the rather cumbersome wooden frame generally used. Being portable it can easily be stowed when not in use but the chief advantages are the ease and comfort provided for working the canvas and the protection given to sections of the work as they are completed.

Construction

Fig. 1 shows two rollers (to which short lengths of linen are attached) held between plywood sides by means of short lengths of threaded rod fitted with wing nuts. This frame swings centrally between two uprights also held in any position by wing nuts operating on threaded rod fixed to the frame sides and passing through the uprights. The lower ends of the uprights, fixed to suitable base pieces, are held together by a single bottom rail which is also held in position by wing nuts and threaded rod.

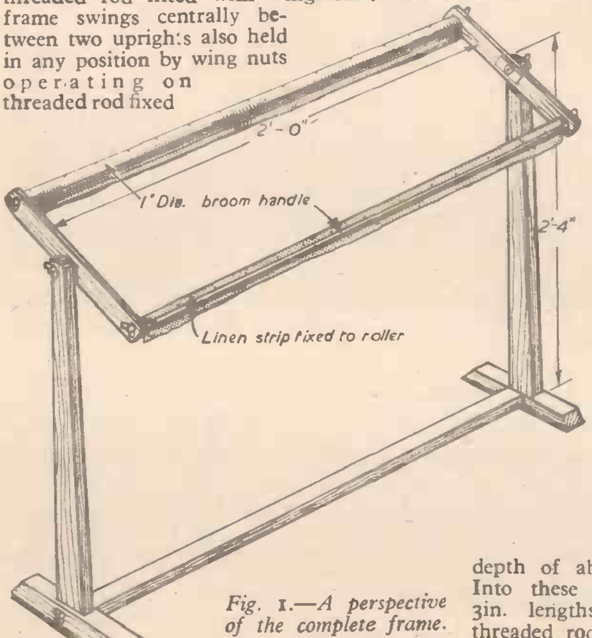


Fig. 1.—A perspective of the complete frame.

The Lower Ends

Details of one of the lower ends are shown in Fig. 2. A cross piece 9in. × 1¾in. × 1¼in. is fixed to the upright by means of a mortise and tenon joint cut as shown. It will be noted the tenon is 2in. wide being ½in. less than the width at the bottom of the upright, the shoulders thus formed provide added stability to the joint. The uprights are 2ft. 4in. in length and cut from 3in. × ¾in. material being planed to finish about 1¼in. wide at the top. It is advisable to mark out the tenon before planing to shape to ensure a square cut for the shoulders. When both uprights are jointed and finished to desired shape they should be glued and set aside to harden.

The bottom rail may next be prepared being 2ft. × 1¾in. × 1¾in. After planing to size ¼in. dia. holes are drilled centrally in each end to a depth of about 1½in. Into these are fitted 3in. lengths of ¼in. threaded rod. To fix these in position 1/16in. holes are drilled about 1in. from the ends carefully positioned to pass through the rod. One inch panel pins driven in from one side of the rail passing through the rods will provide sufficient security.

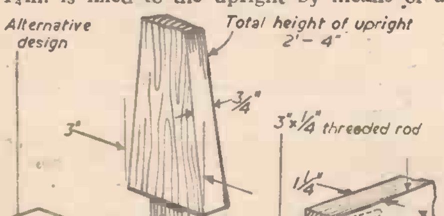


Fig. 2.—Details of the lower ends.

The Top Frame

Fig. 3 shows details of the top frame. The two rollers are 2ft. in length being cut from 1in. diameter broom handle. These are trimmed neatly at the ends and afterwards drilled to a depth of about 1¼in. to receive 2in. lengths of ¼in. threaded rod, which are fixed in position as shown at A (Fig. 3). The sides of the frame are cut from 3/16in. plywood 1¼in. wide and 9in. in length. These sides are shaped and drilled as shown in Fig. 3, which drawing also shows how accommodation is provided

MATERIALS REQUIRED

FRAME:

Uprights	...	2 pieces 2ft. 4in. × 3in. × ¾in. hardwood.
Base	...	2 „ 9in. × 1¾in. × 1¼in. „
Bottom rail		1 piece 1ft. 11¾in. × 1¾in. × 1¾in. „
Rollers	...	2 pieces 2ft. 0in. × 1in. diameter (broom handle).
Sides	...	2 „ 9in. × 1¼in. × 3/16in. plywood.

METAL:

Threaded brass rod	2 pieces 3in. × ¼in. for bottom rail.
„ „ „	2 pieces 1¾in. × ¼in. for centre top pins.
„ „ „	4 pieces 2in. × ¼in. for roller ends.
	2—¼in. brass nuts.
	8—¼in. „ wing nuts.
	8—¼in. „ washers.
	2 pieces 1½in. × ¾in. × 1/16in. brass plate.
	4 only ¼in. × 2's brass screws.
	6 only 1in. × 1/16in. panel pins.

Threaded rod is obtainable in varying lengths.

An artist's impression of the completed frame in use.

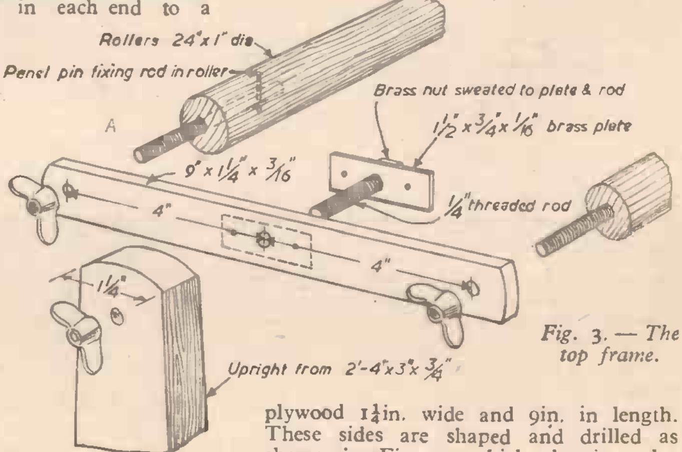


Fig. 3.— The top frame.

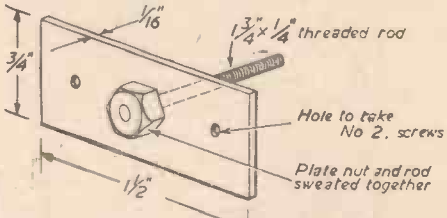


Fig. 4. — The central pivot.

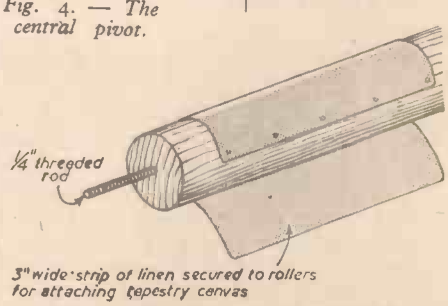


Fig. 5.—How the canvas is attached.

for the rollers and the central pivot. The central pivot is further illustrated in Fig. 4, which shows a 1¼in. length of threaded rod passing through the centre of a 1½in. × ¾in. × 1/16in. brass plate. A brass nut is "sweated" on one end of the rod and also to the plate. Two small holes are drilled in the plate to provide means for fixing with small screws to the plywood sides. Thus the frame when assembled can be held in any required position by means of the central rods which pass through the holes in the top of the uprights and secured by wing nuts (See Fig. 1).

Soldering

The "sweating" together of the parts for the central pivots as mentioned above is a simple operation even for the beginner in metalwork. Having sawn off the required pieces from a length of rod held in the vice (blocks of wood being used to protect the threads) the ends are neatly finished with a fine file. Soldering flux is applied to about ⅜in. of the rod at one end followed by a trace of solder added with the soldering iron. Only a small quantity of solder should be applied otherwise there may be difficulty in screwing on the nut. To accomplish this two pairs of pliers are required. Holding the nut with one pair apply a little flux to the threads inside the nut then, holding the short length of rod with the other pair, heat both nut and rod until the solder is in a fluid state, when it will be possible to screw the two together.

The plate is cut from a piece of 1/16in. brass, filed to size and drilled in the centre to receive the ¼in. rod and also drilled as shown in Fig. 4 The plate is next sweated to the rod and nut by applying flux and solder to the underside of the nut and also a little round the hole in the plate. Smear on a little flux, pass the rod through the plate and hold over the gas jet until the solder has melted, which will be seen by the settling down of the nut on the plate. This second application of heat will, of course, loosen the joint already made between the rod and the nut, but when cold it will be found the plate, rod and nut are securely fixed togther. Fig. 4 shows the completed unit.

When ¼in. holes have been drilled through the lower cross members to receive the rods fixed in the ends of the bottom rail the various parts may be assembled. A final smoothing over with fine glasspaper will complete the job.

The height of the gadget as shown has proved to be very suited to the convenience of the canvas worker when seated in a comfortable chair. A width of canvas up to 2ft. and of any required length is stitched to the two strips of linen, which can then be turned and held in any desired position.

AN ELECTRIC SPINNING GAME

Work Out Your Own Way of Playing This Game

THIS game, which works from a pocket battery costs only a few shillings to make and will provide endless amusement during the winter months.

For a baseboard use a sheet of three-ply wood about 10in. × 6in., although you may make the model any size to suit yourself. Draw a circle of about 2½in. radius on the baseboard and another of 1½in. from the same centre. Now repeat this construction on a sheet of tinplate and equally divide each of these circles round the edge and cut out six segments of tinplate to the shape shown in Fig. 1. These must be nailed or screwed on to the circles marked on the base so as to leave a small gap between each segment. When cutting tinplate it is always a good plan to make a paper pattern first. The pattern in this case is made by drawing the circles and dividing them as explained above. It will improve the appearance of the model if you make sure that the edges are perfectly smooth. If you do not possess a file, rub the tinplate edges on a stone to get them smooth.

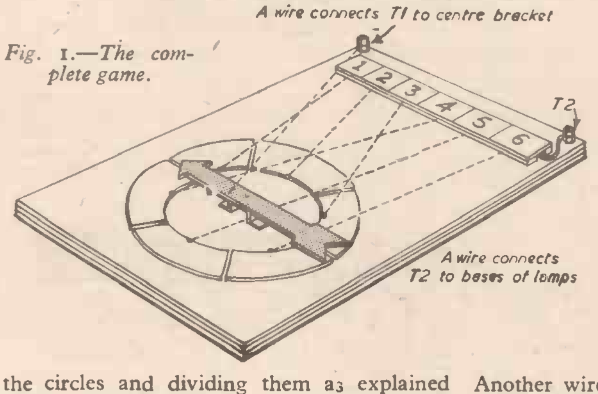


Fig. 1.—The complete game.

The Arrow

The arrow is made from tinplate or sheet brass. An old pair of scissors will cut tinplate, but you may need special shears for sheet brass, unless it is very thin. Make the arrow according to the size of your circle; 4½in. × ¾in. is a suitable size. Cut it to the shape shown in Fig. 2 and punch a hole in the centre.

The spindle consists of a nail knocked through the baseboard from below. In order to make the arrow turn freely and to make a good contact, cut a piece of tinplate 3in. × ¾in. and bend it into a bracket as shown in Fig. 3. Punch a hole in the centre, slip it over the axle and nail or screw it to the board.

Illuminated Score Board

First obtain six small lampholders to take an ordinary 3.5 volt torch bulb and screw them in position. These can be bought for a few pence, but if you prefer to make them yourself, fix to the base a strip of tinplate about 5in. × ½in. Then cut six pieces of tinplate 1⅝in. × ¾in. and bend each one as shown in Fig. 4. Make a hole into which your lamp will fit tightly. This may be done by punching a hole with a nail and enlarging it. Now screw the six brackets in position so that the bottom contact of each lamp will rest on the strip of tinplate. Make sure that each bracket is separated from the next by a small gap. The numbers are painted on a strip of Perspex mounted on two battens.

Connecting the Parts

Solder, or fix by screws, a wire to each piece of tinplate in the circle and to the centre bracket. The wires are shown by broken lines in Fig. 1, whilst Fig. 4 makes it quite clear how the wires must be connected to the lampholders. Each wire from the circle goes to a lampholder and the wire from the centre bracket must be connected to the battery, via terminal T1. Another wire goes from the tin strip under the lamps to the battery, via terminal T2. If you have bought your lampholders, connect the bottom screw of each one to a piece of wire which must go to the battery. This wire takes the place of the tinplate strip in the home-made lampholders.

Connect the wires from the tinplates to the lampholders by passing them through

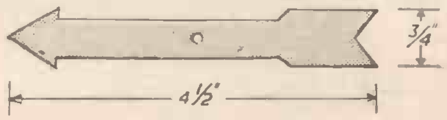


Fig. 2.—The arrow.

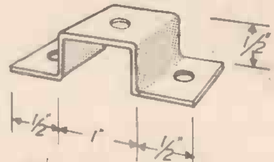


Fig. 3.—The pivot bracket.

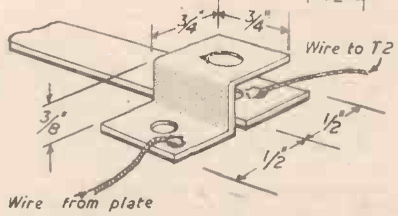


Fig. 4.—The lampholder connections

holes and carrying them underneath the board so that they are out of sight.

You can make a sliding contact between the arrow head and the circle by means of a short piece of copper flex. The arrow may be weighted by clipping a piece of tinplate round it to keep the wire in contact.

The Martian Atmosphere Restudied

A Report from the National Bureau of Standards in Washington

TELESCOPIC observations strongly suggest that Mars has an atmosphere similar to, though more transparent than, the atmosphere of the earth. For more specific information on the Martian atmosphere astronomers have relied mainly on the spectroscope or spectrograph, instruments that analyse the sunlight reflected from the planet's surface. In principle the gases present should reveal themselves by their characteristic absorption lines and bands, but results so far have not been conclusive. However, the persistence of inconclusive results, despite increasing sensitivity of observing techniques, has led to lower estimates of the quantities of gases, such as oxygen, water vapour, and carbon dioxide, that may be present on Mars.

Another attack on this problem has been made by scientists of the American National Bureau of Standards, and they have now completed analysis of the spectrograms obtained during the close approach of Mars in the late summer of 1956. Two husband-and-wife teams—C. C. Kiess, H. K. Kiess, C. H. Corliss and E. L. R. Corliss—participated in the investigation which was sponsored jointly by the National Geographic Society and the National Bureau of Standards.

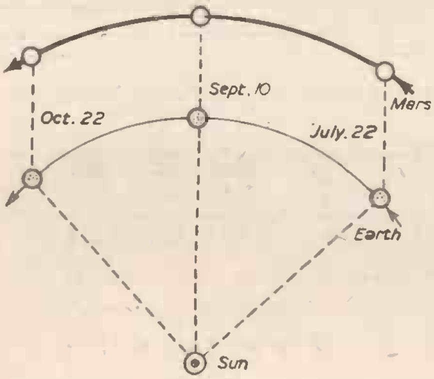


Fig. 1.—The approximate relative positions of Mars, Earth and Sun, in the latter part of 1956 when a spectrographic study of the Martian atmosphere was made by National Bureau of Standards scientists. On September 10 when Mars was "in opposition," its distance from the Earth was a minimum. Spectrograms were obtained around July 22 and again around October 22 when this distance was decreasing and increasing, respectively. In both cases the change was rapid enough so that the resulting Doppler shift in the spectrum of Mars could separate absorption lines of terrestrial origin from those due to the Martian atmosphere, but this effect was not observed.

Using more sensitive instruments than have been previously applied to this purpose the scientists photographed the Martian spectrum under the excellent observing conditions at the new high-altitude observatory, operated by the U.S. Weather Bureau, on Mauna Loa volcano in Hawaii. Also, in an effort to extend observations farther into the infra-red, another set of spectrograms was made at the Georgetown College Observatory in Washington, D.C.

The investigation concentrated mainly on a search for oxygen and water vapour. The results indicate that both of these, if present, occur in quantities too small to be detected with the equipment used. On the basis of laboratory tests of spectrograph sensitivity to water vapour, this means that there is less H_2O in the Martian atmosphere than there is in a film of water 0.08mm. (1/300in.) thick. The spectrograms also showed no trace of the carbon-dioxide lines that have been observed in Venus, or of spectral lines of the noble gases.

It is believed that these results are not incompatible with the presence of water vapour in amounts sufficient to explain, for example, the transport of water from one polar cap to the other. For it is now fairly well established that the white polar caps of Mars consist of solidified H_2O, and it is reasonable to suppose that the seasonal process in which one cap shrinks while the other expands is due to the transfer of water vapour over the Martian surface. The results do raise the question, however, as to whether the spectroscopic tests hitherto used are delicate enough for the purpose. In the case of H_2O molecules there is reason to believe that the bands that have been used (because of accessibility to present methods of observation) are not the most sensitive ones. Both theory and experiment indicate that much stronger bands occur farther in the infra-red, but different or improved techniques are needed to detect them on Mars. The use of spectrographs mounted in high-altitude balloons, rockets, or artificial satellites will reduce the difficulty further.

Methods

The light from Mars, as received near the earth's surface, is really a composite of three different spectra. Specifically, it contains absorption lines originating (1) in the reversing layer of the sun's atmosphere (2) in the atmosphere of Mars, and (3) in the atmosphere of the earth. The wavelengths of the solar lines are accurately known and so can be easily identified. For the much more difficult task of distinguishing lines due to Mars from those due to the earth, two methods have been in use.

One method is to observe Mars at "opposition," that is, when Mars, earth and sun are most nearly in a straight line, with the earth between the other two. Its distance from the earth being a minimum (or nearly so), Mars is then at its brightest. Also, because the distance between Mars and the earth is neither increasing nor decreasing, absorption lines originating in the atmosphere of Mars will not be separated by Doppler shift from those originating in the earth's atmosphere; so that oxygen lines, for example, from Mars will be superimposed on those from the earth. In such a case the line may be noticeably intensified or, more likely, distorted; that is, since the Doppler shift is not negligibly small except for a brief interval, the intensity profile of such a line, as measured with a microphotometer, would be asymmetrical. Such distortions might be detected more readily by comparison with corresponding lines in the spectrum of the moon (which has no atmosphere of its own).

The second method is to observe Mars at some time before or after opposition, when the Doppler shift would separate clearly the Martian from the terrestrial lines. Then, if there is oxygen in the atmosphere of Mars, one might expect the oxygen lines caused by the earth's atmosphere to have faint companions separated by the amount of the Doppler shift.

Comparison with the spectrum of the moon, obtained under similar conditions, would allow the Doppler shift to be measured—for example, by the relative displacement of the solar lines. Comparing the Martian spectrum with the more familiar spectrum of the moon would also help in detecting any unknown lines that might show up.

The second method was used in the present investigation. Spectrograms were obtained about seven weeks before opposition at Mauna Loa and about six weeks after opposition at the Georgetown observatory. In the earlier spectrograms the Doppler shift was 0.22 A (angstroms) towards the short wavelengths, and in the later ones 0.25 A towards the longer wavelengths. The measured values of the shift agreed well with the values calculated from the orbital velocities of Mars and the earth.

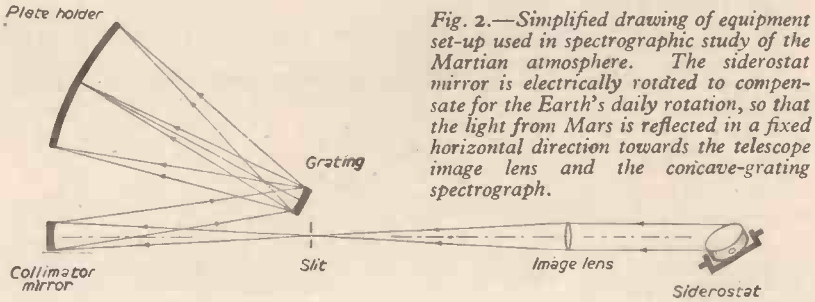


Fig. 2.—Simplified drawing of equipment set-up used in spectrographic study of the Martian atmosphere. The siderostat mirror is electrically rotated to compensate for the Earth's daily rotation, so that the light from Mars is reflected in a fixed horizontal direction towards the telescope image lens and the concave-grating spectrograph.

Instruments

The new study of the Martian spectrum was undertaken in order to see what could be done with the newer aids to observation. These include better diffraction gratings and optical systems, faster photographic plates, and more accurate guiding mechanisms for prolonged photographic exposures.

