The Leading Magazine for Home Craftsmen

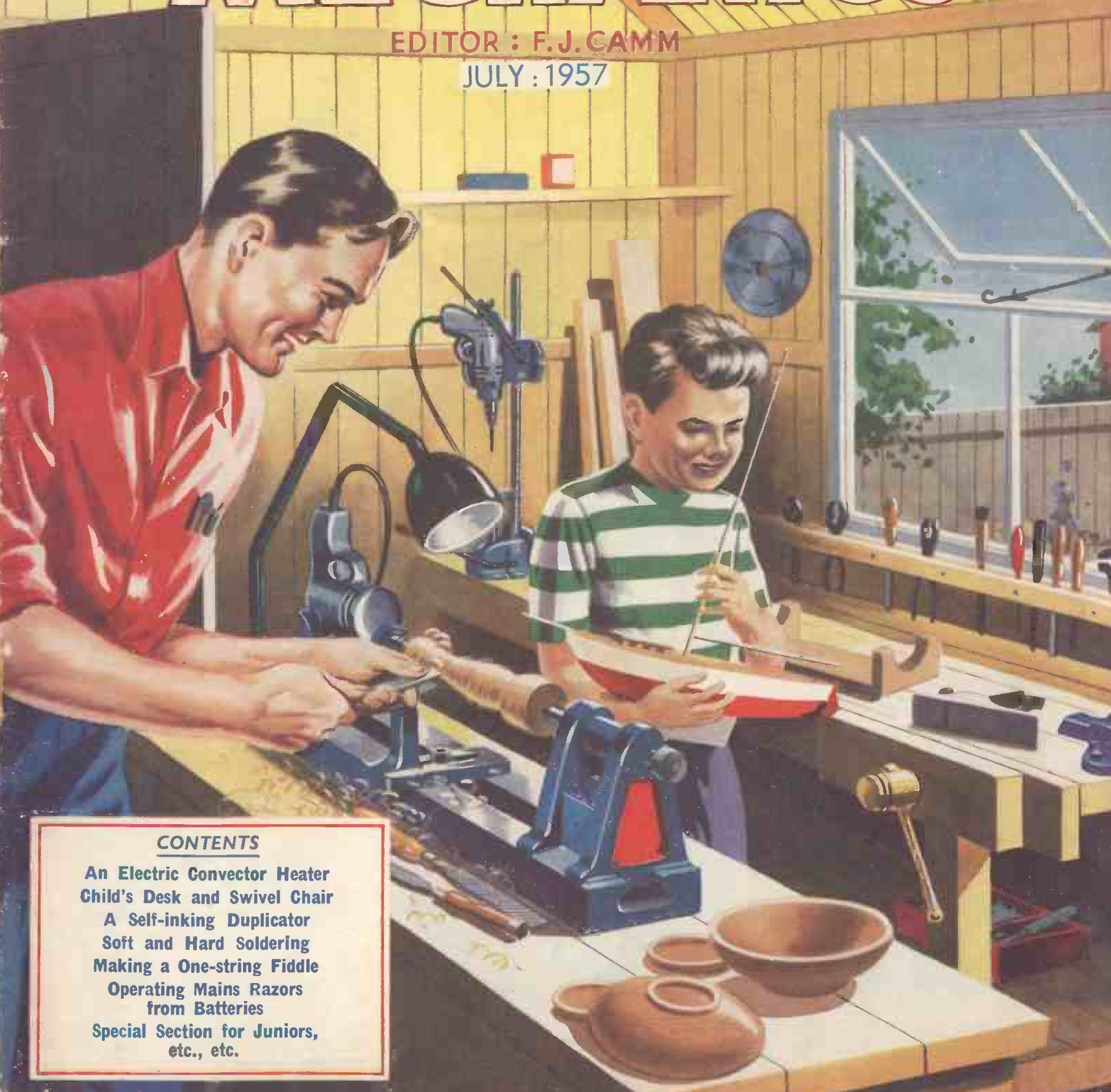
NEWNES

PRACTICAL MECHANICS

1/3

EDITOR : F. J. CAMM

JULY : 1957



CONTENTS

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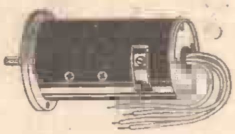

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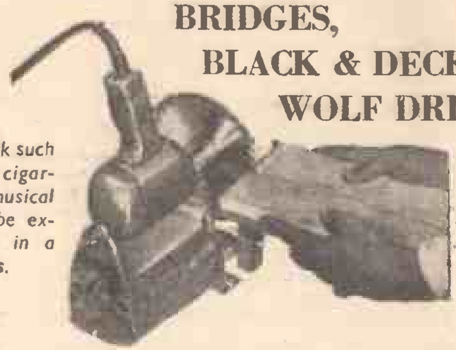

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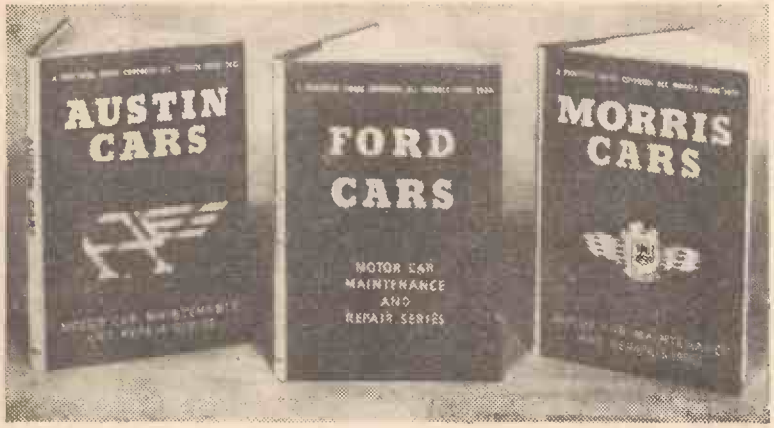

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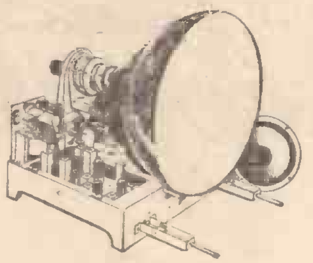

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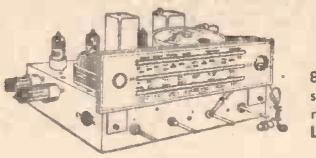

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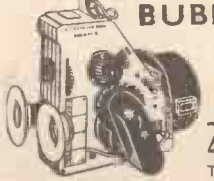

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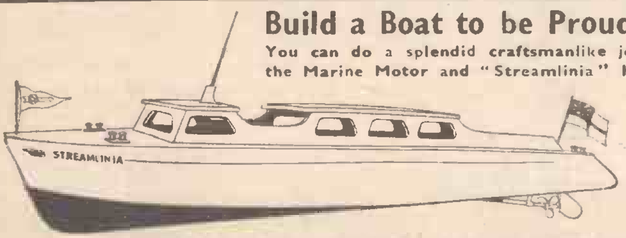

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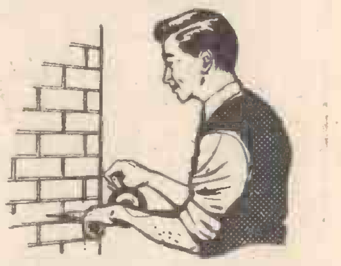

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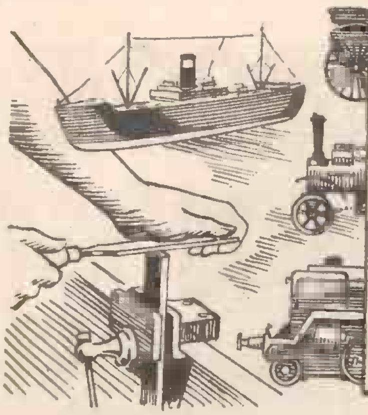

Practical Mechanics

Vol. XXIV. No. 281 JULY, 1957

"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

READING HABITS OF YOUTH

W. H. SMITH AND SON, the booksellers, and a well-known publisher have co-operated to produce the first major survey in this country of the reading habits of boys and girls, and the survey is based on the replies from 8,000 of them attending schools in England and Wales. Those questioned came from public and grammar schools and secondary modern schools. It was found in the hobbies class that the six favourites were stamp collecting, model making, reading, woodwork, fishing, and music and records. Dozens of hobbies were mentioned by the boys, including aircraft spotting, bird watching, drawing, chess, and collecting such things as match-box labels, coins, cheese labels, football programmes, and keeping pets. There was little evidence to show that space fiction was popular. Favourite journals were concerned with hobbies, careers and sport. An interesting comment is that the spelling in a large number of the letters was atrocious.

Career ambitions included radio, TV, archæology, discography. The survey seems to have gone to a great deal of trouble to establish what could have been more easily found from an analysis of circulations and readership, recently published by an independent investigating authority.

THE RADIO PILL

A TINY radio station which will broadcast pressure measures in the digestive system after the patient has swallowed it was recently shown at the Rockefeller Institute for Medical Research. Future radio pills of this type will take temperatures, detect electrical discharges and assess the acidity of the system. The pill was designed by Dr. Zworykin, who invented the electron microscope and the iconoscope. Electronics is indeed plumbing the depths !

THE LIFE OF AN ARTIFICIAL SATELLITE

IF the artificial satellite shortly to be launched in America operates according to plan, it may stay aloft for about nine years, according to an American astrophysicist. Hitherto, it had been calculated that the life of an artificial satellite would be a few weeks, certainly no more than one year. The launching is, of course, awaited with tremendous interest throughout the world, for the information obtained will form the basis of design for space-ships. Radio amateurs are invited by the American Department responsible for the space project to construct apparatus so that the path of the satellite can be observed throughout its orbit and reports sent to them. A special article contributed by them to our companion journal, *Practical Wireless*, explains how to make the apparatus. It is suggested that groups of radio amateurs should co-operate in constructing it.

CONTRIBUTIONS

NO doubt every reader of this journal has devised some new method of doing a job or constructing some model or piece of apparatus, and I invite these readers to send me photographs and constructional details, together with a description which should include a list of parts and sources of supply. All these articles will be paid for if accepted. The manuscripts should be written or typed on one side of the paper only and be accompanied by clear rough sketches on separate sheets of paper, each figure numbered and captioned. Every one of such illustrations should be referred to in the text. I want to encourage readers to become contributors and every manuscript submitted will have my personal attention. Address manuscripts to me at the address printed on this page.—F. J. C.

MAKING FULL USE OF YOUR CIRCULAR SAW

By JAMES VOSE

In Addition to Straight Ripping and Crosscutting, a Variety of Operations Can be Performed on the Saw Bench Described in our June Issue

MOST amateur woodworkers use only one saw blade and expect it to do any kind of cutting in any variety of wood. This is a mistaken policy. Whilst it is true that practically any blade can be made to cut, after a fashion, whether the work is across or with the grain, and in both hard and soft woods, the use of the right type of blade for a particular purpose always results in faster and cleaner cutting.

Four of the most useful blades are shown in Fig. 1. "A" is a ripping blade for fast cutting in soft wood. The hook angle of 30 deg. may be regarded as a maximum. A keener angle would cut well, but would wear dull too quickly for practical use. For hardwood cutting, or for mixed hard and soft wood, the hook angle should be reduced to 20 deg.

The "Peg-tooth" cross-cut saw "B" has lancet-like teeth designed to shear the fibres of the wood. It cuts very cleanly and smoothly and is popular with furniture makers as it produces a practically finished surface on end-grain work. This blade requires frequent sharpening. It is no use for ripping.

The "combination" or "Novelty" blade "C" has both crosscutting and ripping teeth. The deep gullet in front of the ripping or "raker" teeth, clears the sawdust which would otherwise accumulate and choke the saw. This blade is also obtainable hollow ground, that is, the centre of the blade is ground slightly thinner than the edge, enabling the saw to be worked without any set. This blade cuts smoothly with or against the grain, and its principal use is for cutting stock to precisely finished dimensions.

The "chisel tooth" blade "D" is a good general-purpose blade for rough cutting either with or across the grain, in either hard of soft woods. It is not as smooth cutting as the cross-cut blade "B" or the hollow ground blade, but for ordinary cut-off work this is of no importance. The teeth are strong, and will stand up to long periods of cutting without resharpening. Incidentally, this is a good blade for portable saws of the "Ripsnorter" type, because the small hook angle reduces the tendency of the saw to feed itself into the work and "run away" with the operator.

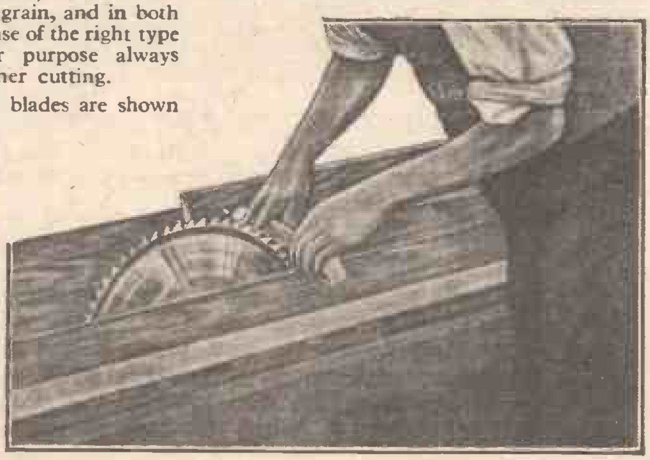


Fig. 2.—Jointing or running down the saw.

Care of Blades

To obtain the best results, the blades must be kept in tip-top condition at all times. One often sees dull blades being forced to cut, with the result that the cut is rough, sometimes burned, and often inaccurate. The time wasted in cleaning up this rough work would be far better spent in putting the blade in order. Each tooth should be made to do its share of the work, and to ensure this the saw should be "jointed" or "run down" occasionally. This process is shown in Fig. 2. A carborundum oil-stone, or a piece of a broken emery wheel, or even a piece of hard white sandstone, is held in light contact with the teeth while the saw is revolving. The saw must be stopped frequently to see how the jointing is progressing. When all, or nearly all, the teeth have been run down to the same height the saw is ready for setting and sharpening. I say nearly all the teeth because it would obviously not be worth while running down the teeth excessively just for the sake of one or two low ones. A small but important point in connection with this jointing or running-down process is that the

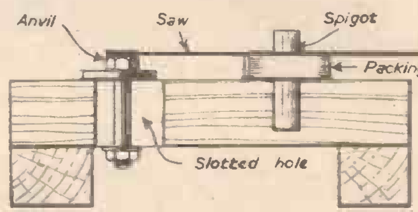


Fig. 3.—Section of the setting jig.

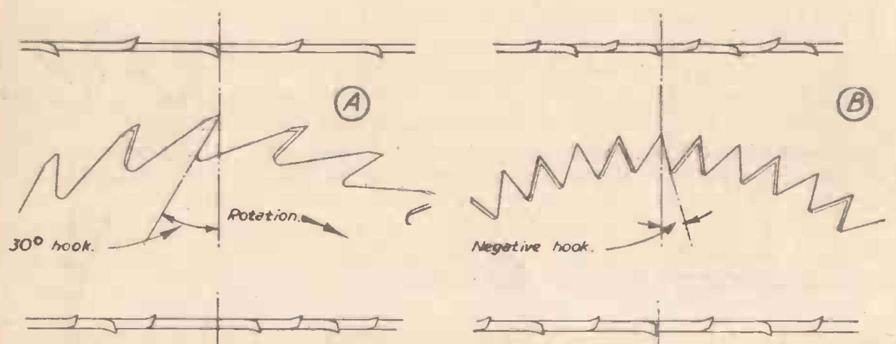


Fig. 1.—Four types of saw blade.

Fig. 4.—The setting jig in use.

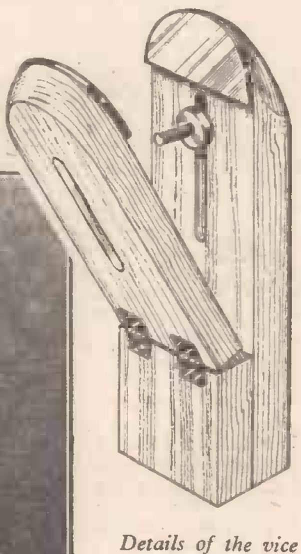
blade must always be replaced on the spindle in the same relative position. Any distortion in the spindle, and any play between the hole in the saw and the spindle diameter, might result in the blade running eccentrically when it is replaced, thus nullifying the effect of the jointing. To ensure that the blade is always replaced in the same relative position, the spindle should be turned so that the driving pin is at the top before inserting the saw blade. As this pin is out of sight behind the collar whilst the nut is being tightened, it is a good plan to mark the edge of the collar with a file-cut opposite to the pin, so that this mark can be kept to the top while the nut is being tightened.

Setting

To enable the blade to clear itself in the cut, the blade, unless it is of the hollow ground type, must have its teeth set. The simple jig shown in Figs. 3 and 4 enables the setting to be done accurately in a minute or two. A stout hardwood block is bored to take the spigot—a tube or solid bar—a good fit for the centre hole in the blade. A slot in the block enables the position of the anvil—a $\frac{3}{4}$in. diameter hexagon-headed bolt—to be adjusted for various diameter saws. A thick steel plate washer is placed under the bolt head, and a packing washer, which may be of wood, is slipped over the spigot to level up the blade. The saw blade is placed over the spigot and the bolt adjusted until a tooth point is just overhanging the chamfer on the bolt head. This tooth should be marked with chalk. A sharp blow with a light hammer will set this tooth, and the blade is then revolved to bring the next-but-one tooth over the anvil. This tooth is set in the same manner, and so on until the marked tooth comes round again. The blade is then turned over and the alternate teeth set.

Only the extreme points of the teeth should be set, and no more set should be given than is required. Too much set wastes wood, and requires more power to drive the saw. Wet wood and certain kinds of fibrous-grained woods require more set than dry; straight grained wood and soft wood usually requires more than hardwood. After setting, some users run-down the saw again, but this time holding the stone to the sides of the teeth in order to reduce any teeth which have too much set. This certainly results in clean sawing, the sawn edge being almost planed up, but, if it is done, great care must be taken that the set is not rubbed off altogether.

Fig. 6.—Touching up the blade in the bench.



Details of the vice in Fig. 5.

Fig. 5.—The saw in its vice for filing. The vice is shown above.

Sharpening

A saw sharpening vice is required to hold the saw rigid whilst filing. This can be easily made from scrap wood as shown in Fig. 5. A $\frac{3}{8}$in. diameter bolt passes through the slot, and is secured at the required height by the round nut. The saw blade is placed over this nut, the hinged jaw closed and tightened with a wing nut and washer sufficiently to prevent the blade vibrating under the file strokes, but not tightly enough to prevent the saw being pulled round to a new position when a few teeth have been filed. The correct files to use for sharpening are—for rip saws, an 8in. mill-saw file with rounded edges, and for cross-cut saws, an 8in. cant saw file. The teeth are filed in the same direction as they are set, every other tooth being filed from one side, and then the saw is turned round whilst the alternate teeth are filed.

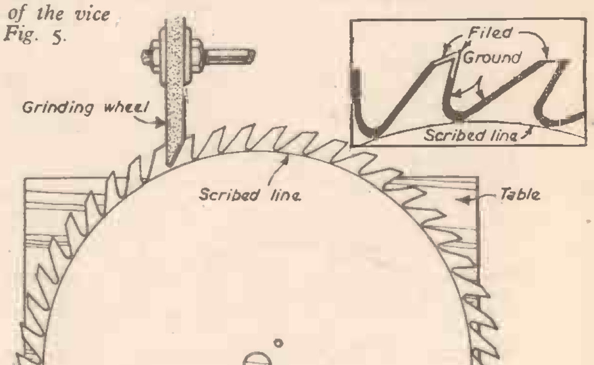


Fig. 7.—Gulletting with a shaped grinding wheel.

The important point in filing is to preserve the original form and profile of the teeth, at the same time keeping the teeth the same size and equidistant from each other. After running down, the points of the teeth are slightly flattened, and show a bright point on each tooth. Most of the filing is done on the front of the tooth until the bright point almost disappears. One file stroke on the top should remove the bright point completely, showing that the tooth is sharp.

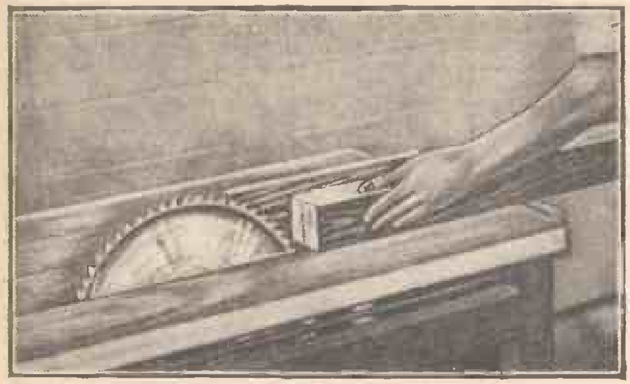


Fig. 8.—Straightforward ripping. Note : guard removed to show operation more clearly.

The amount of cross bevel on the front and top of the teeth should not be too acute, because the keen thin points would quickly wear dull and require frequent retouching. Many saw doctors file rip-saw teeth square across, but this is apt to cause uncomfortable vibration when filing. A good compromise between the two extremes is to file to a bevel of about 10 degrees. The clearance angle on the top of the tooth, immediately behind the point, should not exceed 20 degrees, as this allows ample clearance whilst still retaining enough metal behind the point to leave a strong tooth.

It frequently happens, when sawing gritty or abrasive wood, that the teeth quickly lose their keen points. The blade may then be touched up in the bench, as shown in Fig. 6. A thick wood block is tacked or cramped down to the table, hard in contact with the blade. When every other tooth has been touched up the wood block is removed and replaced in contact with the front of the blade, whilst the alternate teeth are filed. This means filing from the back of the bench, which is not very convenient, so an alternative method can be used, holding the file by its point instead of by the handle, and drawing the file forwards over the tooth. This method of sharpening in the bench is not recommended, but it is useful on occasions, when pressed for time.

Gulletting

After a lot of sharpening the gullets become too shallow to clear the sawdust properly, and the saw must then be gulletted. This can be done with the file, but it is a slow and tedious job. If a power driven grinding wheel is available, this work can be done with a shaped grinding wheel as shown in Fig. 7. The blade is supported on a table level with the centre of the grinding spindle. It is best to take light sweeping cuts round the gullets and backs of the teeth, going round the blade several times if necessary. This avoids the risk of local burning through attempting to take off too much at once.

As a guide for gullet depth, a line can be scribed on the blade, by holding a hard pencil to the side of the blade, whilst pulling the belt round by hand. The grinding may all be done from one side, as this makes it easier to keep the profile of the gullets uniform. The inset sketch in Fig. 7 shows how the teeth may be undercut a little, thus leaving less metal to be removed by the file in the subsequent sharpening.

Sawing Operations

Probably most of the work done on the saw bench will be straightforward ripping to width, and for this the fence must be set at the required distance from the saw blade, and parallel to it. Some sawyers like to set the fence with a slight lead-in to the saw, to correct any tendency for the work to pull away from the fence. This should not be more than 1/64in., or the work will bind between the fence and the saw. The opposite misalignment, that is having the tip of the fence away from the blade line, is fatal to good sawing. For straightforward ripping the tip of the fence should not extend beyond the roots of the teeth. See Fig. 8.

For the cleanest cutting the spindle height should be adjusted so that the blade projects only about ½in. above the work. Another good reason for working this way is that it offsets the tendency for the work to lift at the back of the saw, should the saw kerf close in suddenly, due to a release of stresses in the material being sawn. The riving knife is there to stop this closing in, but it sometimes happens that the kerf closes in before the wood reaches the riving knife. When sawing long stuff, it is always as well to have a second person to support the end of the wood and to insert a wedge into the kerf, should this become necessary.

It is occasionally required to saw wood thicker than the normal capacity of the saw. This can be done by double cutting. The blade is lowered until it projects a little over half the thickness of the wood. One cut is made to this depth, and then the piece is turned end-for-end, and the cut completed by sawing through from the opposite side. The reason for turning the piece end-for-end is so that the same edge can be placed against the fence for each cut, thus ensuring that the two cuts will line up correctly.

Ripping Tapered Work

It frequently happens that a number of duplicate pieces are required to be sawn tapered in length, as for table legs, or a quantity of wedges for wedging up tenoned work. A little jig can be quickly made up as Fig. 9, which will enable the work to be done quickly, accurately and with safety. The dimensions of the jig will vary according to the size of the work being done, but the taper must be an exact duplicate of the required taper on the work. The inclined handle, nailed to the end of the jig, is optional, but as it only takes a minute or two to fit, it is well worth while. It could easily save the loss of a finger. The edge of the work is held in contact with the tapered edge of the jig, and the jig is slid along the fence, the little nib on the jig pushing the work along with it. Note that the open end of the jig is forward. If it was cut the other way, it would be impossible to pull it back again, because the cut piece would bind against the saw.

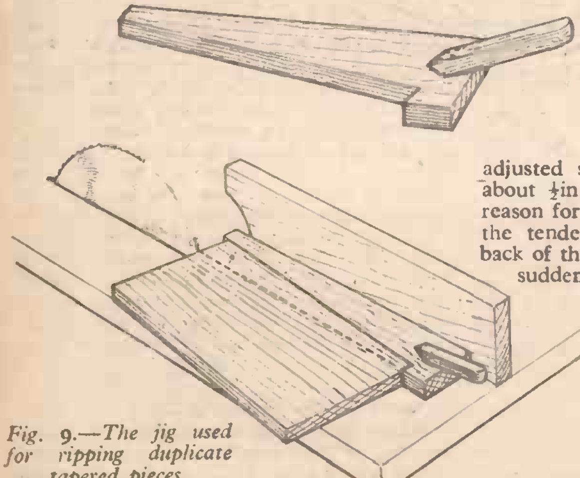


Fig. 9.—The jig used for ripping duplicate tapered pieces.

Bevel Ripping and Chamfering

Bevel ripping of timber into angular sections, or the chamfering off of a corner, can be done by "canting" or tilting the fence to the required angle. If a tilting fence is not fitted, the work can still be done by tacking a riding strip to the fence, of such a width that it tilts the timber to the required angle. See Fig. 10. The riding strip may be bevelled on its edge, but if only one or two pieces are to be sawn to a bevel it is sufficient to use a square-edged strip of the required width. Extra care must be taken when nearing the end of a bevelled cut, because the timber is liable to twist over, and this can easily cause an accident. As a partial precaution against this happening the fence should be extended right across the table. This may be done either by screwing an auxiliary fence—a long board—to the ordinary ripping fence, or by making a special long fence, to be fitted whenever work is to be done which requires support all the way through.

Fig. 10.—Tilting the timber by means of a riding strip.

(To be Continued)

Soft and Hard Soldering

Equipment; Materials and Methods

(Continued from page 430, June issue.)

THE term soft soldering covers all those lower-temperature metal-jointing processes in which the base of the solder is a mixture of tin and lead. These solders are all fusible by the stored heat in a "soldering iron." A soldering iron is really a copper bit, held on to an iron stalk, which terminates in a wooden handle. Copper is used because of its conductivity and capacity for holding heat, and the bit is placed in a fire or over a gas-ring until it is hot enough to melt solder. A certain weight of copper is necessary, but for all average work the reader should use a 12-oz. bit. For very light work a 6-oz. copper head will do very well, but, at the same time, it is very annoying to find that the solder cannot be melted because the bit has cooled in the middle of an intricate piece of work.

Fluxes

The use of a flux is to stop the formation of an oxide on the surface of the metal which would prevent the amalgamation of the solder and the metal. The solder adheres because the metals being soldered together form a local alloy. This is why metals which have a natural affinity for the solder are jointed together more strongly than otherwise.

Metals like aluminium are difficult to solder because their readiness to oxidise prevents the soldering alloy being formed. Special solders and fluxes are therefore sold to overcome these difficulties, and it is also necessary in some cases to scrape the surface of the metal while it is being soldered. Welding aluminium is, however, a much more satisfactory process.

Fluid Fluxes

Paste fluxes have their uses and can be recommended for some forms of electrical work so long as the job is cleaned of all flux after it is completed. For steel, tin-plate,

Fig. 14.—(Above) How to make a simple angle joint.

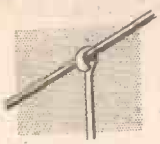


Fig. 15.—(Left) Attaching wire at right angles.

brass and copper strips and sheets the fluid fluxes are to be preferred. By fluid fluxes are meant those which have as their base "killed spirits," viz., chloride of zinc, obtained by putting scraps of zinc into strong hydrochloric acid (spirit of salts). In making this flux always put in an excess of zinc to the mixture to make sure that no acid remains. While any hydrochloric acid is there it will continue to attack the zinc and become converted to the new compound chloride of zinc. If there is insufficient zinc, then free acid is present in the mixture.

