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EDITOR: F. J. CAMM

APRIL 1954

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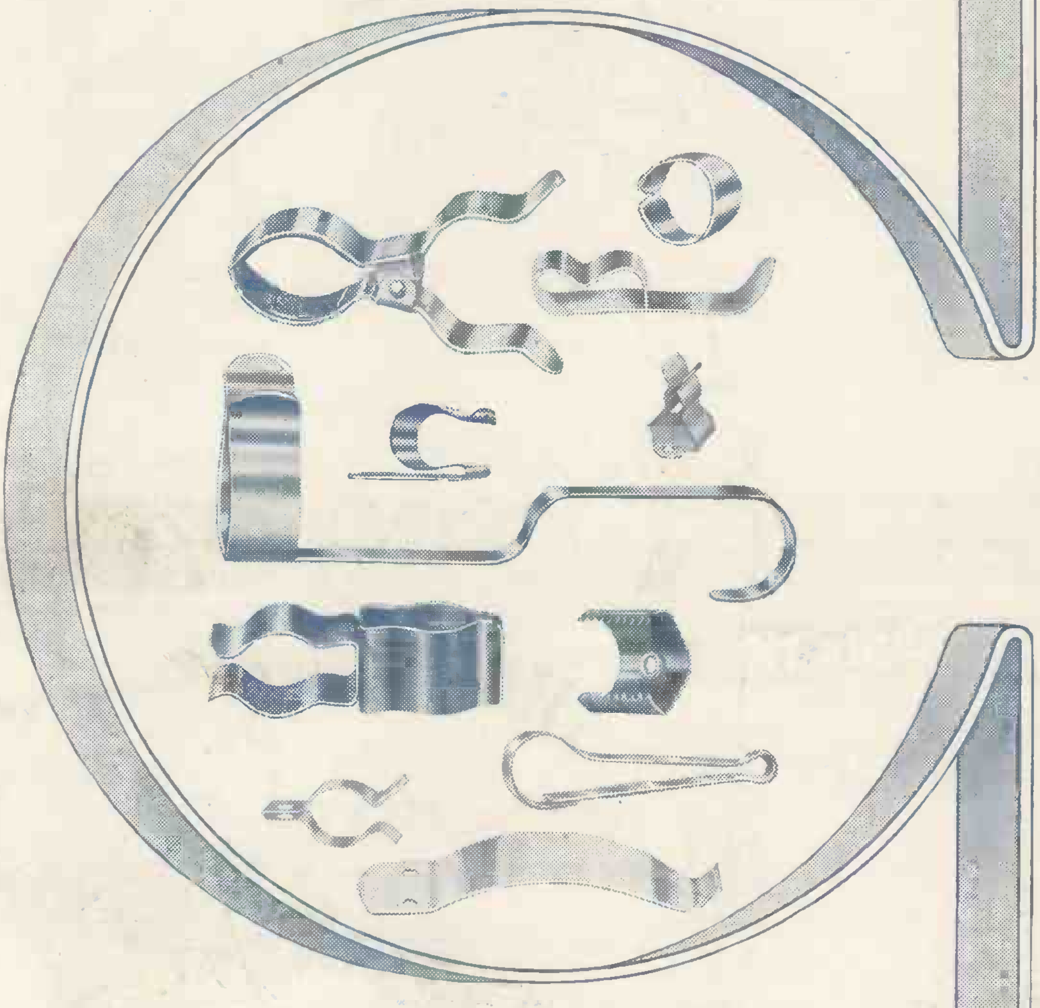

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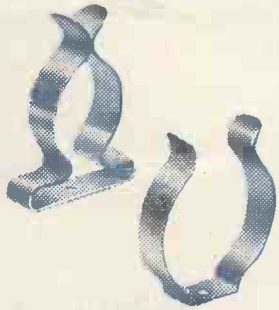

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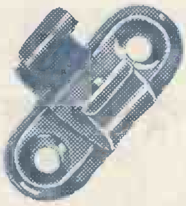

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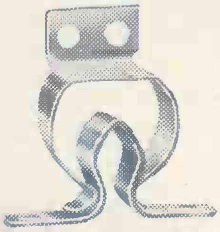

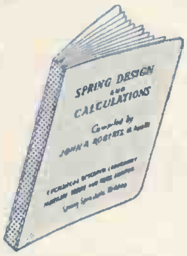

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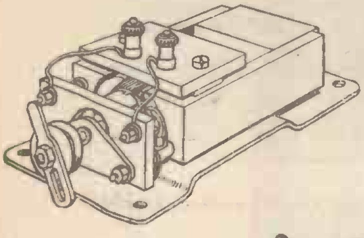