Before proceeding to Hawaii the scientists tested the feasibility of using high-dispersion concave gratings for planetary spectroscopy at the Georgetown observatory. Various arrangements were tried out on Jupiter, which was then about as bright as Mars would be in July, 1956. The tests justified proceeding with the project and showed that the mounting devised by Wadsworth would be suitable for the grating.

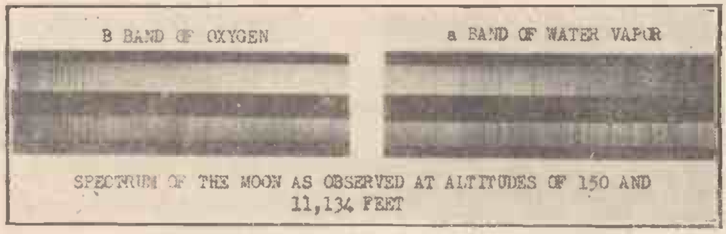


Fig. 3.—Spectra of the Moon obtained by National Bureau of Standards scientists at the high-altitude observatory on Mauna Loa volcano in Hawaii (above) and at the Georgetown College Observatory in Washington, D.C. (below). The comparison shows the extent to which absorption lines due to oxygen and water vapour in the Earth's atmosphere are weakened at the altitude of the Mauna Loa observatory.

Light is gathered from Mars with a siderostat, a mirror that is motor-driven (with manual fine adjustment) so that the light is always reflected in the same horizontal direction towards the rigidly mounted telescope lens and spectrograph (Fig. 1). The telescope lens focuses an image of the planet on to a slit, and the light passing through is converted into a parallel beam by a collimating mirror. The beam then strikes and is reflected from a concave diffraction grating which spreads the light out into its components according to wavelength. The light as thus spread out—i.e., the spectrum—falls upon a thin glass photographic plate which is curved to fit the focal plane of the grating.

Two diffraction gratings were selected. One was ruled by R. W. Wood at John Hopkins University and has 15,000 lines per inch and a (reciprocal) dispersion of 5 A per mm. The other, ruled by H. G. Gale at the University of Chicago, has 30,000 lines per inch and a dispersion of 2 A per mm. Both have the special virtue of concentrating much of the light in one of the first-order spectra. The telescope lens, 12in. in diameter and 12ft. in focal length, was made by J. Clacey, former chief optician at the National Bureau of Standards.

Observations

The observatory on Mauna Loa offers many advantages to the astronomer. Situated in the midst of the Pacific at an altitude of 11,134 ft., it is free from the ruggedness of terrain that produces turbulence in the surrounding air. Particularly important is its height of about one mile above the inversion layer of the atmosphere. This is the level at which the temperature of the air starts to increase with increasing altitude; the bulk of atmospheric dust and moisture are trapped below it.

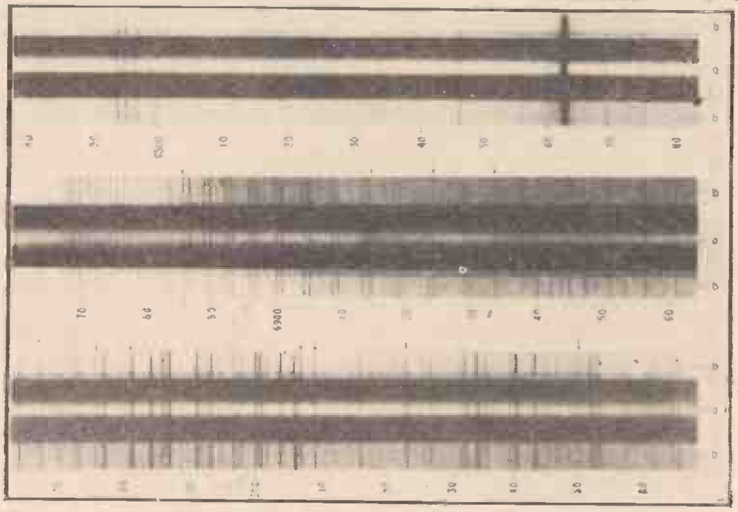


Fig. 4.—Spectra of Mars (a) and Moon (b) obtained by National Bureau of Standards scientists on Mauna Loa, July 21-22, 1956. Because the distance of Mars was decreasing at that time, there is a Doppler shift in the Martian spectrum towards the shorter wavelengths. However, this only affects lines originating on Mars or present in the original sunlight that Mars reflects. The Doppler shift is clearly evident at places marked by arrows. In the case of the strong absorption line at 7187.38 A, which is a blend of a solar iron line and a terrestrial water-vapour line, the shift is sufficient for the iron line to form a new blend with the H_2O line at 7187.01 A and thereby alter the relative strengths of the lines (compare adjacent spectrum of Moon). If oxygen or water-vapour lines were present in these Martian spectra, they ought to appear as faint companions to the corresponding lines produced by the earth's atmosphere; but no such companion lines are to be seen.

Spectra of Mars and the moon were obtained successively on the same plate, the exposures to Mars lasting three hours each. The Wood grating was tried first. The spectrograms proved sufficiently dense to warrant using the more dispersive Gale grating, which was then set up to photograph wavelengths from 5800 to 7400 A.

The Doppler shift is clearly evident in the best spectograms (Fig. 3). In several cases, lines of solar origin that are hidden behind terrestrial lines in spectrograms of direct sunlight are shifted out of their hiding places and appear separately in the spectrum of Mars. If any lines due to water vapour or oxygen in the atmosphere of Mars appeared in the spectrum, they should be shifted by about 0.22 A from those of terrestrial origin. However, there are no companion lines to be seen with the strong lines either in the Fraunhofer *B* band of O_2 (roughly 6870 to 6940 A), or in the *a* band of H_2O (roughly 7200 to 7300 A).

Later, the spectrograph was set up again at the Georgetown College Observatory. The aim was to extend observation farther into the infra-red than was possible at the time on Mauna Loa. The lower altitude of Washington, D.C., made it necessary to use the Wood grating; exposures to Mars were each about five hours long. The portion of the spectrum from 5000 to 9000 A was photographed and scanned for lines of atomic nitrogen, oxygen, and the noble gases, as well as for the *A* bands of O_2 (about 7600 to 7700 A), the H_2O band at 8200 A, and the CO_2 bands at 7820 and 7889 A that were found (1932) by W. S. Adams and T. Dunham, Jr., in the spectrum of Venus. Again the Doppler shift was clearly evident, but none of the lines sought for could be detected.

Interpretation

The results of this investigation, which extended over a greater wavelength range and utilised higher dispersion than those previously reported, confirm the findings of W. S. Adams and T. Dunham, Jr., in 1934 and 1941, with respect to the low abundance

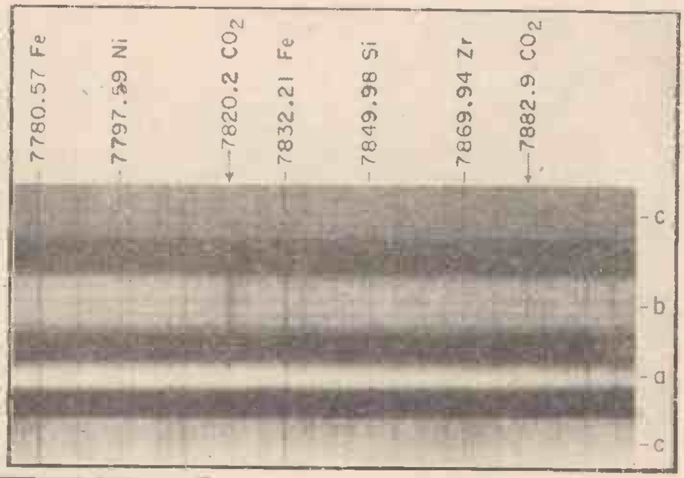


Fig. 5.—Spectra of Mars, Venus and the Moon, obtained during spectrographic study of Martian atmosphere. The carbon-dioxide lines at 7820.2 and 7882.9 A appear in the spectrum of Venus, but not in that of Mars (nor of the Moon). (a) Mars. (b) Venus. (c) Moon.

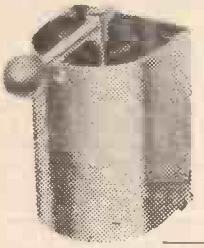
of oxygen and water vapour in the atmosphere of Mars. The numbers of molecules of both gases are too small to be detected with the equipment used.

In the case of water vapour, tests with a spectrograph of dimensions close to those of the one used in this study were made in the Bureau's spectroscopy laboratory. Under conditions in which the water vapour in the light path was equivalent to a water film 0.15 mm. thick, a few of the strongest lines of the *a* band and the one at 8200 A were detectable. Since none of these were detected in the spectrum of Mars, the water-vapour content of its atmosphere must be less than that of a film of water 0.08 mm., or half of 0.15 thick; this is because the light from Mars passes twice through its atmosphere—once coming from the sun and once after reflection from the Martian surface.

The spectrograph used in the present investigation could detect no H_2O bands beyond the one at 0.823 microns (1 micron = 10,000 A). However, theoretical analyses by E. K. Plyler and W. S. Benedict of the Bureau's radiometry laboratory, and others, indicates that the bands at 0.942, 1.135 and 1,379 microns are more intense. As shown

(*Concluded on page 401*)

GAMAGES



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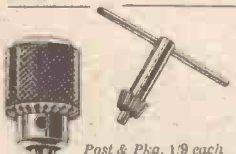

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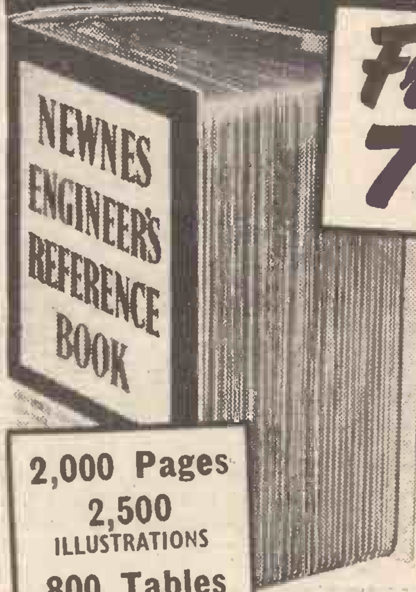

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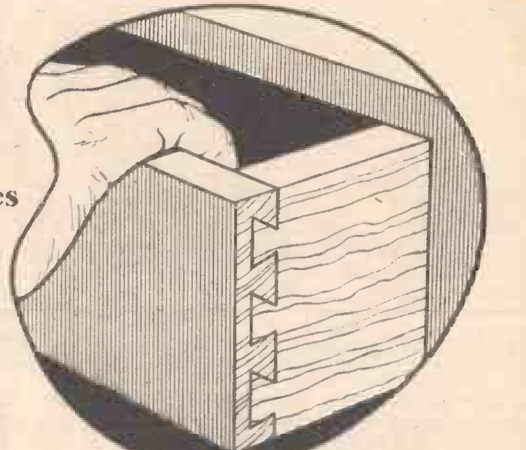
Woodworking Joints

No. 4 (Final Instalment)—Some Less Common Types



By W. J. Stannage

ALTHOUGH not met with every day in the handyman's workshop, a knowledge of these joints is extremely useful as sooner or later the occasion to use them will crop up. Sometimes, for example, it is necessary to construct an article which can be easily and quickly dismantled, and for this job the wedged tusked tenon joint is well worth considering.

The Triple Wedged Tusked Tenon

Fig. 1 gives a good indication as to how the joint is employed. It will also be obvious that the name describes the joint very well as the tenons are cut very long and project through the piece of timber which forms the opposite part of the joint, and that once in place, they are secured by wedges. Three tusks are shown in Fig. 1, but this is not by any means a strict rule. The number of tusks can be varied according to the width of timber.

Fig. 2 shows a tusk in greater detail and it will be seen that its making is not difficult.

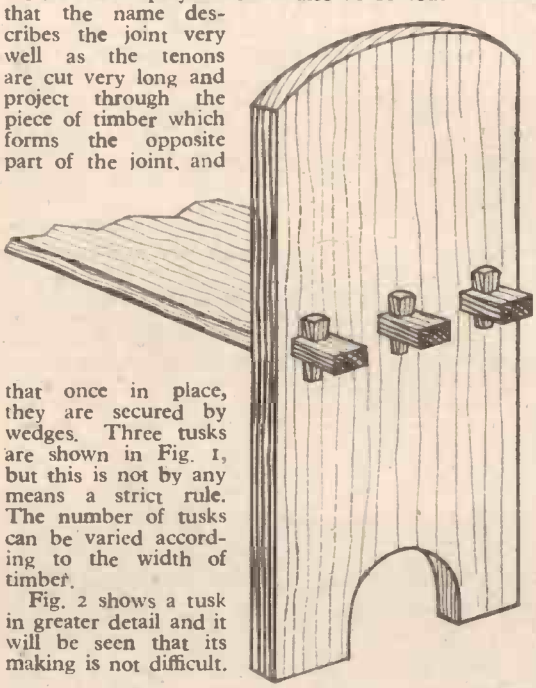


Fig. 1.—A perspective view of the triple wedged tusked tenon.

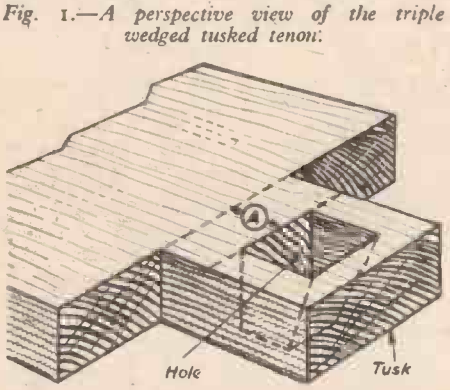


Fig. 2.—(Left) View of tusk.

Points to remember are that the tusk must be long enough to pass through the side member and provide ample timber in which the hole can be cut, and, once the hole has been cut, that there is enough timber around it to withstand the driving of the wedge. Another point, and a very important one, is that the measurement shown as "A" in the drawing must be slightly less than the thickness of the timber through which the tusk passes. If this is not observed the wedge, when driven into place, will simply tighten up in the hole and not against the side member as it should. This clearance can be clearly seen in Fig. 3, which is a sectional elevation of the joint. In this drawing note also that the front face of the hole in the tusk is cut at the same angle or slope as the face of the wedge. With these points clearly in mind it is not a difficult task to design, mark off, and cut this type of joint.

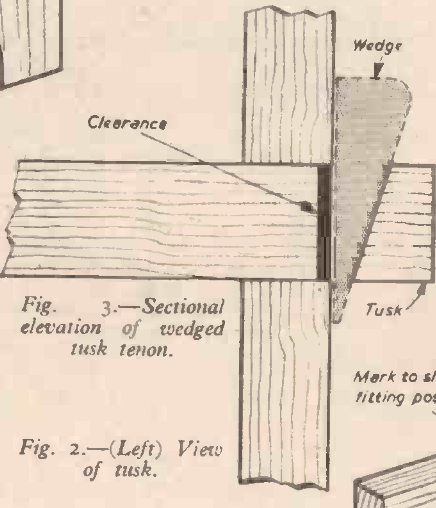


Fig. 3.—Sectional elevation of wedged tusk tenon.

The Rubbed or Edge Joint

Sometimes when constructing a rather wide surface it will be found that timber of the required width is not available, or if it were, the timber would warp unless well battened. When this is the case the rubbed joint, or edge joint, can be used to join several narrow boards together.

The first requirement is a perfectly true edge on all pieces to be joined, and this work must be undertaken with the longest plane available. Planing can be done in the vice, one board being planed at a time, or, as some workers prefer, the two pieces held in the vice together and so both edges planed in the one operation. It is necessary as planing is carried out to try one board on top of the other to ensure that both edges are in close contact and that no daylight is visible between them.

When the edges are in perfect contact place a straightedge over both pieces and make sure by this test that they are perfectly flat and on the same plane. This is shown in Fig. 4, but in actual practice the boards will be vertical in the vice, and there will be only two of them to deal with at one time. However, the four boards shown in Fig. 4 illustrate a very important point, namely the direction of the grain at the end of each piece of wood. Note that

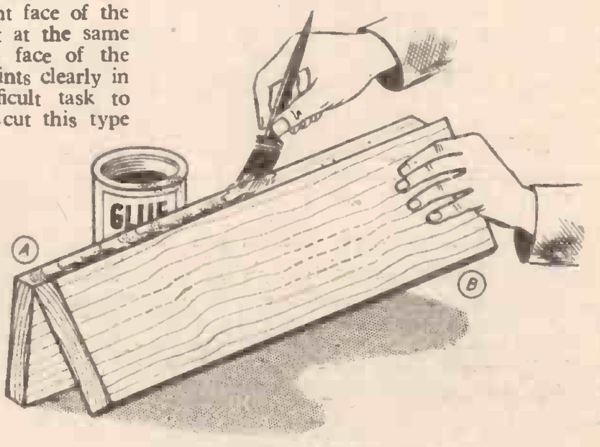


Fig. 5.—Timber held for gluing.

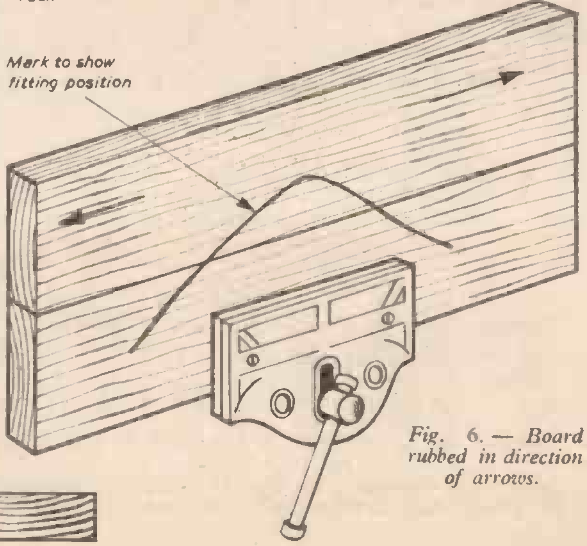


Fig. 6. — Board rubbed in direction of arrows.

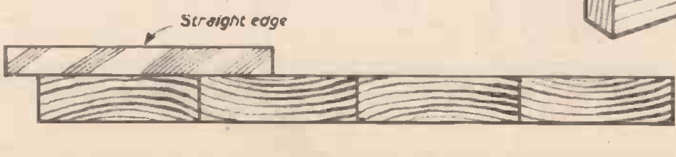


Fig. 4.—(Right) End view showing direction of grain and straight-edge test.

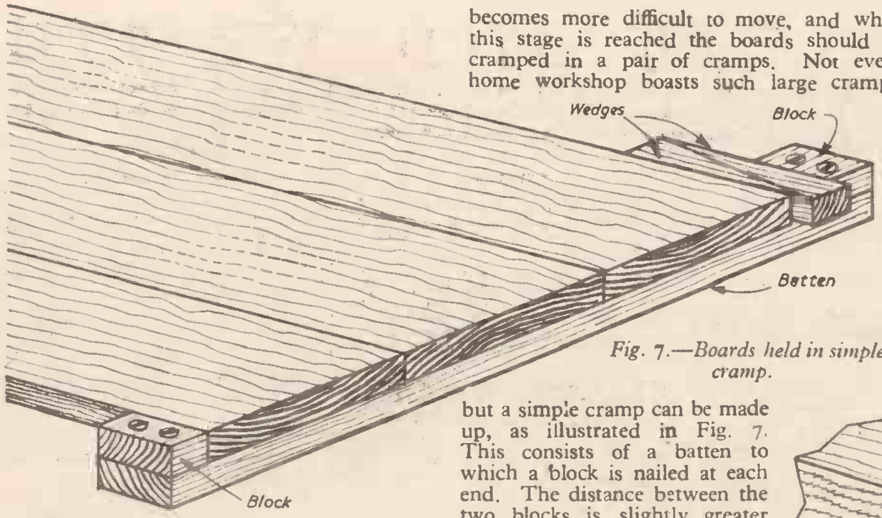


Fig. 7.—*Boards held in simple cramp.*

the boards are placed so that this grain funs in opposite directions in each pair of boards. When glued up as shown the finished job will be very much less liable to warp.

When two boards have been planed up as described, a pencil mark should be made across the two front faces so that they may be easily identified when the actual gluing is in process.