The reaction should be performed in an open earthenware jar, and also in the open air, as the fumes of hydrogen and acid which are given off are, to say the least, not very pleasant gases to breathe.

When the bubbling has ceased, pour on about three times as much water as there is fluid in the jar, picking out the larger lumps of remaining zinc. Then strain off through a piece of rag into another receptacle, and add a few crystals of sal-ammonia. The mixture may be bottled (*and properly labelled*) for future use when diluted with a further equal quantity of water.

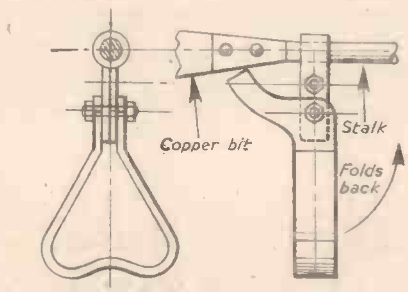


Fig. 16.—How the stand for the iron is made.

A heavy, bulky pot—something like a small edition of the old-fashioned earthenware pickle jars, or an old marmalade jar made of the same material—should always be used to hold a liquid flux. Something that will stand knocking about, and which cannot easily be overturned is essential.

Using a Soldering Bit

When the iron—as it is often called—is taken out of the fire or off the gas-ring, as the case may be, and presuming its working point is already properly tinned, it should be dipped into a pot of flux—quite a quick dip—and then poked into another jar of sal-ammoniac. Experienced workmen usually have a lump of sal-ammoniac on the bench, which is used for "cleaning the iron."

The fumes accompanying soft soldering and the danger of splashing flux, are both so deleterious to adjacent tools that it is always advisable to reserve a special bench in the workshop for soldering. If this is impossible, do the work as far away as possible from workshop appliances.

Paste Fluxes

All fluxes should be applied to the work by means of a piece of stick—a wooden meat skewer is quite suitable; paste fluxes should be placed in heavy pots. Much petty annoyance in working is caused by not transferring a paste flux from the light tin in which it is purchased to a more massive container. If it is attempted to use the paste from the original tin, the stuff is so sticky that just at the critical moment, when it may be necessary to improve the flow of the solder by a touch of flux, you will find that the dibber stick picks up flux, tin and all. Keep the original tin as a store, and transfer enough for use to either a heavy pot or one that is fixed down to the bench.

Where it is advisable for the particular job in hand to employ a paste flux, do not use it for dipping the end of the soldering bit into. Always provide the jar of fluid flux, and the sal-ammoniac already referred to for cleaning the "iron" as it is removed from the fire.

Soldering Small Work

For jointing or "sweating up" small objects which can be brought to the heat, soft soldering can be successfully done by a small Bunsen gas burner, methylated spirit flame, or a blowlamp.

A mechanical attachment of the two or

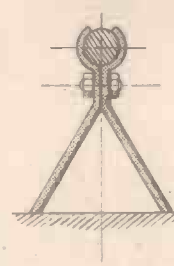
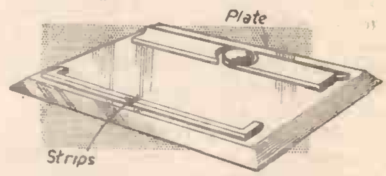


Fig. 17. — (Left) A permanent fixing for the foot of the stand.

Fig. 18.—Arrangement of ornamental strips.



more parts to be soldered is recommended in such cases, in addition to the soldering. A wire to be attached at right angles to another may be either looped round, as shown in Fig. 14, or if it is an angle-joint that is required, like that at the corner of a lamp-shade, the wires may be flattened and wrapped round each other as in Fig. 15.

After hammering or working in any way which may possibly introduce foreign matter into the surface of the metal, the wires, or metal being worked on, must be cleaned and tinned. Even tinned iron wire gets "dirty" if hammered, and refuses to solder afterwards. To tin a wire or other small object, first clean it with emery paper, a scraper or a file and coat it with flux, preferably a fluid flux. Heat it up in the flame and reflux when it is hot with the stick of solder being used, dipped into the flux. If there is any solder on the job, reflux with the wooden "dibber" guiding the solder where it is wanted. Rubbing the solder up and down the job will soon coat it, provided the right heat is preserved. Do not overheat the joint: this burns the solder and the tinning and prevents the job being completed. The work must never be brought to anything approaching red heat. Even the dullest red heat represents a temperature of over 800 deg. F., whereas the finest grade of soft solder melts at about 440 deg.

A Stand for the Soldering Bit

Where small work is being operated upon, the end of the "iron" may be used instead of the naked flame. To facilitate work of this nature a clip may be fitted on to the iron stalk of the soldering bit. To this clip a triangular foot, made of strip metal, is arranged as shown in Fig. 16. It is useful to fit one to the iron. If it is thought that this foot is better if made to fold down, the clip should be provided with two holes, one to grip it to the stalk of the bit, and the other, as shown in Figs. 16 and 17, to carry the bolt holding the foot.

There is no real need either to remove or to fold the foot. It may be a permanent fixing, as shown in Fig. 17, and will then be found most useful in ordinary soldering. It is often necessary to lay the "iron" down for a moment. The foot saves the bench from being burned by the hot copper bit.

Where one or more pieces of metal in close proximity have to be joined on to a rather heavier part, the ordinary process must be modified. Take, for example, the arrangement of ornamental strips on the surface of a plate shown in Fig. 18. The soldering iron is out of the question for such a job. The parts must be sweated in position at one heat.

The surface of the plate should be cleaned and tinned, any superflous solder being wiped off with a damp rag while the plate is hot. The strips may be similarly tinned at the back, although if they are quite clean, edges as well as back, they will sweat up quite satisfactorily if well fluxed.

The positions of the strips are then marked out, and the pieces held in position by spring clamps (see Fig. 19). These may be of strip brass of horseshoe form, or like miniature cycle trouser clips.

The whole plate is then brought up to required heat with a blow-pipe or over a gas flame, with little nodules of solder laying up against the strips. A further supply of flux soon makes the solder sweat into all the crevices, and a neat job will result. It is easy to shake off superfluous solder and

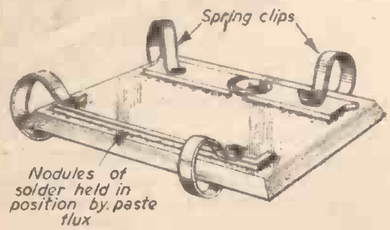


Fig. 19.—Strips held in position by spring clamps.

reheat and reflux as occasion may require. The clamps save all the trouble of drilling and riveting on the strips.

Another form of clamp may be made up out of strip metal, and can be employed to hold two separate parts firmly in a given position while they are being soldered (see Fig. 20).

The Potato Dodge

Where two objects are very close together and cannot, for some reason, be sweated up at one operation, the first joint may be stuck into a raw potato. This not only keeps the original joint cool and prevents it from coming unsoldered, but forms a convenient handle for holding the work in the flame while part number two is sweated up. Fig. 21 shows a typical case where a potato comes in useful.

Don'ts in General

It is of no use attempting to solder work which is not clean. There is just "ordinary dirt," and the oxidisation due to burning on of previous solder, or of the tin coating of tin-plate, and merely heating metal forms a certain amount of oxide on the surface, which prevents a successful jointing.

Do not overheat the bit, as this burns off

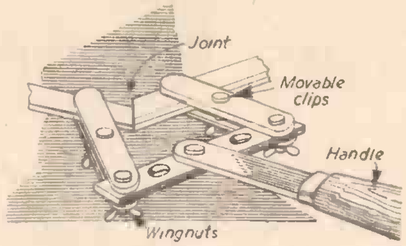


Fig. 20.—Another form of clamp for holding the strip.

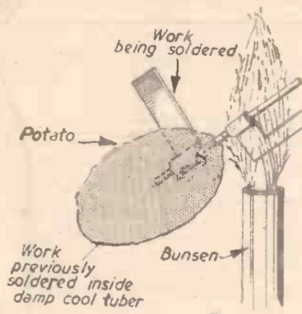


Fig. 21.—A typical case where a potato comes in useful.

the tinning at the end. To re-tin the bit the copper end must be filed quite clean; finally, while it is hot, immediately rub it on a piece of tinplate (the inside of a fixed-down tin lid) with solder and flux until the point is quite bright all over with solder.

Always wipe a soldering iron as it is withdrawn from the fire on a piece of old mat, or anything else of a rough textile character, to remove the soot. Then dip it in the flux and sal-ammoniac as already recommended.

Do not use "killed spirits" for soldering zinc. A dilute solution of the natural hydrochloric acid (spirit of salts) is required.

Have a coil of soft solder with an extended arm over the tinning lid (Fig. 22). The dribbles of solder then fall into the lid, and are useful for future tinning.

Cowl for Gas Ring

Where an ordinary gas-ring is used, and the jets are apt to spread out to too great an angle away from the copper bit, a cowl

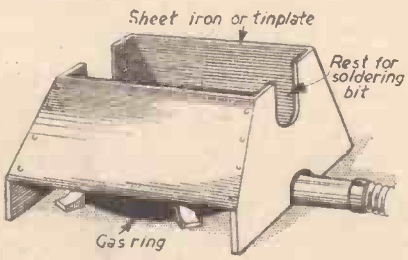


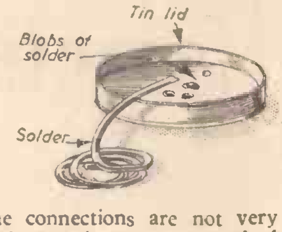
Fig. 23.—An easily-made cowl that can be fitted over the gas ring.

can be made up out of sheet iron or tinplate to conserve the heat and at the same time provide a rest for the "iron" in the heating process (see Fig. 23). By adjusting the amount of flame the iron can, by using such a cowl, be retained at just the right heat, neither too cool nor, however long it remains over the stove, so hot that the tinning is burnt off the end.

Soldering Zinc

Zinc, being a metal with a low melting point, has an annoying habit of melting and running away altogether when a hot soldering iron is applied to it. If you are soldering the connections of a series of small Leclanche cells, this is especially aggravating, since the

Fig. 22.—Coil of solder with a tin lid underneath to collect the drips.



zinc tags for the connections are not very large to begin with, and they are soon melted away to nothing.

Here is a safe and sure way of soldering a copper wire to sheet zinc. Well tin the end of the wire, polish up the zinc with a piece of fine emery cloth, and thoroughly clean the face of the soldering iron. Heat the iron and apply solder to the bit until there is a good blob adhering to it. Hold the wire against the zinc tag, turn the soldering iron over gently so that the blob of solder hangs down underneath, and bring this blob into contact with the wire and the zinc. Be careful not to press the iron itself down on to the work. The solder should run on to the wire and the zinc at once, making a perfect joint. The secret of success is to touch the work with the blob of solder only, and not to keep the iron close to the work for longer than is necessary.

Soldering Aluminium

Success in soldering aluminium depends on the effective removal from the metal of the microscopically thin film of oxide always present on the surface. When measures are taken to deal with this film, the main difficulty of soldering is removed. Three different types of soldering are employed, which may be distinguished by the terms hard soldering, soft soldering, and reaction soldering.

Hard Soldering Aluminium

In this process the solder consists of an alloy of aluminium having a melting-point between 500 deg. and 600 deg. C. Many such alloys exist, but the silicon alloy, containing 10-13 per cent. of silicon, is undoubtedly the best. The oxide is removed by means of an alkaline halide flux, such as is used for aluminium welding. At the temperature at which the soldering is carried out, the flux is melted and rapidly attacks the oxide, permitting the melted solder to come into contact with clean aluminium, and to alloy with the surface. In carrying out the process, a gas blow-pipe is used as heating medium, but apart from this and the higher temperature required, the process does not differ from the ordinary soldering of brass. The flux is melted up and flows

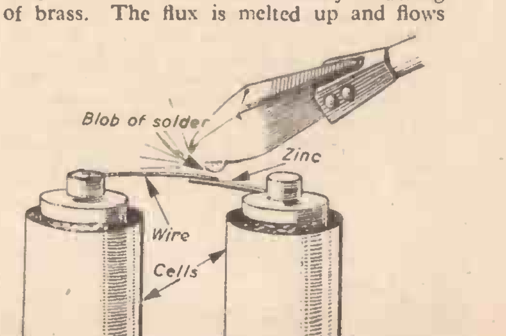


Fig. 24.—Method of soldering to zinc.

readily, sweating the parts together. Certain manufacturers supply silicon alloy solder in the form of a tube with the flux contained inside.

(*Concluded on page* 508)

Operating Mains Razors *from* Batteries

A Handy Device When Mains are Not Available

By G. H. BURNS

THE unit to be described will enable the owner of an electric razor, rated for mains voltage only, to use it in conjunction with a car or motor cycle battery.

The prototype was built for operation from a 6-volt motor cycle battery and has now been in use for some time on camping trips, etc., when no mains supply was available for the 240-volt razor.

Reference to the theoretical circuit (Fig. 1) and the practical wiring diagram (Fig. 2) will show that there are only five operative components in the unit, and it may be constructed to quite small dimensions.

battery with which it is to be used. In many cases this will be 6 volts, but 12-volt vibrators are obtainable for those whose cars have 12-volt electrical systems.

Similarly with the transformer. The primary must be suitable for the battery voltage and be wound for full-wave operation. In addition, the secondary winding should have an output voltage suitable for the razor at a power rating of 10 to 12 watts (this is the power normally required by an electric razor).

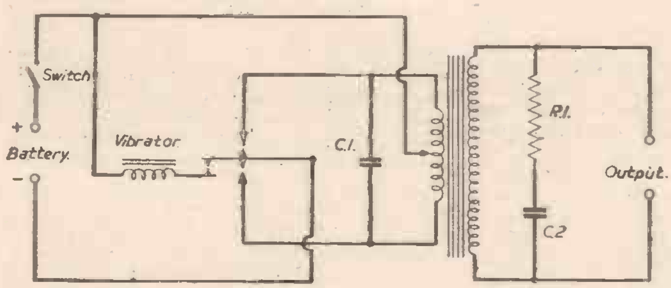


Fig. 1. (Left)—Theoretical circuit.

Components

Condenser C.1 (0.1 μF.), the "arc-quench" component included in the primary circuit, may be of the common paper type with a working voltage rating of 150 to 500 v.

The purpose of C.2 is to absorb voltage peaks developed across the secondary of the transformer. High peaks are encountered here because of the characteristic waveform of vibrator circuits, therefore this condenser should be either a mica or oil type, with a minimum voltage rating of 1,000 v., and it has a capacity of 0.01 μF.

Resistor R.1 is included in series with C.2 in case of a leak developing in the latter—it avoids the possibility of a short circuit across the transformer secondary, which could result in irreparable damage.

The vibrator is of the non-synchronous type, and must have a voltage-rating corresponding with that of the voltage of the

The transformer shown was specially wound for this unit and has a half-wave secondary, whereas the normal type of vibrator transformer used in car radio power supplies has a full-wave output. However, a suitable transformer, with 6-volt or 12-volt full-wave input and 230-volt half-wave output may be had from Electronic Precision Equipment Ltd., who will also supply the vibrator.

The output socket (to accept standard two-pin plug, or whatever type is fitted to razor) should preferably be of the shrouded type, i.e., no contact with the actual metal sockets should be possible accidentally. Messrs. Bulgin produce suitable types which may be purchased or ordered at local dealers.

Miscellaneous items required are a toggle switch and two crocodile clips for connecting to the battery. Where a power point is fitted to a dash-panel, the clips will, of course, be replaced by a suitable plug.

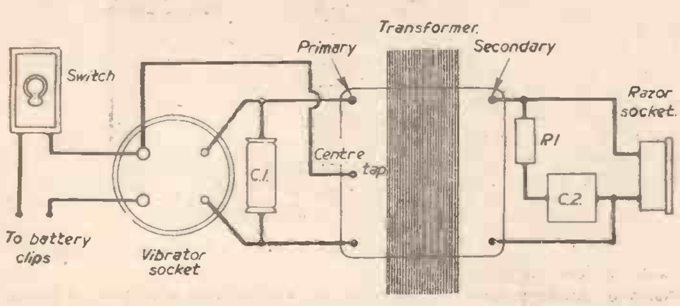


Fig. 2.—Wiring diagram. Component values: C.1—.1 μF paper, 150 volts working. C.2—.01 μF mica 1,000 volts working (min.). R.1—10,000 Ω 5w. wirewound.

Fig. 3.—Interior view.

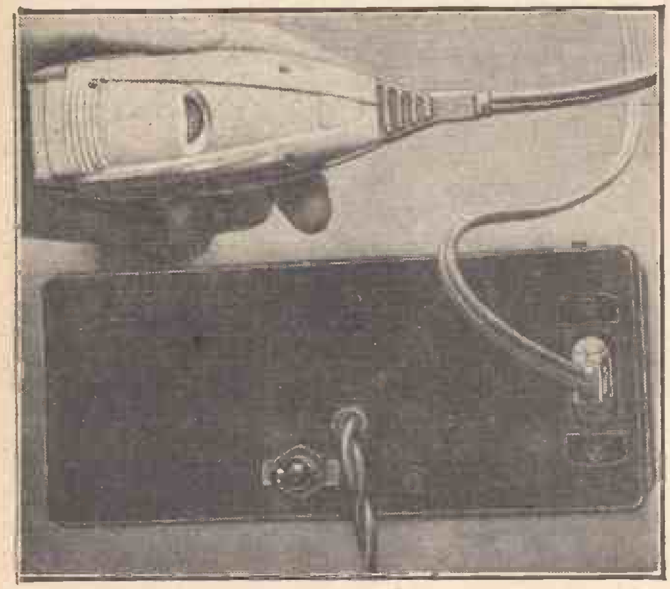


Fig. 4. *The completed adapter.*

Assembly

The writer's model was housed in a metal box 7½in. x 3in. x 3in., which was conveniently to hand and proved ideal for the purpose, all components being mounted on the underside of the lid (see Figs. 3 and 4). However, the constructor will require to find, or make, a container of adequate size after first acquiring the necessary components, as these may vary somewhat in dimensions.

Arrangement of the components may be adjusted to suit individual cases, but the layout, as shown in Fig. 3, makes for ease in wiring.

For efficiency in operation all the electrical connections should be securely soldered.

The low-voltage part of the circuit (on the left-hand side of the transformer in the diagrams) carries fairly high currents and should be carried out in wire of not less than 16 S.W.G. Similarly, the battery leads should be of substantial flex, with the clips (or plug) soldered on. This flex emerges from the case through a rubber grommet, or insulating bush.

Make sure that all wires, and points which are "live," are well insulated and separated from each other and from the metal case, etc. This is particularly important in the high voltage side of the circuit (to the right of the transformer in the diagrams) since, as already mentioned, a "short" could easily ruin the apparatus.

Operation

1. See that switch on unit is "off."
2. Connect flex leads to battery.
3. Plug in razor to unit, and if there is a switch on razor, switch on.
4. Switch "on" at unit.

BARRIER CREAMS

Basic Features; Uses; Simple Formulæ

By K. E. MIKER

BASICALLY, barrier creams are not a recent discovery. Grease, petroleum jelly and lanoline have been used for many years to protect the skin from water, and mutton fat, whiting and china-clay are said to have been used in a similar way by certain workmen to keep dirt out of the pores of their skin so that subsequent cleaning was made very much easier. These substances are not creams but they are barriers, physical barriers that are themselves completely harmless and that act like an invisible glove to protect the skin from harmful substances.

This basic barrier concept has given rise to the present variety of cream preparations. These are not necessarily more effective than the earlier substances but they are much more pleasant to use.

Poison Protection

A barrier cream may also be considered to be a sort of antidote because it gives protection against what is essentially a poison; but unlike conventional antidotes to the more spectacular poisons, it has to be taken before the poison is administered. A satisfactory barrier can usually be developed for protection against any specific harmful substance.

Two Types

In general, harmful contaminants of the skin can be divided into two groups, namely: those that are soluble in water, and those that are not soluble in water. Barrier creams may therefore be similarly divided into the two corresponding types. Thus, the first type protects against acid and neutral irritants, soaps and alkali, photographic chemicals, etc. The second type is for protection against noxious oil and grease, hydrocarbon solvents, paints, tars and dusts.

Certain essential features are common to both types. They must be completely non-irritant to the skin even when used continuously. They must therefore be slightly acid in reaction (between pH5.5 and 6.5) as the skin is slightly acid in reaction. Any preparation that is much above or below these limits has a detrimental action on the skin when used constantly. The barrier substance must obviously be insoluble in the substance against which it is to give protection. It should not be necessary to make over-frequent application, and it should not leave the hands sticky or slippery because this would make it dangerous to use. It should not act as a thermal insulator and it must be easily removable by ordinary cleansing methods, i.e., soap and warm water; special removers should not be necessary. It should not be hygroscopic and it should not remove natural grease. It should in no way weaken the living layer of the skin nor should it have drying, oxidising or reducing action. This is quite a formidable array of essential features but all are listed as necessary by medical authority. If the list seems long, bear in mind that although most people recognise that they would be in a very poor way if their heart stopped beating, they do not realise that they would hardly be better off if their skin stopped working. The skin is indeed a vital organ that separates the body from the outside world about it. It gives mechanical protection to the underlying tissues. It is waterproof. It keeps germs out. It gets rid of certain waste products. It regulates the body's temperature and it cuts off harmful radiation.

Within wide limits the skin can look after and repair itself, but continuous or severe maltreatment causes trouble. Skin disease is common, and it is impossible to exercise too much care about what is rubbed into the skin, especially if applied frequently.

Home-made Barrier Cream

Consider the mixture of soap, water and scouring powder often recommended. This has obviously unknown qualities. It contains soap and, though soaps vary considerably in quality, excessive use of any soap can lead to a dermatitis.

There is no standard scouring powder, but many brands, each with its own formula which the manufacturer can and does change whenever it suits him. In general, scouring powder consists of an abrasive powder such as powdered pumice, quartz or kieselguhr, together with water-softening and dispersing or deflocculating agents; perhaps carbonates, silicates and phosphates. There is also a certain amount of detergent, more being present in the foaming varieties. Such a mixture is not suitable for bodying up a barrier cream because it must be alkaline and it may be very alkaline, depending on the particular ingredients used in its manufacture.

Assuming that the scouring powder confers nothing worse than alkalinity, a cream made up from soap and scouring powder could be useful occasionally, but frequent or lengthy use of it may lead to serious skin trouble.

A Simple Formula

The simplest barrier cream against water and solutions in water is a mixture of lanoline and petroleum jelly. Nature has used lanoline as waterproofing for the sheep's back for a good many years. In use some of this mixture is absorbed by the skin and the pores of the skin are filled so that water is repelled. But it makes the skin rather unpleasantly greasy and interferes with heat radiation. If a small amount of a suitable surface active agent is added it may be thinned down with water to give a cream that is readily applied and that on gentle rubbing almost completely vanishes into the skin, leaving the hands free from stickiness. Effectiveness can further be improved by incorporating a proportion of metallic stearate. Such a preparation does not soil materials being handled nor does it interfere with delicate work. It is also a good barrier for dirt because it is easy to wash off and the dirt comes along with it.

An oilproof barrier may be prepared containing glycerine, water and alkali with sufficient stearic acid to form a simple vanishing cream. The soap which is formed during the preparation emulsifies the excess of free acid that maintains the required acidity. A different type of oil barrier can be made using suitable gums and resins so that a flexible film remains on the surface of the skin when the preparation is allowed to dry. This film must be soluble in water so that it is possible to remove it subsequently, a requirement that brings about the disadvantage that the period of effectiveness is much reduced by sweating. Incorporation of some oil or fat into the film can to some extent counteract this without reducing the effectiveness of the film as an oil barrier.

If it is desired to make a barrier cream at home, start with one of the reputable published formulæ and use good quality ingredients.

Help your child study at home with this DESK AND SWIVEL CHAIR

Cheap : Useful : Easy to Make

By G. KENT

THE desk and chair described here cost less than £1 to make and have been used constantly. The desk provides a most useful place for all pencils, crayons, papers and books which children usually collect. An older child may find it useful for homework.

The desk is made solidly from wooden corned beef cases. If a few good grocery boxes are obtained and carefully taken apart wood can be found to make the sides and top of the desk. All the wood should be carefully prepared with the plane and filled or glued where necessary, after which it will be found quite suitable for this work. In the original the bottom of the desk was planked with 3in. wide strip wood from cheese crates which made a neat and convenient construction. If new wood is used $\frac{3}{8}$in. thick stuff would be sufficient for the sides with a hardboard or plywood base and plywood desk flap.

Full dimensions and the method of construction are given in the exploded perspective, Fig. 1. All joints were glued and where necessary 1in. panel pins were used. The detailed measurements may have to be adjusted slightly to allow for variations in the thickness of wood used. New $\frac{7}{8}$in. square timber was used for the legs. There is no need to make accurate joints where the stretchers join the legs as a strong fixing can be made with a 2in. No. 8 screw if the wood is cut accurately. These screws should be well countersunk and the heads covered with putty or other filler, which is then sanded flat. The foot bar is formed from a scrap piece of oak 17in. x $1\frac{3}{4}$in. x $\frac{3}{8}$in.; this is best wax polished with a good white wax furniture polish after careful preparation. It is fixed to the desk with two chromium round-head screws.

The desk flap is hinged with two 1in. brass back flap hinges, reinforcement of the flap and desk panel being made at the edges where the hinges are fixed (not shown in Fig. 1), and two battens are glued and pinned on the inside of the flap to keep it rigid and flat.

The top panel of the desk is grooved with a sharp gouge to make a pencil ledge and a suitable hole was cut with a fretsaw to

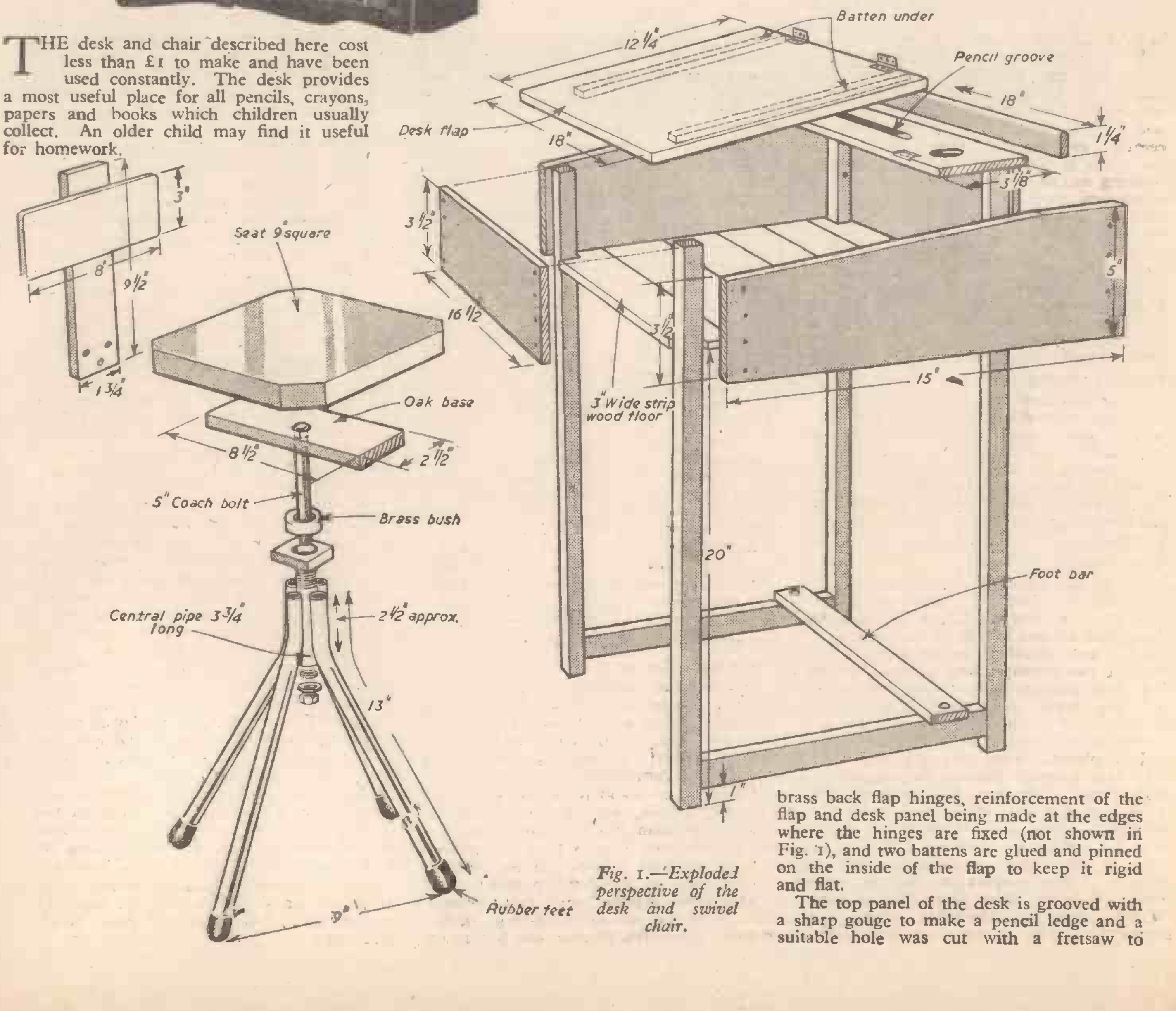


Fig. 1.—Exploded perspective of the desk and swivel chair.

accommodate the china inkwell obtained from an educational supplies shop. A plywood inset is pinned underneath this hole having a smaller hole in it to retain the inkwell.