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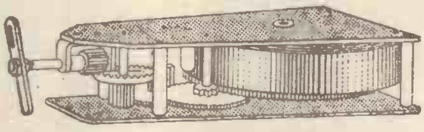

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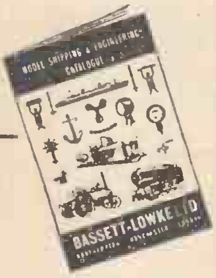

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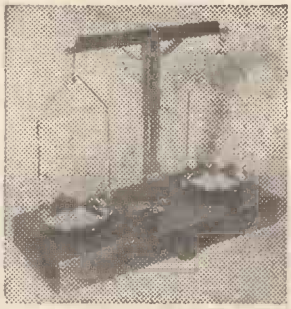

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APRIL, 1954
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PRACTICAL MECHANICS

EDITOR
F. J. CAMM

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

FAIR COMMENT

By The Editor

"The Practical Motorist and Motor Cyclist"

Announcing Our New Monthly Journal

ON April 8th will be published an addition to our group of practical periodicals—*The Practical Motorist and Motor Cyclist*. It will appear monthly at 1s. and it will be almost entirely devoted to the upkeep, maintenance, overhaul, servicing and repair of motor cars, motor cycles and motorised bicycles, leavened with worth-while news, reviews of the latest cars, motor cycles and accessories and backed by a free advisory service.

The articles will not deal with post-war cars alone, indeed, the main mission of the paper is to help all owner-drivers to keep their cars or motor cycles in tip-top mechanical condition, to ensure economical running and to maintain their reliability. Hundreds of thousands of cars and motor cycles are being used today which were made long before the war. The high price of new cars plus purchase tax means that these cars will continue to be used for many years to come. It is essential, therefore, for owner-drivers, especially in view of the high and rising costs of repairs, to do their own repairs, and this *The Practical Motorist and Motor Cyclist* will help them to do, by means of lavishly illustrated articles by automobile experts, all practical men who have handled a wide variety of mechanical vehicles.

Apart from financial reasons, most owner-drivers like to do their own overhauling within the limits of their home garage equipment. It is a fascinating hobby.

The Practical Motorist and Motor Cyclist will be similar in size to PRACTICAL MECHANICS and will have a three-colour cover depicting some aspect of overhaul or repair.

It is essentially a journal which, as its policy develops issue by issue, will become a work of reference. We shall, as with PRACTICAL MECHANICS, issue an annual index so that readers may have their copies bound. It should not be necessary to state that in order to secure its regular delivery an order should be placed with your newsagent today.

Remember the date: April 8th for the first issue of our new 1s. monthly, *The Practical Motorist and Motor Cyclist*.

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To overcome the difficulty we have therefore reprinted in book form a selection of all those articles for which there is an insistent and continuing demand. The title of the book is *The Practical Mechanics How-to-Make-It Book*. It contains 224 pages illustrated by 320 photographs and diagrams, and costs 12s. 6d. The chapters are: "A Tape Recorder; A Master Battery Clock; An Electric Organ; An Electric Washing Machine; A Hand Vacuum Cleaner; Electrically-operated Garage Doors; A Bagatelle Table; A Reflecting Telescope; A Harmonograph; A Designograph; A 15in. Four-heddle Handloom; A Potter's Wheel; A Pottery Kiln; An Electric Oven; Westminster Tubular Door Chimes; A Cycle Trailer; A Pedal-cycle Sidecar; A Portable Air Compressor; A Water Softener; A Spanish Hawaiian Guitar; A Steel-stringed Ukelele; A Double-seater Canoe; A Radio Deaf-aid Unit; A Garden Pool; A Vertical Enlarger; A Photo-electric Exposure Meter; A Synchronised Flashgun; A Combined Printing Box and Safelight; Diascopes and Episcopes; Steam-driven Motor Boat; An Electric Wall Bracket; Inexpensive House Telephones; An Electric Gas-lighter; An Adjustable Drawing-table; A Toboggan.