For gluing, the boards are held as seen in Fig. 5. The board "A" is clamped in the vice, and the board "B" held against it. Glue is spread along the two edges and then board "B" is tipped up and placed on top of "A" as shown in Fig. 6. The arrows in the drawing show the direction in which the top board is moved and a downward pressure should be exerted at the same time. This to and fro movement forces the glue into the pores of the timber and also forces out the surplus. As this movement continues it will be found that the top board becomes more difficult to move, and when this stage is reached the boards should be cramped in a pair of cramps. Not every home workshop boasts such large cramps, but a simple cramp can be made up, as illustrated in Fig. 7. This consists of a batten to which a block is nailed at each end. The distance between the two blocks is slightly greater than the overall width of the boards in question, and the space so formed allows a pair of wedges to be knocked in, thus forcing the boards close together.

For small jobs of, say, two boards, there is no need for cramps to be employed. Simply lean two battens against the workshop wall and set the boards against these. The battens support the boards across their full width.

If scotch glue is used this must be applied hot and the rubbing carried out quickly before the glue chills. If possible heat the boards before applying the glue as this delays the chilling action.

It is advisable to remove all surplus glue before it has a chance to harden.

Double Twin-haunched Tenons

Fig. 8 shows one of the most complicated joints in the mortise and tenon family, namedly double twin-haunched tenons. This joint is only used when the timber is both very wide and very thick. Again, there are variations of this joint. Where the timber is wide but not too thick twin-haunched tenons could be employed. This would be half of what is shown in the drawing and there would be only two tenons, those marked "A" and "B."

In the second article of this series, which appeared in the March issue, we saw that a haunch was only necessary when the cross piece or cross rail was positioned at the end of the upright or stile. The same applies in this case also, so if the twin or double twin tenons were to be used on a rail in the centre of a stile the haunch would

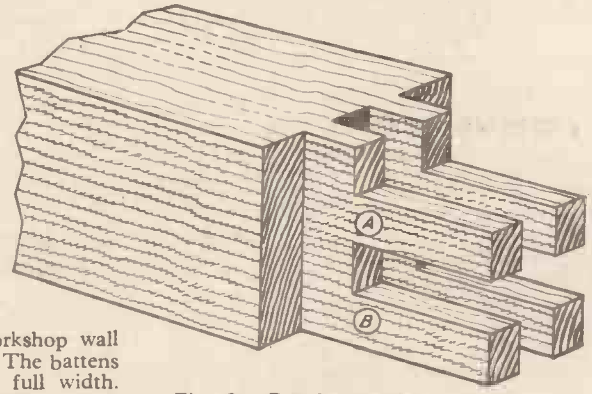


Fig. 8.—*Double twin-haunched tenons.*

not be required. Thus the tenon "A" would be level or flush with the top face of the timber, and because of this both tenons could be wider.

Although this variation of the tenon at first sight appears very difficult, matters can be simplified if the cutting out is undertaken in stages, one part at a time receiving the full attention of the worker.

Simple Conjuring

These Tricks Will Baffle Your Friends

The Mysterious Handkerchief

FOR this trick you will require an ordinary silk handkerchief. (In conjuring a silk handkerchief has a natural tendency to help the conjurer because of its extreme compressibility.) Roll the handkerchief into a compact ball and conceal it in a fold of the coat sleeve inside the elbow (see Fig. 1), the left sleeve preferably. You now pull up your sleeve to show your friends that both hands are empty. In pulling up the left sleeve your hand comes over the concealed handkerchief, and while attention is being drawn to your empty left hand, palm the handkerchief with your right. Your two hands are then rubbed together and the handkerchief allowed to appear slowly through your fingers, giving the impression that it has been produced from nowhere. Practice this a few times before trying it on your friends

Dry Fingers

FOR this trick you require a coin, a saucer, a glass, half a cork and a match. Half fill the saucer with water and place the coin in it. By the side of the saucer place the glass, the half cork and the match. Now request your friends to remove the coin without placing their fingers in the water. Tipping the saucer is not allowed, nor is raking the coin out with the match or piece of cork, or scooping it out with the glass.

When they have given it up, place the piece of cork in the water, insert the match into the cork and light it. Then place the glass over the cork and the match and watch the result. You will notice that the water is gradually drawn up into the glass, thus enabling the coin to be removed without placing the fingers in the water.

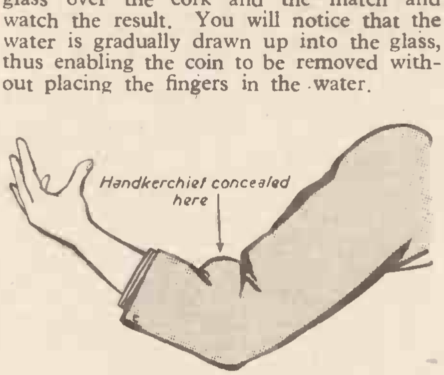


Fig. 1.—*Concealing the silk handkerchief.*

For the best results the match should be bent so that the burning portion is horizontal. Of course, it is not necessary to use a coin, some small and shallow article will do equally well.

The Magic Penny

BORE a hole through a penny and sew it to the centre of a stout linen handkerchief, being careful to see that you use the same coloured cotton as the handkerchief. Now borrow a penny from your friend, telling him to mark the coin so that he will recognise it when it is handed back; then produce the handkerchief and display it to him by holding the top two corners, being careful to see that the coin is not discovered sewn on the back. Hold the penny in the right hand and cover the hand with the handkerchief, and under cover of this palm your friend's coin, telling him to grasp the penny which has been sewn to the handkerchief. The right hand is then withdrawn. Now with the left hand jerk the handkerchief from your friends's grasp, at the same time placing your right hand into his pocket and producing the marked penny.

A Trick with Dominoes

A COMPLETE set of dominoes is required for this trick. While talking to the company, secure one of the dominoes, which must not be a double number. The remaining dominoes are then placed in a straight line as in an ordinary game of dominoes, each two adjacent numbers corresponding. Before this is completed you must be blindfolded.

When the dominoes are set out, you offer to tell your audience the two numbers forming the extreme ends of the line. This is quite a simple matter as the domino which was secreted at the beginning always tallies with the numbers at the extreme ends.

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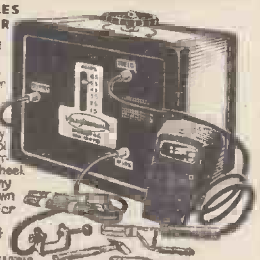

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A Small Electric Motor

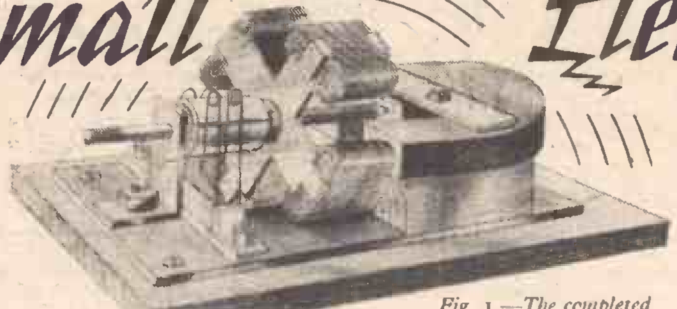


Fig. 1.—The completed motor.

Try This Unit in Your Model Boat!

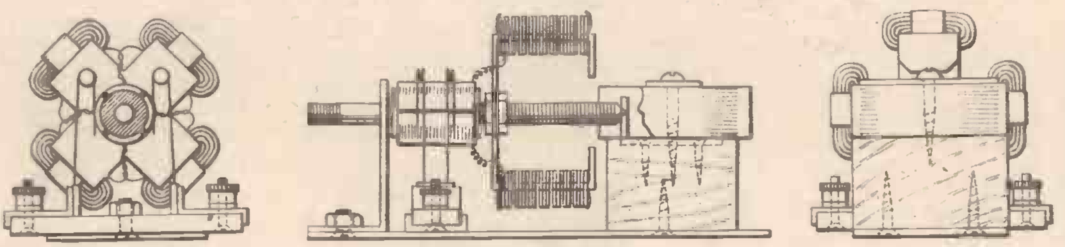
By R. R HUTCHINSON

THIS simple electric motor is designed to produce a relatively high power on a very low voltage (1½-6v.) for small model motor-boats, and can be built quickly and easily with the minimum of tools It has been tried out and works efficiently. The motor is shown in Fig. 1.

First of all a small "Eclipse" magnet must be bought, which is obtainable in most tool shops or model makers' supply stores. This is clamped to a small block of wood, which in turn is screwed to a metal base, as in Fig. 2.

The armature core is cut from a piece of soft iron sheet about 1/32in. thick (Fig. 2) and bent at right angles on all dotted lines to the form shown at A (Fig. 3). Small, thin pieces of brass are bound on with insulating tape or gummed paper, as shown at B, for keeping the armature windings in position when these are completed.

A centre hole is drilled to take the axle and tapped 4 B.A. Each arm is carefully wound with eight layers of No. 26 D.C.C. copper wire all in the same direction, leaving a loop of wire between each arm for connection to the commutator. The two finishing ends are joined together to form the fourth loop. When the windings are all neatly finished, cover with a liberal coating of shellac varnish and bend the brass pieces up and over the ends of the windings to prevent them from slipping. See Figs. 2 and 3.



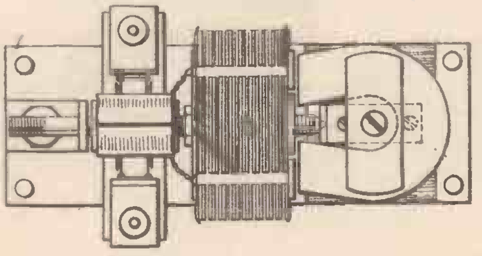


Fig. 2. — Front, side, rear and plan elevations of the motor.

The Commutator

To make the commutator take about 2ft. of thin gummed paper and cut this to 7/16in. in width, damp or, better still, gum along its entire length and roll this tightly and evenly on to a slightly greased ⅛in. piece of rod (the smooth shank of a drill will do), slide off, and leave to dry for 24 hours. Before sliding this off, however, make sure it is going to fit fairly tightly into the short length of brass tube that is to be used for the commutator. This tubing should be about ⅜in. dia. and about 7/16in. long, of light gauge. A piece of old brass gas tubing will do. When the paper roll is perfectly dry and hard, gum the surface with a strong adhesive and force into the tubing, again leaving to dry very thoroughly, with a little of the paper roll protruding at each end. When quite dry cut the brass lengthways into four equal segments with a fretsaw. This forms the commutator, the hole for the axle being exactly down the centre.

The axle is a piece of steel rod 9/64in. in diameter, and is threaded 4 B.A. halfway along its length to take the armature, and at the other end to take some form of coupling to the propeller.

Where no taps and dies are available both the armature and the coupling to the axle can be soldered with equally good results, but it is not so handy for taking to pieces for final adjustments.

The armature is now screwed on to the axle with a nut on each side to keep it square with the axis, and the commutator is forced on close to it (Fig. 2). The two side arms of the armature are omitted in the sketch to show the nuts and screwed axle.

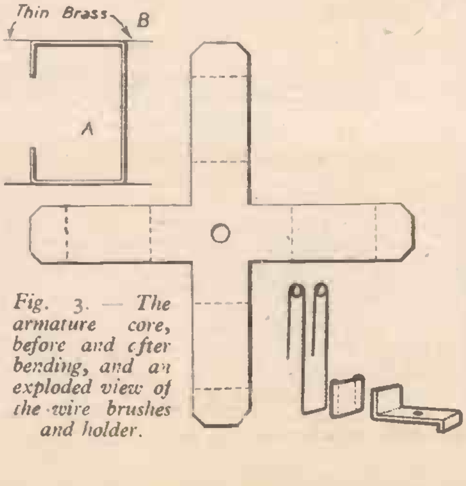


Fig. 3. — The armature core, before and after bending, and an exploded view of the wire brushes and holder.

The end of the axle nearest to the field magnet is carefully filed to a point of about 45 deg. which is pivoted into a bearing made of a piece of odd brass, bent at right angles, countersunk into the block of wood supporting the field magnet and drilled halfway through on its vertical surface to take the point of the axle (Fig. 2). The other bearing is just a piece of brass bent at right angles bolted to the base and drilled 9/64in. to fit the plain part of the axle.

The windings are now soldered to the commutator sections by twisting each loop of wire tightly and soldering to the commutator segment nearest to it. Finally the commutator is adjusted to the position shown in Fig. 1—the cuts opposite each respective leg of the armature. The outer bearing is left out here to show the brushes and commutator details.

The Brushes

Many ways of making the brushes have been tried and the following method has been found most effective. An exploded view is shown in Fig. 3. This consists of a few inches of thin piano wire, about 24 gauge, carefully bent as shown with a single turn at the top to make the brush more springy. A small piece of very thin brass or tinplate is now bent round each leg and the flat side of the brass is then soldered to the brush-holder and terminal strip (Figs 2 and 3).

A small thick strip of ebonite, hard wood, or fibre is now cut and drilled and the terminals fitted, which clamp the brush-holders down firmly, the whole unit being securely bolted to the base plate.

One method of connecting the motor to the propeller shaft is by making a close-wound spring from piano wire, screwing one end to the motor axle and the other to the propeller shaft. This makes an excellent universal joint.

The Martian Atmosphere Restudied

(*Concluded from page 394*)

in Table 1, the band at 0.942 is about three times, the one at 1.135 about 10 times, and the one at 1.379 at least 60 times more sensitive than a band at 0.823. C. C. Kiess was able to detect the bands at 0.942 and 1.135 microns in the laboratory, where a strong source of artificial light was available.

Nonetheless, if water vapour is to be detected in the relatively weak light from Mars by means of the longer wavelength bands, more efficient detectors than the present types of photographic plates are needed. Increased sensitivity could also be obtained from ballon-, rocket- and artificial satellite-based spectrographs.

Wavelength of Band Head (u)	Vibrations 1/1, 1/2, 1/3	Relative Transition Probability
1.379	(1, 0, 1)	—6
1.135	(1, 1, 1)	1,000
0.942	(2, 0, 1)	0.3
0.823	(2, 1, 1)	0.1
0.723	(3, 0, 1)	0.03
0.652	(3, 1. 1)	0.005

Table 1.

Letters to the Editor

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

Flying Saucers Again

SIR,—I have watched with very great interest the correspondence on the subject of "Does 'G' Force Propel Flying Saucers?" and as a member of the Aethenius Society I would like to quote from the Society's pamphlet, "Introduction to the Spiritual Mission of Flying Saucers."

"There are various types of U.F.O. visiting our planet, and they can be summarised as follows:—

"(a) *Mother Ships.* They are cigar-shaped, without appendages, and are used as carrier ships for 'Flying Saucers.' Their length is anything from 1,000 yds. upwards. They are surrounded by a magnetic 'force field' which protects the ship from space debris and atmospheric friction. The 'force field' can be intensified in direct ratio to the velocity of the ship, and causes compass and radio disturbance, car engines to stall, and photographs to appear blurred.

"(b) *Scout Patrol Vessels.*—These are released from the mother ships about 500 miles above the Earth, but sometimes less. They vary in size, but all have a dome and landing spheres. They are capable of performing intricate manœuvres and are also surrounded by a 'force field.'

"(c) *Unmanned Discs.*—These are small silver discs about 12in. in dia. They carry sensitive instruments capable of recording atmospheric conditions and also conditions below the Earth's crust and the sea. They are released from the mother ship and return when their observation is complete. During the war these discs were reported by airmen on hundreds of missions. They named them "Foo" fighters.

"(d) *Cargo Carriers.*—Remote controlled, and surrounded by a 'force field,' they have a plain interior. When necessary they can carry passengers.

"(e) *Green Fire-balls.*—These balls of fire, the colour of burning copper, have always been seen in the vicinity of nuclear tests after the bomb has exploded. Their job is to absorb static radio-activity, and thus reduce the danger of radiation through 'fall-out.' When this is done, they explode harmlessly. The U.S. Air Force have investigated the fire-balls and reported that they cannot be attributed to natural phenomena. Many people would call them meteorites, but there are two good reasons why they are not:—

"(i) Meteorites are rarely the colour of burning copper.

"(ii) The fire-balls travel on a horizontal trajectory, meteorites do not.

"Characteristics of U.F.O.'s:

(a) They are silent, but when very close to the craft a humming sound can be heard to emanate from inside.

"(b) The colours of the craft vary from red to violet. At night-time they emit a luminous or incandescent glow. During the daytime they usually appear silver or gold.

"(c) The saucers are capable of various feats which have astounded observers:—

"(i) The ability to hover and then suddenly accelerate.

"(ii) The ability to climb sharply upwards at great speeds.

"(iii) The ability to attain speeds of 25,000 m.p.h., as at Arney, New Mexico.

"(iv) The ability to turn 90 deg. and acute angles, as well as reverse instantly."

Anyone wishing to contact the originators of the pamphlet should write to: The Aethenius Society, 88, The Drive Mansions, Fulham Road, London, S.W.6.—H. E. FORD (Chorleywood).

[*We should welcome readers' comments on this letter.*—ED.]

Shed and Garage Building Materials

SIR,—In your issue of February, 1958, you published an article on shed and garage building materials by G. Haskell, and this article has a sub-heading under which the author discusses the relative advantages and disadvantages of the various materials now on the market, but there are one or two points in the article which may be misleading.

In the second paragraph there is a remark with which we do not agree; he says: ". . . there is not much variation between firms," and by "firms" we understand him to mean manufacturers of sectional buildings.

In the three types of cladding materials shown in the illustration, he has omitted the tongued and grooved board, which is a better joint than those shown and is one of the advantages contained in our buildings.

It also may be possible to order weatherboard and 2in. × 2in. framing from an importer direct, but if any importer could be found to deal in such small quantities, he would charge more or less the same rate as a local timber merchant.

Please do not think that this letter is prompted by any resistance on our part to the "Do-It-Yourself" movement, but we do think that this article should contain all the facts, and loose statements should be avoided.—J. MORELAND (Robert H. Hall & Co. (Kent) Ltd.).

Home-made Thermometers

The letter below was written by our contributor in reply to a letter we received criticising the method described for heating mercury in our article "Make Your Own Thermometers" in the March issue. Our correspondent was chiefly concerned with the dangers of mercury vapour. E. V. King replies as follows:—

SIR,—With regard to the implication that it may be dangerous to heat mercury in the domestic oven, I should like to point out the following:—

1. Mercury gives off extremely small quantities of vapour at low temperatures. Only the cumulative effect of inhaled vapour of this type is likely to cause mercury poisoning.

2. The vapour given off at boiling point is dangerous, and I was careful to advise filling by shaking and *not* boiling.

3. It is doubtful whether the domestic oven could boil mercury. It will not usually produce a temperature higher than 500 deg. F., while mercury boils at 662 deg. F.

However, to avoid all risk, keep mercury away from children and food and, if using the oven to dry it, keep the oven temperature as low as possible above 100 deg. C., and make sure no food is contaminated.

Alternatively boil in a beaker on a sand bath or wire gauze over a small flame. Do not inhale the vapour. Thirty seconds will suffice.—E. V. KING (Weybridge).

Outboard Motor Boat—Omission

We regret that a short paragraph describing the keel was omitted from the final instalment of the article on the outboard motor boat in the March issue. This was as follows:—

The keel is simply a piece of 1in. × 1in. oak, bedded on white lead and putty mixture along the centre seam of the bottom. Fixing is by means of 1½in. screws about 18in. apart. The stem end of the keel is bevelled to fit against the false stem post, which is cut off and rounded as shown in Fig. 26 (Feb. issue). The keel terminates 4in. short of the transom.

A Review of New Tools, Equipment, etc.

RAWLPLUG "VIBROTO" DRILLING MACHINE

THE Rawlplug Company have introduced an entirely new electric drilling machine which has been designed to combine an intense rate of vibratory action with fast rotary movement for the drilling of holes in all classes of concrete—the special feature being a rapid rate of penetration through a pebble aggregate.

Rawlplug "Vibroto" Drilling machine. The price is £37.10.0 complete.

The ultra-rapid percussion, plus rotation, bores through pebble or aggregate constituent and enables holes of Rawlplug size No. 6 to 20 to be drilled with a speed and accuracy not hitherto possible. In addition to concrete, clean holes can be drilled quickly in granite, stone, engineering and blue bricks, quarry tiles, etc.

The drilling machine is made up from two main units: the portable electric drill motor and gearbox unit, and the vibrating head which is clamped to the motor unit.