After the desk has been put together it should be carefully sanded and all the holes stopped with a wood filler, which should also be used on the exposed end grain of the wood. A coat of good undercoat paint should now be applied inside and out; it is better to remove the hinges and flap during painting. Home-made wooden toys can be finished so much better than bought ones if a little trouble is taken, so effort spent in sanding and painting is well worth while. When dry, the undercoat should be carefully sanded and the finishing coats applied to the outside. Good quick drying (two to four hour) lacquer is best; the original desk was painted daffodil yellow on top, powder blue on the sides and had light grey legs. Two finishing coats are preferable with a light sanding after the first coat.

The Swivel Chair

It was made from $\frac{5}{8}$in. electrical tubing. A 6ft. length was purchased with one end threaded and fitted with a female brass bush. Four legs were cut 13in. long and were formed to the shape shown by bending them in a solid piece of wood. A $3\frac{3}{4}$in. length was cut for the centre piece using the threaded end. The four legs and central pipe were fitted together and fixed with iron wire to a scrapwood base board. This was then taken to a welding firm who welded all four legs and central pipe together into a solid structure for a few shillings.

A 2in. square section of wood with a central hole for the centre pipe is fixed by panel pins to wooden plugs driven into the top of each leg, this gives a neat finish to the legs. The brass bush can then be screwed into position on top of the wood.

A 1in. thick piece of case wood was used for the chair seat and the strengthening member beneath it from a piece of scrap oak about $\frac{7}{8}$in. thick by $2\frac{1}{2}$in. The oak is first drilled to receive a 5in. coach bolt, which should be a close force fit in the hole. Then, with the bolt firmly fixed into the oak, this should be strongly screwed in position beneath the seat as shown. The seat back should be firmly screwed to the seat and strengthening piece by three $1\frac{1}{2}$in. screws.

Two washers to suit the coach bolt were filed on their outside circumference to a force fit in the central pipe in order to locate the bolt centrally. Other loose washers are fitted at each end of the central pipe to provide bearing surfaces. Before assembly all parts were painted to match the desk, then the bolt was slipped into the central pipe and the nut fixed with a little glue in a position to allow the seat to rotate easily but without too much play.

Rubber feet were fitted to the legs; $\frac{5}{8}$in. walking-stick ends are suitable for this, if the type fitted to metal furniture are not available.

Using 828 Colour Film in "12 on 120" Cameras

By R. V. COATES

ALTHOUGH there are now many brands of colour film available for 120 size cameras the resulting transparencies, even if $2\frac{1}{4}$in. square, are inconveniently large for projection, need considerable storage space, and tend to be expensive. Miniature, 2in. by 2in., slides have many advantages over the larger sizes, not the least being their lower cost and the cheap yet efficient range of projectors.

Such slides normally hold 35 mm. frames, but can also accommodate the slightly larger 828 frame. This film is still 35 mm. wide, but has no sprocket holes, permitting a frame size of 28 mm. by 40 mm. to be obtained. "Kodachrome" colour film is available in eight exposure lengths for Bantam cameras, and to people without a "second camera" this length is more convenient than the normal 20 exposure 35 mm. length. The adaptor to be described can be fitted to a "12 on 20" camera in a few seconds without any permanent alterations, enabling an 828 film to be used.

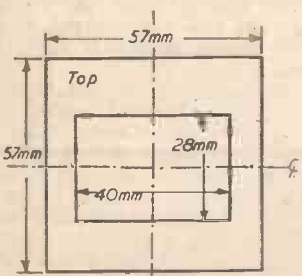


Fig. 1.—Dimensions of the mask.

Exposure Numbers

Frame numbers on the 828 backing paper are along the centre, and can hence be seen through the window as for a size 120 film. Although the adaptor to be described could just as well be fitted in an "8 or 16 on 120" camera, some other indication of frame number would then need to be devised.

Frame Mask

First, a mask is made from 1/32in. brass sheet. Dimensions are given in Fig. 1, but the outer lengths should be made to suit individual cameras so that the mask fits snugly into the existing rebate with its upper surface exactly in the film plane. The side facing the lens is painted matt black to avoid reflecting the image on it back into the camera body. The side in contact with the film is given a high polish to avoid any scratching. A short length of "scotch tape" can be applied along the top and bottom edges of the mask to ensure a positive location in the rather shallow rebate.

Spool Holders

Fig. 2 shows the two spool holders. Four stubs are turned from aluminium or brass to the dimensions shown. Three-sixteenth inch dia. holes are drilled centrally through each, and for 120 cameras one end of each hole is enlarged to 7/32in. to admit the spool-retaining pins. The other end of each hole is enlarged to $\frac{1}{4}$in. diameter to admit the ends of the 828 spool. Into two stubs 6 cm. lengths of 3/16in. diameter brass rod are pinned to act as spool axles. The take-off spool is now complete: a full 828 spool is fitted on the axle and a loose stub slipped over the spool end and axle projection.

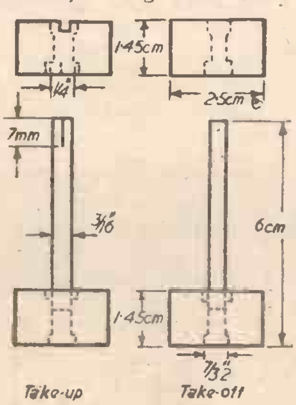


Fig. 2.—The spool holders.

The take-up spool is necessarily more complex. A diametrical slot is cut across the outer face of the remaining loose stub to engage with the camera winding-key. Two small "nicks" are cut diametrically from the hole at the inner face of the stub, into which a small piece of shim brass or spring steel is pressed so as to lie about 1 mm. below the surface. This engages with the serrations on the end of the 828 empty spool, and with a short slot in the axle. Hence, the whole assembly can be rotated as a rigid unit by the winding-key. Fig. 3 shows the complete system as set up in the camera.

Film Tension

Unlike size 20 spools, 828 spool cheeks have a flanged edge. The existing tension spring on the take-up side may be put out of action by the stubs; if so, the film will build up outside the flange and consequently be fogged on unloading unless done in the dark. To ensure the film winds up inside the spool checks a short length of spring steel bent into a shallow "V" (see Fig. 3) is dropped inside the camera body so that it is kept in place by the rotation of the take-up spool. The point of the "V" presses against the centre of the backing paper, and is adjusted so as to give sufficient tension to keep the film winding inside the flanges.

Viewfinder Mask

Lastly, the viewfinder must be masked down to the new size; this is an individual fitting depending on the type of viewfinder, but, in general, a small cardboard mask will suffice. The 75 mm. lens usually fitted on $2\frac{1}{4}$in. square cameras becomes slightly long-focus for the reduced frame, helping to ensure the frame is filled completely.

Use of 35 mm. Colour Film

"Kodachrome" is the only colour film available in size 828. However, if the user does his own processing, 20 exposure lengths of 35 mm. user-processed film can be obtained, cut into two eight exposure lengths plus a short length of four to six exposures, and these wound on to 828 backing paper, and spooled. The height of the mask aperture may now be reduced to 24 mm., but the length will still be 40 mm., not 36 mm., since this is controlled by the spacing of the numbering on the backing paper.

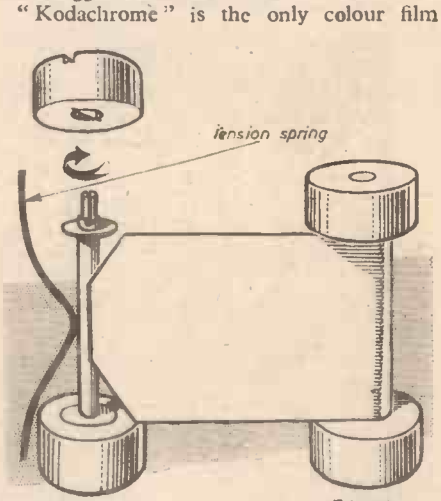
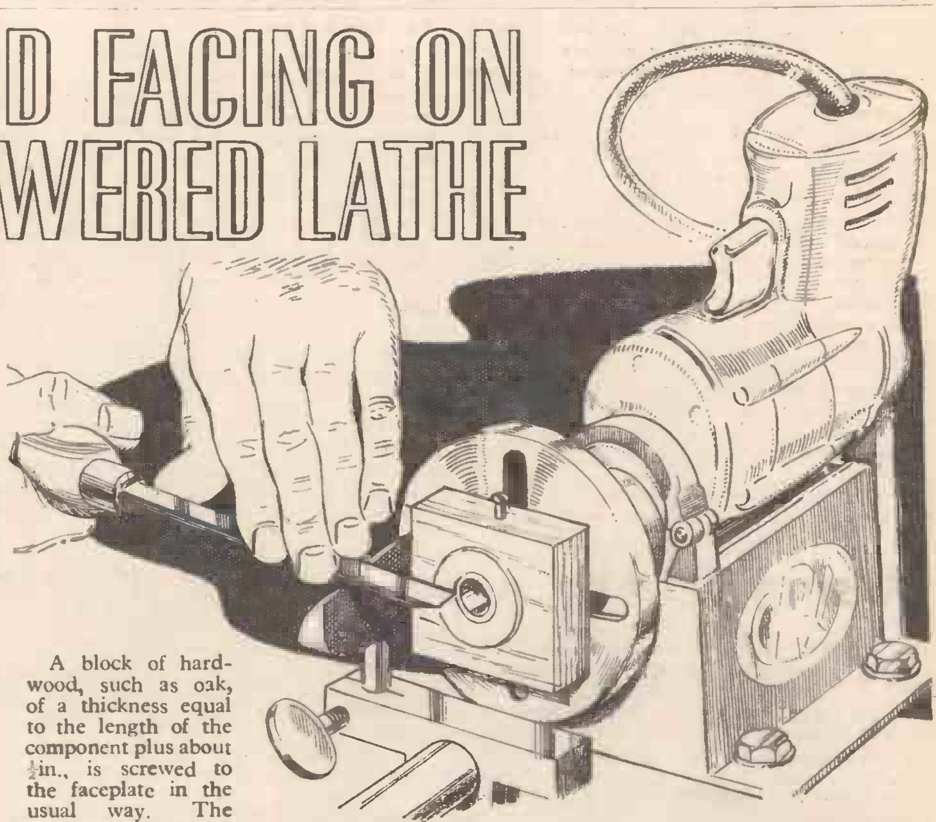


Fig. 3.—The complete system.

BORING AND FACING ON A DRILL-POWERED LATHE



Extending the Range of the Tool to Include Plastics

By ARNOLD E. BENSUSAN

THE admirable little lathe kits powered by portable electric drills have a multitude of uses where wood turning is concerned. Now that plastics are used so widely by home craftsmen, the following hints for extending the scope of a lathe to cover the machining of this material should prove of interest to many readers.

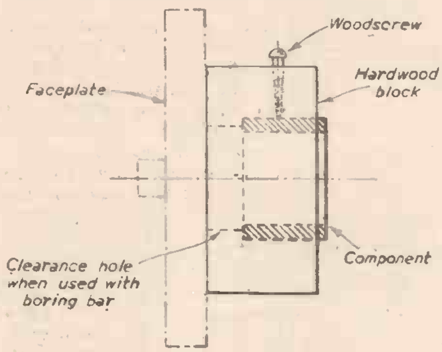


Fig. 1.—Arrangement for facing plastic.

Facing

One of the most commonly required operations is to face both ends of a short plastic tube or rod; perhaps square to the axis of the part, or with a chamfer or radius. This would, for example, be necessary during the construction of serviette rings or similar articles made from Perspex or a similar material. Since no large three-jaw chucks are available to hold work of this nature on the spindle of the power unit and, in any case, such an arrangement would be too heavy for the small motor to swing, an alternative method is necessary.

Fig. 2.—A short tube being faced to length.

A block of hardwood, such as oak, of a thickness equal to the length of the component plus about $\frac{1}{2}$in., is screwed to the faceplate in the usual way. The faceplate is mounted on the drill spindle, and the block is drilled and bored out until it is a fairly tight fit on the plastic component. The hole should extend to about $\frac{3}{8}$in. from the back of the block, so that the overhang of the finished component from the face of the block will be limited to about $\frac{1}{8}$in. Initially, of course, the overhang will be slightly more, since there is a small amount of plastic to be removed from either end.

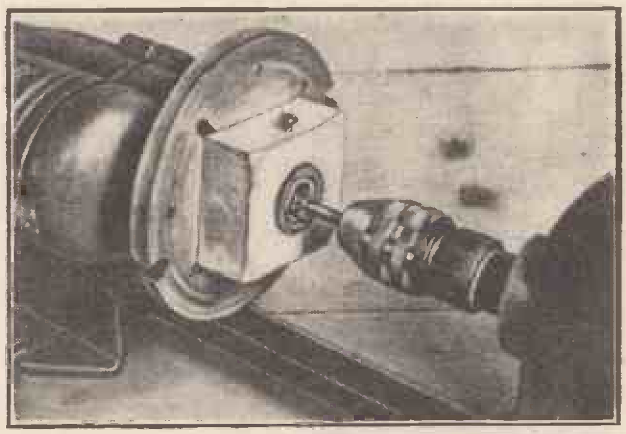
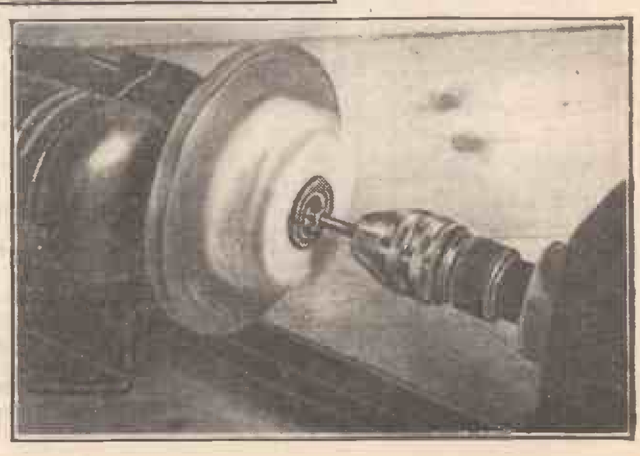


Fig. 3 (Above).—The hardwood fixture mounted on the faceplate and the boring bar in a partially machined component. (Right) the boring bar machining a component.



In order to retain the component in this wooden fixture, a suitable woodscrew should be inserted from one side. Only very light pressure should be exerted by this screw, and if the point is filed off no indentation will be produced on the surface of the component. The arrangement for a typical job is shown in Fig. 1. The slight protrusion of the work from the fixture should enable it to be easily removed.

It must be borne in mind that the fixture should not be removed from the faceplate until all the work has been completed, or it will be found almost impossible to re-align it satisfactorily.

Machining can be carried out with the conventional wood turning tools, kept extremely keen and not overheated by lengthy application to the work. Alternatively, the end of an old file may be ground into the usual profile for turning work. Fig. 2 shows a short tube being faced to length.

Boring Bar

A further useful accessory is an adjustable boring bar, which will often need to be used in conjunction with the fixture described above. This tool enables cylindrical parts to be bored out accurately to size and without any internal taper, as might be the case if a hand tool were used. Additionally, an entire series of components can be bored to the same size without any need for resetting the tool.

The component is mounted on the faceplate of the lathe, possibly with the aid of the hardwood fixture. The boring bar is retained in the drill chuck, which is, for this operation, held in the tailstock. The component is bored by simply moving the tailstock lever. The arrangement is shown in Fig. 3. Where the bar has to pass right through the work, a suitable clearance recess must be bored in the fixture.

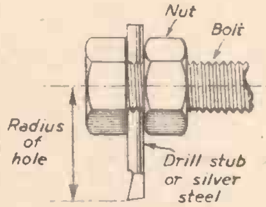


Fig. 4.—How the parts are assembled and how the boring diameter is set.

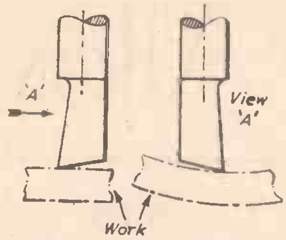


Fig. 5.—How the silver steel drill stub is ground.

The shank of the tool is a ¼in. B.S.F. or Whitworth bolt, preferably, although not essentially, with a hexagon head to facilitate tightening. The bolt should be long enough to be securely gripped in the drill chuck, leaving sufficient of the shank clear to completely pass through the work. A hole should be drilled transversely through the bolt, close up to the head, to suit any odd pieces of silver steel or broken twist drill shanks of about 3/32in. diameter which may be at hand. A standard ¼in. hexagon nut with a matching thread is also required. Fig. 4 shows how the parts are assembled and the boring diameter is set.

The silver steel or drill stub is ground as shown in Fig. 5 and a few tools of various lengths will cover an extremely wide range of work.

A Photographic Retouching Desk

A Device for the Camera Enthusiast

By "TECHNICUS"

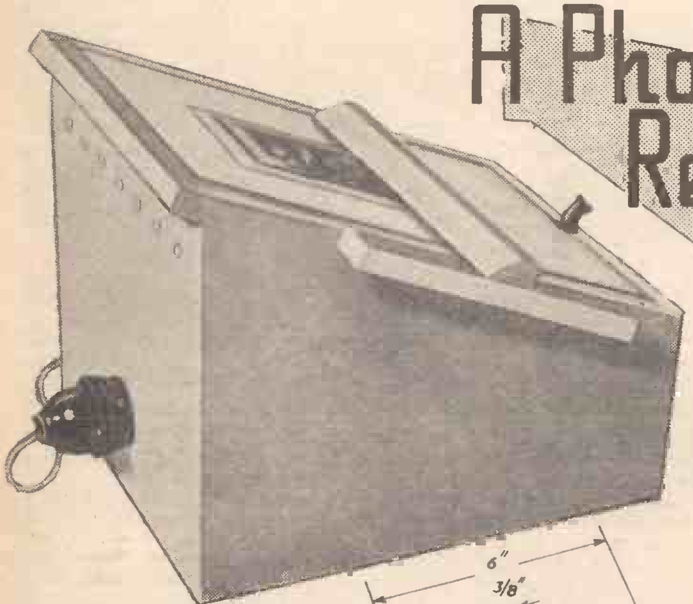


Fig. 1 (Above left).—The completed retouching desk.

THE retouching desk described here costs only a few shillings to make, consumes 15 watts of electricity, and can be stored in a small area when not in use. Apart from retouching and similar afterwork on film or plate negatives, the desk facilitates the blocking-out of technical and similar photographs where a perfectly white background is required on the print. The completed desk is shown in Fig. 1.

Two sheets of ordinary glass, 11in. x 7in., with a piece of tracing paper between them, are bound all round the edges with cellulose tape to form the working surface. Negatives for treatment are simply taped to the face of this part. It is advisable to obtain the glass and make up this section before constructing the remainder, since slight adjustments of size are more readily made to the wooden parts.

The sides of the desk are cut from ½in. thick chipboard, as this is inexpensive and easy to work. The back, front and base are ¼in. thick plywood, or ⅛in. thick hardboard. A row of ⅜in. diameter ventilation holes is drilled in both front and back panels, and a larger hole centrally placed to accept a standard lampholder with built-in switch is cut in the back panel alone.

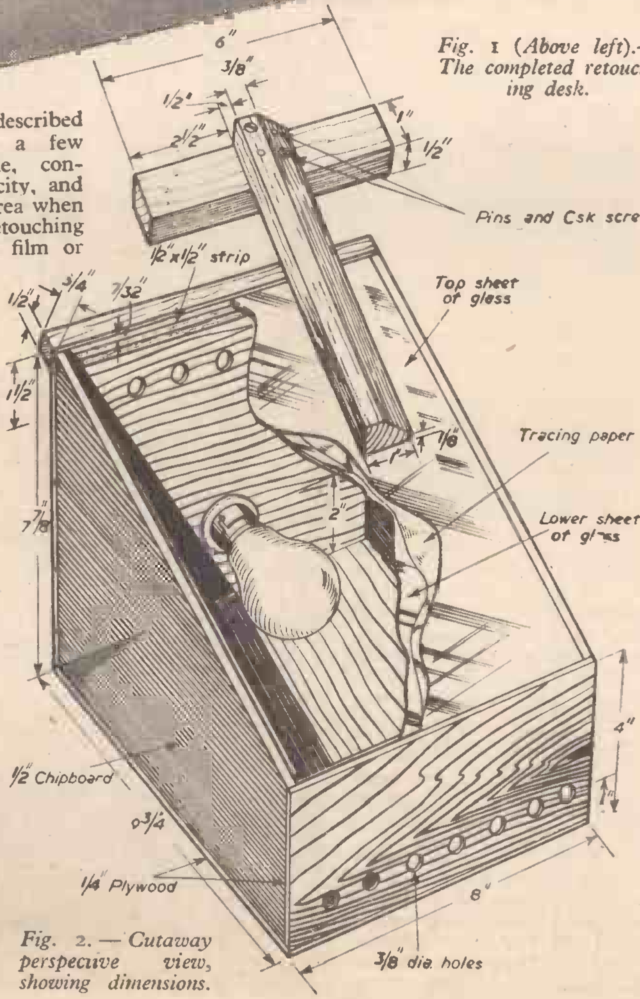


Fig. 2.—Cutaway perspective view, showing dimensions.

The desk should be made up as shown in Fig. 2, screwing and gluing all parts together. Strips of ½in. x ½in. wood, planed to suit, are glued and pinned to the inside faces of the sides, front and back to support the glass.

Where a great deal of squaring-up has to be done on negatives, it is an advantage to fit a ½in. x ¾in. strip, planed to the appropriate angle, to the back of the desk as shown in the diagram. This strip should be precisely square with the left-hand side of the desk. A specially constructed tee square can then be used in both horizontal and vertical positions for drawing straight lines with a ruling pen and liquid opaque.

The square shown covers all negatives up to halfplate in size, the remaining area of the glass being used to support the hand while working. The arms must be exactly at right angles; pins and screws being used for accurate location and firm fixing. The thinned-down working edge facilitates the ruling of lines.

Both inside and outside surfaces of the desk are given two coats of white gloss enamel, and the square may be similarly painted to simplify cleaning.

Fusible Alloys

Some New Applications Including Soldering to Glass

JUST as the addition of tin to lead will produce an alloy which melts at a lower temperature than either metal, so the addition of a suitable third metal will cause the melting point to fall again, while a fourth metal may bring about a further lowering, and so on. By using this principle, a large range of materials known as "fusible alloys" has been produced. If the choice is restricted to the more common metals—lead, tin, bismuth and cadmium—an alloy with a melting point of 70°C. may be made, but if other, more expensive, metals are introduced, such as indium and gallium, still lower melting points can be realised.

Mercury is in a special class. It is the only metal liquid at room temperatures (it freezes at minus 39°C.) and its addition to an alloy will, of course, lower the latter's melting point. Alloys containing appreciable amounts of mercury are called amalgams and, although they have low melting points, are not usually classified as fusible alloys.

Fusible alloys, in general, are not very strong, about 2 or 3 tons tension per sq. in. being sufficient to cause rupture. This fact is sometimes turned to advantage where a joint of weak strength is required (e.g., the sardine tin in Fig. 1, where the solder joint is torn in opening the tin). The other outstanding property, apart from their abnormally low melting points, is that many of them either expand on freezing or suffer little or no volume change.

Uses

These lead alloys have many uses. Those which depend on their low melting points, include soldering applications or taking impressions of articles sensitive to heat; for example, a fusible alloy mould may be made by direct contact with a wooden shape and this mould used for reproducing the article in plastic wood or thermo-plastics.

Perhaps the most widespread use is in safety devices in circumstances where a rise in temperature would be dangerous, such as fire extinguisher sprinkler systems. The alloy is used to make a component of a mechanism which holds back the flow of water. Should a fire start and the room temperature rise, the soft lead alloy melts (or usually gives way just below its melting point) and the water is released. Similarly, fire-proof doors, which shut by gravity, are held open by a simple pulley system, an essential component of which is welded by a fusible alloy.

Oil pipe lines occasionally incorporate a cut-off device, using a fusible alloy, and the latter may also be found in some domestic water heaters. Industrial boilers are often fitted with a plug of fusible alloy, designed to blow out at a certain temperature and pressure. The same device is also used on some domestic pressure cookers to act as a second line of protection should the operating pressure valve fail.

The property of expanding when freezing, possessed by some of these alloys, makes them very useful when called on to reproduce an intricate pattern by casting; it is also valuable for the bending of thin tubes. Such a tube, on being bent, will sometimes collapse, or at other times develop unsightly wrinkles. If, however, the tube is first filled with metal it can be bent as if it were a solid bar, with consequently less distortion. For this purpose it is necessary that the metal used should fill the tube completely when solid, and not shrink away from the walls as it sets. The fusible alloy chosen for the work is usually melted under hot water to keep it free from dross. The resulting bent tube is emptied by dropping it back into the water, when the alloy melts and runs out.

A considerable tonnage of lead is made (*Concluded at foot of page* 489).

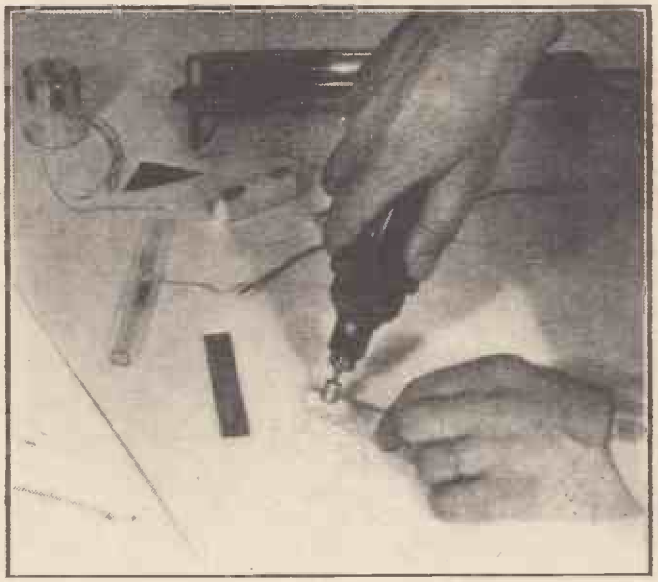


Fig. 3.—Tinning stainless steel with a grinding wheel loaded with Wood's metal. Photo.—Las Alamos Scientific Laboratory of the University of California.

Fig. 1.—A low-strength solder used on a sardine tin. Photo.—Messrs. Grey and Marten Ltd.

Fig. 2 (Left).—Metal soldered to glass in a hypodermic syringe barrel.

Fig. 4 (Right).—Artificial jewellery produced from lead-based solder alloys. Photos. — Messrs. Grey and Marten Ltd.

The Sun and the Solar System

Part 1.—Bode's Law; the Asteroids; the Radiation, Temperature, Magnetic Field and Corona of the Sun

BY "STAR GAZER"

SUPPOSE that we wished to make a model of the Sun and all of the planets which revolve around it with diameters and the distances all to a uniform scale. We decide that 1ft. will be a convenient size to make the Sun's diameter and we shall then find that the sizes and distances of the planets will be as follows: Mercury, which is the planet revolving nearest to the Sun, would be represented by a tiny ball a little larger than a pin's head, and this would be placed

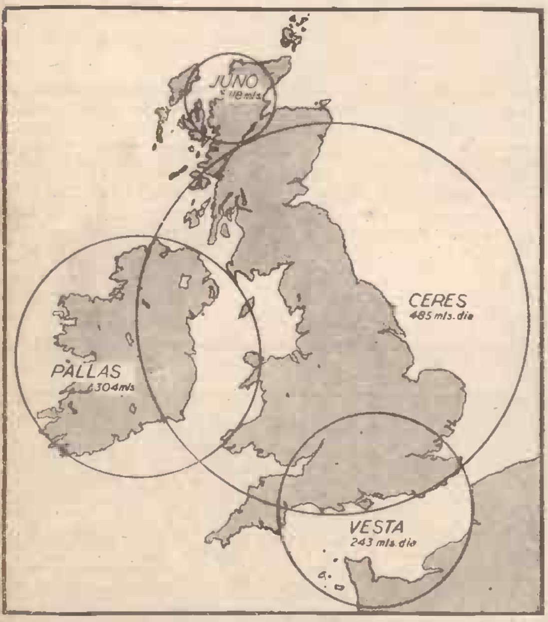


Fig. 1.—The four largest Planetoids to the same scale as the British Isles.

at a distance of approximately 42ft. from our 1ft. diameter "Sun." Venus could be likened to a small lead shot at a distance of 78ft. The Earth would be represented by a very small pea at about 107ft. distance. Mars by another, but smaller, pea placed at 163ft. Jupiter would be of about the size of a tangerine orange at 559ft., Saturn by a smaller orange at about 1,055ft. Uranus by a large cherry at about 2,110ft. Neptune by a normal-sized cherry at about 3,300ft., and Pluto by a green pea which is placed at a mean distance of 4,225ft., although the orbit of Pluto is so eccentric that it at times increases its distance, by the scale of our model, to a little more than one mile.