These contents represent a selection of popular articles which have appeared in this journal during the past five years. *The Practical Mechanics How-to-Make-It Book* will be published on April 22nd. It is essentially a book which every reader should possess, and copies should be ordered now through your local bookseller. If any difficulty in obtaining a copy arises send a remittance to us for 13s. od., and a copy will be reserved. Correspondence should be addressed to the Book Department, George Newnes Ltd., Tower House, Southampton Street, Strand, London, W.C.2.—F. J. C.

Building an OUTBOARD HYDROPLANE

Constructional Details of a Small High-performance Craft

By M. L. BEACH

SEVERAL years ago I became interested in outboard hydroplanes and I started building hulls and experimenting in my spare time. After a while, however, it became obvious that to achieve any success it was necessary to have a large amount of money and a fully-equipped machine shop; as I had neither, the prospects appeared rather black. Another major problem was to find a suitable racing motor, and this was becoming more and more difficult.

I examined many boats and it became apparent that the majority of them were the same basic design of hull, with different-sized motors ranging from 250 c.c. to 1,000 c.c. This, of course, leads to bad performance with the smaller motors as they have not enough power to push the heavy hulls. I then began to consider the possibility of building a hull designed expressly for an easily and cheaply obtainable motor of about 150 c.c. The motor would be a standard type and the performance would not be as good as a boat powered by a large racing outboard, but it would be at least possible for an amateur to build and use this boat cheaply.

General Design Notes

The hull was designed with cheapness, lightness and ease of construction as the main factors and the finished boat fulfilled all these aims. It took two weeks to build, cost £12 10s. and weighs only 60lb. The motor weighs 40lb. and the complete outfit with a 10-stone driver aboard draws approximately 1½in. of water when floating level; this light weight is very important as it lowers the speed necessary for "planing" (the speed at which a hydroplane rises out of the water and skims over the surface), and no skimming boat of any kind can reach a useful speed until it does actually begin to plane. Reaching this speed in a heavy boat takes a lot of power, so obviously the lighter the hull the more chance there is of reaching planing speed with a small motor. It is necessary, then, when building this boat to remember that every bit of extra weight means a reduction in speed.

The design is comparatively straightforward, it is a three-point hull (it planes on the two forward steps and an area of a few square inches at the stern); the purpose of the chines, the bevelled sides at the stern, is to stop the hull digging in and turning over when turning; this feature will also be noted on the two forward steps. The plywood bottom is extended aft of the transom and steps to assist in planing.

Driving Hints

Just a few words about driving the boat; always drive it kneeling down as this permits better control and greater use of exit if anything goes wrong, *and always wear a life-jacket.* When you take it out for the first run select a suitable stretch of water, and when you feel confident of the turning abilities, etc., open the throttle wide and lean forward, this will counteract the weight of the motor and the outfit will start to plane over the surface. If this does not work try moving about more; if you still do not get any results get out your tools and start tuning the motor. If there is a tendency to snake and a lack of directional stability at speed fit the small fin as shown.

The Motor

We now have to consider what motor is most suitable; a point to remember is that outboards are always rated at the horse-power they develop and not by their cubic capacity as in cars, consequently the 150 c.c. motor needed will be classed as about 5 h.p. The motor I use is a Johnson rotary valve alternate firing twin, model No. A-50, with a capacity of 140 c.c. Of all the standard motors this model, which is about 1938 vintage, is probably one of the most suitable for this class of work as it is easily tuned

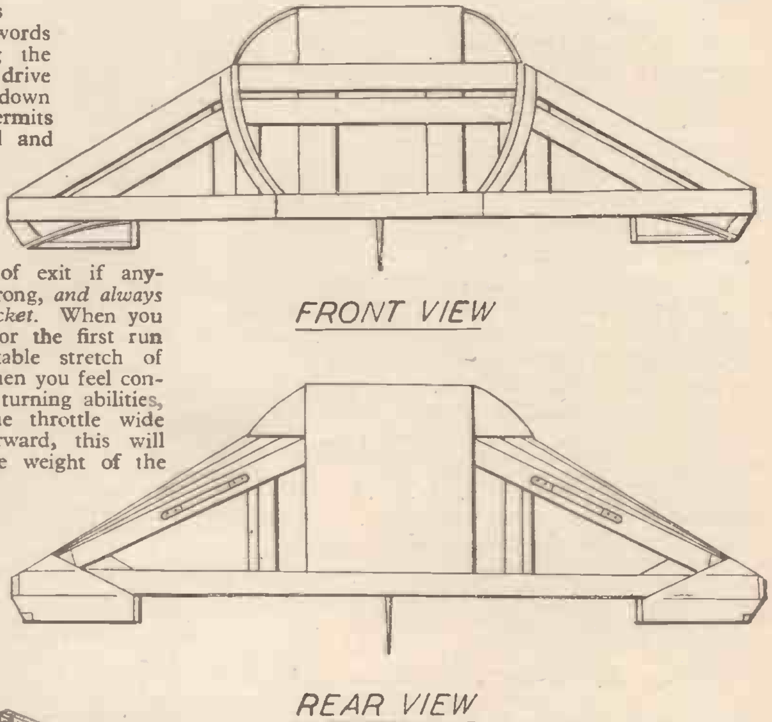


Fig. 2.—Front and rear views of the framework construction.