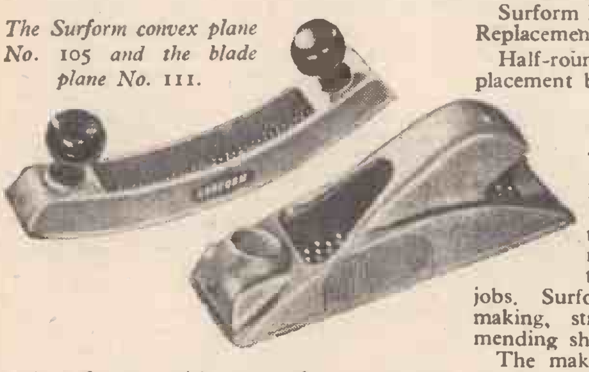
Selection of force and speed of vibration to suit the material being drilled is obtained by turning the knurled ring. The three positions give (a) rotary movement only, (b) light, rapid vibrations, (c) heavy, slow vibrations.

The weight of the Vibroto drilling machine is 9¼lb., length overall 18½in. chuck speed 940 r.p.m., drilling speed is dependent on type of material. Voltages 230/250 (standard voltage). Consumption is 310 watts. Special drills are also available.

SURFORM FILES AND PLANES

FOUR new Surform tools have been introduced by Simmonds Aerocessories Ltd., the manufacturers of the Surform file and the Surform plane. All incorporate a hardened and tempered Sheffield tool steel blade, set with 500 scientifically angled teeth and perforated with 500 holes to prevent clogging.

The Surform convex plane No. 105 and the blade plane No. 111.



The new tools have been designed for the smoothing of concave surfaces (Convex Plane, No. 105 and the Half-round File, No. 103); for work on mild steel, and other tough materials (Surform Fine Cut File No. 102); for quick, one-handed smoothing of edges and small surface areas (Block Plane No. 111. Its fine cut blade will be ideal, especially in awkward places).

These four new tools, together with the Surform standard plane and file are particularly recommended for use with Formica, plastics, plywood and hardboard, where there is a danger of splintering, chipping or splitting, or where frictional heat might damage the material. Excellent results are also obtained with all metals, wood and timber products, fibreglass, asbestos, linoleum, cork, leather, ebonite, horn and bone.

Retail Prices:

Surform Fine-cut File(No. 102): 12s. 6d. Replacement blade: 3s. 6d.

Half-round File (No. 103): 13s. Replacement blade: 4s. 3d.

Convex Plane (No. 105): 17s. 6.d Replacement blade 4s. 3d.

Block Plane (No. 111): 10s. Replacement blade 2s. 9d.

The new tools are not intended to replace any of the existing range, but are designed to facilitate the carrying out of certain jobs. Surform tools can be used for model making, stripping paint, plumbing work, mending shoes and many other tasks.

The makers' address is Simmonds Aerocessories Ltd., Treforest, Glamorgan.

Changes of Address

THE Swisscross Co. Ltd., makers of musical movements and musical boxes, have now moved to 202, Tulse Hill, S.W.2. They were formerly at 116, Winifred Road, Coulsdon, Surrey.

The Publicity Department of the Talbot Tool Co. Ltd. has now moved to K.D.L. Works, Crowhurst Road, Hollingbury, Brighton, 6.

The address of Messrs. Griffin & George Limited is now Ealing Road, Alperton, Wembley, Middlesex.

Woodworker's Vice

A LIGHTWEIGHT portable woodworker's vice is the latest addition to the growing range of tools manufactured by Stanley Works (G.B.) Ltd., of Sheffield. The Stanley 702 vice is fitted with a sturdy clamp uniquely positioned to allow the vice to be attached to a bench, table, sawing stool or any type of working surface up to 2½in. thick. The jaws, which are drilled to allow the fitting of protective faces, can take material up to a thickness of 3½in. They are shaped like an inverted L catering for both horizontal and vertical holding positions. Cast in tough aluminium alloy, the body of the vice has a satin grey lustre finish; all steel parts are plated to give protection against rust. The price is £1 5s.

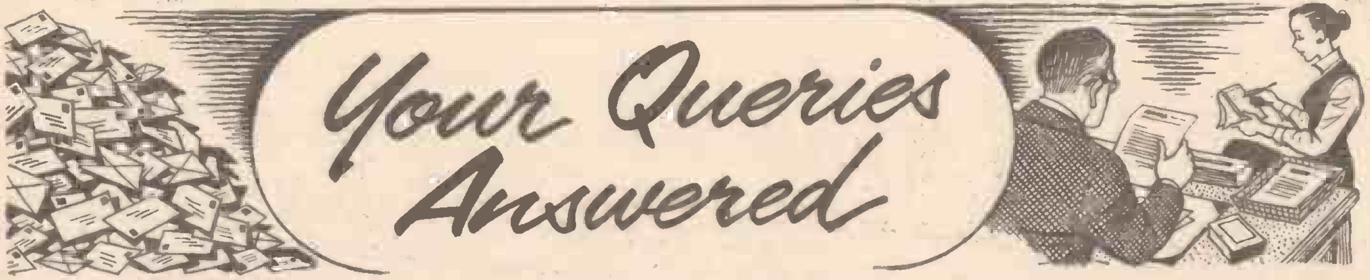
Stanley 702 vice.

Epatam Solder Paints

SOLDER paints of many types for various jobs, solder pastes tinning salts, several types of flux, soft solder and a "Do-It-Yourself" soldering kit are some of the products described in new leaflets issued by the makers, Perdeck Solder Products Ltd., Abbey Mills, Waltham Abbey, Essex. All of these products find many applications in the home and in the workshop and the comprehensive range of materials available includes solder paint for tinning stainless steel. Information on the "Epatam" range is available from the above address.

A New Motoring Atlas

USEFUL to the cyclist as well as the motorist, this atlas of Great Britain is scaled at six miles to the inch. It is primarily a road atlas and the main through routes are clearly shown, both Ministry of Transport A and B class roads being included. Distances between towns are marked, and contours are shown. Also included are 42 simple street plans of the principal towns. The price of the atlas, which is produced by W. & A. K. Johnston and G. W. Bacon Ltd., Edina Works, Easter Road, Edinburgh, is 8s. 6d.



Film Drying Cabinet

I WISH to build a "drying cabinet" for roll of films and plates. The size would be approximately 5ft. 6in. × 14in. sq. What type of heater would be required and is a motor and fan necessary?—J. Lightfoot. (Leicester).

THE degree of heating is unimportant provided it is not so fierce as to cause reticulation. Drying will be greatly hastened by wiping off with a photographic sponge in advance. Most commercial drying cabinets of the type you mention would use a heater of about 500 watts, at the bottom. A metal baffle should be used to spread the hot air, and the bottom of the films must be well away from the heater, which can be of low temperature type. In all probability two or more 100-watt lamps would suffice.

If top and bottom of the cabinet are open, forced ventilation will not be necessary. It will hasten drying, however; only a small motor and fan being required to keep air rising through the cabinet. If more heating is required, so that bulbs are not suitable, two 250v. 1000 watt fire bars, wired in series, can be used. The fan and motor may be at either top or bottom.

It is desirable to allow at least half an hour, as very rapid drying will cause trouble. Small commercially-made drying cabinets do not employ a forced draught, relying on the rising, warm air for sufficient current.

Radio-controlled Boat

I WOULD like to build a model boat using transmitter, receiver and controlling gear as described in a past series in "Practical Mechanics." What type of boat is suitable to house these components? Could you let me know where blueprints could be purchased?—P. J. Curtis (Herts).

MANY experimenters interested in radio-control work build models of boats and ships to their own design and of these a good proportion are of the "Hard Chine" cabin cruiser or M.T.B. type. These are constructed on a keel and a skeleton is built up of ribs cut from plywood. The vessel is covered with 1/16in. thick resin-bonded plywood and often this is covered with a skin of silk (parachute panel) to ensure firmness and water tightness.

Size is very important as there is usually a good deal of weight to be carried. If steering only is contemplated then a boat of say 24in. long by about 7in. beam may be big enough, but for anything at all ambitious (i.e. to include engine speed control and incidentals which most enthusiasts eventually desire) a very minimum size of 34in. long by 10-12in. beam is necessary.

Some suitable commercial kits are as follows:

"Wavemaster" 34in. long × 11in. beam, 69s. 7d. from A. A. Hales Ltd., 45 & 49, Eleanor Road, Bowes Park, N.11.

"Sea Commander" 34in. long × 11in. beam, 70s. from E. Keil & Co. Ltd., Wickford, Essex.

"M.S. Dolphin" 37in. long × 7½in. beam £3 19s. 6d. or £6 12s. 6d. for the de-luxe version from The Model Shop, 18, Blenheim Street, Newcastle-upon-Tyne, 1.

Plans can be obtained from: Model Maker Plans Service, 38, Clarendon Road, Watford, Herts.

Of these a good plan for a radio controlled model is that of an Admiral's Barge.

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.

Self-energised Telephone Sets

I HAVE seen advertisements for self-energised telephone sets. Is the energy produced by vibration and is it electrical current? Does the volume of sound increase this energy?—D. P. Knowles (Leeds).

"SELF-ENERGISED" telephone sets consist of reproducers similar to single earpieces from headphones. When one is spoken into, the armature vibrates, which produces an electrical current. This flows through the connecting lines to the other instrument, where it causes the diaphragm to vibrate, exactly as with a headphone, etc. The output is extremely small, being only a tiny fraction of a ampere. The louder the voice (or the nearer the person is to the microphone) the louder will signals be the other end of the line. Volume equal to a GPO telephone must not be expected, as they use amplifier arrangements.

Moulding the Human Foot

I WISH to make a casting of a foot and ankle (for supply to shoe-maker). Will you please advise as to the best method of making the mould and the most suitable material for the casting which will have to be sent through the post.—G. Kendall (Watford).

THE best way to model a foot will be to make a mould in plaster-of-paris to which a portion of hair has been added to bind the particles together. The mould can be in four parts and each part can be worked upon in succession in the order of casting. In a rough box make the first cast of the bottom or sole of the foot letting the plaster come up to a line on which the fullest curve comes, but not above this. Hold the foot stationary until the plaster has set. Then move the foot out of the mould, drill three of four holes around the impression of the foot and insert dowels.

Dry the mould, shellac varnish it and again insert the foot in it. Now cast plaster over the tops or upper sides of the toes at the same time covering two of the dowels. Let this plaster come back to about the instep. Now dry and varnish this mould replace the foot and cast one side of the foot including as much of the leg as is required, dry this and shellac it, replace it and cast the fourth and last piece of mould. All the four pieces will have to be thoroughly dry before shellac varnishing and then they must be dowelled or in some way keyed together to ensure the relative positions when assembled coming into line.

Before pouring in the casting material the shellac varnished part should be brushed over with vaseline to prevent sticking. Plaster-of-paris is quite suitable for making the final casts especially if strengthened with the addition of hair but if you do not have confidence in plaster, you can use Portland cement. Let this be a mixture of clean sand 2 parts, Portland cement 1 part. The resulting casting will take longer to dry out and will be stronger and harder than plaster.

A third method of casting will be to use one of the low melting point metals, such as Newton's, Rose's or Darcet's, the melting points of which are 205 deg., 212 deg. and 200 deg. respectively. There would be no need to make the foot solid if metal were used. The way to cast would be to pour in the molten metal wait for a second or so and then invert the model and empty it out again. Not all of the metal will be evacuated. It will depend upon how long you wait before emptying and the temperature which the metal was raised to before pouring. Knowledge of this will be gained by practice.

Child's Electric Car

I WISH to convert a child's pedal car into an electric car by using a starter motor. Before starting I should like to know whether a 6 volt or 12 volt motor is more reliable, what type of battery would be required, what type of charging unit is necessary, the ratio of the drive, and whether the drive should be shaft, belt or chain. Can you help?—H. C. W. (Gloucester).

A 12-VOLT series motor, such as a car starter motor, could be used to drive a pedal car. A nickel-alkaline battery would be the best source of power and ten cells would be needed. The batteries could be charged from A.C. mains through a transformer and rectifier. A chain or shaft drive is advised and a speed ratio of 10 to 1 should be suitable.

We think that you will, however, find that such a power-driven vehicle will not be allowed on the public highway, as your child will be too young to pass a driving test or hold a driving licence.

Air Compressor

I WISH to build an air compressor to deliver air at 25 p.s.i. (or more) through a tube ¼in. square. That it should be of very light weight is all important.

What is the best type of compressor to build. What H.P./current is needed to drive it?

Can you recommend any books to solve the problem?—W. R. Stobart (Northampton).

THE pressure required can be provided by a rotary compressor of the sliding vane type, but it is suggested that the vanes should be of steel. Restraining rings should also be fitted to take the thrust of the blades; in order to prevent contact with the casing. These restraining rings fit into recesses in the casing and are free to rotate with the blades. They are machined slightly less than the bore of the casing, the difference being just sufficient to prevent contact of the blades with casing while preventing excessive leakage.

The shaft horsepower will depend upon such factors as operating pressure, capacity and operational speed. Only one of these is given and it is therefore suggested that Querist refers to the "Compressed Air Section" of Newnes Engineer's Reference Book for methods of computation. Current will depend upon the factors shaft horsepower and voltage/electricity supply.

There are few books dealing with the subject of compressed air. It usually forms a section of standard reference books, as the one quoted. Other references are to be found in text-books on thermodynamics.

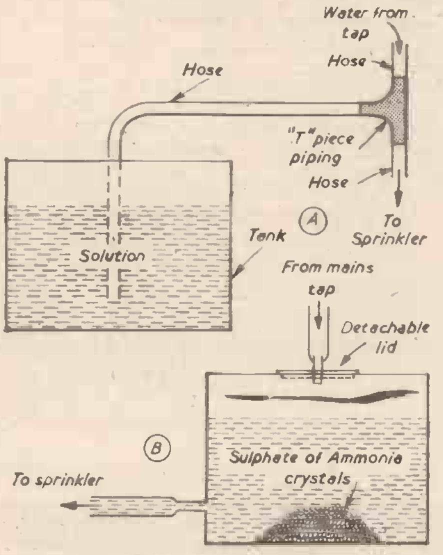
Telescope Modification

I HAVE received the Astronomical Telescope blueprints and wonder if it is possible to make the telescope which is x80 magnification into a more powerful one by different lenses in the eyepieces.—M. Sutcliffe (Leeds).

THERE would be no gain or advantage in making this telescope more powerful. A magnification of 80 diameters is a very appreciable power and you would see no more detail with higher magnification. We think too that the eyepiece is as fine a job as you can expect to be able to make. A higher power involves shorter focus eyepiece lenses and we think that the only way to mount them accurately would be in an all-metal eyepiece.

Spraying Mixed Solutions

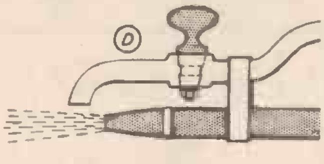
I WISH to dress my lawn with sulphate of ammonia solution, two gallons to each square yard. The lawn is 1,000 sq. yd. I have tried to pass it through the garden

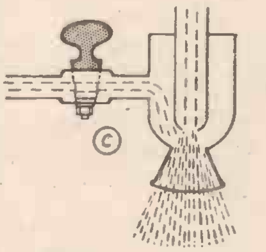


Unsuccessful Methods.

hose, using the methods drawn above. In scheme at A, the mains water rushing through the T-piece was intended to suck the solution out from the tank and carry it (diluted of course) to the sprinkler. Unfortunately the water flowed into the tank as well as out through the sprinkler—mains pressure here is extremely high!

I also tried the device shown at B, but the container burst under our mains pressure. A simple gravity operated system, using just a raised tank with a tap at the bottom connected to a hose was found too slow. Can you suggest an alternative?—K. J. Style (Surrey).





Two suggested methods of mixing.

THE problem of watering your lawn with amm. sulphate depends upon the proportionate lengths of the pipes. We are referring to the tank and T-piece shown at A in your sketch If the pipe to the solution tank and to the sprinkler were equal then the water would divide almost equally and almost one half of it go to the tank. The best way will be to bring the supply of amm. sul. down to the sprinkler and let the high pressure water take the form of a jet below the introduction of the solution. On the solution pipe there must be either a non-return valve or a cock. This arrangement is shown above at C. A more simple device will be to bend the solution pipe down outside and let the solution enter the jet by gravity as at D.

In either case the solution tank must be quite near to the jet and the tank may be on wheels and be made to follow the jet movements by pushing it.

Loco Wheels on a Curve

I UNDERSTAND that the wheels of a railway engine are on fixed axles. This being the case, what happens when it travels round a curve?—R. Whitehurst (Derby).

YOU are correct, all wheels are permanently fixed upon the axles. When a locomotive or other vehicle negotiates a curve two things happen. Firstly there is a certain amount of side movement of the wheels between the rails and the two wheels are coned, each wheel being a little larger in diameter next to the flanges, consequently the wheels move outward on the rails and tend to make the smaller diameter run on the inner rail and the larger diameter on the outer rail. Note we say "tend" to make them so run.

However, differences in the wheel diameters is not sufficient to meet all curves excepting perhaps those of the largest radius and so some slipping of the outer wheel takes place.

Covering Creosote

A JAR of creosote used for staining beams was upset in our loft and has penetrated through the hall ceiling and down the walls. The ceiling is composed of plaster board. What can I put over the marks to prevent them showing through when I redecorate?—A. E. Johnson (Northampton).

COAL TAR products are very penetrating and will bleed through oil paints unless sealed with a barrier coat.

We recommend that you treat the stained area with either two coats of sealer, such as knotting or aluminium paint, and then follow with normal oil paint.

Information Sought

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

Automatic Roof Closing

COULD you please give me the details for the construction of the device, fitted to some open cars, which closes the roof as soon as rain falls on it.

I am only interested in the rain detector and not in the mechanism for closing the roof.—JOHN H. REID (Edinburgh).

Air Pump

I WISH to construct a twin-cylinder air pump for aquarium use.

I have an induction motor rated at 1420 r.p.m., which I would like to use as the motive power. Can you help?—E. MANNING (Exeter).

Dartboard Renovation

I HAVE in my possession an old bristle hair dartboard. In some places the bristles have risen from the base of the board. Could you please advise me how to renovate it?—R. C. O'DELL (Bedford).

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300 ,, ,,	6in.	MI/FR	150/-

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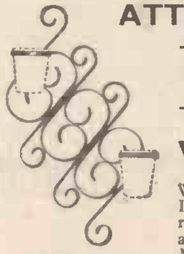

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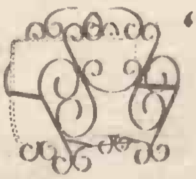

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THE Cyclist
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WHAT I THINK By F. J. C.

Can We Raise the Standard?

IN the early days of cycling, before the advent of the motor car, when it was the "thing" to ride bicycles, the pastime attracted men and women from the higher grades of society, and they conducted themselves with decorum wherever they went. This state of affairs, however, did not exist for very long, for as soon as the C.T.C. and the N.C.U. commenced organising clubs, cyclists perigrinated in mobs and not as singles or in pairs. It is a fact, also, that cycling expanded as prices came down and the machine was within the means of the lower-paid classes. A restaurant or tea house bearing the sign of one of the national organisations was an indication that you would receive good food, served under pleasant conditions and with excellent company. To-day there is no such assurance. It is unfortunately true that an otherwise well-mannered individual becomes a bear as soon as he goes out on a club run. The tea shops are places to avoid. You are likely to be hit in the eye with the remnants of a bun or witness the room being turned into a bear-garden. The conversation is of a low order, and some of these club cyclists are not those whose company you would seek for pleasant conversations on a country run. Club life, as far as club runs are concerned, has developed into organised hooliganism, and one has only to remember that disgraceful display at the Cycling Concerts at the Albert Hall in years gone by to realise that something ought to be done to raise the standard of conduct of cycling clubs generally.