	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
Distance from Sun (mean) m. of miles	36.0	67.2	92.9	141.5	483.3	886	1,783	2,793	3,666
Revolution around Sun (years)	0.24	0.62	1.00	1.88	11.86	29.46	84.01	164.8	248.4
Inclination of Orbit to Ecliptic	7°.0	3°.4	0°.0	1°.9	1°.3	2°.5	0°.8	1°.8	17°.1
Inclination of Equator to Orbit ...	?	?	23°.45	25°.2	3°.1	26°.75	98°	29°	?
Mean orbital Velocity, m. per second ...	29.7	21.7	18.47	15.0	8.1	6.0	4.2	3.4	3.0
Diameter, miles, Equatorial	3,100	7,700	7,927	4,216	88,700	75,100	32,000	27,600	3,700 ?
Diameter, miles, Polar	—	—	7,900	—	82,800	67,200	—	—	—
Volume (Earth = 1)	0.06	0.92	1.00	0.15	1,312.0	734.0	64.0	42.0	0.1 ?
Mass (Earth = 1)	0.04	0.81	1.00	0.11	317.0	94.9	14.7	17.2	0.1 ?
Gravity (Earth = 1)	0.27	0.85	1.00	0.38	2.64	1.17	0.92	1.4 ?	?
Rotational period	88 days	35 days	23 h. 56 m.	24 h. 37 m.	9 h. 50.5 m.	10 h. 14 m.	10 h. 45 m.	13 h. 48 m.	?
Number of Satellites	—	—	1	2	12	9	5	2	—

Now I think this is a very interesting illustration of the tremendous distances which separate the orbital paths of the nine planets from the Sun and from each other. With the Sun having a diameter of only 1ft. the planet Pluto can be so much as a mile from it and the nearest fixed star is over 5,000 miles away by the same scale.

Bode's Law

The separation of the orbits of the planets appears to be almost exactly fixed by a law which was first formulated by two astronomers: Titus and Bode, both of Wittenburg. Write down a series of numbers thus: 0, 3, 6, 12, 24, 48, and so on, each number, after the second, being double that which precedes it. Now add 4 to each number and you have 4, 7, 10, 16, 28, 52 onwards. These resulting figures give the mean distances of the planets from the Sun out to Uranus. Neptune and Pluto depart from the law, especially Pluto, whose orbit is very irregular, so much so that at times it must encroach upon that of Neptune. The following table gives actual results:

	Mercury	Venus	Earth	Mars	Asteroids	Jupiter	Saturn	Uranus	Neptune	Pluto
By Bode's Law ...	4	7	10	16	28	52	100	196	388	772
Actual distances ...	3.9	7.2	10	15:2	—	52	95.4	192	300.7	394.6

For the first seven planets, or eight if we include the Asteroids positions, the figures are useful to remember when calculating planetary distances. The figure 10, for the Earth, represents 93 million miles, mean distances being referred to in all cases. The paths swept by the planets are elliptical, the Sun being at one of the focii of each ellipse. In most cases, however, the deviation from a true circular orbit is very slight. It may be noticed that in the Bode Law table no actual distances are given for the Asteroids, but their paths fit in very well with the figure given by Bode. The table at the bottom of the page relating to the planets will be useful for reference.

The Asteroids

The Asteroids have their orbits between those of Mars and Jupiter, and in the year

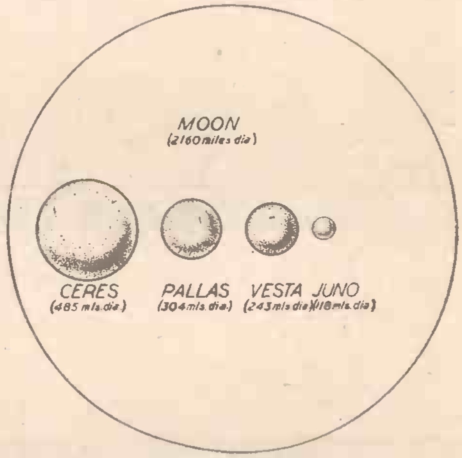


Fig. 2.—The largest planetoids compared with the moon.

1950 there were over 1,500 discovered by photography. Of course, the difficulty now is to recognise the old ones because there are so many thousands and some of the orbits are so eccentric owing to disturbances by Mars, Jupiter and Saturn. But a few, some four or five, are fairly large: Ceres, for instance, has a diameter of 485 miles, Pallas 304 miles, Vesta 243 miles, and Juno 118 miles. So the correct title to give to these bodies would be Planetoids. The Asteroids vary in size between, say, 100 miles or less in diameter and particles no larger than bits of gravel or some as fine as sand. The theory appears to be held by some observers that all these particles are parts of a planet of normal size, which exploded or became in some way disintegrated and really there is some reason for accepting this theory. By Bode's Law we have seen that the Planetoids and Asteroids occupy a position which would be given to a single planet, and, if the explosion occurred before the planet had become solid, that would account for the largest fragments becoming globular as they undoubtedly are. The smaller bodies appear to be irregular in form. Eros is irregular in the light which it reflects and Mr. F. G. Watson considers it to be about 14 miles in length by 4 miles wide, and rotating about its minor axis. Thus it would reflect more light in one attitude than in another. Very many of the Asteroids yield variable light reflections, showing that they are not spherical. So enormous are the eccentricities of some of these bodies that they approach the orbit of Jupiter on the outside and of the Earth on the inside, in fact, they may encroach upon the orbit of the Earth. They move at far greater speeds than does the Earth.

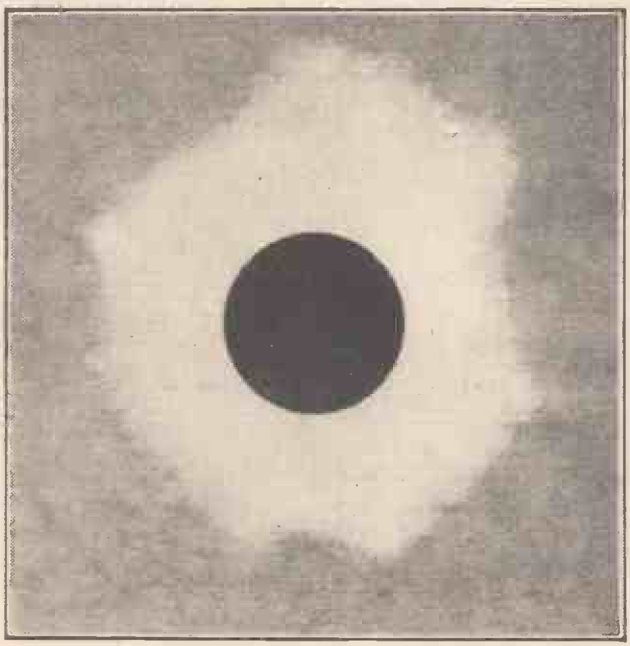


Fig. 3.—The sun's corona when sunspot activity is near maximum.

It seems likely that the explosion of the planet must have occurred long ago when our Moon was in a plastic state and that the Moon and the Earth, Mars and Jupiter must have collected much fragmentary material, the rest being blown at angles which have resulted in periodic revolution around the Sun. The size of the hypothetical planet must have been equal to that of Venus, or, say, a trifle smaller than the Earth. It may be pointed out that if the explosion of the planet took place at the time when the Moon's surface was plastic the ring mountainous condition of its surface is explained by the impact of the particles, a few of which must have been as large as Vesta, or at least as Juno.

Fig. 1 shows the largest minor planets, or planetoids, with their diameters compared with Great Britain and Ireland and Fig. 2 shows them placed over the Moon. In both cases they are drawn to scales but the scales are different.

The whole of the nine planets, the planetoids and asteroids and some of the comets, revolve in paths varying from nearly circular to very elongated ellipses around a massive, hot and self-luminous central Sun. They revolve in the same direction as the Sun rotates on its axis and approximately in the plane of the Sun's equator. These planets turn also on their own axes in the same direction of rotation with the exception of Uranus whose motions with his satellites were referred to in our December, 1954, issue. The satellites also revolve in conformity with the whole system. All this tends to show, with its extreme isolation, that the whole is a self-contained unit, it must have had a common origin in all its parts and is no fortuitous assembly of matter. What that origin was we do not know definitely, but it might have been condensation from a nebula.

The Sun

The pivot about which the whole system operates is, of course, the Sun and now let us devote a little attention to this; the source of light, of warmth and of all forms of life itself. For if the Sun were suddenly blotted out and the light and heat rays extinguished, that light would only continue to shine for eight and one-third minutes, then would come death to every living thing.

The mass of the Sun is about 745 times that of the cumulative weight of all of the planets, including planetoids and asteroids, so it is evident that it is well capable of controlling them. Its diameter is 864,000 miles; just 109 times that of the Earth, but its mean density is a little less than $1\frac{1}{2}$ times that of water. It is, however, entirely gaseous but varies greatly between extreme compactness at the centre to rarefaction in the envelope.

The Sun's Radiation

Daylight is radiation from the Sun and its range of frequencies of pulsation fall within that to which our eyes are sensitive. As a matter of fact we are actually only able to see a range falling between the violet end of the spectrum and the bright red end. There are only about 1,000 wave lengths beyond the violet which cannot be seen but at the other end the red becomes invisible at a point just beyond the peak of the curve of visibility and continues for five times the length of the visible range. This represents heat waves. The portion representing the most intense radiation is in the orange, between the yellow and the red. The spectrum may be seen and analysed with a spectroscope which consists of a series of prisms and lenses. No colours have sharply defined boundaries but all merge into those adjoining it. Photography plays an important part in the analysis of the spectrum: what we cannot see we can photograph, i.e., the ultra violet and the infra-red portions which are invisible to the eyes.

Radiation is a phenomenon relating to waves and the frequency of pulsation results from the number of waves passing a given point in a given time. The length of a wave of light is very small, approximately $\frac{1}{50,000\text{in.}}$ and light speed is 186,280 miles per second, so the frequency of pulsation is, for green light, about 600 million million per second. For greater convenience radiation is now defined by its wavelength in Angstrom-units, one such unit, or "A," being one ten-millionth part of a millimetre. The visible part of the solar spectrum extends from 4,000 A to 7,800 A whilst it commences at about 3,000 A and is carried on to about 28,000 A.

The solar spectrum is crossed by dark lines, the Fraunhofer lines, which greatly vary in thickness. These lines—there are thousands of them—are where the light has been cut off, or partially cut, by the atoms of gases at the surface of the Sun. The atom has been likened to an extremely small solar system in which the Sun is represented by a nucleus consisting of a proton and neutrons. Around this neutron and proton a number of electrons revolve, one in the hydrogen atom, two in the helium atom, three in the lithium atom and so on. The proton carries one charge of positive electricity, but the neutron, which has the same mass as the proton, is uncharged. As the atom is normally electrically neutral the number of electrons, each carrying a negative charge, which revolve around the nucleus, is the same as the number of protons. Thus the lithium atom has three protons and four neutrons and to neutralize the three positive charges on the protons there must be three electrons revolving around the nucleus.

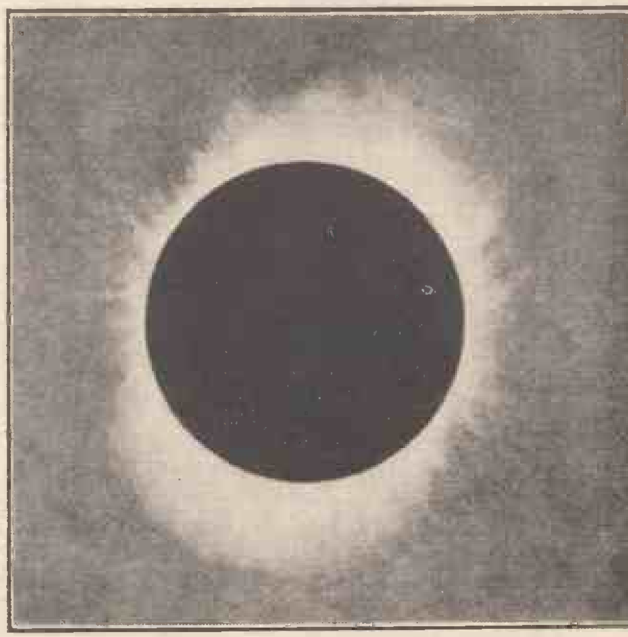


Fig. 4.—The sun's corona when sunspot activity is near minimum.

The electron may move in many differently fixed orbits; in a normal state it will choose the smallest and easiest orbit nearest to the nucleus. If the atom is heated or excited by collisions with other atoms in a gas, or by electric discharges, it will fly away into the next orbit farther away from the nucleus and in doing so will absorb a certain amount of energy. Left to itself the electron will fall back into its original orbit and will emit, in doing so, the same amount of energy. This energy will be registered, in the spectrum of hydrogen, by a line in the position of the wave length corresponding to the leap which the electron has made.

When hydrogen, or any other gas, is present in the Sun there are millions of atoms colliding with each other, at millions of times per second and, therefore, millions of electrons are jumping from one orbit to another and back again. The orbits are all occupied by some electrons in some atoms and jumps are occurring, at millions of times per second, between all parts of orbits, so that lines in the spectrum are registered in all possible wave lengths which are peculiar to hydrogen. The same applies to all other gases in the sun, so making up the complete solar spectrum.

If, having been driven outward from orbit to orbit, the electron now reaches the outermost it will, by the absorption of more energy, be entirely driven out of the atom, which will then be ionised and be unstable. In hydrogen the nucleus is left without an electron and is them known as a hydrogen ion, or proton, which is at present indivisible. It is positively charged owing to the missing negative electron and will capture another electron at an early opportunity. Atoms with a number of electrons may be simply, doubly or trebly ionised and the nuclei of the more complicated atoms are composed of more than one proton.

We can, therefore, imagine the Sun to be an incandescent mass of atoms, free electrons and nuclei almost stripped of their electrons, especially as we approach its centre, the resulting radiation from all this energy always passing outwards to the surface.

A Gaseous Mass

Hydrogen is by far the most abundant gas in the Sun. The spectroscope indicates that over 90 per cent. of the visible gases are hydrogen and it is estimated that possibly more is maintained throughout the solar sphere.

If a solid mass of some imaginary material were of a substance which could not be fused, melted or gasified, could be dropped on to the Sun, it would enter its substance and fall for many thousands of miles before it met with any resistance whatever. The extremely rarefied state of its surface is difficult to realise when we consider its size and mass and especially its hard or comparatively smooth outline. Its mass is such that the force of gravity at its surface is so great that an object which on Earth weighs one pound would, on the Sun, weigh a quarter of a hundredweight, 28 times as much. Therefore, an ordinary human being would weigh nearly two tons.

The explanation for the extremely tenuous state is that in the Sun, as in other stars, a new force comes into operation, acting outwards from its centre. This force becomes important where there is intense radiation from massive gaseous bodies at high temperatures. It is known as *Radiation Pressure*, and is due to perpetual shedding and recapturing of electrons by the atoms of gases at high temperatures in the presence of radiation. At the surface of the Sun, radiation pressure, helped by ordinary pressure exerted by any gas, is nearly equal to the effect of gravity so that as it is not quite equal the Sun does exhibit a definite circular outline which has the appearance of a hard, or nearly hard, edge to the solar globe.

Temperature

The approximate temperature of the Sun at the surface is 6,000 deg. K and this increases rapidly towards its centre where it is estimated to be round about 20 millions C. and the pressure such that one ton of matter is contained in two or three cubic inches of space. Nevertheless, the Sun is entirely gaseous and at one time it was difficult to conceive of a gas having a greater density than any solid which we know.

The Sun's polar axis is inclined to the vertical of the Earth's ecliptic at 7 deg. .25. The siderial period of rotation, which occurs at about latitude 15 deg. is 25 to 30 days. But the Sun's rotational speed is not uniform. At the equator the period of rotation is 25 days, but at about latitude 40 deg., either north or south, it is 27.5 days. At about 80 deg. the period is as much as 30 days. As seen from the earth the rotation period appears longer and this is called the Synodie Period of Rotation; it is 27.27 days and is due to the Sun's rotation in the same direction as the Earth's orbital motion.

The Corona

Outside of the solar surface, as seen by us, there is a vastly rarefied atmosphere, or excrescence, surrounding the Sun, which is known as the corona, the density of which is almost as rarefied as the vacuity of interplanetary space. This corona is best seen and photographed during the few moments of total-eclipse when the body of the Moon is exactly in line with that of the Sun. During very recent times an instrument has been designed which enables this to be done at any time, when our atmosphere is clear, without waiting for an eclipse. Owing to its extreme tenuity the atoms in the corona are so widely separated that they can travel great distances before they collide with, or are disturbed by, other atoms and under these conditions the orbital leaps of the electrons are unusual. There is evidence which tends to show that the temperatures in the corona are extremely high, probably having a mean in the neighbourhood of one million degrees C. The energy required to maintain these high temperatures would be small, as radiation in such a rarefied gas would be insignificant; but it is somewhat difficult to explain this high temperature in the gases of the corona when that of the solar surface is only 6,000 deg. K. However, it has been suggested that the gathering of interstellar material at very high velocity may remove the difficulty.

The size and extent of the corona changes with the state of the Sun's magnetic and other activities, for the Sun, like the Earth and other planets, is an enormous magnet, the poles being approximately 6 deg. from those of the axis of rotation. The magnetic field is probably variable but, in general, it is weak and almost imperceptible to measurement.

The Magnetic Field

In general the Sun's magnetic field is much like that of an ordinary short bar-magnet of steel. If we lay such a magnet upon white paper and sprinkle iron filings upon it, they, the filings, will follow the magnetic lines of force in a very beautiful pattern and, especially near the poles, will adopt radially curved lines. Such lines appear in the Sun's corona and are most noticeable when solar, or sunspot, activity is at its minimum. Fig. 3 shows the corona when the activity is at its maximum and Fig. 4 when it is about at its minimum. Sunspots give rise to much more powerful magnetic fields and when these are present the corona is more evenly distributed, though by no means circular, around the Sun, beside which it is much deeper and lines of force are not so marked, as may be seen by comparing the two figures.

To those readers who are interested in the whole of the subject I would advise them to read, "Astronomy for Everyman." This is a work edited by Martin Davidson, B.A., F.R.A.S., to which there are 13 contributors. It was first published in 1953 and in 1954 a revised edition was issued. The publishers are J. M. Dent and Sons, Ltd. It is from this work and particularly from a section by F. J. Sellers, M.I.M.E., F.R.A.S., who was Director of the Solar Section of the British Astronomical Association, that much of the foregoing has been taken.

(*To be continued*)

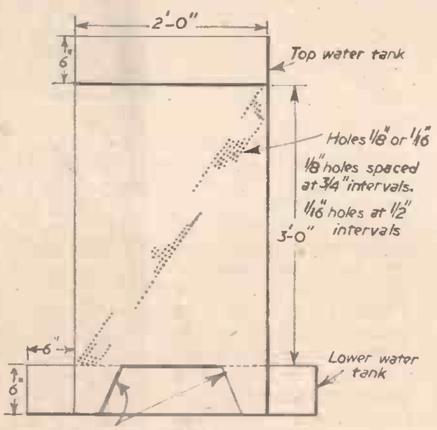
Water-cooled Safes

How to Make Two Types of Cooler

By D. SCHRODER

THE cooler is constructed from heavy galvanised iron in the form of a convenient box about one and a half times as high as it is wide. All four sides are the same size for convenience. The box is drilled every ¾in. with ⅛in. or 1/16in. holes running diagonally up the sides to allow free circulation of air; the top is not drilled but the bottom is, and any shelves inside are also drilled.

Two tanks must be made to complete the construction. The upper tank is the same size as the top of the cooler and 6in. deep; the lower tank is 6in. bigger all around than the cooler. An old sack of the heavy hessian type is cut open to make a long strip; this is then hung around the cooler, the top being kept in place by strips of metal bolted on to it, using galvanised iron roofing washers and bolts. These strips are hung around three sides of the cooler with the metal strips inside on the floor of the top tank. The "curtain" should be long enough to reach the floor of the bottom tank and be held by the same method as in the top tank. To cover the door a curtain of hessian should be used. If the tanks are now both filled with water the water will flow down from top to bottom by a siphoning action and from bottom to top by capillary attraction. After being left to soak in this fashion for 48 hours the water level in the top tank should be lowered to about half-way. If put in an airy place the water going both ways evaporates and cools the interior of the cooler. It only remains now to replenish the water at suitable intervals, and to facilitate emptying the tanks two small stopcocks can be fitted.



Constructional details of the evaporation type cooler.

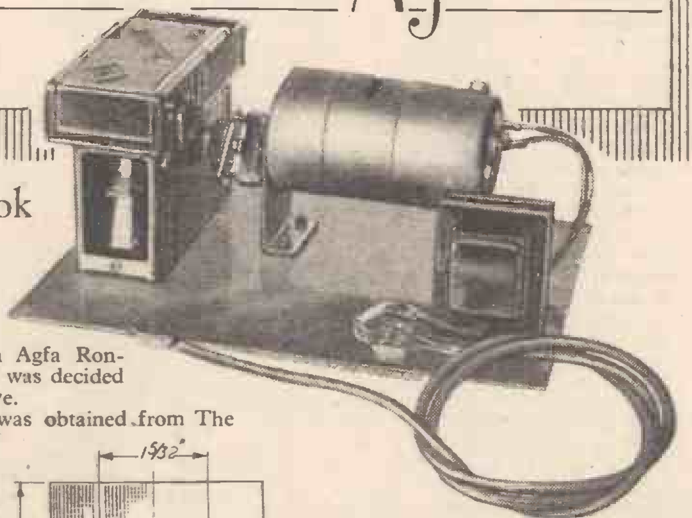
Charcoal Type

In this type, the actual cooler is only a wooden box framework with a thin mesh netting nailed to the inside and another to the outside. The space between is filled with charcoal, and the thicker the framework is the thicker the walls of charcoal will be. If placed in a tank as in the previous method water will always be available, and by wetting down the sides the charcoal will absorb water which will cool the interior by evaporation.

Motorised Tank Agitation

A Device for the Photographer to Eliminate Uneven Development and Reduce Developing Time

By S. F. Hook



AFTER uneven developing had been experienced with hand agitation of an Agfa Rondinax 35mm. tank, it was decided to motorise the drive.

A suitable motor was obtained from The Midland Instrument Co., Moorpool Circle, Birmingham, 17, and to mount this the L-shaped bracket shown in Fig. 1 was made. This ensured that the shaft centre of the motor was in line with the rotating knob of the tank. The bracket was made from ⅛in. thick aluminium and mounted on an oblong piece of the same material about 12in. by 10in. A driving dog was evolved so that the tank could be withdrawn for emptying, etc., without stopping the motor. Details of this are shown in Fig. 2.

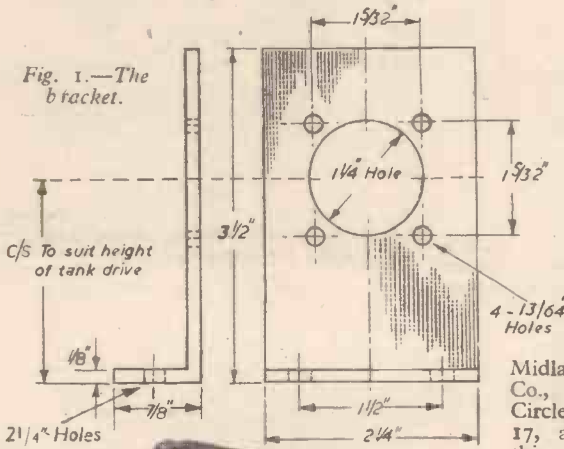


Fig. 1.—The bracket.

The voltage was obtained from a transformer which reduced the mains input to 8-10 volts at the output terminals. The motor is a shunt type and the only way to make it run satisfactorily was to disconnect the field altogether and to connect the supply voltage direct to the armature. In this way it acted as an induction motor. Figs. 3 and 4 show the completed arrangement.

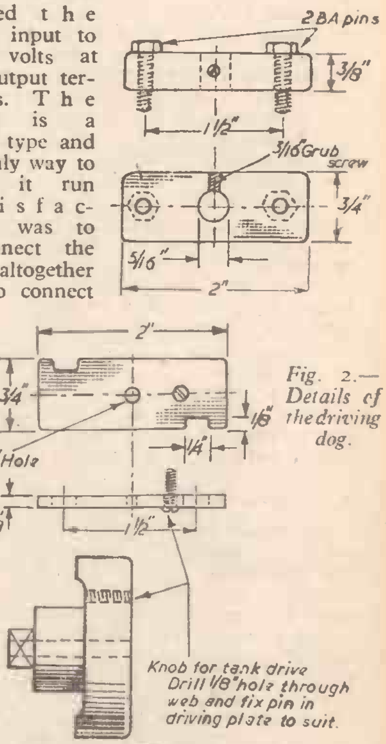


Fig. 2.—Details of the driving dog.

Fig. 3.—The unit with tank removed.

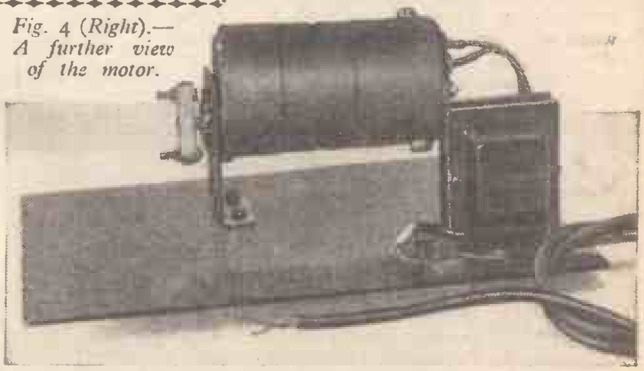


Fig. 4 (Right).—A further view of the motor.

Fusible Alloys

(Concluded from page 485)

into fusible alloys which are used for low-temperature soldering. Special applications in this field are the jointing of pewter, and in cases where a second joint is required near to a previously soldered one which must not be melted, and other instances where damage may result from overheating.

So large is the overall field now becoming that manufacturers no longer produce a fixed range of fusible alloys for the customer to choose from, but produce alloys to customers' specifications, or design a new alloy to meet customers' needs.

New Applications

Some fusible alloys have the property of wetting glass. Thus, as shown in Fig. 2, it is possible to solder glass components to each other, or metal to glass. Wood can be impregnated with fusible alloys and so this material, too, can be soldered. A recent improvement on this technique involves the "tinning" of smooth surfaces with either a lead-based solder or fusible alloy by applying the metal from the surface of a small grinding wheel which presses the alloy into the ground surface (see Fig. 3). The success of this method with such materials as glass and plastics suggests that in future many unusual materials will be joined by soldering.

(Reprinted from "Applications of Lead" by courtesy of the Lead Development Association.)

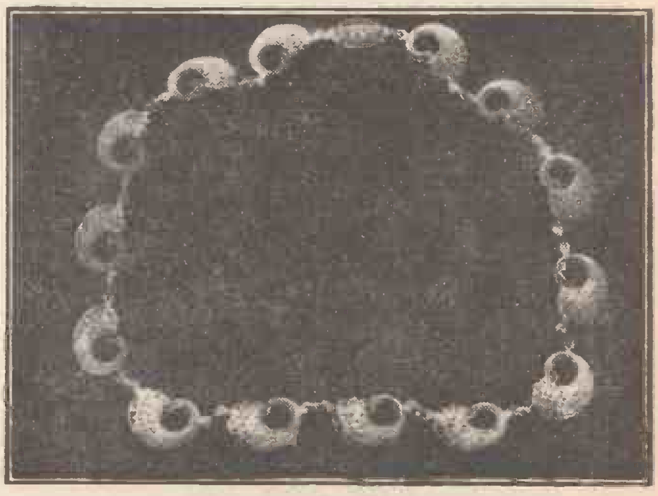


Fig. 5.—A further example of lead-based solder alloy jewellery. Photo.—Messrs. Grey and Marten, Ltd.