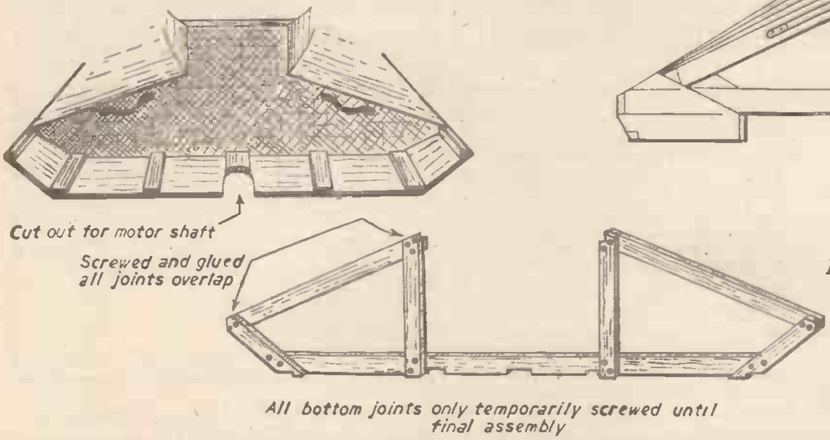
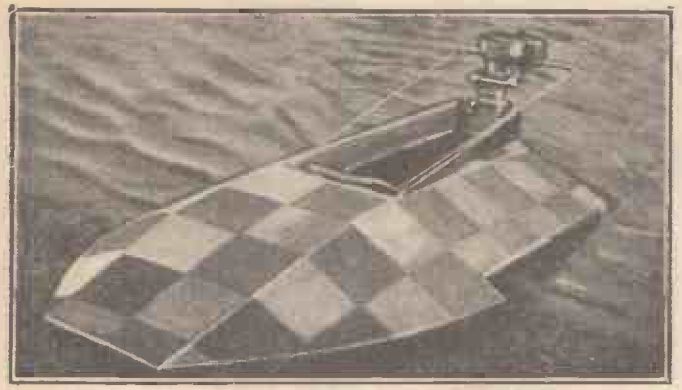


Fig. 3.—(Left) Transom and aft planking details. (Right) Typical former construction.



The hydroplane beached.

and is naturally high revving. Other motors that could be used are the "Evinrude" and possibly the "Anzani" super single. If you are going to buy a motor look for these features: it must be short shaft, have a cleanly designed underwater unit, and preferably be rotary valve and a twin.

Now having obtained a suitable motor the possibilities of reworking it for high speed can be considered. I did very little work on my Johnson; in fact, reshaping the underwater unit was the main trouble. This was achieved by filing all the edges razor sharp, cutting of the skeg and smoothing out the bumps with Loy plastic metal. The underwater exhaust was plugged with wood and streamlined with Loy and the back of the expansion chamber was cut away so it exhausted straight into the air.

The propeller was another problem, as the pitch has to be increased considerably and the blade area reduced to keep the revs up. This was done by heating and twisting the blades until the pitch increased to 12in.; the blades were then filed down and reshaped. This is such a tricky business that it is best done gradually by trial and error.

The Hull

When purchasing wood for the hull try to obtain seasoned Honduras mahogany for all the formers and battens and make sure it is free from any knots, twists or warps. When selecting the mahogany-faced plywood be certain that it is exterior grade resin-bonded, otherwise the laminations will come apart when wet. All screws must be brass, as it is impossible to stop steel screws rusting and ruining the wood. Regarding glue, only the best quality resin-bonding waterproof cement can be used; I used Beetle cement with good results.