Most club cyclists are of the militant type, always fighting for their right, always imagining that motorists want them off the road. They are not entirely to blame. The militant attitude of the C.T.C. and the N.C.U. has been largely responsible for breeding this attitude of hostility. Many tea shops have closed their doors to cyclists. Every week-end one can witness a pigtail of cyclists pelting down the road, hurling invective at motorists, or making objectionable remarks. Some of the clubs are deliberately obstructive and would prevent vehicles passing. In the beginning of club life things were different. The club had its own uniform when it sallied forth. The captain led his members and a bugle was used to call them to order. Members were proud to wear the badge of a particular club. Unless you wish to go in for racing, in which case you will have to join a club, there is really little advantage in membership. A club riding *en bloc* is not a pleasant experience for some of the members—the slower ones. The club must pelt along at the same pace until it reaches the tea house and the unrestrained levity usual on such occasions. Solo riding in my view has a far greater fascination; if you wish for cheerful conversation you can always ring up a friend or two and ask them to meet you at a certain place for tea, so that you arrive by your individual route and in your own individual time.

Low tide at Isleworth. Looking towards the old town from the Middlesex bank near St. Margarets.

History of the Cycle Trade

I WONDER that the British Cycle and Motor Cycle Industries' Association does not commence the immediate preparation of the history of the bicycle trade, whilst those who could contribute so much factual data are still alive. The bicycle was the father of the motor cycle, the motor car, and the aeroplane, and hundreds of famous names are, and have been, associated with it. Dunlop wrote his "History of the Pneumatic Tyre," and has therefore left to posterity a great deal of information concerning the early days of air tyres, and a fascinating story it is. The late H. H. Griffin spent the best part of his life ferreting out the history of the bicycle, but the last published edition of this work was in the early part of the present century and much has happened during the past fifty years in the world of wheels. H. O. Duncan produced a monumental work in collaboration with Jean Vavin, but unfortunately it was badly compiled, badly edited and badly arranged. It lacked classification, chronological sequence, and worst of all, for a book of such monumental size and large number of pages, it lacked an index. If you wish to find any particular item of information, you will spend hours wading through this otherwise interesting book. H. O. Duncan was a vain man. He thought he was far more important than he really was, considering his practically non-existent achievements in the world of wheels. You will find, for example, several references to a "fine old English gentleman—H. O. Duncan" which is about the limit of conceit in the book of which he was the author, especially when the article merely deals with the fact that he won a club handicap in a small field of riders. A great deal of information is also available in books such as the "History of the C.T.C." "The History of the Catford Cycling Club" and similar books. No doubt, the Association has a library of old cyling books from which a competent historian would be able to compile a complete and connected narrative. Although Duncan spent several years on his book it was a complete mess. He was not a qualified historian. I would also warn the trade to accept with the greatest reserve any of the statements made in print by the late Bartleet who wrote his extremely inaccurate "Bartleet's Bicycle Book," at one time published by Dunlop, who were finally forced to give a large percentage of the edition away.

There is also the late Sir Arthur du Cros's book on the "Romance of Wheels" which not only dealt with the history of the pneumatic tyre and provides a wealth of unquestionable data but deals also very fully with other matters concerning cycling, including the dramatis personæ.

Sir Arthur bequeathed the copyright, photographs and blocks in this book to me, but I should be glad to place any of the material at the disposal of the British Cycle and Motor Cycle Industries' Association if they care to get into touch with me. There is also a fund of interesting cycling facts in "Every Cyclists' Pocket Book," published from the offices of this journal at 7s. 6d. Several generations of cyclists have grown up in the past fifty years who are quite unaware of the history of the industry which makes their machines.

Roadster Brakes

THESE brakes are always used with the Westwood type of rim and the general layout of a typical front brake is shown in Fig. 1. As can be seen from the diagram, when the lever is applied, the rod part of it turns in the two blocks, actuating the short lever at the other end. This imparts a lifting motion through the vertical rod to the stirrup; thus the blocks are brought into contact with the rim. Two small extension rods on the bottom of the stirrup are fitted inside two holes in guides attached to the fork blades. These guides hold the brake blocks in place against the pull of the rim when the brake is applied, and, as the stirrup is trying to spring outward, the angled rods and clips help the blocks to return to the off position.

Adjustment

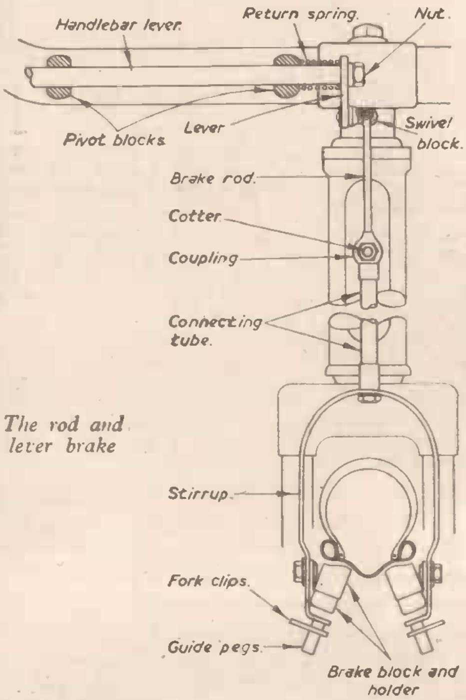
The height of the blocks in relation to the wheel rim is adjustable by means of the rod sliding in the tube (see Fig. 1). To make an adjustment, loosen off the nut on the cotter, adjust the stirrup to the correct height, make sure that the brake lever is in the down position and then re-tighten the cotter nut.

The Rear Brake

Adjustment of this is a little more complicated; the rod and tube portion from the handlebars leads to a bell crank and from there along the down tube to a pivoted link near the bottom bracket. Connection from here to the rear brake stirrup is by means of another rod and tube adjustment. A return spring is fitted to the link.

To adjust the brake, first loosen the cotter nut as on the front brake and then the one on the bottom bracket connection. Pull the bottom link back to its limit and hold it while the brake block position is adjusted and then tighten the cotter nut. Now tighten the handlebar cotter nut. This procedure ensures maximum brake efficiency, but if it is found that maximum travel is not provided by this method, check that the clips holding the bell crank and the link at the bottom bracket have not shifted. It may be found that the rod between the bell crank and the bottom bracket link has to be shortened. This is done by removing the bell crank, loosening the nut on the rod and then screwing the forked piece further on to the rod. Finally the nut on the rod is re-tightened and the forked piece attached again to the bell crank.

How the Rod and Lever Brake Works and How to Adjust it



The rod and lever brake

Pump Maintenance

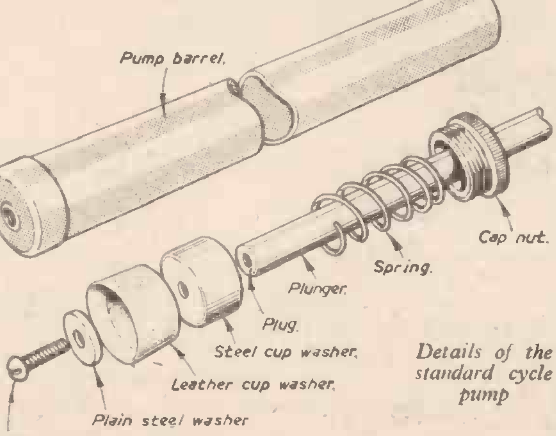
Make Sure it is Working Properly and Avoid Unnecessary Work

THE ordinary cycle pump is a very simple device and seldom needs maintenance or repair of any kind. The connector needs replacement every now and then and it is hardly worth while trying to repair this. Sometimes, when one end af the rubber tubing splits it is possible to cut off the split part, refit the shortened connector on to the brass end and bind it into position with wire. New connectors, however, are not expensive to buy.

Replacing a Washer

The leather washer on the pump is the only part which is subject to wear. To replace this unscrew the cap nut at the top of the pump barrel and withdraw the plunger. The end of the plunger will appear as in Fig. 1, although the parts here are "exploded" for clarity. Remove the screw which will release all the parts and find a washer which is a good fit in the barrel. The pump is reassembled as shown in Fig. 1. It is a good plan to soak the leather washer in castor-oil before fitting it. A few drops of lubricating oil on the barrel of the plunger is all the maintenance that is required.

It is worth while experimenting with several leather washers until the best one is found. Very few of the average cycle pumps in use on bicycles are ever working at the maximum efficiency, which is a pity because much unnecessary work can be avoided by having an efficient pump.



Details of the standard cycle pump

Tightening Mudguard Rivets

THERE is nothing more annoying to the cyclist than a persistent rattle, and one of the worst rattles than can occur is caused by loose mudguard rivets. Rivets are used to hold the strips of metal inside the mudguard to which are fitted the mudguard stays. When they wear loose, these strips vibrate against the mudguard itself, thus causing the irritating noise.

To eliminate this rattle remove the mudguard from the machine and hold it with the head of the loose rivet against a flat metal surface. Then with a small peen hammer tap the spread end of the rivet on the inside of the mudguard until all looseness has disappeared. Sometimes, if this fails to eliminate looseness, new rivets must be fitted. If a rivet is so worn that replacement is necessary, it is seldom very difficult to remove the old one—a file and a small hammer and punch being the best tools to use. The new rivet is fitted by passing it into position and placing the head against a flat surface; then hammering the protruding end of the rivet until it spreads.

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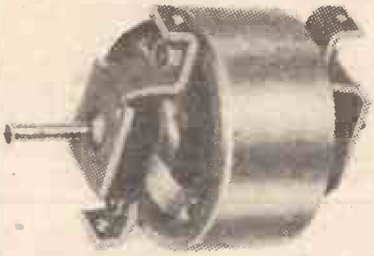

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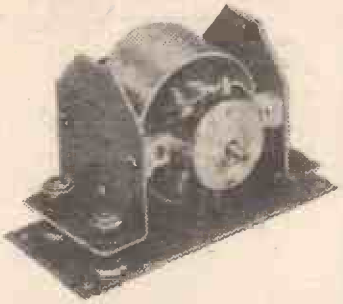

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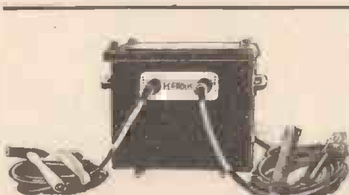

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The Practical Photographer

Monthly Supplement to "Practical Mechanics"

A SMALL PRINT TRIMMER
Simple to Make : Efficient in Use

THE base is made of wood and its size will of course depend upon the maximum size of print which has to be trimmed. The dimensions shown are adequate for dealing with small prints, but may easily be modified to accommodate ½-plates and wholeplates.

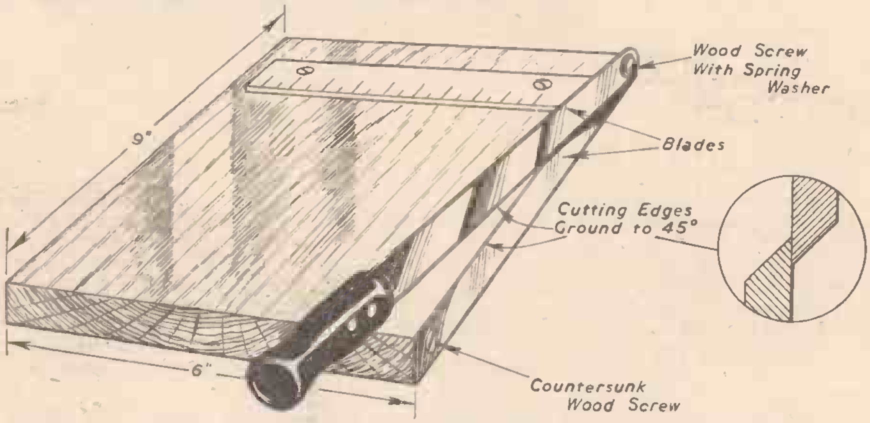
The measuring scale is a flat piece of aluminium marked out in inches and quarter inches, although part of an old steel or boxwood rule could be used.

Two machine hacksaw blades will be required (the normal hacksaw blade is too thin for the purpose) and the teeth ground off. Next they must be heated and the ends cut off with a chisel and squared off by grinding.

The holes for the pivot end are the original holes in the blades but the other ends are drilled and countersunk with an ordinary hand-drill—a fairly simple operation as the blades have already been softened when they were cut to the required length.

Both edges must be ground to 45 deg. as shown in the sketch and finished off with an oil stone. A wood screw of suitable size with a spring washer is used for the pivot.

The handle could be fashioned in wood, either in one piece or in two halves and a screw passed through it and the hole in the handle to provide a firm fixing. Alternatively a small piece of garden hose could be forced over the end of the blade to form the handle.



Details of the print trimmer.

Mounting Prints

THE photographer who wishes to save money when mounting a large number of prints, might do well to remember that starch is useful for this purpose.

Put about a teaspoonful of pure starch into a flask and add cold water. The water should be added a few drops at a time and the mixing done with a spoon, until a stiff mass results. Pour on boiling water to make 3-4 fl. oz. and the mixture should take on a jelly-like appearance. Allow to cool and then skim. Obtain the starch from a chemist.

To use the mountant, lay the prints (still wet) face down on a mirror or piece of plate glass, cover the backs of the prints with the paste, using a stiff brush. Lift the prints off one at a time, lay into position on the mounts and sponge lightly with a damp sponge.

What is Blooming?

THIS is a question one often hears asked. Blooming when applied to new lenses consists of an even coating of magnesium fluoride. This coating is very thin, is purple in colour and is applied by deposition.

Its purpose is to suppress the wasteful scattering of light which occurs when light is refracted on the lens surface. When the lens is coated, image quality is improved and the speed of the lens increased.

A coated lens is easily damaged and should be treated very carefully. A lens cap will eliminate a lot of dust and when the lens is cleaned, a camel hair brush and lens tissues should be used.

The coated lens will be found to show the greatest improvement with colour film.

A Vest-pocket "Tripod"

By H. JOSEPH


Fig. 1.—The "tripod" in use.

PROVIDED you already posses a ball-socket tripod end, as most photographers do, all that is needed to make the gadget shown in Fig. 1 is a stout wood-screw and a short metal crossbar, which can be made from scrap.

Fig. 2 shows what is wanted and the details are left to the handyman who should have no difficulty in threading the end of the wood-screw from which the head has been removed.

The method of using is to make a hole with the pointed end of the crossbar and screw in the screw. Next screw on the tripod ball-socket end and then the camera. A tree (as in the illustration) or some other place to fix the screw can usually be found. A stick could be cut and pressed into the ground and the gadget screwed into the top or better still, a walking stick carried for the purpose.

With this simple device the camera can be fixed in positions which would be impossible for the conventional tripod. Where great depth of focus is required and light poor, it will be found invaluable.

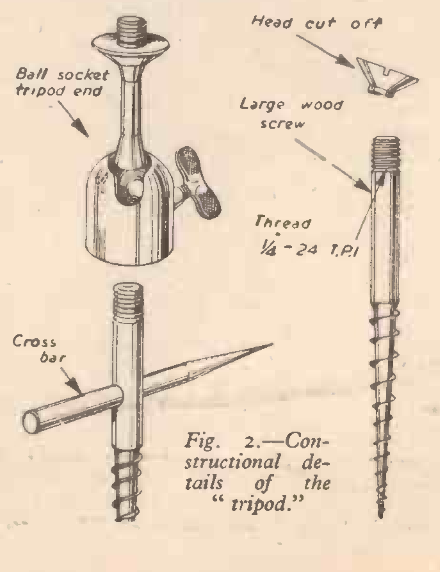


Fig. 2.—Constructional details of the "tripod."

CHILD PORTRAITURE With one lamp

(Left)—One lamp from front plus little daylight from left. (Right)—Sunlight as main modelling light and artificial light as fill in.

An Economical and Simple Technique is Discussed and Illustrated

By E. C.

FOR the photographer who has occasional requests for photographs of the children of friends and relatives the best method to obtain natural expressions from subjects is to photograph them in their own homes. Here is shown the type of picture possible with the very simplest of equipment; i.e., a camera and one photoflood in a reflector—an outfit which is easy to carry!

This is not an article on the psychology of photographing children but it is felt that the more simple the apparatus and proceedings are the less conscious the child will be of something special going on. The first essential then is a really efficient reflector with a large, highly polished surface; the shallow wide reflectors will naturally give the greatest spread of light and avoid any tendency towards the spotlight effect sometimes met with in deeper types. It is necessary, as far as possible, to avoid contrast lighting for the type of subject under discussion. One photoflood lamp and perhaps a single layer of muslin as a diffuser completes the equipment.

Taken on a very dull day with no help from daylight. Lamp at top right.

(Right) Lamp from right. Daylight almost as a back light.

Lamp a little right of centre with daylight to help modelling.

Lamp from left; diffused daylight from right.

No Stand Required

It has always been found useful, unless their presence is otherwise inadvisable, to have the lamp held by a relative or friend and thus dispense with a stand. By working in this manner the photographer can see the lighting effect from his position at the camera and can ask for the lamp to be either raised or lowered, moved to one side or the other, without the need for numerous adjustments to a stand and several trips between camera and lamp. He is thus able to keep his attention and camera focused on the child, who is less likely to fidget.

To obtain good modelling the lamp should be held to one side of the camera and a foot or two higher than the model, depending, of course, upon individual circumstances. Particular points to watch are strong shadows in eyes and under the chin—if these appear too fierce the lamp should be taken further back and exposure correspondly increased.

Daylight and Artificial Light

Natural light is very useful as an aid to the single lamp, but it must be used with care; for instance, the response of the film to artificial light and daylight is different, and some experience is necessary before one is able to balance the two with any confidence. Strong sunlight as a side or back light is usually too strong, but a rather cloudy day will provide just enough light to give an accent to the portrait, thus making it rather more interesting. Furthermore, if the model is facing a window giving a soft light which fills in the shadows, the artificial light can then be used more boldly and yet be always controllable. On the other hand, natural light, if of good quality, can be used as the main light and the photoflood as the fill in.

Light colours are nearly always preferable for children's clothing, at least from the photographic point of view, and they are also useful in helping to throw light into shadow areas thereby reducing the contrast. It is, in fact, the question of high contrast, which is one of the chief obstacles to be considered when using one lamp only, and all means of reducing it by employing light surroundings should be employed. Exposure times will vary considerably, of course, with the brightness of the surroundings and the efficiency of the reflector, but if the fastest films are used and the lamp, presuming the use of a number two flood, is held at about 6ft. from the model, a stop of f5.6 can be used with a shutter speed of 1/50 sec.

THE BOX CAMERA

For the Beginner in Photography the Box Camera is Explained

By J. C. LOWDEN

A GENERAL study of the simple box camera will give a thorough grounding in the basic principles of photography, since the box contains all the fundamentals.

Basically, any camera consists of a light-proof box. Inside this box is held a sheet of material sensitive to light (the negative film). When the light, reflected from a clearly defined image, falls upon the sensitive surface it is retained by the film as a latent image. This image is later revealed by chemical action, giving a negative picture of the original.

The light reflected from the image is collected by the lens, which also focuses it upon the film. The light, of course, must fall upon the film at only the right moment of time, and for only a very short period of time. The admission of light, therefore is controlled by a shutter mechanism, capable of giving a short "exposure."

The great majority of box cameras in use to-day take negatives of size 2¼in. × 3¼in. (sizes 120 or 620). While they are not intended to produce negatives which are to be greatly enlarged, postcard-size prints can be obtained which compare favourably with more expensive models.

The outer casing of a box camera varies with each manufacturer, and even each model produced. Some still adhere to the traditional black box, while many others are most attractively styled and finished.

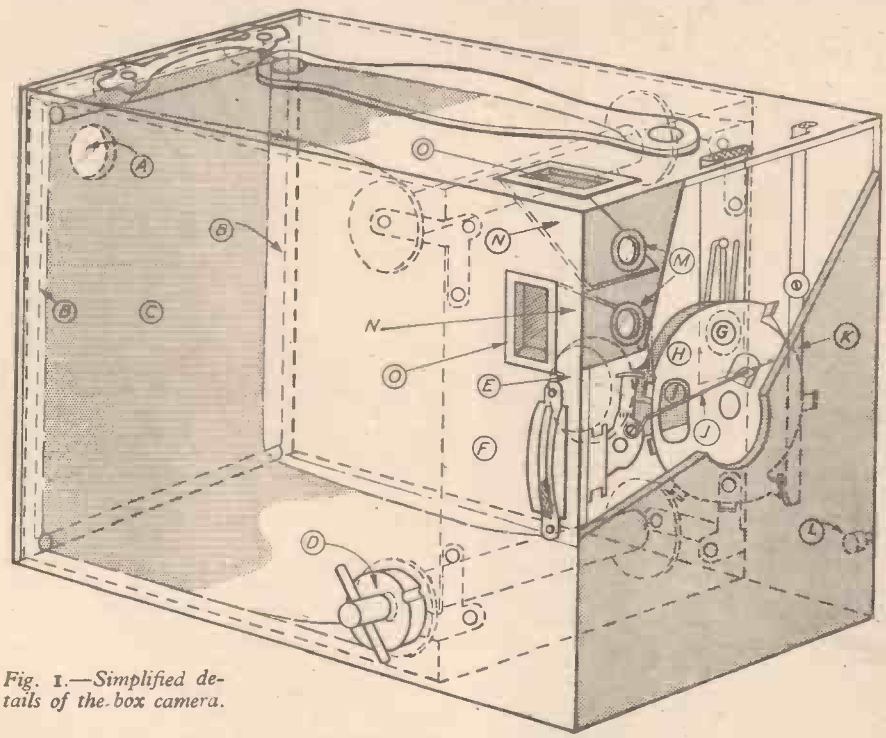


Fig. 1.—Simplified details of the box camera.