An Electric Con

THE conventional electric fire or radiator operates at a high temperature and emits the bulk of its heat energy in the form of infra-red rays. These are generally concentrated in one direction by a polished reflector, and warmth is only apparent in objects in front of the fire. A convector heater, however, has a much lower working temperature, and warms the air in any enclosed space directly. There are certain advantages in this arrangement. The convector heater will take the cold air off a room much more quickly than an electric fire, and so is ideal for warming the bedroom or that cold hallway. It is safer, too, in view of the lower working temperature and lack of exposed wires. Unfortunately, the commercial product, whilst undoubtedly very efficient and decorative, is rather expensive.

In principle, the convector heater is very simple, and an effective heater at very moderate cost is well within the scope of the average handyman. The author recently made two 1,000-watt heaters for less than £1 each, both of which have given very satisfactory service for some months, proving completely reliable and safe. The construction falls into two distinct stages: an element and a case to house the element. The construction of the element will be described first and in greater detail, as several choices of material are possible for the case, and the design is not too critical.

Cheap to Make :

By P. DA SV

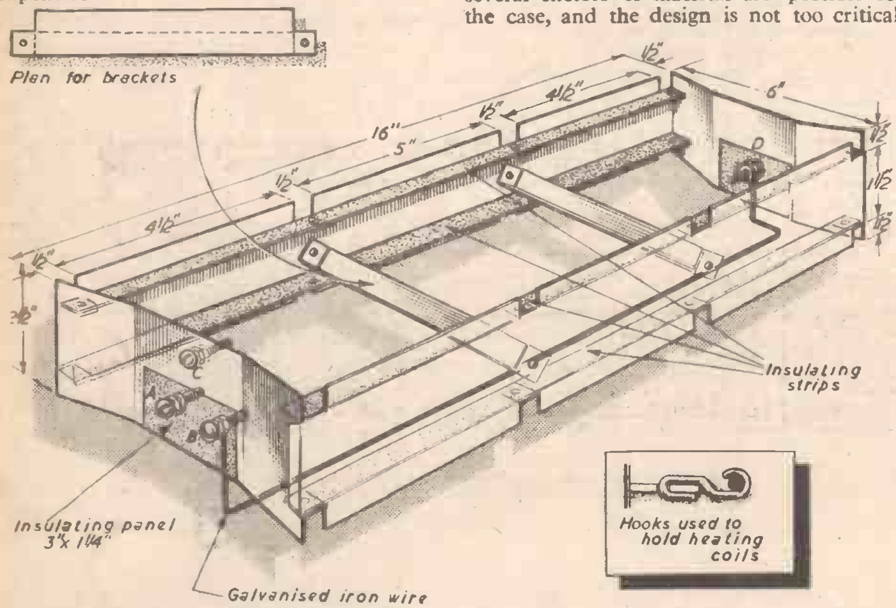


Fig. 1.—General view of the heating element.

Fig. 2.—The completed heater.

The Element

The element is shown in Fig. 1 and also in the photograph, Fig. 3. The basic requirement is an aluminium frame measuring 16in. x 6in. x 2½in. deep. The method of construction is not important. The ends must be dished as shown, and a small vice may be conveniently used for this. It was found that the aluminium frame was a little flimsy and stiffeners were added. These were also of aluminium; the construction can be clearly seen in Fig. 1. Small cuts are made with tinsnips, positioned as shown, to form flaps which can be bent down to carry the four insulating strips. The latter are heat-resisting laminated plastic—"Formica" offcuts are ideal—and measure 15⅞in. x ½in. A small panel 2in. x 1¼in. must be removed from each end of the frame to carry two more insulating pieces. These measure 3in. x 1¼in. and are attached to the frame by aluminium rivets.

Before fastening the insulating strips to the frame it is necessary to drill holes for the hooks which will subsequently carry the element wires. The distances between holes are shown in Fig. 5, and it is as well to keep to the dimensions given. The hooks are made of 20 g. soft iron wire (galvanised iron wire is quite satisfactory) and are shaped as shown in Fig. 1. The hooks are inserted in the holes drilled to receive them and are tightened in position with a pair of pliers.

The insulating strips may now be fastened to the frame using aluminium rivets. If the holes and flaps have been correctly positioned the hooks should be well clear of the rivets. This is very important as any accidental connection will result in a short circuit. The frame is now ready to receive the actual heating wires.

The heating element is composed of four 1,000-watt spiral heating elements of the type which may be purchased at a well-known multiple store for 1s. each. (The type which are wound on porcelain are not suitable.) The voltage of the individual elements should be the same as the voltage on which it is finally desired to use

Fig. 3.—The heati

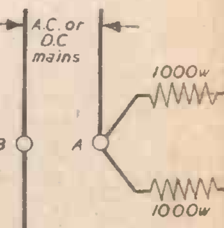


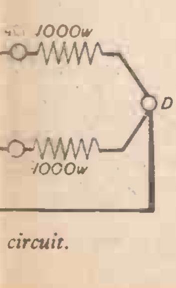
Fig. 4.—The

nvector Heater

Reliable : Safe

WALES

ng element.



circuit.

the heater. If two 1,000-watt elements are joined in series, then the result is a 500-watt element, which will run at a much lower temperature than the originals. This reduced temperature is necessary if the heater is to function as a convector and not as a radiator. 500 watts is not, however, sufficient power to heat even a moderately-sized room very satisfactorily, and the power is doubled by taking another two 1,000-watt elements in series and putting them in parallel with the first two. Fig. 4 shows the arrangement of the wiring. It is possible to use the elements as they are but it is better to rewind them with a slightly larger diameter — rewinding around a pencil is satisfactory. In this way the coils of the element are cooled more rapidly by the rising air.

Connecting terminals are formed by $\frac{1}{8}$in. nuts and bolts fastened through holes in the insulating panels. The top and bottom elements are connected to terminal "A" and are then stretched and run across from hook to hook. Where it is necessary to join the second 1,000-watt element on to the first, it is convenient to replace the hook at that point by another $\frac{1}{8}$in. nut and bolt. At the other end of the frame, both the upper and lower elements are joined to the terminal "D."

A connection between terminals "B" and "D" is necessary and is effected by a length of stiff galvanised iron wire. The ends are bent into small rings so that they can be attached to the terminals. (It is as well to put a nut between each separate connection on the same terminal.) The wire is so bent that it passes about $\frac{3}{4}$in. below the coils of the lower element. Finally the three-core mains flex is taken through a $\frac{1}{2}$in. hole in the insulating panel. The live wires (red and black) are connected to terminals "A" and "B," and the green earth wire is connected to terminal "C." Terminal "C" is fasted *to the aluminium* above the insulating panel. It is important to see that the frame is correctly earthed.

The Case

Of the case, little will be said. The one in Fig. 2 is made of aluminium, which was acquired cheaply secondhand. The first heater that was constructed was of a simple design, using wood for the sides and top, and aluminium panels for the front and back. Because of the low working temperature the wood has suffered no damage, though it is to be admitted that a metal case is to be preferred. Aluminium is fairly expensive and it is possible that a cheaper material which could be used effectively is galvanised iron sheet. Yet another material which suggests itself is "Formica" used on wood or aluminium formers.

Whatever the material and design adopted, there are certain requirements for the case which must be met. The dimensions of the case should be roughly those given in Fig. 6. The inside must be large enough to take the heating element. The latter is fastened as shown in Fig. 6, 2in. above the open bottom of the case and held by four Parker-Kalon self-tapping screws. A grill of wire mesh or, preferably, expanded metal must be fastened to the bottom of the case to admit the air and yet keep out prying fingers. Again to admit air to the element the case must stand on legs about 4in. high. The mains flex, incidentally, is brought out through the expanded metal underneath the heater. The vent for the hot air is an expanded metal loudspeaker grid, which may be purchased in a standard 16in. x 7in. sheet for 2s. at any radio component shop. Another requirement for the case is a

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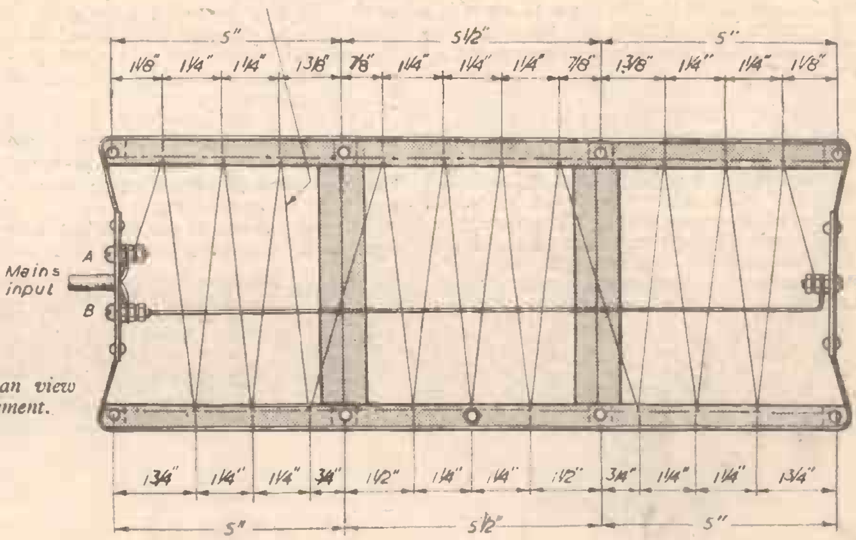

Fig. 5.—*Plan view of the element.*

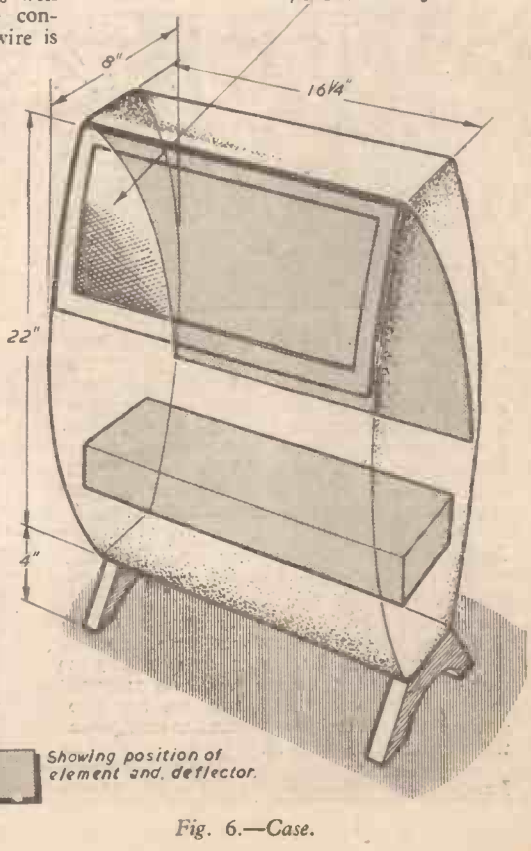

Fig. 6.—*Case.*

A Universal Enlarger

Apparatus for Enlarging 35 mm. to $\frac{1}{4}$-plate Negatives

By P. WILDON

THE basis of this enlarger is an old $\frac{1}{4}$ plate camera. As can be seen from Fig. 1 the lamphouse is suspended by specially shaped brackets between two upright columns. This method of construction was chosen because it gives a firm support and lessens the chance of overbalancing for an enlarger of this size.

Each column has 28 $\frac{1}{8}$in. dia. holes drilled in it, the holes being spaced 1in. apart and numbered consecutively. These are provided to enable the user to record the degree of enlargement. For example, when the enlarger head is lifted to its required height for any particular photograph, a small peg or sawn-off nail is inserted in the hole directly below the brackets. After the exposure the number of the hole is written on the corner of the negative, or on the envelope the negative is to be filed in. If the enlargement has to be duplicated at any time, all that is required is to peg the enlarger head at the same number hole to get exactly the same magnification.

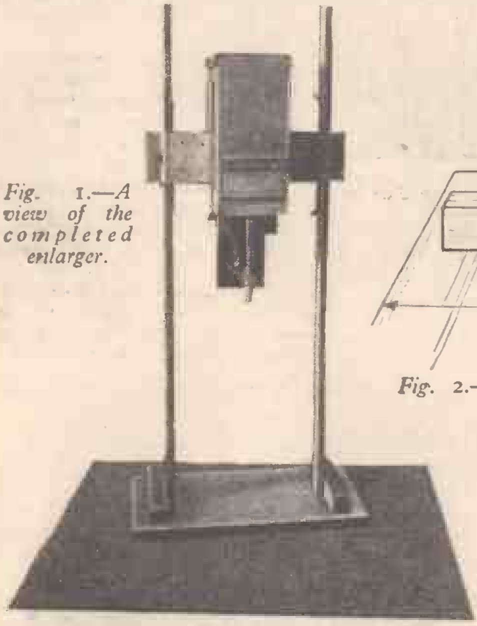

Fig. 1.—A view of the completed enlarger.

Baseboard

The size of the baseboard is 19in. long by 12in. wide by $\frac{3}{4}$in. thick. The two columns are 40in. long by 2in. wide by $\frac{5}{8}$in. thick. Each one is secured firmly in position 12in. from the other by being attached to a wooden bar $1\frac{1}{2}$in. square which is screwed to the baseboard. Two brackets are also screwed to each column to further strengthen the support (see Fig. 2).

Lamphouse

The dimensions of the lamphouse are governed by the size of the plate camera used. In this case the lamphouse is 12in. high by $5\frac{1}{2}$in. wide by $8\frac{1}{2}$in. deep. The sides are made of $\frac{1}{4}$in. thick plywood with an internal framework of $\frac{1}{2}$in. square beading.

The top of the lamphouse is hinged to give easy access to the bulb (see Fig. 3) and has a piece of half-round beading nailed to both sides to prevent any light from escaping.

The light source of the enlarger is an opal bulb, the rays from which are diffused by a piece of opal glass. The glass rests in position on two ledges which are fixed to the sides $7\frac{1}{2}$in. from the top. It can be slid out for cleaning when required through the slot in the front of the lamphouse. A

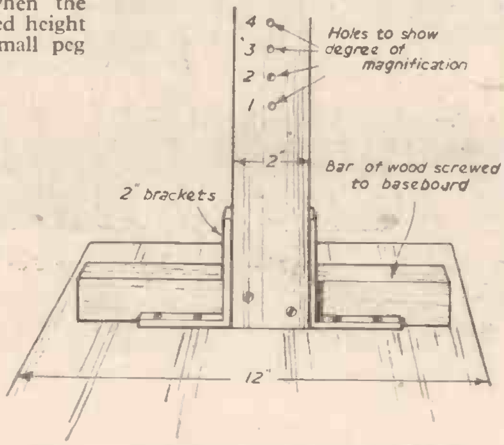

Fig. 2.—Method of attaching the columns.

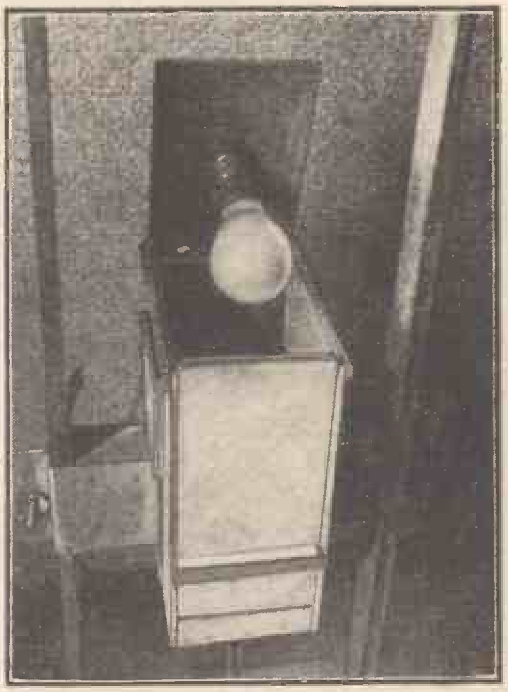

Fig. 3.—A close-up of the lamphouse with the top open.

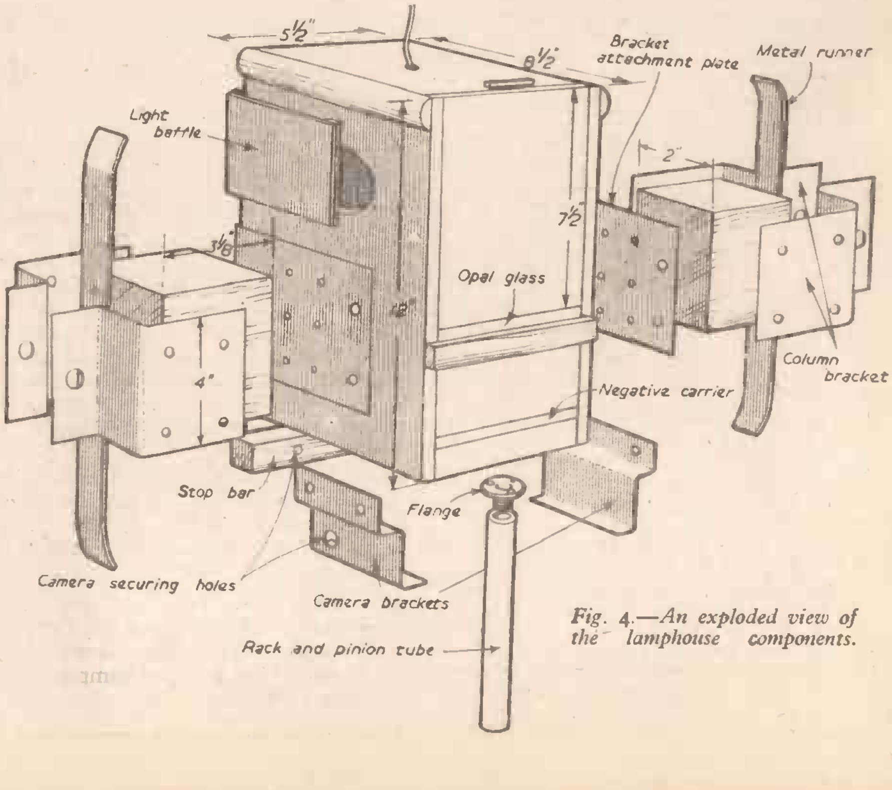

Fig. 4.—An exploded view of the lamphouse components.

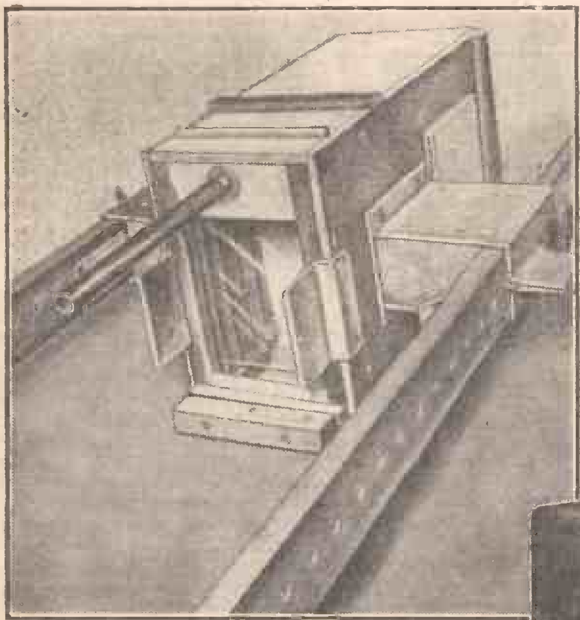

Fig. 5.—A view of the underside of the lamphouse.

bar of wood is nailed underneath the slot to prevent any stray light from being reflected on to the baseboard.

It is not recommended that the opal glass be positioned too close to the light source, as uneven lighting will result.

Ventilation is provided by cutting either a series of small holes or one large hole in each side. These are covered by a light baffle, which is open at the top to allow the warm air to escape.

The two pieces of glass which form the negative carrier are held in position in a similar manner to the opal glass, except that two guides are used on each side, and the sandwich of glass slides between. This is to ensure that the negative is held perfectly flat while in use.

The distance the negative carrier is positioned from the camera depends entirely on the focal length of the lens used and the amount of bellows extension available on the camera. In the prototype, the correct position was found by experiment before the lamphouse was assembled.

Fig. 4 shows the shaped brackets and "stop bar" which hold the camera in position. A hole is cut in the one bracket, and also in the "stop bar" through which bolts are passed to screw into the camera tripod bushes.

Focusing is by rack and pinion. The tube which is used for this purpose is fitted quite simply by being threaded and screwed on to an ordinary electrical flange, of the type used for table lamps. The flange is then screwed to the underneath of the lamphouse. A view of the underside of the lamphouse is given in Fig. 5.

The casting which slides up and down the tube was picked up cheap in a junk yard. It is attached to the camera front by means of a short length of metal which is bolted in position. A hole is drilled and tapped, in the casting, and a locking nut fitted.

The original lens and shutter were removed from the camera, and a flange fitted which takes the majority of modern enlarging lenses.

Fig. 6 shows the camera with the flange and casting fitted.

The brackets on which the lamphouse is suspended consist of five parts. Fig. 4 shows these parts and other components. The central part is a block of wood the same width as the column. It is 3⅛in. long, and 4in. high. These measurements can, of course, be altered to suit individual requirements. A metal plate 1/16in. thick is screwed to one end of the block of wood. This in turn is bolted to the lamphouse with four nuts and bolts. A strip of metal 10in. long x 1¼in. wide is screwed to the other end of the block. This is slightly curved at each end, and acts as a "runner" to ensure smooth movement of the lamphouse up and down the columns. Two pieces of metal are bent to shape and screwed, one on each side of the block to converge round the column, where a hole is drilled and a wing nut and bolt fitted. Tightening the wing nut clamps the bracket to the column. Fig. 7 is a close-up view of one of the brackets.

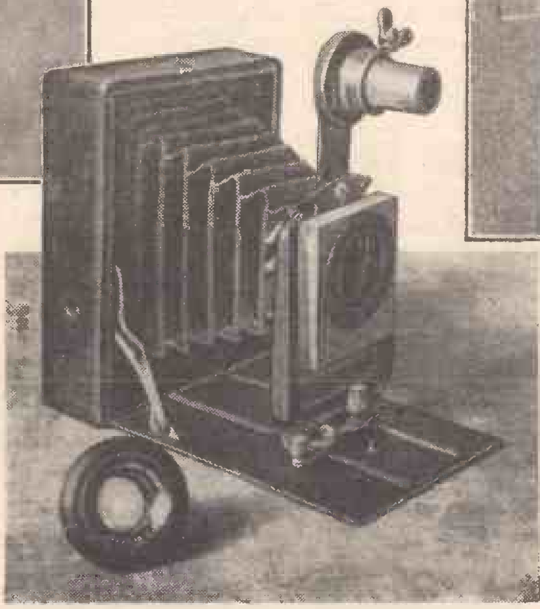

Fig. 6.—Camera with lens flange and casting fitted.

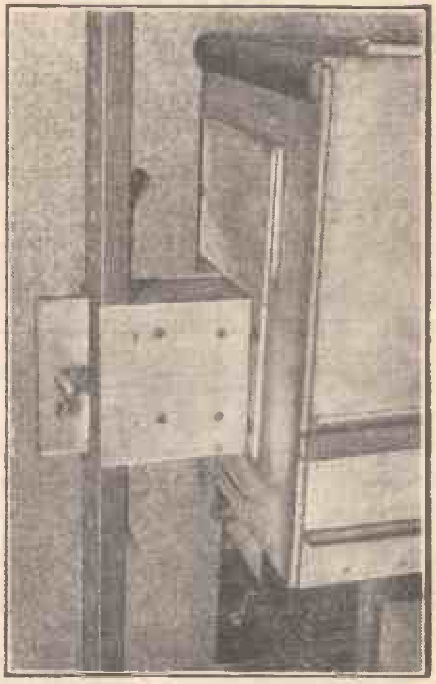

Fig. 7.—A close-up of a lamphouse supporting bracket.

No switch was fitted to the lamphouse because of the possibility of movement during exposure. Instead an "on-off" switch is fitted in the light flex.

If bigger enlargements are required than is possible on the baseboard, the enlarger head can be reversed on the columns, laid on its side, and the picture projected on to the wall.

This enlarger has been deliberately left unpainted to give a better idea of its construction, but a coat of black paint should be applied.

The enlarging lens should be the same focal length as the camera lens used to take the largest negative to be enlarged.

A Sensitive Steelyard Balance

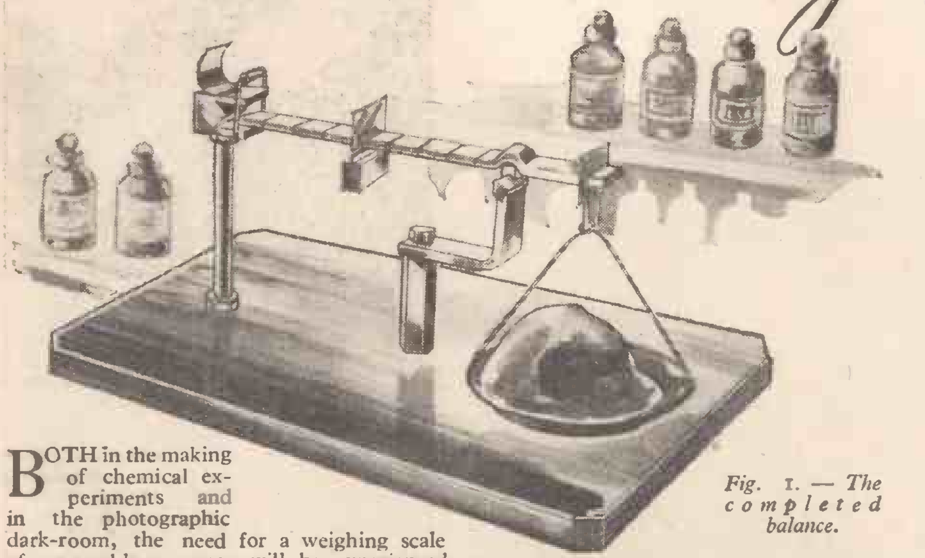

Fig. 1. — The completed balance.

A Device for the Chemistry and the Photographic Enthusiast

BOTH in the making of chemical experiments and in the photographic dark-room, the need for a weighing scale of reasonable accuracy will be experienced before one can proceed beyond the preliminary stages. The sensitive balance on the steelyard principle to be described and shown in the accompanying sketches will be found very useful.

How to Obtain Sensitiveness

There are two conditions which are essential to success in making a delicate balance on the lines illustrated in Fig. 1. The first is to see that all the three points on the steelyard (A, B and C, Fig. 3) and also the intermediate notches between A and B are in one horizontal line. The other requirement rests in the making of the two sets of knife edges and "Vees" (see B and C) on which the steelyard is supported and the scale pan hangs in suspension. For the main support (B, Fig. 3) a safety razor blade can be utilised, the cutting edge of which should be blunted a little on an oil stone and made to engage the Vee piece, made of steel and soldered into the crutch of the balance arm, as indicated in Figs. 2 and 3.

The Base

The original balance was built up on an ebonite base $\frac{1}{4}$in. in thickness, and sawn to the shape and dimensions indicated in Fig. 2. Two holes are tapped into it—one to receive the central support and the other for the end balance pillar. The first mentioned support can be made from a piece of hexagonal brass rod tapped 2 B.A. at the top end, and shouldered down and screwed $\frac{1}{4}$in. Whitworth at the other (lower) end. If this material is not available, a piece of stout brass tube, squared off at the ends, and threaded through with another piece of 2 B.A. screwed rod, can be used. Both methods are shown in Fig. 4.

The Main Support Pillar

On the top of the central pillar, under the head of the bolt or nut (see Fig. 4), a bracket made from rectangular section brass bar $\frac{1}{2}$in. by $\frac{1}{8}$in. is fitted. This 2in. bar is bent at right angles at or near the centre of its length, and at the top, in a fine saw cut, a piece of safety-razor blade is soldered, edge up, to support, in the inverted Vee strip, the weighing beam or steelyard of the scales. In making this, the full-size razor blade is broken approximately to the size required and then ground down evenly on a hand-operated emery wheel to the correct dimensions.

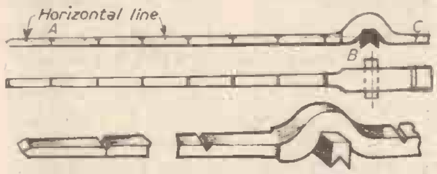

Fig. 3.—Details of the steel yard.