The building instructions have been cut down to a minimum as the plan should be

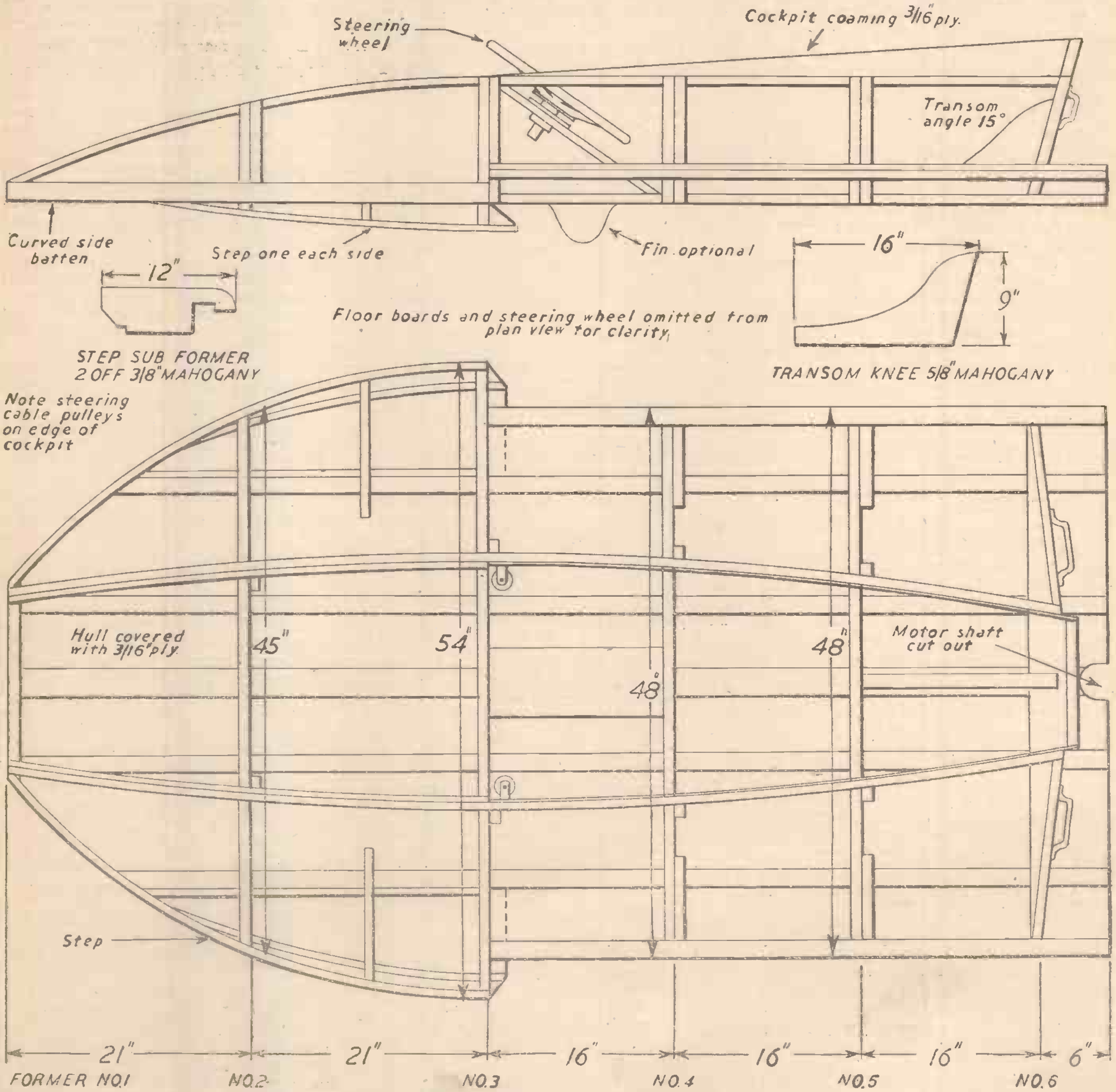


Fig. 1.—Plan and side views of the assembled hull framework.

self explanatory, but it is recommended that it be built in the order described, as it simplifies matters greatly.

The Formers

The formers are the first parts to build, and these are shown collectively in Figs. 1 and 2 and individually in Figs. 4, 5 and 6. Full-size drawings should be made of each one and the formers built over them from $\frac{5}{8}$in. by $1\frac{3}{8}$in. mahogany. All joints overlap and there is no complicated carpentry. Cut the notches for the battens accurately; the centre notch is for a $\frac{3}{8}$in. by $1\frac{7}{8}$in. batten, while the others are $\frac{3}{8}$in. by $1\frac{3}{8}$in. It will be noted that the bottom joints are only temporarily screwed and not glued; this is to allow the bottom half of the hull to be built upside down on the floor.