"Folding box cameras" are simply cameras which, while having the same essentials as a box camera, are designed to fold or reduce their bulk in other ways. This increases "portability" (sometimes at the cost of efficiency).

The Lens

The lens of a box camera is normally a single meniscus achromatic, so fixed by the designer that it will give sharp focus on an object at a distance between 10ft. and 30ft., with objects beyond that distance in tolerably sharp focus. It is one of the disadvantages of the lens that it will not yield a sharp image at distances shorter than 10ft., but for moderately "close-up" work a supplementary lens (portrait attachment) can be fitted. If used with care this will give a clear "head and shoulders" effect at about 5ft.

The efficiency of a lens in terms of light transmission is invariably stated by an "f" number, the smaller the number the greater the efficiency of the lens. In a box camera the efficiency of the lens is low, usually f11. Some more ambitious boxes are fitted with a lens of the order of f7.7. In these cases this extra "aperture" is normally stated on the instrument or in the instruction book, and the extra facility of a simple sliding "stop," to reduce the diameter of the lens so as to restrict the amount of light, is fitted. A typical older-type box camera is shown in Fig. 1.

The Shutter

The lens, then, governs the *amount* of light which falls upon the film. The shutter, which controls the *time* for which it falls, is the next important component. In box cameras, the shutter is a disc of metal, situated immediately before, or behind, the lens. At rest, the disc covers the lens, obscuring all light. The disc is pivoted, and is rotated, or partly rotated, by a spring actuated by a lever or button which protrudes outside the box. An elongated slot in the disc allows light to reach the lens for a restricted time (the exposure) while the disc is in motion. In an average box camera the exposure is normally 1/25 sec. The actuating mechanism is so arranged that the shutter is ready positioned for the next exposure without any further action on the part of the user.

In cases where the light is so poor that the exposure of 1/25 sec. would be insufficient, a slide or button is placed outside the box. When this is in action, the travel of

Fig. 2.—This picture which required a high shutter speed, wide aperture lens, accurate focusing and speed view-finding is outside the scope of the box camera.

Key to Box Camera Parts

A—Red window. BB—Film Guides. C—Film. D—Film wind. E—Lens. F—Inner lens panel. G—Portrait or filter attachment. H—Shutter disc. I—Exposure slot. J—Shutter trigger spring. K—Time exposure slide. L—Flash Contacts. M—Viewfinder lenses. N—Reflector. O—Viewfinder screen.

the disc is so restricted that the shutter is opened to admit light, and remains open until it is closed again by a separate action of the lever. This is, of course, "time" exposure.

The exposure time of 1/25 sec. is, of course, very slow by modern standards, and if a clear image is to be obtained there must be no movement on the part of the subject, and the camera must be held still. This is especially essential in the case of time exposures. To help in this vital "steadying" a few models on sale to-day are fitted with a tripod bush, by which the camera may be fixed to a tripod or clamp.

The Viewfinder

In the past the worst drawback of the box camera was the tiny, murky scrap of ground glass into which the photographer had to peer, in order to define the limits of his picture and to compose his work. The better modern boxes are fitted with either eye-level sights, through which the field can be seen in miniature, but fully lighted, or with a large, bright focusing screen. With this bright, hooded image, the box camera approaches, in quality of view-finding, its expensive brothers of the "reflex" family.

At one time, indoor photography was a "hit or miss" matter of estimated time exposure, but any box camera with "time" facilities will give excellent results with the inexpensive flashguns on sale everywhere. The bulb is held in a simple holder, preferably with a reflector. The camera is held rigidly on a support, and the sitters posed. The shutter, set on "time," is opened, the flashbulb fired, and the shutter closed as quickly as possible. This simple method really works.

Most box cameras are nowadays designed with an internal synchronising device. A flashgun lead is connnected to a standard outlet on the box. As the shutter disc rotates, a full contact is "made," just as the lens is fully uncovered. The flashbulb then fires, giving ample light at exactly the right instant.

Another facility offered in several box models is a fitted portrait attachment. By the operation of a lever or button a tiny supplementary lens is slid across the main lens, allowing a head and shoulders or other close-up picture to be taken. Similar in structure and operation, but different in function, is the built-in filter. This is a disc of (usually) pale yellow glass. When this is slid across the lens, the blues in the picture are rendered darker. This is especially helpful in the depiction of skies, where the blue is darkened, and the white clouds, so often lost in an unfiltered picture, are greatly strengthened. This effect is more marked with panchromatic film.

Colour Film

It may sound very optimistic to consider the use of colour film with a box model, but with one of the better cameras using one of the faster negative colour films such as Gaevart N.5. it is possible to obtain fully exposed negatives. These materials are not often enlarged, on economic grounds alone, and the standard of sharpness given by a good box camera is perfectly adequate on the "contact" size positives as pro-

Fig. 3.—This photograph was taken with a box camera after the roundabout had stopped.

cessed by the suppliers Care should be taken to ensure a still, well-posed and brightly lit subject at the correct range, a procedure which will give excellent pictures whether colour or monochrome is used. The two photographs, Figs. 2 and 3, give an idea of the camera's scope, and, of course, point out its limitations.

Is Your Lens Clean?

John Dee Points Out the Dangers of Neglect

AMATEURS who put their cameras away during the winter months and take them out for the summer only often overlook an important precaution.

Look at the photograph on this page with its light-spread round the high-lights, which was passed on for examination by a thoroughly mystified owner who had quite a good camera and who, up to a short time previously, was getting good pictures.

The trouble was a dirty lens, and once the optic was cleaned, bright, well-defined pictures were once more obtained. But for some reason the cause of the trouble was quite unsuspected. Pictures which fall off badly in crispness may also be due to the same cause.

The Reason

The image on a film is built up by rays coming from every point on the subject to *all* parts of the lens, reassemblage taking place on the farther side. A limited number of rays getting through can form a sharp image as long as the few that do get through are clean and sharp. Thus a lens can be anything but flawless and still give a satisfactory picture.

When the glass, however, becomes completely smeared all over its surface, as it can when put away, no sharp rays can make their way through anywhere—and the pictures are blurred.

With a small amount of smearing the effect may only be a little less contrast in the print, but as smearing gets worse this can become real fuzziness, and bad "filming" can bring about light-spread as shown.

Fig. 1.—Notice the flare around the shirt in this picture. It was caused by "light scatter" due to a dirty lens.

Cleaning

Before using the camera then, inspect the lens and give it a clean. Outside and inside components should be wiped over.

Lenses in most folding cameras are not hard to reach for the front and rear cells usually screw out. With certain box cameras it is not so easy to get at the glass, and, unfortunately, it is in this kind of camera that "filming over" most often takes place. In all cases the smearing can be seen by opening the back of the instrument and looking through it up to the light.

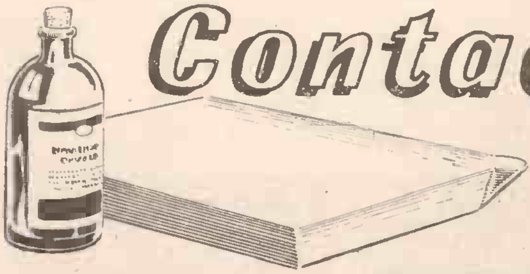
The utmost care must be taken when cleaning for optical glass is not very hard and can easily be scored by minute scratches if the softest of materials are not used. Should the lens be merely dusty a small camel hair brush run over the surface will do all that is required. If, however, there is definite filming a more positive cleaning method is needed.

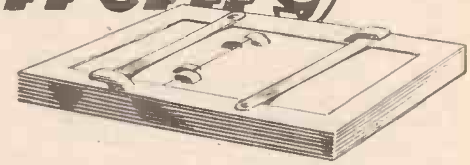
Chamois leather dipped in pure methylated spirits is best for the job; even so carry out the cleaning with as few movements as possible and avoid anything like hard rubbing. Rubbing repeatedly with unsuitable material can destroy the surface polish and bring about the same loss of definition as a deposit of grease.

A Thorough Check

While thinking about overhauling, check other parts of the camera for cleanliness. Work over the inside of the bellows or box with a small paint brush, slightly moistened. This brings away all particles of dust which, settling on the film, cause spots of clear gelatine that print as black dots on the final picture. Clean, too, the film track as grit here causes horizontal scratches. The camera case also should receive attention and be made free of dust.

Contact Printing





FOR THE BEGINNER

Simple Step-by-step Instructions

LAST month we gave simple instructions for developing your film and now here are some simple instructions for making your own contact prints.

The equipment required is shown in Fig. 1. The fixer and developer can be the same as were used to develop and fix the film, but make sure when mixing that the right quantities for contact or "gaslight" papers are used. In addition, a stop bath will be required and this can consist of 1oz. of potassium metabisulphite dissolved in 20 oz. of water.

Three dishes will be required, one small one, say $\frac{1}{4}$-plate size for the developer, a larger one whole plate size for the fixer. It is best to use proper photographic dishes for these two chemicals, but an ordinary pie dish may be used for the stop bath.

Fig. 1.—The equipment and materials required for contact printing.

It is best, if possible, to work in the kitchen, so that the prints on being removed from the fixing solution can be transferred to a large amount of water ready for washing. If the printing is carried out in some other room, the washing-up bowl will act as a substitute. Alternatively, the bathroom can do duty as the darkroom instead of the kitchen.

In the kitchen, the table can be moved under the electric light and the height raised by means of a box or something similar so that the printing frame can be brought nearer the light, and always placed the same distance from it. The light should shine directly down on to the printing frame, but should be shaded so that it does not shine directly on to the developing and fixing dishes, a piece of yellow or red cloth draped over the shade should be suitable.

The Printing Frame

A typical printing frame is shown in Fig. 2, and consists of a frame with a piece of glass resting on a flange inside. There is also a back which fits inside the frame and is fixed in place by means of spring clips.

When loading the frame, place a mask in first. This is a piece of opaque thin paper cut to fit the frame and an opening cut in it slightly smaller than the negative. It masks a narrow strip along the edges of the paper, giving a neat white border to the prints.

After the mask, the negative is placed in the frame (dull side up) and this is followed by the printing paper, coated side down. A good way to tell the coated side of the paper is to note the way it curls, the coated surface being the one inside the curl. When all is in place, the back is clamped in place by means of the spring clips and a piece of cardboard placed over the front of the frame. Then the whole is transferred from the shaded side of the room on to the printing platform under the light. The cardboard is removed and the exposure commenced.

Determining the Exposure

The best method of determining the correct exposure required is to use a test strip. This is merely a strip of contact paper placed in the frame across the most important part of the negative instead of the complete sheet of paper. Cover with the cardboard and place the printing frame in position for the exposure. Remove the cardboard, count up to five seconds and then move the cardboard across to cover one-third of the strip, count another five seconds and then move the cardboard another third of the way along the strip. After another five seconds has elapsed cover the test strip completely and remove the printing frame. The three sections of the strip have respectively been exposed for 5, 10 and 15 seconds.

Slide the strip into the developer and develop for the time stated in the developer instructions and then note the part of the strip which shows the best gradation. If all three are under-exposed, expose another strip, giving longer exposures; if over-exposed, move the printing frame farther from the light and expose another test strip.

Developing and Fixing

The procedure for loading the printing frame and exposing the print has been described. When this has been completed, the print is transferred to the developer in which it is immersed quickly and completely. Prints should be allowed their full time in the developer; it is a mistake to over-expose them and then to take them from the developer before they develop too far, although it is possible to save a print from being completely wasted by this procedure. Rock the dish gently while developing is proceeding.

When development is complete, rinse the print in the stop bath (plain water will do) and then immerse it in the fixer. Agitate for a few seconds before leaving it to fix for the required 10 to 15 minutes. After fixing, the prints should be transferred to the sink or washing bowl and washed in running water for half an hour.

Finally, dry the prints on photographic (fluffless) blotting paper and lay them face upwards on newspaper to dry out thoroughly overnight. They will curl up, but may be flattened out again between the pages of a book or some similar method.

Hints and Tips

Handle the prints with tongs and use one pair with the developer and another with the fixer. If chemicals get on to the fingers, wash your hands before touching the printing papers again. Do not let the prints stick together in the fixer and do not let them remain too long in either developer or fixer.

It will not be found necessary to expose a test strip for every negative. This becomes less and less necessary as experience is gained, and it will soon be found possible to give an accurate estimation of the exposure time required for almost every negative.

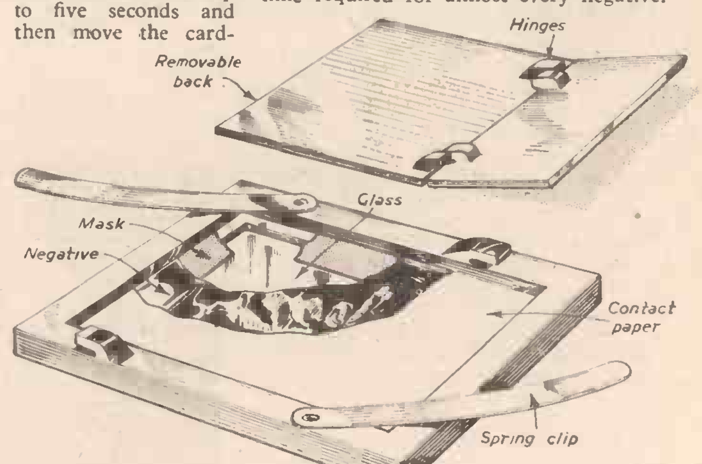


Fig. 2.—A typical contact printing frame.

Paper Grades

Negatives will sometimes be met with which will not give a good print on "normal" printing paper and here it may be possible to obtain improved results by using "hard" or "soft" grades. A soft negative which is lacking in contrast, would on normal paper give a dull, flat print. Printing on contrast or hard paper will give an improved picture. Similarly, a hard black and white print, with ugly contrasting shadows, may be rendered much more subtly on a soft grade of paper.

Using Colour Film

By ALBERT BENSON

Successful Colour Work is the Modern Trend and Simply Accomplished

TODAY, colour photography is within the reach of anyone with a camera having an anastigmat lens, generally with a maximum aperture of $f6.3$ or larger. Most of the leading film manufacturers, both British and Continental, offer a range of suitable materials in different types and sizes at a cost which, although in excess of that of ordinary monochrome film, is not prohibitive.

In the first place, it is necessary to decide whether the ultimate object of the use of colour film is to be the production of colour transparencies, for viewing against the light or by projection, or of colour prints for conventional hand viewing. The former requires the use of reversal stock, while negative stock is available for the latter process. Although it is possible to obtain colour prints from transparencies, and transparencies from colour negatives, the best results are obtainable when this interpolation does not take place. The actual exposure of the two basic types of stock is, however, almost identical.

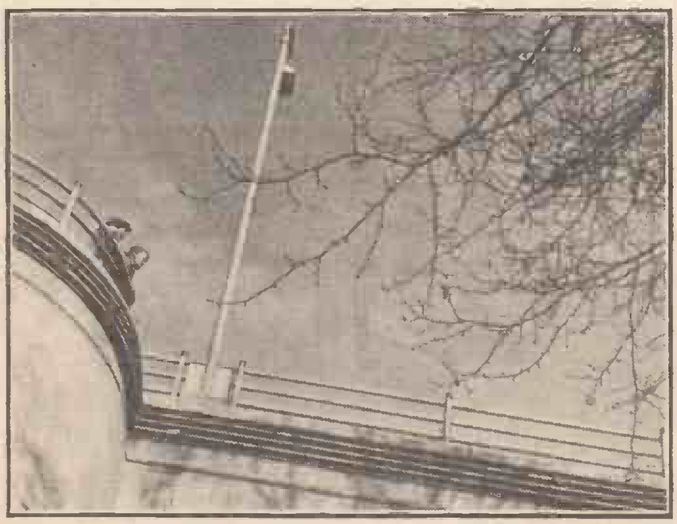


Fig. 1.—An example of strong composition, using large areas of colour.

Artificial or Daylight

Reversal stock, and certain makes of negative colour films are made in types to suit either artificial light or daylight and, where only a daylight type is put out by a manufacturer, it may also be used for artificial light. One British manufacturer also offers a film specially balanced for use with flash illumination. The foregoing does not mean that a change from outdoor to indoor work must necessitate a change from one type of film to another, as suitable conversion filters are available in optical glass or the less expensive gelatine leaf form. Naturally, there is some loss of effective film speed, due to the absorption characteristics of the filter but, at least, there is a solution to the problem of different film stocks.

Since some degree of colour correction is possible during printing, the colour temperature of the light used for exposing most brands of negative stock is not so important, and many varieties may be used for either form of lighting. However, for really first-class results, a conversion filter can be used in conjunction with artificial or flash lighting.

Exposure

Colour film does not have a very wide exposure latitude, and the use of a reliable photo-electric meter on every occasion is strongly recommended. Once a meter has been used in a consistent fashion on one roll of film, and the results of the exposures co-ordinated with the meter readings, further work can be carried out with considerable confidence, provided that the same brand and type of film is employed. Reversal film will still perform satisfactorily with very slight over-exposure, since this produces a lower density and less colour saturation, but negative film should be given the correct exposure, or even a little less, to provide prints of good quality.

Fig. 3.—Flat lighting and diffusion used for colour portraits.

Outdoor Work

The initial work with colour film will probably take place by natural lighting, under out-of-doors conditions, and this technique will be considered first. The use of colour under these circumstances provides greatly increased scope over the use of black-and-white film and, although the standard rules of satisfactory composition still need to be regarded, the arrangement may now be based on colour patterns and not on the monochrome interpretation of these hues.

Broadly, the pictorial application of colour may be split into two categories; mass effect and delicate rendering. In the former case, the object is to produce an impressive picture with the aid of large areas of colour—in principle, the production of a dramatic result. Extensive areas of blue sky, with slight cloud, strong lines passing through the picture, high colour contrasts and almost severe subject matter are the main

Fig. 2.—A more delicately coloured subject.

components for this kind of photography (Fig. 1).

The other form of outdoor colour work, that depending upon the use of delicate variations in tint, employs picture elements entirely different from those mentioned above. No large areas of heavy colour are present, but rather a pattern formed by numerous small patches of more gentle tone. Pictures including trees and flowers fall more readily into this section (Fig. 2). The really bright areas should be limited in extent, and the more quiet colours should occupy the greater part of the picture space.

A reasonable general rule is to avoid severe contrasts in lighting intensity, whichever type of film is being used and whether the exposure is made indoors or outdoors. The latitude of the film is insufficiently wide to give good shadow detail if the exposure is made at a standard consistent with the highlights of a contrasty subject, with the result that the shadows may have some discolouration as well as being far too dark. Exposure for the shadow detail will cause drastic over-exposure of the highlight areas, which are often the principal centres of interest in the picture. Fairly flat lighting ensures that the contrast range is kept within reasonable limits, and capable of being recorded faithfully by the film. A meter reading taken from the highlights should show half or one third of the exposure needed for the shadows; certainly no less unless some exceptional effect is required.