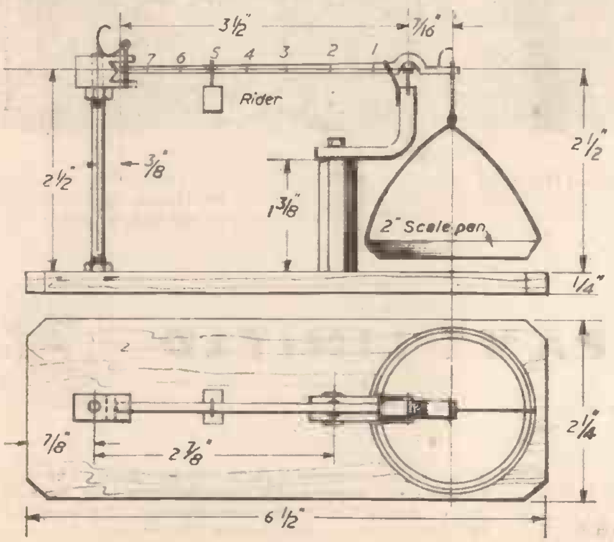

Fig. 2 (Left).—General arrangement.

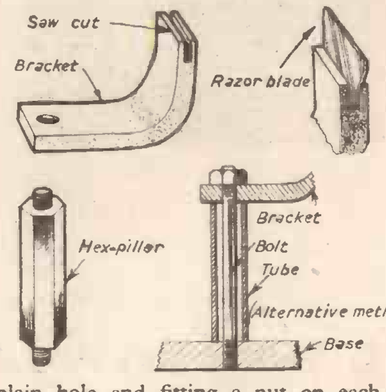

Fig. 4 (Right).—Making the central support.

Fig. 3 illustrates the shape and construction of the steelyard. It is very important in finishing off the beam to get its top surface just above the horizontal line running through the apex of the main supporting Vee and the bottom of the notch from which hangs the scale pan. Further, it is necessary to file away the arm to balance it accurately with the scale pan suspended in position (without the rider, of course), the extremity of the steelyard swinging exactly opposite the point formed in the head of the end pillar.

The Scale Pan

This is a light dish of tinplate or other sheet metal of about 2in. diameter, and it can be made from any tin lid, if nothing more suitable is to be found. A wire hanger is formed as shown at A in Fig. 5 and soldered to the sides of the pan. The looped top of this wire is pierced to engage the end notch in the steelyard. Where it is looped, the wire should be soldered, just at the crossing, to prevent the thin metal hanger jamming in the joint when the pan is removed from the scales. To facilitate carrying the balance about, a wire hook or guard is soldered on to the end of the steelyard, as shown in Fig. 2 and bent over the scale pan hanger. This wire may be pushed into a hole drilled in the steelyard and soldered, or reliance may be placed on soldering alone.

The Vee Piece

The steel "Vee" is soldered into the crook of the steelyard. If duralumin or some other aluminium alloy is used for the balance arm, then a dovetail fitting must be used. The Vee strip must be filed to a wedge section to fit this dovetail and driven into place, thus being secured by friction.

The Balance Pillar

The outer pillar is made from a length of No. 2 B.A. screwed rod, and the head, a piece of 5/16in. square brass rod, is drilled and tapped to receive the pillar (see B in Fig. 5). If no 2 B.A. taps are available, the head may be secured by extending the pillar through a plain hole and fitting a nut on each side. The head has an open jaw (B, Fig. 5) which limits the movement of the steelyard arm and also marks the central position. A wire guard is made and fitted to this head. This prevents the side displacement of the steelyard when the balance is being carried about.

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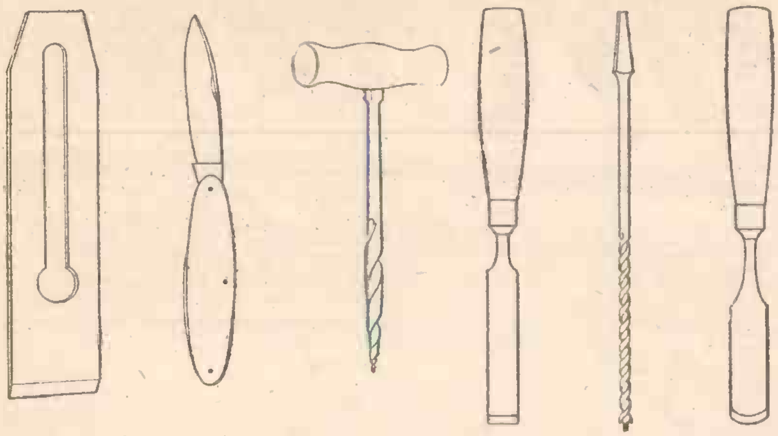
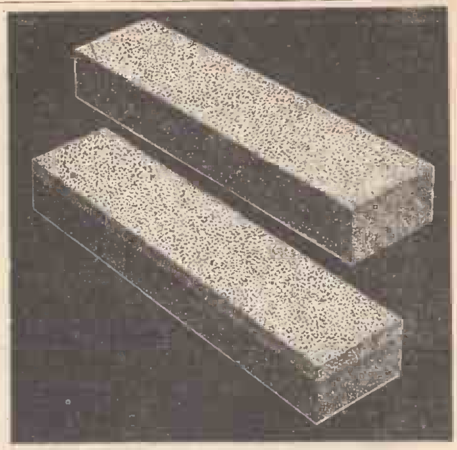
For Every Cutting Tool



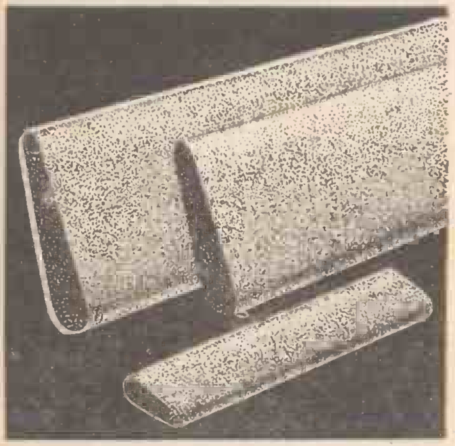


FOR CHISELS AND PLANE IRONS
Flat stones suitable for sharpening any flat-bladed tool, and for outside-bevelled gouges. In coarse or fine grits of silicon carbide or of ALOXITE abrasive. Combination coarse and fine stones are also available.

FOR GIMLETS
Bore two holes in hard wood before the gimlet is blunt enough to make hard going of it. When the gimlet eventually needs sharpening work it in one of the prepared holes with silicon carbide grit (120 to 180) and oil. Repeat in the second hole, using silicon carbide grit without oil.

..there's a

Sharpening Stone by CARBORUNDUM



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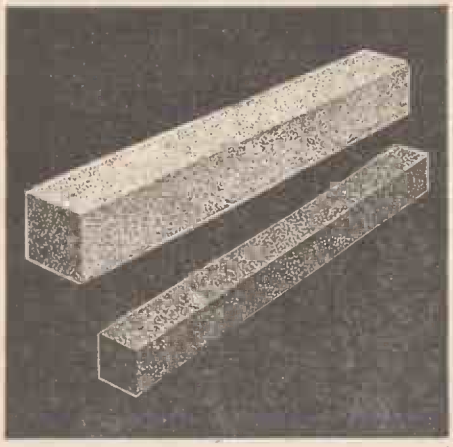

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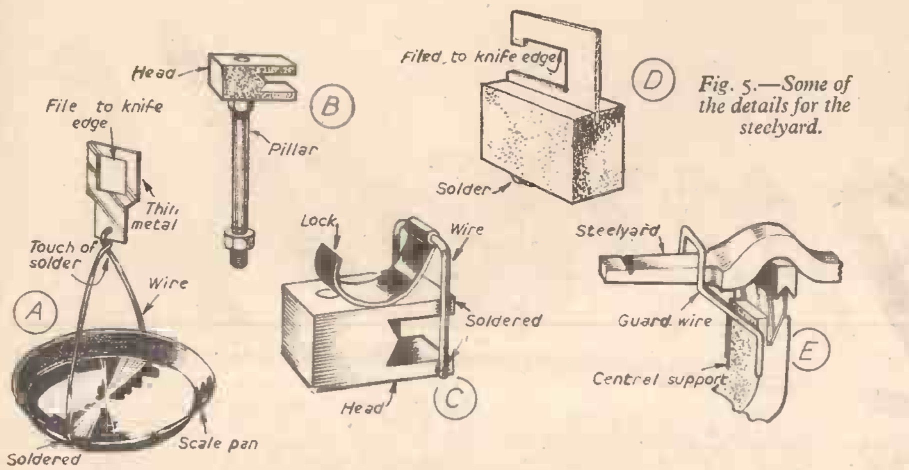

Fig. 5.—Some of the details for the steelyard.

It is a thin wire of an inverted U shape, and on the horizontal portion a scroll of tinplate or other sheet metal is hinged. This can be swung back (as shown at C in Fig. 5) to clear the arm or thrown over into the locked position on the steelyard when it is desired to hold the steelyard, to add anything to the scale pan, remove the latter, or when it is necessary to remove or slide the rider up and down the steelyard arm.

The Riders

These are blocks of brass with a steel hook soldered to the top. They must be of a known weight, which is adjusted generally by altering the overall size, and finally by carefully scraping away or adding to a blob of solder which is made to adhere to the under surface (D in Fig. 5). The system of weights adopted must, of course, determine the actual dimensions of the riders. If the avoirdupois ounce system with its subdivision of 16 drams to the ounce is adopted, the first rider may be made of $\frac{1}{8}$oz. (2 drams) weight. An additional block of metal $\frac{1}{4}$ dram in weight may form the rider used for smaller quantities. For the metric system of weights the dimensions of the balance should be such as will divide the arm in tenth units, rather than divisions of eight, and riders may be proportioned accordingly.

Calibration

The scale pan notch having been made on the steelyard and the arm balanced accurately by scraping off from a blob of solder previously formed on the underside of the scale pan, the $\frac{1}{8}$oz. rider, also previously weighed and adjusted to correctness on another balance, should first be placed in such a position on the steelyard that it balances another 2 dram ($\frac{1}{8}$oz.) weight on the scale pan. This will determine position No. 1 (Fig. 2). Position No. 6 will need 12 drams ($\frac{3}{4}$oz.) in the scale pan to effect a balance, and when these two positions are found the others can be determined by measurement; there will be five equal spaces between the first notch (No. 1) and the sixth (No. 6). For smaller riders the same notches will give proportionate weights.

If carefully made, the scale will be found to be quite accurate.

Science Notes

Solar Energy

BY harnessing the energy of the sun, the Russians plan to produce 1,000 to 1,200 kilowatts of electrical power next year. Some of the uses to which this energy will eventually be put are for elevating water for irrigation, distillation of salt water, drying vegetables and fruit, refrigeration, heating and cooling buildings and producing steam.

Satellite-tracking Cameras

THE Schmidt cameras that will track the earth satellites to be launched during the International Geophysical Year will be able to do this with an error of less than 1 per cent. The optical system uses a 3-element apochromatic corrector plate, has a 20in. aperture, a focal ratio of 1.0 and a 30 deg. field.

Natural Insecticide

THE Amazon fly, imported from Brazil, is the insect killer that is being used to control the destructive sugar cane borer. The Amazon fly's larvæ, which are parasites, feed solely on the larvæ of the sugar cane borer. It has been shown by five years of tests that this fly can control the pest, where man-made insecticides fail.

The Night Sky Glow

A FIRST-OF-ITS-KIND experiment in America has shown that the faint glow in the night sky, not caused by moonlight and starlight, is due to sodium reactions. The basis of the experiment was a high flying rocket throwing out sodium vapour, used in conjunction with sensitive instruments which can detect the night time glow characteristic of sodium.

Saving Desert Water

A NEW method of cutting down water evaporation has been found by the Commonwealth Scientific and Industrial Research Organisation and will be applied in Australia. A chemical extracted from whale oil, Cetyl alcohol, is used to lay a film over the surface of the water, which restricts the evaporation of water into the air, but does not stop oxygen entering the water and keeping it fresh. It is invisible and tasteless and harmless to animal life. Trials have shown a saving of between 20 per cent. and 70 per cent.

World's Largest Atom Smasher

RUSSIA already has the world's largest atom smasher and work is beginning on another five times larger.

Clouds on Venus

THERE are two conflicting opinions about the composition of clouds surrounding Venus. Dr. E. J. Opik, of Armagh Observatory, Northern Ireland, believes that they contain "great amounts of dust, ground off the rocky surface of the planet." Two American scientists disagree and believe that they are water vapour. The clouds would be white if they were water vapour Dr. Opik says and photographic measurements show the clouds to be yellow.

I.G.Y. Exhibition at the Science Museum

AN exhibition to illustrate the scope and aims of the International Geophysical year will be on view at the Science Museum from May 10th to October 31st. The exhibition includes a representative collection of scientific instruments of the type to be used during the I.G.Y., earth satellites, high altitude rockets, the weather, earthquakes and the earth's magnetic field are among the topics included.

Nuclear Detection of Fire

THIS system causes the alarm to be sounded at the first stage of smoke from smouldering material. The sensitive element is a small ionisation chamber, the electrical characteristics of which are changed when the first trace of products of combustion reaches it, causing the alarm to sound. These detectors are manufactured by The Minerva Detector Co. Ltd., Lower Mortlake Road, Richmond, Surrey.

Static Ship Models

Designs, Hints and Tips for Making Small Waterline Models

(Concluded from last month's issue)

FIG. 5 is a drawing of the largest vessel afloat to-day, the mighty Cunard White Star liner, R.M.S. *Queen Elizabeth*. She has a length of 1,031ft. overall and a beam of 118ft. Built by John Brown and Co. Ltd., at Clydebank, she was completed in 1940 and has a service speed of 28½ knots. The drawing is to the scale of 100ft. to ⅝in. and if made 100ft. to 1in., the model will be over 10in. long. This therefore is a strong argument in favour of adopting this scale instead of the larger one of 50 ft. to 1in. On the larger scale the model would come out at over 20½in. in length, so that if all the models were made and mounted on the same "water" the whole display would be too large for a private house, or at any rate the showcase would be too large for convenience.

Painting

In connection with painting the *Parthia* as well as the *Queen Elizabeth*, the method of getting a clear sweeping line for the sheer between the black of the hull and the white of the superstructure can be mentioned: Paint the black and the white before the superstructure is stuck down on the hull; a definite line results without any wobbling, between the black and the white. Nothing looks worse than an untrue line marking the sheer. In the *Queen Elizabeth* it will depend upon the method of painting the line of the sheer, what thickness of wood is used for the hull. Either make the hull just the depth of the black portion, carve the sheer and then paint it black or, in making the hull, let it come up to include a part of the white bulwarks, both forward and aft. Each reader must decide this for himself, but remember that it will tax the skill of the painter if the method of lining in a long sweeping curve with both the black and the white is adopted.

Throughout the long amidships portion, the sides, from just below the boats, will be flush right down to the waterline. The boats, of which there are thirteen on each side, can be made from a long strip of wood, planed to the correct section, and cut up with a razor blade, each boat being pointed at either end. They will be supported by being glued on the edges of the boat launching gear, of which there will be one pair to each boat. They will be cut out in Bristol board.

The funnels will be, as before, either of metal tubing 7/16in. diameter, or of paper, which can be rolled around a rod and glued. Whichever is used, the tubes must be made slightly elliptical. Masts will be of wire filed to a taper, or long pins can be used. The stays and wireless aerials can be of very fine copper wire, the aerials being finer than the stays. In fact, the smallest gauge you can get will not be too fine and, if you cannot get wire fine enough, use human hair, cementing it in place with glue. The colours of the *Queen Elizabeth* will be the same as the *Parthia*.

The Harbour Tug

Tugs are all made alike or nearly alike, for all builders have adopted a modern design which varies but little. Fig. 6 shows the general arrangement. This drawing is made to 50th scale because in the 100th it would have been difficult not only to draw but to work from in making the model. This means that all measurements will have to be halved. The length of the hull is 116ft. so the model will be a little more than 1⅛in. long and the beam a little less than ¼in. The thickness of the wood will be ⅛in. There is a considerable amount of sheer which rises sharply to the bows. Note the parallel tumble home on the bulwarks, which will be taken off after the sheer is formed.

All the top hamper will be built up as shown. To form the bridge a piece of thin Bristol board must be cut and glued under the wheelhouse, which is the highest rectangular block. The tow-rope guards can be formed from three thin and narrow strips of Bristol board. The funnel is circular in plan.

Painting

Some of the originals are painted brown on all woodwork with iron work in black and a vermilion funnel with a black top. Others are much smarter, having black hulls with white tumble home on bulwarks, white deckhouses and a black-topped vermilion funnel. There is some brown on the after works, the engine-room light and inside of bulwarks, etc., but the general effect is as light and smart as first-class ships.

Sailing Ships

There are many sailing ships still in existence, but the days of sail are really over, for although the space taken up by boilers, engines and fuel can be used for the stowing of cargo, the sailing vessel is too much dependent upon the vagaries of wind and weather; though under favourable conditions and under a good master, officers and crew they put up some wonderful records for speeds as good as steamships of their times. They are not yet extinct, however, and an example of one of them is given: the *Loch Torridon* in Fig. 7. This vessel was built by Barclay Curle and Company, of Glasgow, in the year 1881 and her loading was 2,081 tons gross. She was rigged as a four-masted barque. Her length of hull was about 287ft. and her beam 42ft. 6in. She was built for the Australian wool trade, in which she made many successful voyages. Her end came during the first world war, for in 1915 she sprang a leak off the west coast of Ireland and as this could not be coped with by pumping she was set on fire in order to prevent her from becoming a menace to other shipping, and she was abandoned.

As a model she will make a charming addition to a collection of steamships in the

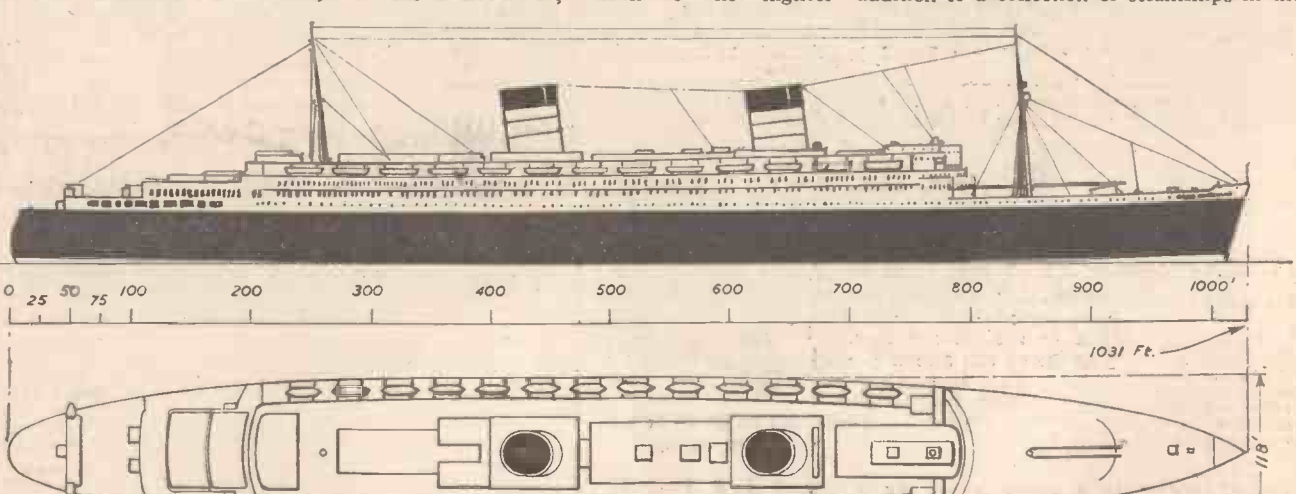

Fig. 5.—R.M.S. Queen Elizabeth, *drawn to a scale of 100ft. to ⅝in.*

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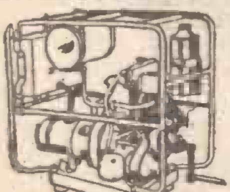

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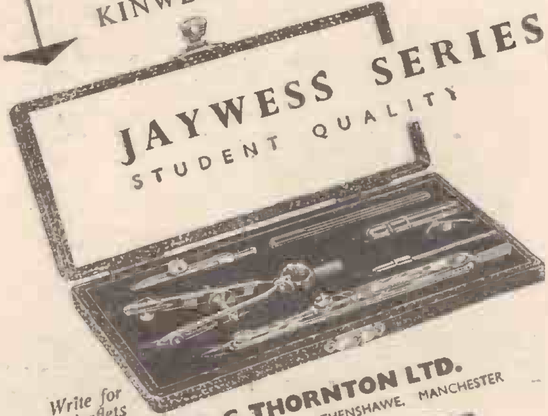

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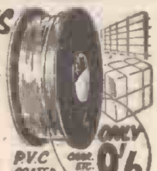

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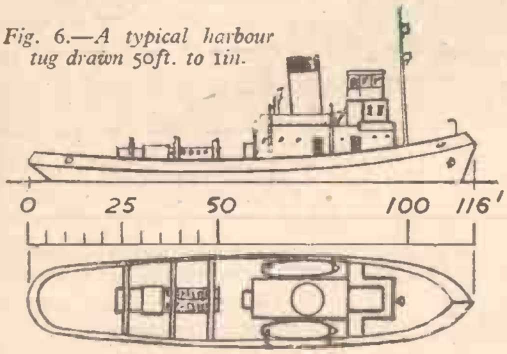
same scale. Fig. 7 was drawn for ease of draughtsmanship, half as large again as the size of the intended model, but if she is modelled alone or with small ships, all, including the *Loch Torridon*, can very well be made to 50ft. to 1in. This scale will certainly be easier to work to than the smaller size.

Fig. 6.—A typical harbour tug drawn 50ft. to 1in.



Commence by making the hull, which will need for the larger model a piece of wood 7/16in. thick and for the smaller scale one-half of that thickness, i.e., 7/32in. This is carved down for the sheer. Then add the poop, the forecastle and the deck-houses, etc., shown in the drawing. The four boats should not be mounted on the deck, for they would be too low, but upon small additional deck houses, one under each boat.

The masts and the yards will all be of metal. Masts are stepped each at one point only and that will be above the upper topsail yards. All the yards on each mast must be set at the same angle with the centreline of the hull. The exact angle is not important, but it should be approximately as shown in the plan view. In the sheer plan they are shown laid fore and aft so that their lengths and the sizes and shapes of the sails can be taken off. They could never actually be laid thus. The foremast had an actual height of the truck above the deck of 148ft. and the next two of 152ft. All yards, the top-masts and lower masts will be tapered and the steps and tops, etc., soldered, and yards soldered together. Then drill the hull and insert each mast with glue. See that each mast stands square with the hull and that each is parallel with all the others. The bowsprit will be treated in the same way as a mast.

The Standing Rigging

This is made up of ropes which are never moved through blocks or in any way. In later sailing ships it was mostly of stranded steel wire cable. Its object is to take all the strains above the deck from wind pressure on sails and masts and transfer them to the hull. The standing rigging will consist of all back stays which will include the shrouds and all fore and aft stays which will be on the centreline. The other ropes shown in Fig. 7 make up the principal running rigging which will consist of the braces attached to the yard-arms and a few other odd ropes on the mizzen sails and the fore and aft sails or jib sails.

Any kind of twisted material, such as cotton or silk, would be too fluffy for this rigging and would be too thick, but a lady's torn hairnet or a stocking which is too badly laddered to be worn can be utilised. The stocking would be preferable because it involves less trouble in getting the threads unravelled. On a 50ft. scale model human hair could be used. Whatever is utilised for rigging, knots cannot be tied and the way to put the ropes on will be to cement them: each rope as a separate unit and stuck at both ends.

The rigging shown is, of course, not by any means the whole, but it will be found enough to make the model look complete. There should be the halliards, the clew lines and the sheets, to mention only a few, but some of the ropes would be attached to the sails and all of the omitted ropes are running rigging. Much of it is too small to be put on or shown, so the matter of the sails is the last job, except the painting. It would be better to paint at this stage and add the sails last. They are cut out now from very thin white tissue paper of the kind which is opaque. A fine thin paper may be found in cigarette packets. If the tinfoil is removed, enough paper will be found in two packets to do the whole set of sails. They should be drawn first and then cut out carefully with a small pair of scissors.

To put them on to the yards apply a fine line of adhesive along the forward side of each yard and just a touch of glue at the ends of the yard below. Then, lifting the sail with a pair of tweezers, place it accurately on the yard, making sure that the bottom corners are stuck. Do one mast at a time, commencing with the Royal at the top and working downwards. The jib sails will be a little more delicate operation; here the adhesive must be applied to the stay with a brush, care being taken not to break the stay away.

Painting

The masts and yards and all spars will be a light yellow-brown, the deck a pale cream colour and deckhouses white. The outside of the hull will be black from the bulwarks down to the white embattled strake: the black squares imitate the painting of the gun ports of the old-time warships. Then below the white there was a black line and below that the colour was a warm middle grey or lead colour.

The "Sea"

For the 100ft. scale a sheet of glass is used which is known in the trade as pattern "G." This, if it is used with the embossed pattern downwards and smooth side up, gives an excellent representation of the ripples on the sea. If you want a heavier "sea" or if the scale is 50ft. to 1in., get the glass which is known as "Arctic" white or colourless; this also will be mounted with the pattern side downwards. Whichever glass is used, the models will be stuck down upon it. Then with white paint in the wake of the ships, the wash from the propellers at the stern, and a little of the bow-wave at the cut-water and the model is finished. Obviously if there is no painting on the water it will be indicated that the ship or ships are at anchor.

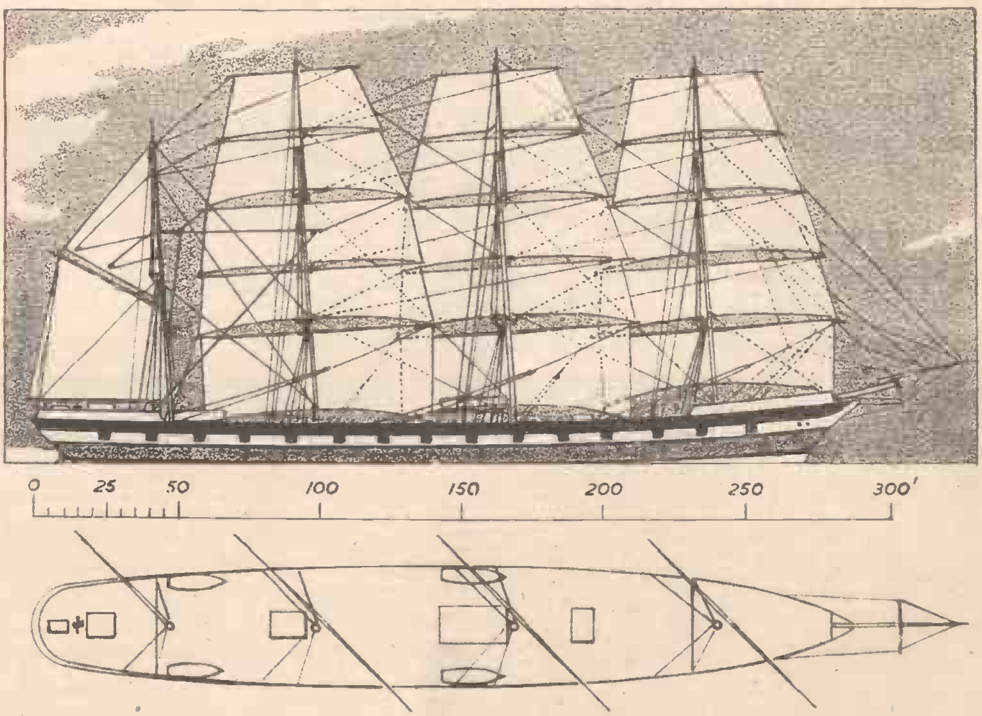


Fig. 7.—The four-masted barque, Loch Torridon.

Electric Convector Heater

(Concluded from page 491)

sheet of metal extending from just above the expanded metal grid inside the heater curving from immediately above the top grill to half-way down the back of the heater—the shaded area in Fig. 6 indicates the positioning. This serves to prevent any dead space of hot air at the top of the case. Finally, a handle at the back is useful for lifting.

Possible Refinements

The heater has been described as it was made, and is fairly simple and free from complication. It is impossible to give the exact cost as so much will depend on the materials of construction. The element can certainly be made for as little as 8s. Certain refinements will suggest themselves to the ambitious. Another element unit could be added, with a switch on the side of the case to bring it into operation when required, or a thermostat could be included in the circuit. Some commercial heaters have red pilot lights which create an illusion of warmth and show when the heater is working. This could also be incorporated without too much trouble.

Fig. 1.—The completed one string fiddle being played.

JUNIOR SECTION

Making a One String Fiddle

An Amusing Novelty Musical Instrument Made from a Cigar Box

FOR the body of the fiddle you will need a cedar cigar-box, measuring approximately 8½in. x 4¾in. x 2¼in. Tear off as much as possible of the paper decoration and binding and take the box to pieces carefully. Clean off the remainder of the paper, inside and outside, with glass-paper. On no account should the wood be damped to help this or the pieces are sure to warp.