Assembly

When the formers are completed pencil numbers on them so that they can be assembled again correctly, then unscrew the flat bottom sections and lay them upside down on the floor at the correct spacing for assembly. Pencil the spacing distances on the $\frac{3}{8}$in. by $1\frac{7}{8}$in. centre batten and screw and glue it down to the formers with $\frac{3}{4}$in. countersunk screws, making sure the formers are properly aligned and at right angles to the batten. No. 6 should slope so that the transom will be at 15 deg. when assembled (see Fig. 1).

Glue and screw in the other battens and then fasten in the curved side battens of $\frac{3}{8}$in. by $1\frac{3}{8}$in. which bend round from formers 1 to 3 (see Fig. 1) Allow to set and then plane the outer straight batten to conform to the chine line aft of No. 3. Remember that the battens must extend 6in. beyond No. 6 former to support the plywood extension.

Plywood Covering of Bottom

The framework should be checked for flatness, as the next step is fastening down the 3/16in. mahogany ply. This sheet should be in one piece and must not cover the step areas; these will be put on later.

Cut the ply to shape, if all is well it will be rectangular 8ft. by 3ft. Coat the battens and formers with glue and stick down the ply, fastening it with $\frac{1}{2}$in. countersunk screws at about 6in. intervals. When this has set the lower half of the hull is complete except for the steps and it can now be turned over and the formers fastened permanently in place.

The next step is to screw in the $\frac{5}{8}$in. square strips which form the edge of the cockpit and run the whole length of the boat, fasten in the $\frac{3}{8}$in. square which runs beside them between formers 1 and 3; this is to support the ply covering. These are shown in Fig. 1.

Securely fasten in place the transom knee, as this has to absorb a lot of vibration; screw firmly and use plenty of glue.

Obtain a 4ft. 6in. length of $1\frac{3}{8}$in. square wood and have it sawn diagonally lengthways; this will form the top chine edges, which run from former No. 3 aft. Glue and screw these triangular strips in place and plane to the exact shape when finished. Cut out two 7in. wide strips of 3/16in. ply 4ft. 6in. long and fasten them in place, forming the chines.

The completed hydroplane in action.

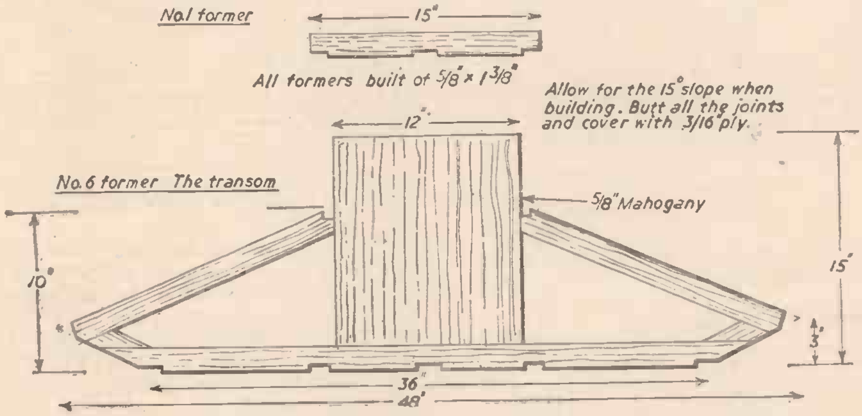


Fig. 4.—Constructional details and dimensions of formers Nos. 1 and 6.

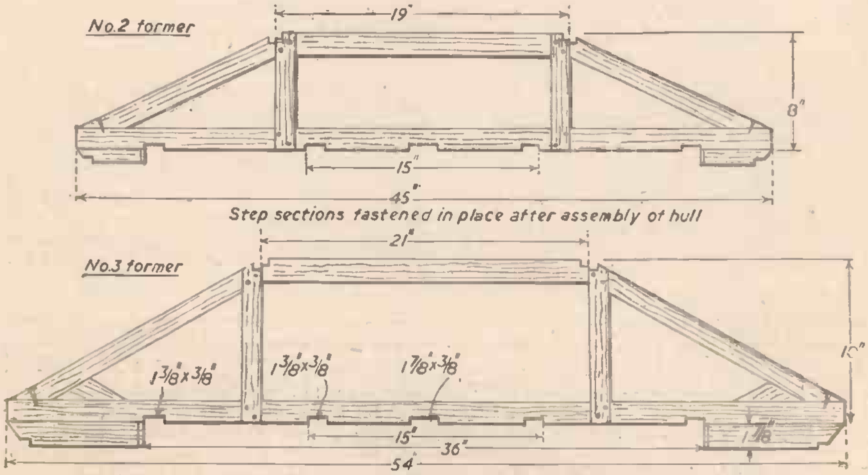


Fig. 5.—Constructional details and dimensions of formers Nos. 2 and 3.