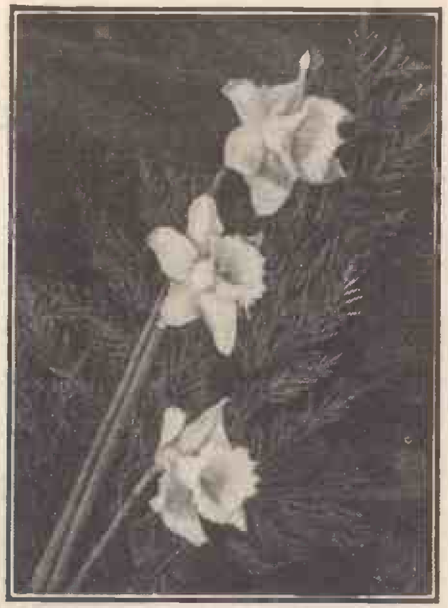


Fig. 4.—An example of still life using spring flowers

Portraits

These require special care in observing the rules for a limited contrast range. An exposure which is satisfactory for the skin may well be inadequate for the eyes, and so produce heavy tonal areas in the eye sockets. Floodlights should be used to provide good, even lighting over the entire area, in a manner which would give a rather flat result if the picture were taken with monochrome film. Since the background will also be recorded in colour, it should be carefullly chosen, and illuminated sufficiently to come within the contrast range and at the required depth. The use of a diffusing disc in front of the camera lens produces attractive results when used with colour film, and smooths out minor variations in the complexion (Fig. 3).

Remember, too, that colour film provides many opportunities for still-life work under artificial or daylight conditions. Flower studies can be recorded particularly well by this means (Fig. 4).

Making the Most of Your Negatives

A Useful Darkroom Technique

The pictures which may be obtained from one negative.

WHEN photographing open outdoor scenes such as landscapes or seascapes always try to obtain a wider range of view upon your negative than you actually require at the moment. This gives an amateur the opportunity later on of obtaining several pictures from that one exposure. This does not entail any difficult masking, double exposure printing or costly set-ups. It is, in fact, simplicity itself. The accompanying illustration shows quite clearly how several pictures, each one different, may be made from a single negative.

Place the chosen negative in the enlarger in the usual way and throw the image on the screen. Then take two or three pieces of white card or thick paper and cover the unwanted portions of the image. Move the cards from side to side and up and down till a picture of the desired area is left uncovered. This picture should be pleasing to the eye, of correct size and of regular shape. It should contain all that it is desired to have in the final picture.

Then when satisfied that all is in order expose the printing paper in the usual way. Develop according to your usual practice for ordinary enlargements.

Masking the Negative

If more than one copy is required from any particular area of the same negative, it would be better to make an opaque paper mask for use in direct contact with the negative. These masks must be made to the same overall dimensions as the negative. The openings must, of course, be cut to suit the special area chosen for enlargement.

To prepare a contact mask make one contact print to use as a sample and draw upon it boundary lines for the wanted area. Then transfer these lines to the masking paper and cut to suit. With this method the picture may be enlarged up to any size in direct proportion and ratio to the desired area or to suit the occasion. An unlimited number of exact copies may also be taken with the same simplicity as contact prints.

Blue Toning Prints

Two solutions are required for the blue toning of prints. They are as follows:

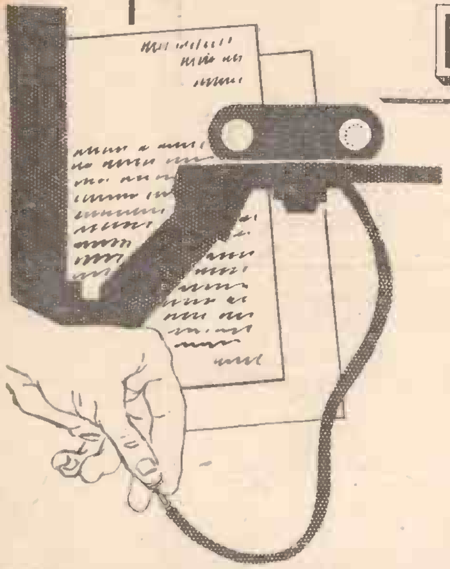
A

Potassium ferricyanide	20 gr.
Sulphuric acid	40 mins.
Water up to	20 oz.

B

Ferric ammonium citrate	20 gr.
Sulphuric acid	40 mins.
Water up to	20 oz.

Wash the prints thoroughly and place them in a bath of equal parts of solutions A and B. When a blue colour is obtained wash them until the yellow tinge has been removed from the whites. The depth of the blue colouring will be reduced by further washing unless the washing water has a few drops of hydrochloric acid added to it.

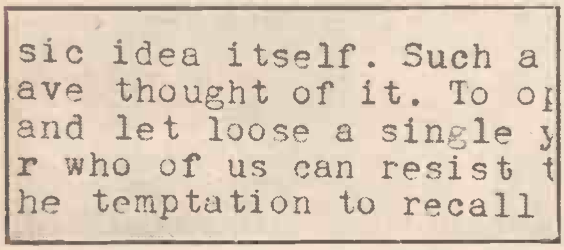


DOCUMENT COPYING

By A. E. BENSUSAN

This Process is Useful for Duplicating Illustrated Articles, etc., of Which Only One Copy is Available

THE apparatus required for document copying is precisely that mentioned in the April issue for copying photographs. In general, the routine employed is identical, the main difference being in the varying treatments required by the diverse natures of the originals. For instance, the colour of the paper and printing or writing, the marks made by folds, stains or other results of handling or age, and so on.



sic idea itself. Such a
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r who of us can resist t
he temptation to recall

Fig. 1.—Portion of a copy of a typewritten original made on orthochromatic film.

Negative Material

Ordinary black printing, typewriting or handwriting on clean white paper is the easiest subject to tackle. The ideal negative material to employ is a process flat film or plate, as this gives a high degree of contrast, together with good definition and a practically grain-free structure. For an occasional copy job of this nature a standard M.Q. developer can be used, with a suitably lengthy development time to build up the contrast. One of the special process developers, sold in packaged form by the leading negative material manufacturers and chemical houses, will be found to give better results. However, this is sold in fairly large packs, and would prove worthwhile only for reasonable sized runs of work.

Process emulsions are not available in roll-film form, and an orthochromatic stock should be used in its place when copying black and white documents with a roll-film camera (Fig. 1). However, this does not apply to 35 mm. film, for special micro-films are readily obtainable in that size. When using orthochromatic stock keep the exposure fairly short, and develop for about 25 per cent. longer to increase the contrast. An example of a pictorial photograph taken while using the copying technique is shown in Fig. 2. The microphone was cut from black card.

Fig. 2.—A pictorial effect gained by using standard copying technique.

Stain Elimination

Black characters on a stained paper, whether this is discoloured all over or in patches, necessitate the use of a panchromatic emulsion. The user of plates or flat films again has an advantage, in that a wider range of suitable materials is available but, this time, a number of appropriate films may be obtained in roll form. A good general rule to adopt is to select material with the slowest speed rating. This ensures the most accurate colour rendering and the finest grain structure which, in turn, results in good definition on the copy negative.

A filter to match the stain as accurately as possible is clipped over the camera lens and the exposure made in the usual way, allowing for the increase due to the density of the filter, as recommended by the manufacturer. Since the volume of this work is unlikely to justify the expense of a comprehensive set of optical glass filters, gelatine filters may be obtained in the appropriate colours and densities at a fraction of the cost of glass filters. Provided that they are not handled on either face, and that they are stored in a dry, cool place, they will keep in perfect condition for many years.

Fig. 3.—Enlarged copy of a coloured original made on panchromatic film.

The underlying principle is that a stain will cease to be apparent if it is illuminated by light of a similar colour. Since the fitting of large filters to the lighting equipment would not be feasible, the same effect is obtained by colouring the light as it enters the camera lens. Precisely the same principle and practice are applied to originals on paper which has been coloured during manufacture, and the corresponding filter is used to eliminate the background shade.

Coloured Inks

Subjects which have characters printed or written in coloured ink require a reversal of the practice. Here the object is to intensify the total effect of the colour, in terms of black, rather than to eliminate it. For this reason a filter having a colour complementary to that of the ink should be used. For example, a deep yellow filter will darken the effect of blue and violet inks, while an orange filter will also darken green to a slight degree. This latter effect is increased by using a red filter, which also darkens blue originals. A blue filter is employed to darken red printing and, to a lesser degree, green subjects.

When full correction is not required, a modified system is used. This may range from panchromatic film without any filter, to the same film with a filter which is not exactly complementary in colour to the original. The use of a panchromatic emulsion without any filter is shown in Fig. 3. Had a filter with a darkening effect been

(Concluded on page 31)

A UNIVERSAL ENLARGER...

A Robust and Inexpensive Design

By W. F. BUTTERY

WHEN this enlarger (shown in Fig. 1) was built, suitable castings were not available, and the writer was compelled to use the material which was to hand at the time. Special arrangements have, however, now been made with Messrs. Acton Equipments Ltd., 168, Upper Tooting Road London, S.W.17, and Messrs. E. Crabtree, 403, Tong Street, Dudley Hill, Bradford 4, to supply castings, and finished parts if the demand warrants it. Messrs. Clement Waine Ltd., Red Lion Square, Newcastle, Staffs., will supply specially made bellows for the enlarger. For those readers, who, due to lack of equipment, may find difficulty in making certain metal parts shown in the working drawings, the purchase of finished parts would cut the work down tremendously, leaving only the woodwork to make. For those constructors who decide to make everything, every part is described with the aid of the working drawings.

The Baseboard

It will be found an advantage to construct the baseboard first because from this all test measurements are taken. A piece of ½in. plywood 18in. × 16½in. will be required. To strengthen it and counteract any tendency to warp or twist, three battens, 2¾in. wide, are screwed and glued to what will be the underside, as shown in Fig. 2. Two 3/16in. holes are drilled at (A) to receive the wiring to the light switch, and a 5/16in. hole at (B) for the wiring to the lamp house via the column. The remaining holes for fixing the column base to the baseboard are drilled at a later stage when fitting the completed column and base to the baseboard.

Fig. 1 (Right).—The completed enlarger with negative carrier removed.

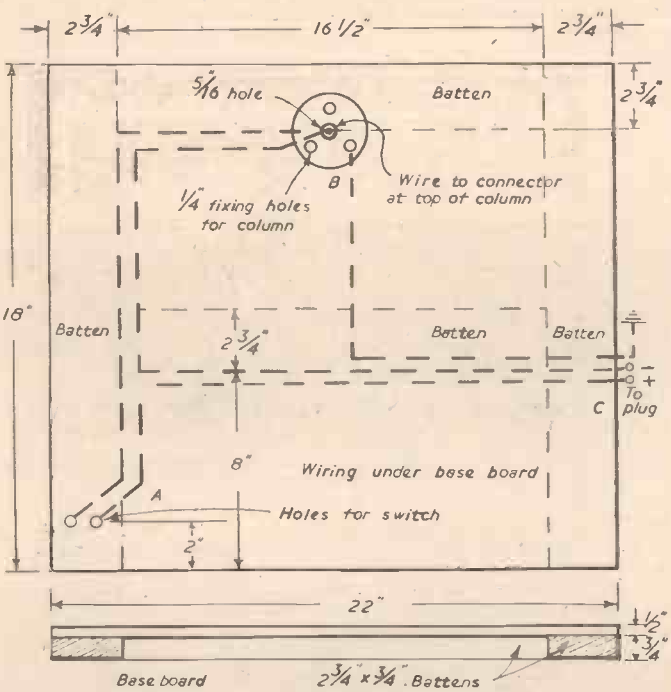

Fig. 2 (Left).—Details of the baseboard.

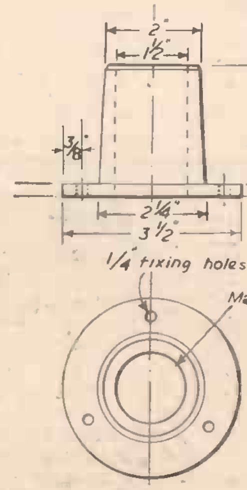

Fig. 3 (Right).—The column base, which can be made in cast iron, brass or aluminium.

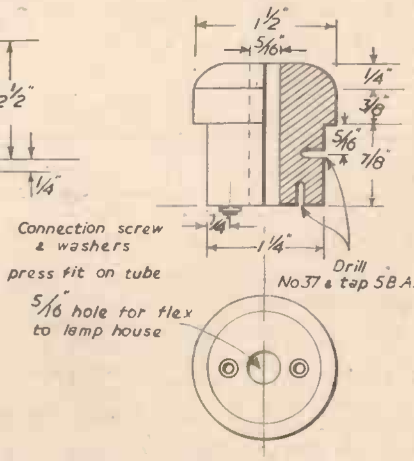

Fig. 4 (Extreme right).—The connector made of plastic or bakelite.

The Column and Base

The column is a piece of metal tubing 3ft. long and 1½in. dia. The column base (Fig. 3) may be made of any available metal and is a straightforward turning job, being made a press fit on the column. In the writer's case it was made from an old cast-iron wheel boss. Three ¼in. clearance dia. holes are drilled where shown for the fixing bolts, and it was given a coat of black paint and left to dry before finally fitting to the column.

Check Each Part

In order that the enlarger will be as accurate as possible when in service, check each stage of the work as it proceeds; therefore, when the column has been fitted to the baseboard, make quite sure with the aid of a square that the column is square with the baseboard from the front, as well as from the side. This is very important.

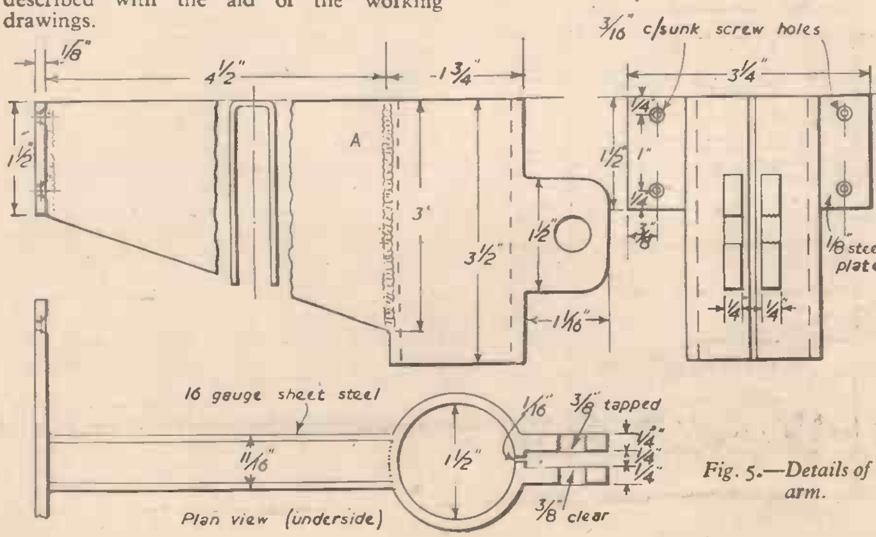

Fig. 5.—Details of the arm.

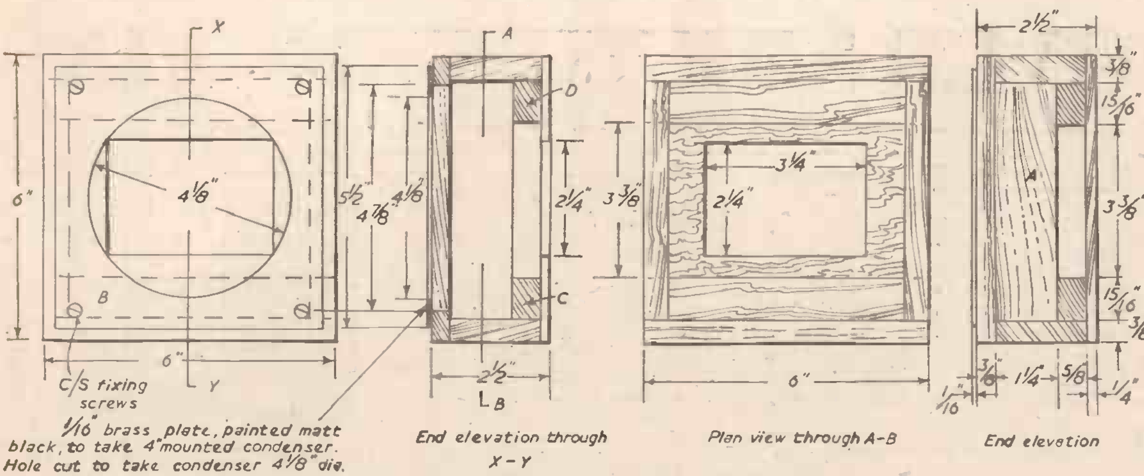

Fig. 6.—Details and dimensions of the condenser housing.

The Column Connector

A very efficient means of connecting the wiring under the baseboard to the flexible lead from the lamp house is provided by the column connector (Fig. 4). This can be made from any good quality insulating material. It is turned up from $1\frac{1}{2}$in. dia. stock, and for $\frac{7}{8}$in. of its length it is reduced to fit the inside of the column. A 5/16in. hole is drilled through the centre to receive the flexible cable, and on the underside two number 37 holes are drilled and tapped 5B.A. for the connecting screws. A further number 37 hole is drilled and tapped at the side for securing the connector to the column, the exact position of this being determined by first drilling a number 30 hole 5/16in. from the top of the column, placing the connector in position and marking off the hole with a scriber. A piece of twin flexible cable 2ft. 6in. long is required for the connection between the lamp house and the wiring under the baseboard. After the ends have been neatly clamped under the screws provided in the base of the connector, a piece of Empire cloth or Presphan is placed round the inside of the column at the top to insulate it, the connector is finally fitted in position.

The Enlarger Arm

As previously mentioned, castings may be available for this item. To those who are fabricating the arm from sheet metal, time spent making it is time well spent, due mainly to the required accuracy. Details are shown in Fig. 5.

A piece of 20 g. sheet metal, cut and bent to shape, was welded as at "A" to a $3\frac{1}{2}$in. piece of $1\frac{3}{4}$in. tubing, the inside of which measured $1\frac{1}{2}$in. Two lugs, 1 1/16in. × $1\frac{1}{2}$in. for the purpose of locking the arm in position when in use were next welded in such a position as to leave a $\frac{1}{4}$in. gap between them. Between this gap, the tube is cut away with a metal saw to provide the necessary grip on the column when the locking nut is tightened. A 19/64in. hole is drilled through both lugs. One is tapped $\frac{3}{8}$in. Whitworth and the other drilled $\frac{3}{8}$in. clearance with a 25/64in. drill.

Make and fit a $\frac{3}{8}$in. locking screw as shown in the photograph, then place the bracket on the column in the locked position to test for squareness of the front part of the bracket on each face prior to fitting the $\frac{1}{8}$in. plate, which is $1\frac{1}{2}$in. wide by $3\frac{1}{4}$in. long.

When these two faces are square with the baseboard, and also square with the arm itself, the bracket is removed from the column and the plate welded to it. The completed bracket should once more be replaced on the column and locked in position as before, and the whole face of the plate tested for squareness with the baseboard, any errors which will most certainly have occurred due to welding should be corrected with a file and scraper. The whole assembly is now cleaned up and given a coat of black paint to complete the job.

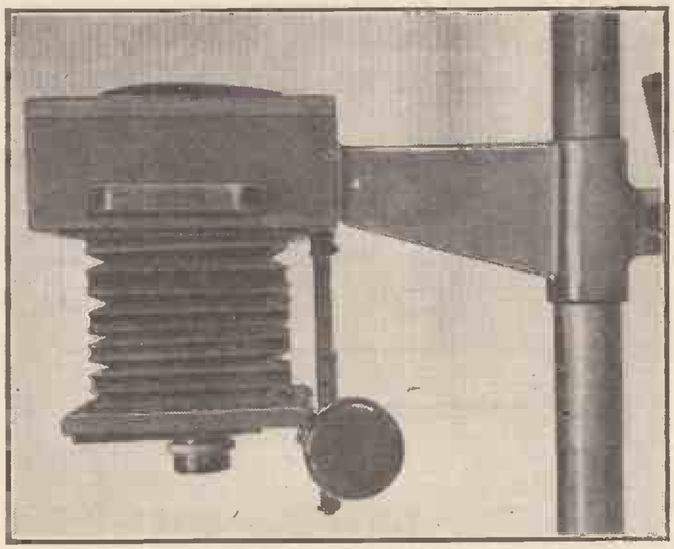

Fig. 7.—A close-up of the condenser housing, focusing, etc.

The Condenser Housing

This unit, shown in detail in Fig. 6, not only accommodates the condenser, but the negative carrier as well. Its construction is in the form of a square box $2\frac{1}{2}$in. deep, and is a simple joinery job. For the top, a piece of $\frac{1}{4}$in. plywood 6in. square is required. Exactly in the centre scribe a circle $4\frac{7}{8}$in. dia., and cut this out as accurately as possible, finishing off with a spokeshave to the scribed line.