Making the Body

Before you begin work on the body, you will find that the bottom of the box will eventually be the "belly" or upper surface of the fiddle, and the lid will be the back or the bottom. With a sharp centre-bit or fret-saw cut two holes, 1in. dia. and 1½in. apart, in the belly. Then in one of the end pieces cut a square hole measuring ½in. x ½in., and 9/16in. from the lid side of the box. In the other piece cut a hole ½in. x ⅜in. and 9/16in. from the edge, as shown in Fig. 3. The fingerboard is made next from a straight-grained piece of wood planed to 2ft. 5in. x 1⅞in. x 1¼in. Any wood will serve, but a hardwood such as mahogany, walnut or oak would be best.

The Fingerboard

The fingerboard is shown in Figs. 1 and 2. Mark one of the narrow sides as the "faceside" (the upper surface) and one wide side as the "face edge." Across the face side, 6¾in. from the end, make a clean saw cut 3/16in. deep. Now gauge a line 3/16in. from the face side but 8¾in. long and another below it and 1⅞in. from the face side. With a fine hand-saw cut along these lines and then remove the wood between them. Turn the fingerboard face side downwards, and gauging two lines ⅜in. from each edge and 8½in. long, saw along them and cut away the outside pieces. The remaining portion is the rod which passes through the cigar-box, and where it passes through the far end of the box it needs stepping back to make a shoulder on two sides. The hole to receive it has been cut to ½in. x ⅜in. The upper portion of the fingerboard (Fig. 2) needs to be tapered.

From a point 9¾in. from the lower end of the fingerboard plane the sides of the wood equally, so that it tapers to ¾in. at the top.

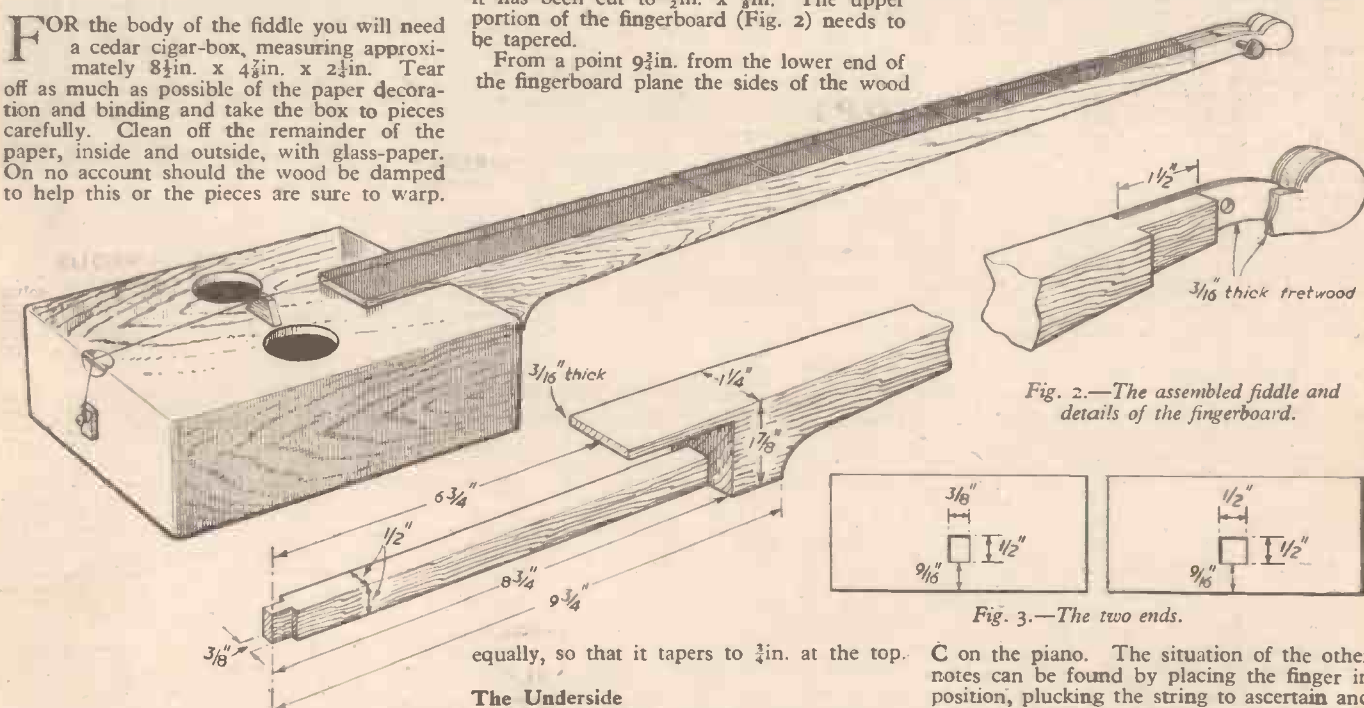


Fig. 2.—The assembled fiddle and details of the fingerboard.

Fig. 3.—The two ends.

The Underside

The underside should be cut away as shown in Fig. 2 so that the fingerboard is ¾in. square at the end. Now mark out and cut the tenon, the centre-piece at the top, which measures ⅜in. wide and 1½in. long. For the cheeks of the scroll, the part which takes the peg, take two pieces of 3/16in. fretwood 4½in. x 1½in. and cut to shape.

These two pieces are now glued and screwed to the sides of the tenon, and a small piece of wood ⅜in. thick is sandwiched between them to fill up the space. This should be glued in and pressure applied so that it sets quite solid. Nor bore a hole ¼in. in diameter through the cheeks for the string peg. It is probably best to buy a violin peg from a music dealer. When all is ready for assembling, fit the box end with the larger hole on to the centre, gluing it in position. A couple of fine screws should be put through it into the shoulders of the fingerboard. Fit the other end in the same way and then fasten on the sides, top and bottom (cigar box lid with hinges removed) in that order.

Tuning the Fiddle

The string (a violin "E") is looped over a small roundhead screw which is inserted in the projecting end of the post and, passing over the bridge placed midway between the holes in the belly, is then taken through the hole in the peg. The bridge is easily cut from a piece of 3/16in. fretwood. It should be about 1in. wide at the base and ¼in. at the top. The height should be such that the string stands ¼in. above the surface of the fingerboard. Tune the string to middle C on the piano. The situation of the other notes can be found by placing the finger in position, plucking the string to ascertain and correct note and marking the point in pencil. These places can be marked permanently by making shallow saw cuts across the fingerboard and filling in with strips of inlay or plastic wood. A good plan is to stain the fingerboard black before making the saw cuts, and then the inlaid bands will show up clearly. When the fiddle has been cleaned up and smoothed with glass-paper, give it a coat of glue size and, when this has dried, give two coats of best copal varnish. To prevent the string cutting into the wood, a small piece of tin or brass should be bent and inserted under the string on the edge of the box.

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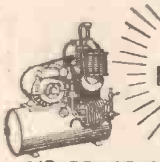

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Figure 1 gives a good idea of the machine, resting on its box, all ready for work. A useful size is that known as quarto, which is 10in. x 8in., and the dimensions given in Fig. 2 plan and side elevation are suitable for that size paper.

The two pieces of wood, A and B, are cut from ½in. wood, glued together and left under a weight until the glue is hard. Note that the grain of the wood runs crosswise on A and lengthwise on B, also that the top surface must be planed quite flat. The groves, C, should be cut out to accommodate the two strips of metal which keep the stencil taut. The size of these strips, within reasonable limits, is not important; ¼in. square brass rod would suit. Smooth off the sharp edges of the metal so that when pressed in the grooves it does not tear the paper. The four small catches are to keep the metal strips in place.

The Tinfoil and Pricker

A piece of tinfoil is cut 9in. wide and 11in. long; this is laid down to prevent the ink soaking into the wood top. Over it is laid a thickness of flannel, cut the same size, and the two are kept in position by a drawing pin at each corner.

A pricker (Fig. 3) will be required; this is simply a stout darning needle, forced into a penholder, and secured with a binding of thread. The roller (Fig. 3) is a 10in. length of wood rod, about 1½in. in diameter. A piece of curtain pole would be suitable.

It must be accurately centred at each end and a screw driven in for a spindle. The frame is a convenient piece of metal strip drilled at each end and in the centre, then bent as shown. A piece of broomstick, or a tool handle, is screwed to it through the centre hole, while the spindle screws of the roller are pushed through the end holes. The roller should work easily. It is covered with a layer of flannel, sewn on.

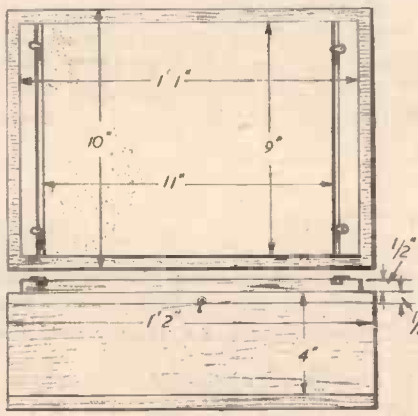


Fig. 2.—A plan and side view of the duplicator.

The Box

This needs little comment, it is the same size as the base of the duplicator, and should be about 4in. deep. It is intended to accommodate the roller, ink and pricker, and the duplicator itself, reversed, forms the lid.

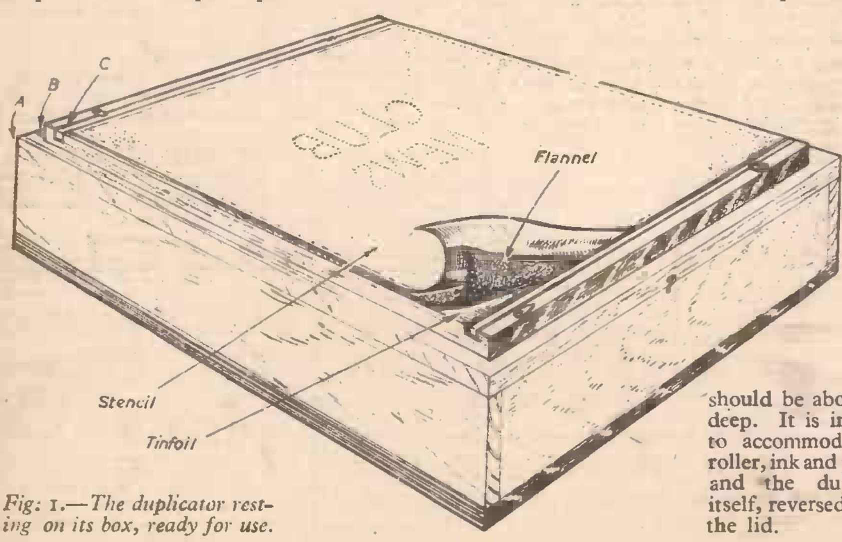


Fig. 1.—The duplicator resting on its box, ready for use.

For the stencils you can use tracing paper. Write out the matter to be duplicated in pencil, lay the paper on a blotting pad, and with the pricker outline the letters with a series of pricked holes, fairly close together, but not close enough to run into one another and cause smudges.

How to Use the Duplicator

Ink the flannel pad with a brush and lay the stencil over, press the metal strips in place and thus secure the stencil against shifting. Lay a sheet of paper on the stencil and run over it with the roller. This will need to be repeated a few times until the ink works through. Any obstinate bare patches will be due to uneven inking, so release one end of the stencil, lift, and apply a little more ink to each bare place. The impression being even all over, it is only necessary to lay a sheet of paper down on to the stencil and run over it with the roller for each copy required.

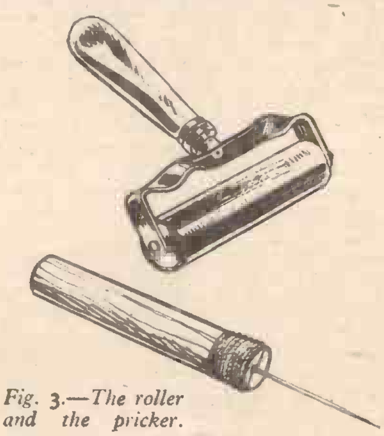
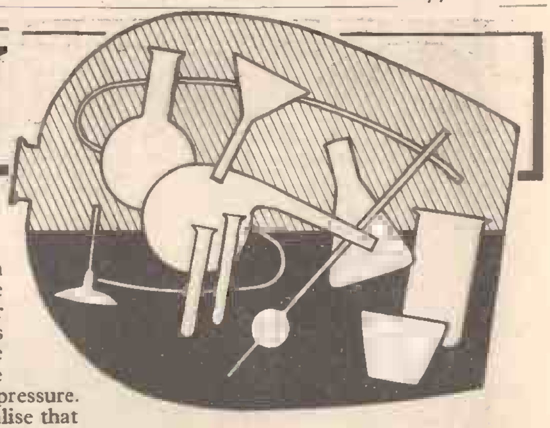


Fig. 3.—The roller and the pricker.

Special duplicator ink can be bought, but for the purpose of this machine a suitable ink can be made up with glycerine, to which a small quantity of aniline violet, or black (soluble in water) has been added. To prevent smudging, it is always best to use duplicating paper, as it absorbs the ink quicker.

THE JUNIOR CHEMIST



No. 8.—The Simple Process of Distillation

A CHEMICAL process of great utility and interest is that of distillation. By its means, highly purified products are obtained from crude substances. For instance, modern lubricating oils are distilled from crude petroleum, while "Scotch Shale" subject to the same process, provides us with paraffin (medicinal), paraffin wax and soft paraffin (white and yellow, known usually as petroleum jelly). And thus we might continue with illustrations, whisky and spirits, raw alcohol, benzine and a multitude of other commodities—all these are manufactured by a distillation process.

The operation is simple. It consists merely of converting a liquid into its vapour and then recovering it by condensing the vapour against a cool surface.

A few moments consideration will make it evident that the distillation process may be employed to separate a liquid from solids dissolved in it, to separate two liquids of different boiling points—the alcohol may be distilled over from a mixture of water in the still, or again we may utilise the distillation process to obtain a liquid the vapour of which is produced by heating some other substance.

There are numerous modifications of the distillation process in common use. Perhaps the junior chemist has already encountered such expressions as "distillation in vacuo," "fractional distillation" and "distillation in steam."

The Distillation Under Reduced Pressure (or In Vacuo)

The temperature at which a liquid boils and passes into the gaseous state is dependent on the pressure to which it is subject. Water, for instance, under normal atmospheric pressure (nearly fifteen pounds per square inch) boils at a temperature of 100° Centigrade approximately. Now, if we reduce the pressure below that of the atmosphere, the water boils and passes into vapour before a temperature of 100° is attained.

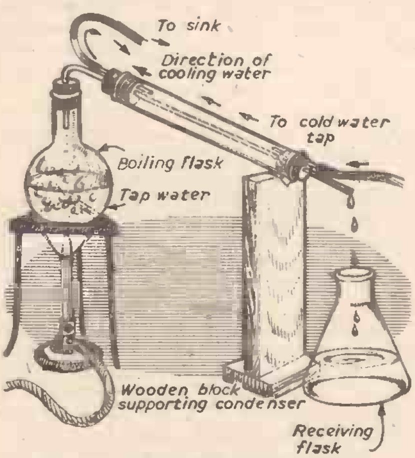


Fig. 1.—Apparatus for distillation

Eggs Cannot be Boiled on Mountains

Although the subject of egg boiling seems a far cry from the more technical subject of distillation, it is an admirable illustration of a lowered boiling point caused by a reduction in pressure and is proved without the use of a thermometer. Egg albumen (the "white") is coagulated at the temperature of boiling water under normal pressure. Below 100° it is coagulated only with difficulty. The higher we ascend from the earth the lower becomes the atmospheric pressure. Coupling these two facts you will realise that on a high mountain boiling water is too low in temperature to successfully boil an egg.

Fractional Distillation

This is a method used in separating two or more mixed liquids whose boiling points lie close together, and consists of distilling carefully at the boiling point of the more volatile liquid. This portion of the distillate (known as the first fraction) is set aside and a second fraction is collected at a slightly higher temperature. A third and more fractions are collected until the volatile vapours cease to be evolved. The first fractions contain practically all the more volatile liquid and little of the other, whereas the final fractions contain the reverse. Each fraction is very carefully distilled perhaps several times until complete separation is effected. This is a method used in separating the water from alcohol in the manufacture of the latter.

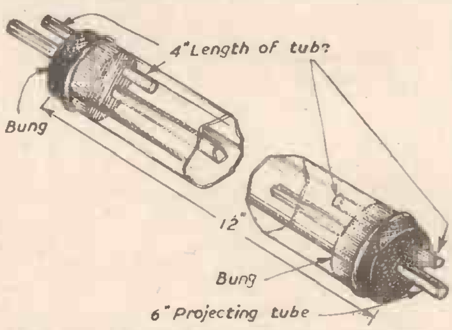


Fig. 2.—The condenser, showing dimensions

Distillation in Steam

Many liquids boil at a lower temperature in contact with water with which they are immiscible. The reason for this is too involved for explanation here. The operation either consists of heating the liquid and simultaneously passing steam through it, or heating the liquid and water together. In each case, the distillate contains both water and the liquid under treatment and as they are immiscible they are readily separated. Many essential oils used in medicine are obtained in this way, the leaves of the plant, which contain the oil are treated by either of the above methods. The oil passes over with the steam and finally is separated in the distillate from the water upon which it floats.

Having grasped the theory of distillation, the junior chemist will no doubt wish to satisfy himself of the truth. The apparatus required for distillation consists of the still boiler, the condenser and the receiver.

The Still Boiler

This consists of a glass flask. The capacity is immaterial; if much distillation is to be done, then a larger flask is necessary to avoid constant filling. A bored cork closes the mouth of the vessel.

The Condenser

For this you require about a foot of glass tubing about 1 in. in diameter. Any good chemist will obtain this for you, if he does not actually stock it. You will also need a yard of ordinary thin glass tubing and two bungs which will fit the ends of the wide tubing. It is unnecessary to describe in any detail the construction of the condenser, as it will be quite evident from Fig. 2. The glass tubing is cut with a three-cornered file as previously described in this series. Two holes are bored in each bung. These must accurately fit the narrow tubing which they house, otherwise the device will not be watertight. In use, the condenser is connected to the tap, the overflow pipe returning the water to the sink after it has traversed the water jacket. The inner tube of the jacket enters the bung or stopper to the boiling flask.

Three-quarters fill the boiling flask with tap water and arrange the apparatus as shown in Fig. 1. The boiling flask or still rests over the Bunsen on to a wire gauze and tripod is connected to the condenser. The outlet end of the latter passes into the receiving flask. Turn on the heat until the water in the still is boiling vigorously, then turn down the flame, keeping the water steadily boiling. The liberated steam will be seen condensing in the condenser inner tube.

The first portion of the distillate is used to rinse the receiver and is then thrown away. It is not pure distilled water as it contains the more volatile impurities and dissolved gases always present in tap water. This precaution having been observed, proceed to collect the distillate now coming over until about two ounces of water only remain in the still boiler. At this point cease to collect the water now coming over as it will contain the less volatile impurities.

The simple type of still employing a Liebig type condenser such as described, is not capable of delivering large volumes of distillate in a few minutes, but, nevertheless, is quite adequate in output for most small laboratory purposes. On the larger scale, continuous forms of still are employed in which the cooling water in the jacket, becoming warmed by contact with the condenser pipe or "worm" is passed on to the boiler which is automatically kept at a constant level. Some saving in heat is thereby effected, and there is no risk of the still running dry.

Letters to the Editor

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

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

The Chronometer—Britain Leads

SIR,—In your May issue, p.395, your contributor writing on "The New Electric Watch" states "——the world supply of marine chronometers, *hand-made in Switzerland*, was cut off when the Nazis took over Europe."

We should like to point out that "the *world's* supply of Marine Chronometers" did not (repeat NOT) originate in Switzerland, but in the works of Messrs. Thomas Mercer & Son, Limited, St. Albans, ENGLAND.

We agree that Hamilton's helped to fill the gap during the war (at a price), but as soon as the war finished, and chronometer-making became unprofitable, they stopped manufacturing. This was due to no fault of theirs, but simply that the demand reverted to pre-war levels, and Messrs. Thos. Mercer—who were making chronometers for both the Merchant and Royal Navies during the war—once more took over their business of supplying to the Merchant Navies of the world.

We know quite well that both Swiss and German makers produce very good chronometers, but we do feel that Mercer's should be given full credit for the most satisfactory service they have always given to the Shipping Industry of the world for so many years.—MANAGING DIRECTOR (Lilley & Reynolds Limited).

Space Visitors

SIR,—In reply to Mr. Anstee's letter in the April issue, may I point out that a meteor such as I have postulated to explain the Captain Mantell incident need not necessarily betray its presence by falling to Earth almost immediately. It might be vapourised, it might escape from a "grazing" encounter with the Earth into a changed orbit about the Sun, it might enter an unstable orbit round the Earth and fall to Earth only after several grazings of the atmosphere, losing speed each time (the same principle as "aerodynamic landing" of space-craft), and when it did fall, either at the time of the Mantell incident or later, it would be more likely than not to fall somewhere in the deep ocean beyond observation.

I think it is safe to say that no object obeying the normal laws of Physics could attain the velocities and accelerations claimed for flying saucers, as it could not carry sufficient reaction-mass. If, on the other hand, it was propelled by an inertialess drive, then it would have no exhaust stream, and Captain Mantell's aircraft would not have been destroyed, as is claimed, by the exhaust stream. Thus the fact of the destruction of the aircraft is in itself almost conclusive proof that we are not dealing with a "space-ship."

"A foo ball" which appears luminous in certain directions, unless it actually is self-luminous, is obviously absorbing light in some directions and emitting it in others. If viewed along one of the directions of absorption it will clearly appear darker than its surroundings, and silhouetted against the sky. This, I believe, is what was observed by Captain Howard, and I still maintain that all objects which keep formation with aircraft are foo balls.

All these cases are reported by eye-witnesses, and eye-witnesses are notoriously unreliable, as has been proved by experiment time and again. The only evidence a scientist will accept, at any rate of something so important as the possibility of intelligently-controlled space visitors, is good photographs. By this is not meant, misty pictures which might or might not portray lighting fittings, nor photographs showing "lights in the sky." So many of the latter class may be put down to lens flare and similar photographic imperfections that it does not seem unreasonable to discount the entire class of such pictures, while "night photographs" with passably well-exposed foregrounds and quite sharp images of what purport to be flying saucers in the sky contain their own internal evidence of faking.

I, for one, shall not be satisfied until a picture is produced of one of these objects sharp enough to show some detail *and with something else in the picture to give it scale*.—BRIAN C. KERSHAW (Leeds, 16).

SIR,—I have read "Theorist's" letter in the May issue. May I, respectfully, refer him, and others interested in surface conditions on the planet Mars, to a report of the December meeting in New York of the American Astronomical Society and the American Association for the Advancement of Science, under the title "Mars Symposium." Interesting details are given of the results of observations during the 1956 opposition, particularly as to the methods used for detecting the presence of oxygen and water vapour. It seems unlikely that these substances are present except in very small quantities indeed.—WALTER H. GRAHAM (Cornwall).

Battery Alarm

SIR,—With reference to the letters in the February issue of PRACTICAL MECHANICS from Mr. A. Strang and in the May issue from Mr. D. G. Salmon in reply to Information Sought, December issue, may I be allowed to say that I disagree with Mr. Salmon's criticism of Mr. Strang's circuit. His argument that the battery would become exhausted in a short time cannot be supported as this circuit is used in professional alarms.

I would, however, point out that the main switch in Mr. Strang's circuit should be a double-pole switch and break both the magnet and bell circuits. I would also point out that circuits of this nature must not be worked from the mains but should be fed from a dry battery or other source of supply which cannot be cut off and must not be switched (other than by the main switch already referred to) or fused.—J. E. DIXON (Bristol).

Relining a Potato Washer

IN reply to Mr. D. Lowe in your Information Sought, May issue, who asks how to reline a potato washer, below is the address of a firm supplying carborundum and fluid for same: Surfix Ltd., 9, Spring Street, London, W.2.

I reline my machine once a year at a cost of 30s. I mix it in a saucer and apply with a table knife. First dry the lining and roughen with light taps of a centre punch and apply compound. Leave, if possible, for 24 hours.—DAVID MUIR (Ayrshire).

THE STEAM CAR

SIR,—I read with interest the article and correspondence in the April issue of your magazine regarding the possibilities of the Steam Car.

I am an engineer myself and have recently given a lot of thought to the various problems involved. Consequently, I have one or two ideas, which, if pursued, may overcome the difficulties. Therefore, I should be pleased to hear from fellow readers who are also interested in obtaining a solution to these problems with a view to the production of such a vehicle, if successful.—D. GLENISTER (Rotherham).

SIR,—Regarding the recent correspondence on steam cars, I note that all complaints are of burners.

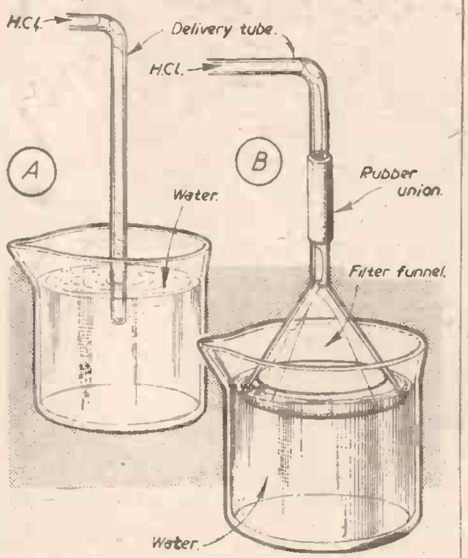
Your contributor, Mr. C. E. Hooker, while admitting the superiority of the steamer, remarks that although it beat the I.C. car, the I.Cs were only in their infancy, etc. But then so was the steamer! Burners in the year 1957 could be made as reliable as cooking stoves, surely!

Is it completely impossible to give some thought to producing steam (and superheated subsequently) by producers similar to the Bellis and Morcom idea? My own knowledge of steamers, while not as extensive as that of Mr. Hooker, does not give any indication of continued burner trouble—and judging by the numerous Stanleys in America (and here at one time) most owners apparently had satisfaction.—R. F. MACDONALD (Johannesburg).

THE JUNIOR CHEMIST

SIR,—In the Junior Chemist section of the May issue it was stated that hydrogen chloride gas could be dissolved in water by the method sketched at A. As the gas is rather soluble in water (at 0°C. 1 c.c. if water dissolves 500 c.c. of hydrogen chloride) may I tender the following method of dissolving the gas? A filter funnel is fitted to the end of the delivery tube and this is just allowed to dip below the surface of the water, as shown at B in the sketch.

This method prevents sucking back of water. The danger of this sucking back is that if the water is sucked back into the flask and comes into contact with the hot flask and the hot sulphuric acid, the water will be vaporised, an explosion will occur, and hot concentrated sulphuric acid will be scattered all around, probably resulting in serious injury to the experimenter.—M. KEEN (Bodmin).



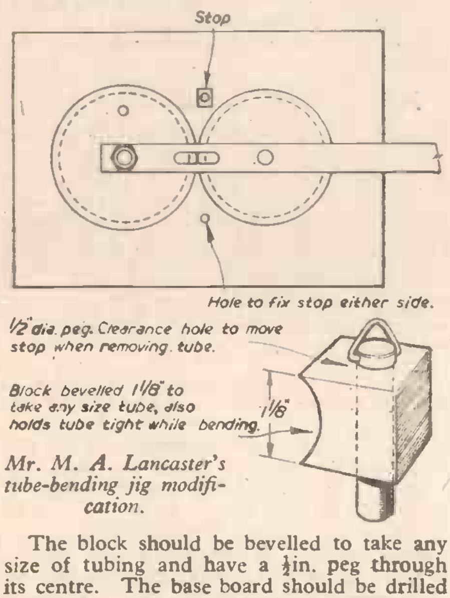
(A) The method shown in our May issue.
(B) Mr. M. Keen's modified method.

SIR,—Re your method of making hydrogen from hydrochloric acid in the Junior Chemist section of the May issue, I think the author would need more than a little manipulation to keep the hydrogen burning at the mouth of the test tube. It would have been better to fit the test tube with a cork and a length of glass tubing drawn out into a jet. The hydrogen evolved would then be under enough pressure to remain burning. As an alternative, ordinary coal gas could have been burned up against a cool surface to form water droplets, because for purposes such as these coal gas can be considered to be made up of practically 50 per cent. hydrogen (the 30 per cent. methane and 2½ per cent. ethylene also burn to form water).—P. M. WARTON (Rhondda).

Bathroom Stool

SIR,—I was interested in the article on making a bathroom stool in the May issue, but think that the tube bending jig could be improved.

In your diagram you show the two pulleys, one fixed and one free, and with this arrangement the user would have to hold one end of the tube while bending the other. I have bent a number of tubes of all sizes and would suggest that a stop be included on your bending jig in the position shown in the sketch below.



Mr. M. A. Lancaster's tube-bending jig modification.