The Steps

Now we have to make the two steps, and this is rather tricky; it is best to consider them as two curved boxes built on to the bottom. The rear step formers are made of $\frac{5}{8}$in. by $1\frac{7}{8}$in. wood and are screwed on to the bottom of former No. 3. Fasten the $\frac{3}{8}$in. thick side members to the outermost straight battens and glue in the sub formers. When set screw in the curved $\frac{3}{8}$in. square batten that forms the chine edge, plane to shape and cover the framework with 3/16in. ply, extending the ply 2in. aft of the step.

Screw some light-weight handles on the transom as these will prove very handy when lifting it out of the water, etc.

Fit the flat $\frac{3}{8}$in. by 6in. board that forms the steering wheel support and the $\frac{3}{8}$in. by $1\frac{3}{8}$in. floorboards.

The hull is now far advanced and needs only the top skin and painting, but now we come to an important part—check the construction thoroughly for unsuspected cracks and holes that could leak, make sure every joint is firmly screwed and glued.

Varnishing Hull Interior

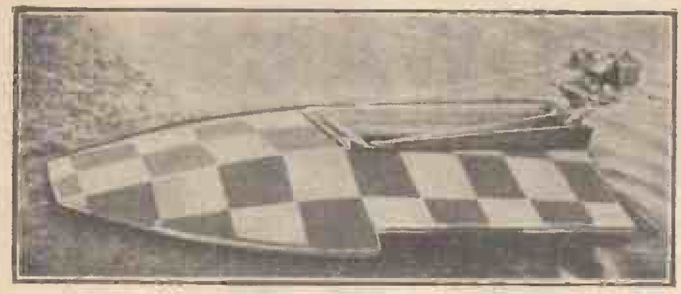
When satisfied, varnish the complete inside of the hull except for the edges where the top ply covering will be in contact; the first coat should be thin enough to soak in and when it is completely dry brush on two medium coats.

When the varnish is dry we can put on the top ply covering, which is in three pieces, the two sides and the front section. First temporarily screw down a sheet of 3/16in. ply of the approximate size to each side and pencil round them, then remove and cut to the exact size and screw and glue these sections in place. When both sides are fitted and set varnish the inside of them and allow to dry. Now fasten down the front section of ply in the same way and varnish. Cut out the cockpit coamings from 3/16in. ply and fasten them in place.

Steering Arrangements

Attach the steering pulleys and start on the steering system. This consists of a 4in. dia. drum fastened to a lightweight car steering wheel; cut away as much of the superfluous material from the wheel as you dare as they are always very heavy. Fasten in a central pivot and screw the drum to the back of the wheel. The 5-cwt. steel-steering cable runs from the motor around the pulleys and four times round the drum; it is not necessary to fasten the cable to the drum as the friction will be sufficient for it to grip securely.

Block up the back of the boat and attach the motor—it will be necessary to cut away a small section of the ply aft of the transom



A side view of the completed hydroplane.

to allow the motor shaft to assume the right angle and swivel—connect the steering cable and make sure it works perfectly, now remove the motor and decide what finish you require.

Some people prefer an all-varnished hull, but I, personally, like a nice bright colour scheme; my boat is chequered all over in maroon and blue and looks really vivid!

Painting

If you desire to paint the hull, first plug all the screw holes with plastic wood and then sand the hull with progressively finer sheets of sandpaper until the surface feels like silk. Decide what type of paint you are going to use and apply two coats of the appropriate primer. I used synthetic enamel as it does not crack with the repeated hammering on the water and seems very durable. As the paint is heavy cut down the number of coats to a minimum; two of primer and two of colour should be enough.

When the hull is dry fasten a light replaceable bumper bar all around. The best material to use for the rather awkward V-section aft of the steps is rubber gas tubing split down one side lengthways, fitted over and tacked in place.