For the base a similar piece of $\frac{1}{4}$in. plywood is required, and in the centre of this, instead of the circle, an oblong is removed measuring $2\frac{1}{4}$in. × $3\frac{1}{4}$in.; drill a small hole at each corner inside the lines and cut between these holes with a suitable saw, finishing off with a file. The two side pieces, each 6in. long × $1\frac{7}{8}$in. wide × $\frac{3}{8}$in. are pinned and glued to the base. The guides for the negative carrier, C and D, shown in the end elevation through X Y, are fitted next. They are pieces of hardwood 6in. long × 15/16in. × $\frac{3}{8}$in. To complete the framework two pieces of hardwood 6in. long × $1\frac{1}{4}$in. (shown at A on the end elevation drawing) are fixed in position, and the whole assembly checked for squareness before fitting the top piece. Clean up with glass-paper and paint the inside matt black.

A 20 g. sheet metal plate, $5\frac{1}{2}$in. square, with a $4\frac{1}{8}$in. circle cut in the centre is fixed to the top where shown at B, to accommodate the 4in. condenser. Paint this plate matt black before fitting in place.

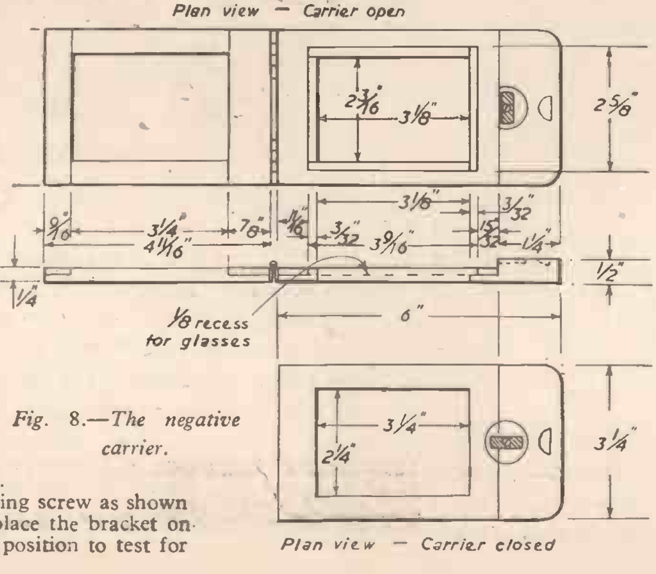

Fig. 8.—The negative carrier.

The Negative Carrier

The negative carrier, which is made of wood, should be a sliding fit between the guides in the condenser housing and when completed it lies flat against the base of the housing when in position between the guides. It will also be noted that the negative carrier has been made to accommodate a $2\frac{1}{4}$in. × $3\frac{1}{4}$in. negative. This was done with a view to altering the enlarger if required to this size by simply removing the metal plate and replacing the present condenser with a larger one. The construction of the carrier is clearly shown in Fig. 8; it is made of wood, and holds two thin glasses between which the negative and mask are placed. Paint matt black when finished.

(To be continued.)

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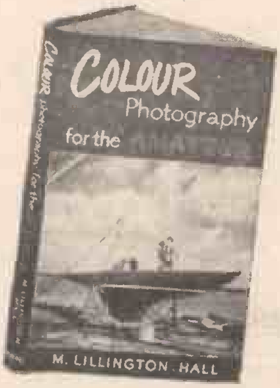

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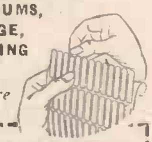

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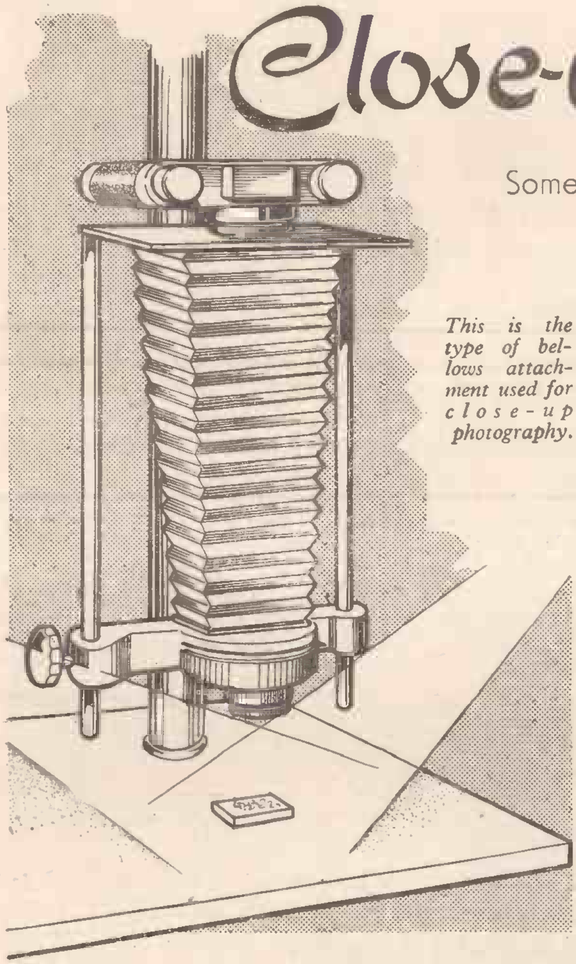
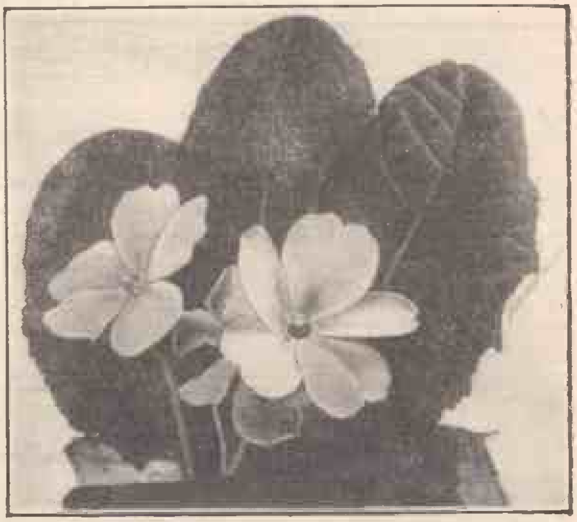
Close-up Photography

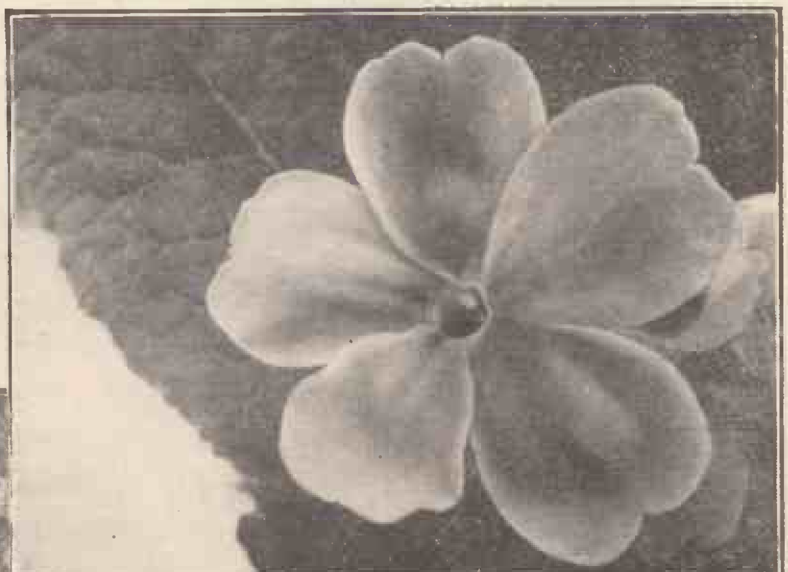
Some Fine Examples and Notes on the Techniques Used. Part 1 Deals Mainly With Macrophotography

By E. CLEMENTS



This is the type of bellows attachment used for close-up photography.





The two photographs above provide a comparison between the image obtainable, using a 7in. lens in a half-plate camera at double extension and a 2in. lens with only about 10in. extension. The top picture employed the 7in. lens.

(Left) A 2in. lens was used in a quarter-plate camera to obtain this picture of a leaf. As reproduced here, it is approximately seven-eighths full size.

BEFORE discussion of the various aspects of close-up photography it is perhaps as well to clarify the terminology for it is evident that many photographers are somewhat vague about the meaning of photomicrography. microphotography and macrophotography. The first-named is the production of photographs by means of a microscope, that is to say the camera is used as an adjunct to secure a record of the image formed by the microscope lens and seen in the eyepiece; it is therefore concerned with images of considerable magnification. Macrophotography is also concerned with the recording of magnified images but of lesser magnitude; the term is usually applied to photographs of up to about ten times magnification. Microphotography is the direct opposite of the previously mentioned techniques and is the term applied to the production of very small photo images involving considerable reduction; the process is used widely in the recording of documents, books, etc., on miniature film thus providing a means of storing in a small space records which would otherwise take up too much room. It also enables invalids and others to read books and papers which have been microfilmed and projected on to walls, ceilings, and specially constructed cabinets.

Microphotography

Microphotography is not of any great practical interest to the average photographer for he has but little use for it; macrophotography, however, can be most absorbing. Getting very close to the subject can reveal detail not previously appreciated to the full and cap often produce prints of considerable "punch" which compel attention. The idea is prevalent among many photographers who have not tried the technique that a long focus lens is necessary to obtain an enlarged image; this is, however, only true in a limited sense when comparing the images formed by different lenses from the same viewpoint, they do not form an image larger than the object itself.

What is required to obtain a two or more times magnified image is a lens of short focal length which will work close to the object. There are many accessories on the market to enable one to do this, extension tubes, bellows attachments, supplementary lenses, etc. For same size images a camera with provision for carrying the lens much nearer the object than the normal focusing scale provides will suffice (double extension). Triple extension which will allow the lens to move even closer to the object will provide definite magnification according to the lens in use and carrying the idea even further it is interesting to explore the possibilities of a 2in. lens on a half-plate camera, when magnifications in the region of twenty times are possible.

Extension tubes are available for most miniature cameras with interchangeable lenses and a set of these giving about three focal lengths will provide a magnification of about two.

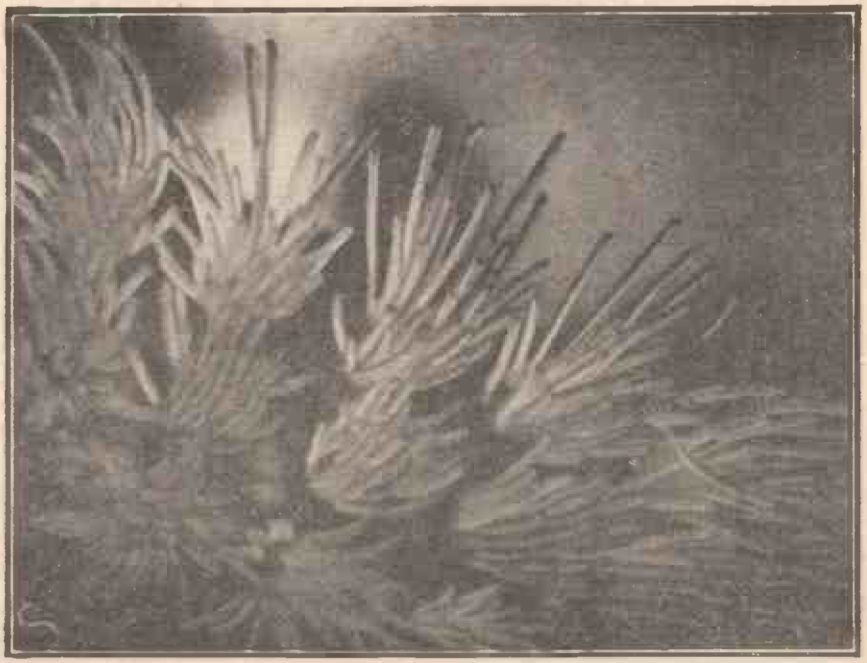
Lighting

With the very short focal lengths of the miniature, working very close to the subject however (the lens may not be more than 1in. away), the task of lighting the subject becomes something of a problem; it is often found that a strong sidelight can hardly be avoided, and whilst this is not always a disadvantage it is as well to endeavour to introduce as much diffused light as possible by working in conditions of good general illumination.

When one commences photography in this fascinating field one is suddenly aware that the world and even the confines of the home are teeming with new subjects; practically everything that is used in daily life takes on a new significance when considered for a really close-up picture.

The second part of this article will deal with photomicrography and will include some examples of this type of work.

(*To be concluded*)



An example of household objects making unusual pictures. Bristles of an old toothbrush, photographed with a 2in. lens at 9in. extension. Magnification is approximately x2.

(Above) Matches. A 2in. lens was used at 9in. extension on a half-plate camera to give a magnification of x2.

(Left) Pins. A 2in. lens was used at approximately 10in. extension.

Sepia Toning

SEPIA toning can only add charm to a good print and the best print to use is a "sparkling" one from which all traces of hypo have been rinsed.

The following stock solutions are required:

Bleaching Solution

Potassium ferricyanide ...	1 oz.
Potassium bromide	¼ oz.
Water up to	10 oz.

Sulphide Solution

Sodium sulphide	½ oz.
Water up to	10 oz.

Boiled and cooled water must be used to dissolve the sulphide and the solution must be stored in well corked bottles. The bleaching solution must not be exposed to bright light.

Procedure

Add 1 oz. of stock bleaching solution to 10 oz. water and immerse the prints in it. When a yellowish brown tint is obtained, wash the prints and transfer them to a dish containing 1 oz. stock sulphide solution and 10 oz. water. This bath will change the prints to a rich sepia tone. Finally, wash the prints thoroughly.

Warning

The sodium sulphide solution gives off a very unpleasant smell and these fumes will ruin any sensitive photographic material with which they come in contact. Keep bromide paper, etc., well away from the area. The smell may be finally dispersed by rinsing the sink, etc., with potassium permanganate solution.

The Use of Filters

No. 2.—Effect Filters

THE first part of this article dealt with the use of filters for correcting the inadequacies of the various types of emulsion and the production of prints which reproduce scenes as the eye sees them. However, it is not always desirable to have exact reproduction as seen by the eye and here filters enter a whole new field of application, that of changing the tone values of the print to create special effects.

The filters used for correction were mainly light yellows, medium yellows, pale greens and yellow greens, but for effects, the stronger filters are used. These include green, orange, red and blue filters and it should be noted that they all necessitate a considerable increase in exposure.

Emphasising or Subduing Brightness Contrast

As mentioned last month the eye distinguishes detail by means of colour contrast, but the camera records it by means of brightness contrast. In some cases, then, it is desirable either to emphasise brightness contrast or to subdue it by subduing either one colour or the other. The best-known example of this type of effect is seen when photographing a yellow haystack against a blue summer sky. To the eye, there is a strong contrast between the blue and yellow colours, but the camera will record the colours with the same degree of brightness and record the haystack as merging into the sky. Truth must be sacrificed for the sake of contrast and the sky is over-corrected using an orange or red filter for the purpose. Deciding which colour to emphasise is not always easy, but in this case it is better to darken the sky and lighten the haystack as this will also bring out the clouds, if there are any.

Darkening skies by means of a dark yellow, orange or red filter is an effect which is very often used when there are large areas of white in the picture. For instance, when photographing a yacht race, the contrast between white sails and the filter-darkened water and sky gives a very pleasing effect. Remember, the stronger the filter the darker water and sky will appear.

This method of increasing contrast is often used in architectural photographs of white buildings, where the white walls brightly silhouetted against an over-corrected sky provide a brilliant effect, see Fig. 1.

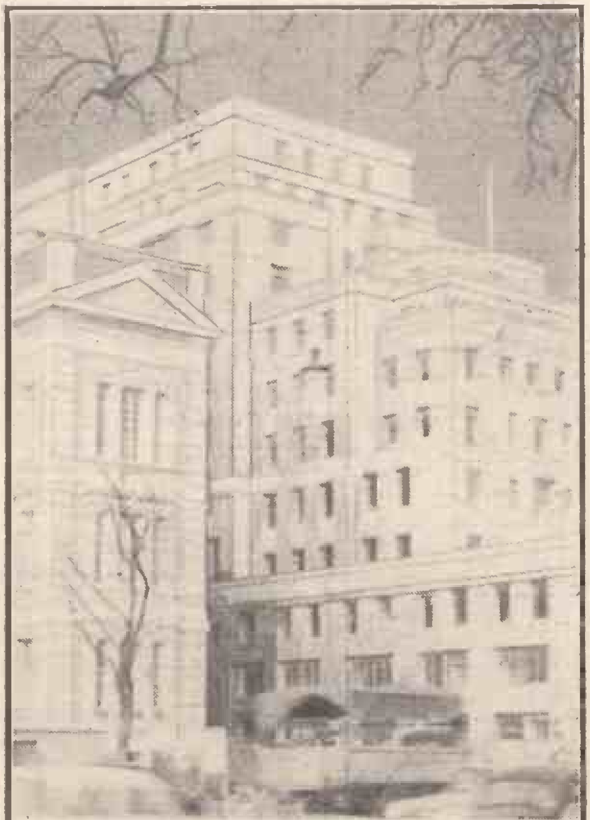


Fig. 1.—Using an orange filter to photograph white buildings.

The same principle of darkening skies can be applied to already dark sky to produce a lowering or stormy sky of considerable dramatic impact.

A dark-red filter will have the effect of producing a picture which looks as though it were taken at night. The sky looks completely black and the scene is dark except for the parts which are brightly lit by sunlight.

Using Infra-red Film

With this type of film and a red filter the effects of night scenes taken in daylight are even more pronounced. The sky is rendered very dark and trees and foliage have a bright silvery effect similar to that produced by moonlight.

Another effect which is very pronounced in infra-red photography is that of haze penetration. Distant views taken using this technique show no trace of haze whatever.

The same effect of haze elimination is obtained also by using a red filter on panchromatic film and to a lesser extent on ortho stock using a deep yellow filter. There are occasions when this characteristic of haze penetration is useful, particularly when taking aerial views for map-making, etc., but for the landscape photographer its usefulness is open to considerable doubt. Slight haze in the middle distance and its greater prominence in the background is the chief means of giving an impression of depth to a view.

Specialised Uses of Filters

In many commercial applications of photography the use of filters can become a very specialised business, especially in the copying of coloured prints, photographing stained microscope sections, etc., but there are some of these which will be found advantageous by the amateur.

The amateur who wishes to copy photographs may have some difficulty when faced with sepia-toned prints, but this can be overcome by using a red filter and copying by red light.

In document photography difficulty may be experienced in photographing coloured inks, but handwriting or type which is, say, red can be reproduced by using a green filter, which will darken it. If there are two colours, say, purple and red, both colours would be reproduced, but if some of the copy was in green, the green would not show in the copy. Inks are darkened by using filters of the opposite colour, or backgrounds lightened by filters of the same colour.

In portrait photography the effect filter has no place. Here the idea is to reproduce a person's features as they would appear to the eye and filters used should be for correction only.

Ultra-violet Filters

These are not true effect filters and have but limited application since normally the ultra-violet content of the light is small. They are, however, useful in mountain photography.

Polarising Filters

These have no colouring and are used to eliminate undesirable reflections from mirrors, pictures, show windows, etc. They are useful for photographing the contents of a shop window, for instance, but give a somewhat unreal effect.

Document Copying

(*Concluded from page 24*)

used, the cancellations on the stamps would almost have disappeared. A filter of similar colour would have shown only the cancellations on two otherwise perfectly blank stamps. Various tones could have been obtained by using different filters.

Dealing With Colours

Often, an original carries printing in several colours and a decision must be taken as to the effect required. Is it desired to accentuate one colour at the expense of the others? Should a compromise be accepted with the best possible treatment for all the colours, or should all be quite dark on the final copy print? If one colour only is to be emphasised the appropriate complementary filter is selected. A compromise may call either for no filter or one which partially darkens all the light colours, but perhaps slightly lightens the dark ones.

Where all the ink values are to be darkened, and no filter appears to cover them all, the only method is to make separation negatives for each colour, using the correct filters and masking off portions which cannot be filtered out. The negatives are later bound up in correct register to be printed, or they may be printed in sequence on the same sheet of paper, using some black marks as vertical and horizontal registers. Naturally, this is an elaborate procedure and it should be avoided if possible.