The block should be bevelled to take any size of tubing and have a ½in. peg through its centre. The base board should be drilled so that the peg may be positioned either side as shown.—M. A. LANCASTER (S. Wales).

Ellipse Construction

SIR,—With reference to the simple ellipse construction given in the May, 1957, issue, I should like to point out two things:

(1) There is no need for the angles taken to be 30° and 60°. Any angles would do, and any number of them.

(2) The construction is exact.—F. S. DEWHIRST, B.Sc. (Yorks).

The Comet and Space Travel

SIR,—I have never read any convincing explanation of comets, though I have browsed through much popular astronomy. Perhaps you or your readers will be so good as to give the latest theory?

I have read that their tenuity is such that all the matter present would pack into an attaché case, also that the light-pressure from the Sun causes the rarefied gas or atoms to be forced away from the comet nucleus and the Sun's direction.

This latter appears a fallacy, for if the Sun's radiation could accelerate atoms from conglomeration about the nucleus into a tail a million miles long, such radiation must be more powerful than the comet's self-gravitation, even close to the nucleus (or there would be no dispersal). At a distance of even a thousand miles, cometal gravity would be greatly reduced, thus any force which could displace atoms in close proximity would sweep them entirely away, and there could be no "tail" whatever.

I suggest that, though the nucleus is matter, with weight and inertia, the surrounding "aura," including the tail, cannot be matter in any form, and that it is radiation, possibly "cathode rays," which cause fluorescence of cosmic dust but which are deflected, by radiation from the Sun, and caused to follow the more powerful radiation stream, therefrom.

This leads to the interesting speculation that, whereas "radiating" comets are rare phenomena, non-radiating comets, or cold, invisible meteoric bodies may persist in great numbers, travelling elliptical or hyperbolic paths that link the galaxies.

I have always felt that the greatest of all hazards in space navigation would be the constant shower of high-velocity projectiles of all calibres! "No man's land," in truth!
—F. O. BROWNSON (Bedford).

BOOKS Received

"The Microscope Made Easy," by A. Laurence Wells. 254 pages. Illustrated. 12s. 6d. net. Published by Frederick Warne & Co. Ltd.

AS an introduction to the subject of microscopy this book is ideal. It deals primarily with simple mounting techniques applied to such objects as single-celled algae and animal forms, hairs and fibres, diatoms, minute crustacea and many others. Every chapter is illustrated with both drawings and photographs and there are seven coloured plates.

"Know Your Lathe." 114 pages. Numerous illustrations. 6s. 6d. postage paid. Published by Denfords Engineering Co. Ltd., Halifax, Yorks.

THIS is more than a handbook for the Box-Ford and Harrison lathes made by Denford Engineering Co. Ltd. and their subsidiary, T. S. Harrison & Sons Ltd., and chapters are included on lathe tools and their application; accurate measurements, plain turning; taper turning and boring; chuck work; drilling, reaming and tapping, screwcutting; special types of work; and lathe parts. The illustrations included with the chapters describing modern change gear lathes, installing the lathe, how the lathe operates, show Box Ford tools, but the information can be applied to any modern lathe. Both half-tone and line illustrations are used liberally throughout the book.

Soft and Hard Soldering

(*Concluded from page 478*)

Hard soldering with a silicon alloy solder is to be thoroughly recommended as regards ease of application, strength and permanence. Unlike soft soldering, the joint is capable of withstanding the action of boiling water or steam without protection.

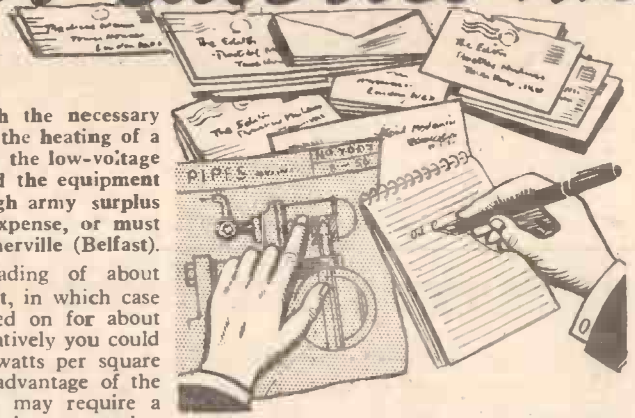
Soft Soldering Aluminium

In this process the solder melts at a comparatively low temperature, and it is this type of work which has given rise to the widespread view that aluminium is difficult to solder. The reason is that no satisfactory flux is available which will attack the oxide at the low temperature of working, so that the oxide must be removed by mechanical means. After a preliminary cleaning, the metal is heated until the solder melts upon it. The molten solder will not adhere, but it can be made to do so by scraping through it with an old hacksaw blade or other form of scraper to break up the oxide film. Once the film is broken, the oxide cannot reform under the solder, and alloying takes place. When the surface is fairly well covered with molten solder the adhesion is improved by rubbing with a wire scratch brush while the solder is still molten, thus breaking up any remaining traces of oxide. After such "tinning," the parts can be sweated together in the ordinary way. Fluxes are sometimes supplied with these solders, but these consist largely of stearin or resin, and are of little assistance.

Reaction Soldering of Aluminium

The solder is a chemical mixture, which is spread on the parts to be jointed and heated by a blow-lamp to about 200 deg. C. A chemical reaction takes place which results in the deposition of pure zinc in a molten condition on the aluminium surfaces to be joined. The zinc flows easily between the edges, and alloys readily with the aluminium, forming an excellent joint.

Your Queries Answered



Greenhouse Heating

PLEASE furnish me with the necessary information regarding the heating of a greenhouse (12ft. by 8ft.) by the low-voltage soil-heating method. Could the equipment required be obtained through army surplus stores in order to reduce expense, or must it be bought new?—F. Somerville (Belfast).

YOU could adopt a loading of about 5 watts per square foot, in which case the heater could be switched on for about eight hours per day. Alternatively you could use a loading of about 1.7 watts per square foot continuously. The disadvantage of the former method is that you may require a time switch to control the heaters, and a comparatively large transformer will be required. The disadvantage of the lower loading is that if the soil should freeze up before planting, such a low loading might be unable to thaw out the soil.

However, we will assume a loading of about 1.8 watts per square foot, in which case a total loading of 160 watts or so will be required. It might be an advantage to use two separate heating units, each covering half the soil area so that you can heat either half as required. This method would be very convenient if you find it easier to obtain two transformers, each with an output of 80 to 100 watts, rather than a single transformer having an output of 160 to 200 watts.

Each unit could consist of 70ft. of 17 s.w.g. bare galvanised iron wire for use on 12 volts; alternatively you could use 110ft. of 15 s.w.g. bare galvanised iron wire for each unit. The wire should be laid in a zig-zag formation about 6 to 7 inches below the eventual soil surface. You should be able to obtain a suitable transformer or transformers from an ex-Government stores. A transformer having an output of 160 to 200 watts at 12 volts (approx. 14 to 18 amps.) may be used; or two transformers, each having an output of 80 to 100 watts (approx. 7 to 9 amps.) at 12 volts would be suitable.

It is, however, most important that the transformer(s) should be continuously rated and should be double-wound. An auto-transformer is unsuitable. The British Electrical and Allied Industries Research Association of 13, Savoy Street, London, W.C.2, have produced a most useful technical report (Ref. W/J7) which deals in a practical way with simplified electrically heated hotbeds, which we think would be most useful to you.

Zinc Oxide Paint

YOUR advice is sought regarding paint making.

Can you let me know how to make up flat and gloss paint using zinc oxide as the base?—G. F. Bramham (Rhyl).

TO make zinc oxide paint (flat), mix your zinc oxide with turpentine to the right consistency in a 2-gallon pail, stir well with wooden slat. Add a teacupful of shellac varnish and also a bit of paste drier the size of a walnut. Terebene can be substituted for the paste drier if desired.

To make zinc oxide paint (gloss), mix your zinc oxide with boiled linseed oil and thin with turpentine to required consistency.

Tinning Effect on Brass

COULD you give me the composition of a solution which, when heated, will coat brass and copper with a film resembling tin? It is, I believe, composed mainly of stannic chloride. Please give approximate prices and tell me where it is obtainable.—P. J. O. Hogan (Southsea).

STANNIC CHLORIDE will certainly not serve, as it is a fuming volatile liquid.

It is possible to obtain from any good ironmonger a preparation of powdered solder in flux, and this, when smeared over object and heated, gives an excellent tinning effect.

> **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.

Non-setting Adhesive

PLEASE tell me the formula for making an adhesive for sticking paper or card on to a painted surface so that it can be removed and used again without damaging the surface.—S. C. Deadman (S.W.16).

WE suggest you try the following formula:

Take 2oz. boiled linseed oil, heat over a low flame on a gas ring in a small can for several hours until the contents become very sticky. When this mass is cold, add a saltspoonful of metol H.Q. developer or a few drops of nitrobenzene. This mix should remain sticky indefinitely and may serve your purpose. When paper is removed from painted surface any adhesive may be removed with a quick wipe of turpentine.

Camera Rangefinder

I AM trying to make a rangefinder to fit my camera, and would like to know what type of lenses I shall require.—T. A. Rollings (Kidderminster).

THE normal type of rangefinder requires no lenses. Half of some selected vertical on the object to be photographed is viewed direct, and the other half is viewed by means of the mirrors. The split image is made to coincide by movement of the outer mirror.

If you are endeavouring to make the field of view of the rangefinder agree with that taken in by the camera this could most simply be done by adopting the direct-vision type of finder. In this, the relative sizes of the apertures and the distance between them, control the field of view. The sizes and spacing may be worked out by drawing a scale diagram, or found by trial. However, it is usual to use the rangefinder to determine distance only, and then apply the eye to the viewfinder for the shot.

Two-note Door Chime

I HAVE constructed the two-note door chime described in your April, 1952, issue. I find, however, that although the first note strikes properly, there is not sufficient rebound to make a really loud second note. I have tried various alterations without success and am wondering if it would be possible to utilise a solenoid with a bell transformer. Can you tell me what type to use and where it is obtainable?—M. Shortman (Mon.).

YOU will be very unlikely to obtain a solenoid suitable for use with door chimes.

There is no reason, however, why the unit you have constructed should not work efficiently. It would seem that the speed of rebound, or the striker weight, is insufficient. First, try the effect of adding to the striker weight. If not satisfactory increase the spring tension. If, as a result, the armature fails to draw in when the switch is operated and the voltage cannot be raised, try the following: Unsolder the coil connections and join in parallel instead of series. Note that the magnetic strength increases. One coil should be experimentally reversed to check this. The distance between armature and pole faces can now be increased, which, together with improved spring tension, should give the desired result. Adjust the chimes as described in the article.

Winding a Shocking Coil

I WISH to make a hand-operated shocking coil. Could you please supply information regarding the winding of the primary and secondary coils?—Eric Milne (Scotland).

THE coil core could be made of a bundle of straight, soft iron wires of 18 s.w.g. by 5in. long, these being packed tightly in a brass tube 5in. long and ½in. in diameter, with a thin wall. Draw the wires out of the tube an inch or so at a time so that they can be bound together evenly with fine wire, the ends being filed straight and square; the core afterwards being dipped in "killed" spirits of salts, followed by dipping in molten solder. The core should then be washed and dried and then soaked in hot paraffin wax to produce a core over which the brass tube will slide easily.

Roll a piece of white demy paper round the brass tube, then cut a piece of tough brown paper 12in. by 4in. and roll this tightly round the paper tube after coating the brown paper with hot glue. When dry and hard, withdraw the brass tube and after trimming up the paper tube, soak it in hot paraffin wax. Form a paper collar on the core ½in. from one end and about ½in. wide by wrapping on a strip of brown paper. The overall diameter of the paper collar should be just sufficient to enter the paper tube. One end of the paper tube should be squarely glued into a 3in. square piece of mahogany or teak about ½in. thick, with the core projecting slightly.

The secondary bobbin may have two mahogany or teak ends ½in. thick by about 3in. square, with a 4½in. long paper tube between the ends, which is just sufficient to slide smoothly over the primary coil. The latter coil should be wound on the brown paper tube over the core and should have 4 layers of 22 s.w.g. S.S.C. wire; each layer should be basted with hot paraffin wax, and the ends connected to terminals. The secondary coil is wound with about ½lb. of 36 s.w.g. S.S.C. wire which should be soaked in hot paraffin wax before winding. Each layer of the secondary should be basted with hot paraffin wax, with a thin layer of paper wound over each layer of wire. The secondary coil may be covered with velvet or a similar material. The ends of the secondary coil should be connected to terminals and the complete secondary coil arranged in suitable guides so that it can be slid over the primary and core. The contact breaker operating on the end of the core should be connected in series with the primary coil.

Display Turntable

I WISH to make a revolving turntable similar to those used in shop windows for display.

The motor is a clockwork gramophone motor and the difficulty is to reduce the speed of the table sufficiently, as when I do this by the governor the table stops revolving before the speed is sufficiently slow.

Can you suggest some other method of control?—J. C. Whiteley (Grimsby).

THE only suggestion we can offer to enable you to reduce the speed of the turntable of your gramophone motor is that you ignore the governor and apply a brake on the edge of the turntable itself. This brake may be a very light adjustable leaf spring, having a piece of oiled leather on the end of it to rub on the polished edge of the table. Let the governor absorb none of the power but allow the brake on the edge to absorb it all.

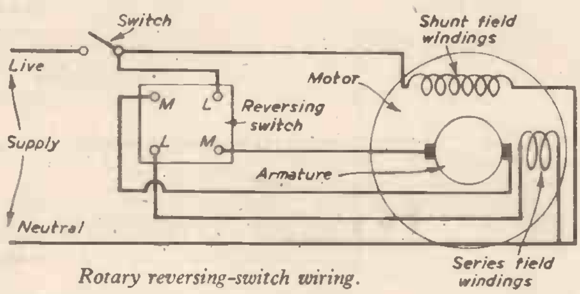
By far the best scheme is to abandon the gramophone motor and adopt an electric motor. The Klaxon Co. make a small machine with combined gearbox, terminating in a vertical shaft, and this is so designed that it revolves at the usual window display speed. Current is taken from the ordinary house wiring.

Rotary Reversing-Switch Wiring

I HAVE a rotary reversing switch (drum type) which I wish to use on my lathe. Can you inform me how to wire it? The motor is a ⅓ h.p. D.C. compound, and a plate inside states that to reverse the rotation, the brush leads should be changed over.

The terminals on the reversing switch are: $\frac{M\ L}{L\ M}$.—D. Wharton (Birkenhead).

WE presume the M terminals of the reversing switch are intended to be connected to the motor and the terminals L to the supply. In this case you should use the following connections:



Rotary reversing-switch wiring.

No Dye for Perspex

CAN you give me any information on the type of dye used on engraved Perspex (i.e., decorative brooches)? Also, where same can be obtained?—T. Jones (Manchester).

THERE is no dye for treating finished Perspex. This resin is usually coloured before casting or forming into the articles required. A transparent dyeing process has been evolved by various firms, as, for example, the "Lustrex" process of Monsanto Chemical Co. Ltd., Victoria Station House, Victoria Station, London, S.W.1.

Oil Immersion Objective

I POSSESS a 1/12 fluorite (oil immersion) microscope objective. Is it correct to use cedar wood oil with this?—S. Parnell (W.C.1).

IF your 1/12 fluorite objective is really designed for oil immersion then it will be safe to use any of the essential oils usually employed and cedar wood oil is one of the best. Oil of aniseed, turpentine and glycerine may also be tried.

Annealing Process

MY hobby is iron founding and I have become very interested in malleable cast iron. I have an ordinary cupola furnace, green foundry sand, boxes, etc.

I understand there is an annealing process involved, if so will you give me full particulars on this process and how I may use my present gear to the best advantage? I should also be grateful if you would recommend some inexpensive literature on the subject.—D. O'Connor (Waterford).

THE castings are packed into suitable canisters with a neutral packing material and gradually heated in an annealing furnace to a temperature approximating to 820 deg. C.-1,000 deg. C. and are maintained in this condition for 3 or 6 days, when they are permitted to cool slowly.

That very briefly is the process for Blackheart annealing, and you can well imagine it will require some consideration and possible expense before you will achieve good results.

You can probably find several books dealing with the subject on the shelves of your local public library under the title of Foundry Practice, but one interesting book you should study is "Modern Foundry Practice," edited by E. D. Howerd.

This book deals, of course, with foundry work generally, but there are several pages devoted to malleable cast iron founding and annealing.

Information Sought

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

Bowl Making

I WISH to make some bowls in a material similar to that used for making hard fancy hats; this appears to be 1/16in to ⅛in. thick, with a closely-woven cloth base. It is tough and slightly flexible. An ordinary pudding basin will be used as a mould.—W. F. TUNNAH (Edinburgh).

Byre Roof Lights

I AM constructing a cow-byre which requires roof-lights. The byre is to be covered with corrugated asbestos and I intend cutting panels from the sheets and inserting glass, or glass substitute. How is this done, and what fixative will be needed in making the roof-lights weather-proof?—J. HUGHES (Eire).

Non-drying Adhesive

PLEASE tell me of a formula for making a non-drying strong adhesive. I require this to stick pieces of cut photographic film on to plates of metal or glass to use in a plate camera.—J. WILD (Halifax).

Spinner Type Wire Straightener

I HAVE a wire-cutting and straightening machine, it has adjustable rollers horizontal and vertical for the straightener.

I wish to make up a spinner type straightener, but I have no idea how it functions. Could you give me any information about it?—D. MCGUINNESS (Co. Dublin).

Moulding and Vulcanising Rubber

PLEASE tell me how to mould and vulcanise rubber and also from whom the masticated unvulcanised rubber can be obtained in small quantities.

I would also welcome any other relevant information on the subject, for instance, can rubber be moulded in plaster casts?—J. MCCAFFREY (Croydon).

G.45 Gun Cameras

PLEASE give me a source from which full details and information may be obtained on the ex-Government G.45 16mm. gun camera.—R. SPILLER (Erith).

THE Cyclist

Editor : F. J. CAMM

VOL. XXV JULY, 1957 No. 420

All letters should be addressed to the Editor, "THE CYCLIST," George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2

Phone: Temple Bar 4363
Telegrams: Newnes, Rand, London

WHAT I THINK By F. J. C.

Another Lighting Regulation

A PROPOSED new regulation which will affect cyclists using dynamo lighting not fitted with a stand-by battery will make it compulsory to show their lights fore and aft when stopped at traffic lights. The law at present permits a cyclist to halt when his lights are out provided that he keeps to the left of the carriageway. Just to make the matter a little more complicated, a cyclist will still be enabled legally to wheel his bicycle without lights, if the lights for some reason have failed, such as can happen in the case of a broken bulb or an exhausted battery. Most of the dynamo lighting sets on the market have no provision for stand-by batteries and this new regulation may affect the sales of such equipment in favour of battery lighting.

The present Minister of Transport continues to fiddle with regulations and does not concern himself in the least with how those regulations work out in practice. The M.O.T. is a purely legislative body and it has not its own investigating squad. If the Minister wishes to interest himself in lighting, he might usefully investigate the congestion and confusion caused by traffic lights, the timing of which is left in the hands of local authorities and often has no relation to relative traffic volumes, and in numerous cases having a time bias in favour of side roads carrying little traffic.

Cyclists for years opposed rear lights, and largely owing to the advocacy of the late F. T. Bidlake, reflectors were accepted as a compromise. We have had compulsory rear lights, reflectors and white patches singly and collectively. The compulsion has been relaxed and reimposed. For 11 years, cyclists have enjoyed the liberty to remain at stopping places close to the left-hand side of the carriageway with the lights off. There is no evidence that any other road user has suffered as a result of it. We fail to see the purpose to be served by withdrawing the concession.

Honour for Gordon Randall

OUR artist, Gordon Randall, whose sketches of buildings and places of interest have decorated our pages for many years, has been elected a member of the Royal Institute of Painters in Watercolours. He performed a hat trick in 1956 by having a watercolour hung for the third year in succession in the Royal Academy Summer Exhibition. This year he has gone one better, by having two paintings accepted for the Summer Exhibition.

He is considered by cyclists to be the successor to the late Frank Patterson, and in many respects his work is better than Patterson's, who relied rather too much on white space and the omission of detail.

Drop in CTC Membership

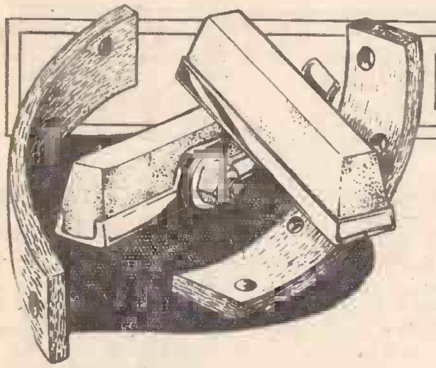
SINCE 1950, the CTC has lost 17,378 members, or approximately one-third. Whether this considerable loss of membership is due to apathy on the part of cyclists, or to an effete policy, it is impossible to say. It is impossible nowadays to rattle the sabres and frighten cyclists into membership on the pretext that their rights are being challenged. New members will not be attracted by propaganda which would make them appear to be a militant body—like the NCU. The CTC should confine its attention to selling cycling. In fact, the CTC has achieved very little for cyclists. Its main Aunt Sally—opposition to rear lights—vanished with the new lighting laws, and cyclists accepted rear lights without a murmur. The membership of the CTC is far too small to impress any Government department such as the M.O.T., and it cannot claim to speak for cyclists generally. The latter can point with relish to the fact that most of the things which the CTC has opposed have been put on the Statute Book without demur. The office-made policy of the CTC is unpalatable to-day, as is obvious from the fact that out of 10 million or so cyclists, its membership is so small.

Its own analysis of the position is that the average subscription paid now is 13s. 9d., against 8s. 1d. pre-war, but it is my opinion that the cause goes much deeper than that. The function of the CTC is to promote, assist and protect cyclists according to its Articles. It has concentrated on what it considered to be protection. Nobody stops to enquire whether it really has protected them. Like the NCU, the CTC is passing through a difficult time. Last year there was a deficit of £1,295. Unless the present downward slide is arrested, the present membership of 36,196 members will show a further decline next year and, of course, a corresponding increase in loss. Members of the CTC apparently are against an increase of subscription. It could usefully investigate whether it is really necessary on such a low subscription to publish their House journal more than four times a year. The postage on 36,000 odd copies must be considerable and the advertising revenue is by no means what it was. It should drop its policy of dabbling in pedal politics and concentrate on the great advantages of cycling as a pastime.

The Beaulieu Museum

IF you want an interesting weekend run you should steer towards the village of Beaulieu, on the borders of the New Forest. Lord Montagu's museum of old bicycles is bound to interest you. There is a small admission fee, but you can also have a look at some of the early motor cars which were collected by Lord Montagu's father.

The famous old Inn at Hampstead--The Wells, which still radiates old-world charm.



BRAKE BLOCKS AND LININGS

The Correct Way to Fit New Blocks in Rim Brakes and New Linings in Hub Brakes

THERE is no need to stress the importance of efficient brakes on a cycle; the prominence given to this point in road safety campaigns underlines its prime significance. One of the contributory factors to efficient brake working is properly fitted brake blocks. It is quite often forgotten by the man-in-a-hurry that there is only one way that they may be fitted. Fig. 1 shows the correct way of inserting brake blocks in their shoes; note that the camber on the face of the blocks follows the shape of the rim and that the closed end of the shoe points in the direction of wheel rotation. This ensures that the whole of the block face bears on the rim and that the pressure of the rim will tend to push the block more tightly into its shoe. If the shoe were inserted the other way round, application of the brake would tend to slide the block from the shoe.

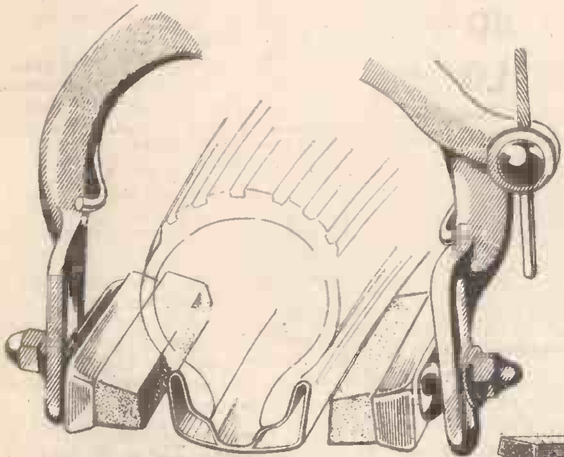


Fig. 1.—Properly fitted brake blocks.

The Right Type of Block

As can be seen from Fig. 2, there are many types of brake block and care must be taken to ensure that the right type is selected for the particular brake in use. If there is any doubt, take the shoe along to the shop so that an exact match may be purchased.

When replacing the shoe make sure that the face of the block does not lie at an angle to the rim, and adjust the brake so that the shoes just clear the rim when the wheel is rotated. Fig. 1 will make these points clear.

The Hub Brake

This is not such a simple proposition to deal with, but is certainly not beyond the scope of the amateur mechanic. The hub brake is thought by many to be more efficient than the rim variety and it has the principal advantage that the braking surfaces are independent of both the weather and state of the rim. A typical hub brake is shown in Fig. 3.

How it Works

The hub brake works on a similar principal to the motor or motor cycle brake. Inside there are two semi-circular shoes hinged at one end and parted at the other by a cam. When the cam is turned by the application of the brake lever, the shoes are forced apart and against the inside of the brake shell. When the brake is released, a spring pulls the shoes together and returns the cam to its normal position.

Dismantling

It is not often necessary to dismantle the brake mechanism; only when the linings must be replaced or when they have been flooded with oil. The first step is to dismantle the lever mechanism and remove the wheel and to lift out the whole of the brake mechanism. Unscrew the nut or screw on the fulcrum and the nut on the lever; then drive the cam out of the lever, when the shoes will drop clear.

Fig. 2.—Some of the many types of brake block available.

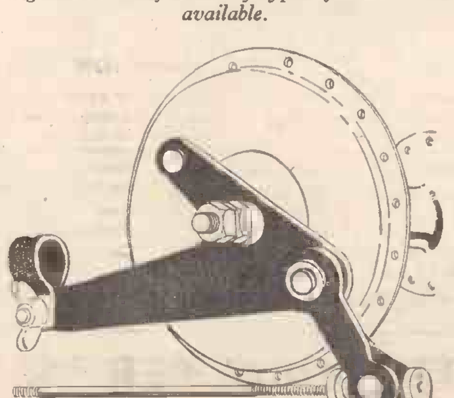


Fig. 3.—A typical hub brake.

Oil can be scrubbed from the brake linings by means of a brush and some form of cleaning compound, i.e., petrol; paraffin should not be used as it leaves an oily deposit which will reduce the efficiency of the brake.

Replacing Linings

Remove the old linings first by prising them off with an old screwdriver; the rivet heads can be cut off with pincers or filed off. Make sure that the replacement linings are the correct pattern for the brake in question. It will be found that the holes for the rivets have already been drilled. If the correct spares are not available, bind linings of the correct shape into position with twine and drill through the back of the rivet holes in the back of the shoe. Drill again from the bearing surface of the lining with a larger drill to about half the thickness of the lining. so that the rivet head may be recessed into the lining.

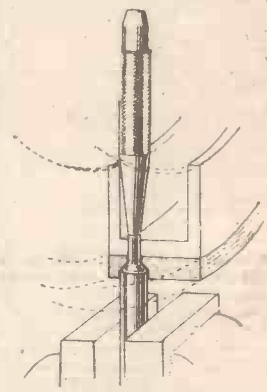


Fig. 4.—Riveting linings.

Riveting

The method of riveting is quite standard. The set-up is shown in Fig. 4, a piece of rod the same diameter as the larger drill being used as an anvil and the ends of the rivets being burred over with a punch. When it has been ascertained that none of the rivets projects above the bearing surface of the linings, as a final touch, to avoid the brake squealing when it is applied, bevel the ends of the lining with a file.

All the parts of the brake are now replaced in the opposite order to that in which they were dismantled.

Cycling Publications

WE have received copies of two annual handbooks. The first of these is "Kuklos," the Cyclist's Annual, published by Ed. J. Burrow & Co., and priced 2s. 6d. net. It comprises three sections: Part 1 gives the essentials of good cycling and good cycles and contains information on many aspects, including cycle camping, cycle clubs, road records, photography, etc. Part 2 contains tours in Britain, Ireland and the Continent and Part 3 is a list of 1,500 addresses for Bed and Breakfast.

The second publication is the 1957 Racing Handbook, published by the N.C.U. and priced 2s. 6d. net. Its contents include calendars of N.C.U. sports meetings and road and circuit races, Scottish C.U. events, rules of racing, National and World records, National and World champions, National records, centre officials, timekeepers, watch testers, etc.

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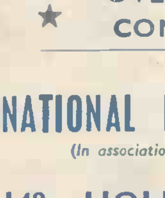

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