The Final Stages

Putting a rubber pad over the floorboards to protect your knees, install a forward throttle and line up the motor. It is rather difficult to say which is the best angle as this can only be found out by trial and error; however, as a start, adust the transom bracket so that the central axis of the propeller shaft is pointed slightly past the horizontal and up towards the bow; set the height so that the anti-cavitation plate is about 1in. below the bottom of the hull, then try varying settings until you get the highest speed.

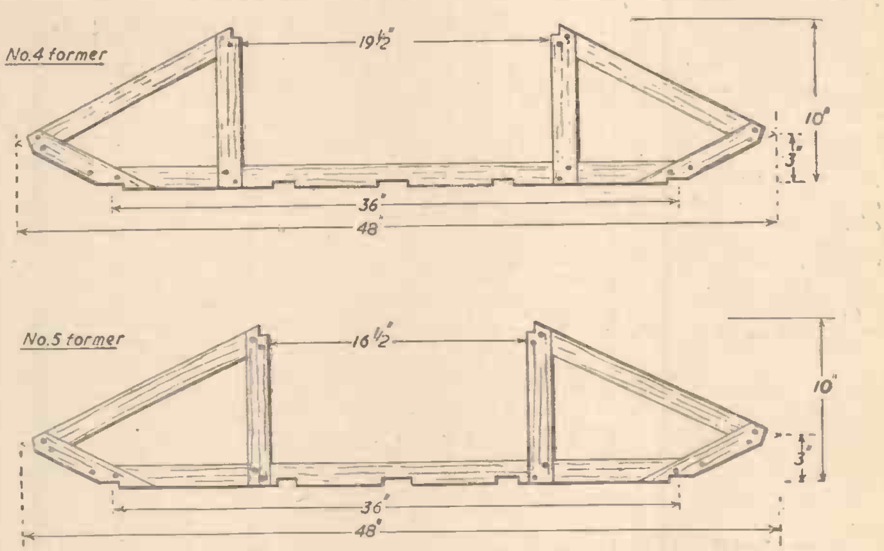


Fig. 6.—Constructional details and dimensions of formers Nos. 4 and 5.

Improving Performance

At the beginning of the article I mentioned a few ways of getting higher performance out of the motor, but it is a very complex matter and should be approached with great caution as irreparable damage can be done. The propeller is an important factor as it determines the revs of the engine and also the boat's speed. The standard propeller as fitted is completely useless and must be modified, if this is possible, by fitting a two-bladed prop of around 12in. pitch and trimming the blades until the r.p.m. reach at least 5,000; if this does not help start work on the powerhead by improving the port timing, increasing the compression ratio and running on hot fuels. One modification at a time should be attempted and the results checked after each. The hull is capable of a high performance, but whether or not it reaches it depends on the constructor.

I have owned and driven quite a few hydroplanes, but this one has given me the most pleasure and cost me the least; all I can do now is wish you equal pleasure.

Research Into High Pressures

A 20-ton Compressor has been Installed at Northwestern University to Prevent Vibration from the Building Interfering with Experiments

A NEW super pressures unit, the first to be used in research by any American university, was recently dedicated at Northwestern University, Evanston, Illinois. Most of the equipment used in this was fabricated by personnel of the university's chemistry department machine shop, including some armour plate, controls and some of the safety devices.

The unit took five years to plan, design and build. Scientists from all over the world will have the opportunity in the new unit to study and do research on the application of super pressures to catalytic reactions of organic compounds.

Experiments Behind Steel Plate

Experiments will be conducted behind ⅜in. thick steel armour plate. This is necessary since the equipment develops pressures up to 25,000lb. pressure per square inch. Windows for observing experiments are protected by thick steel mesh. Their construction is such that they will "fold" outward in the event of any explosion.

Instrument dials are visible through 1in. thick bullet-proof glass. One of the features of the unit is a spring suspended compressor capable of building up to the high limit. This weighs 20 tons, and is suspended on giant springs so that no part of it touches any part of the building. This eliminates the possibility that vibrations might interfere with experiments.

Compressing Gases

This compressor will be used to compress gases such as hydrogen, carbon monoxide and others used in high-pressure catalytic study and research. Investigations of new chemical reactions will be carried out using the equipment at temperatures up to 1,000 deg. F. and at pressures up to the full limit of 25,000lb. Another piece of new equipment installed at Northwestern is a liquid pump capable of pumping liquids up to that pressure.

The super pressures unit is installed in the University's Ipatieff Catalytic and High Pressures Laboratories, named after the late Professor Ipatieff, who gained world fame for his research into high pressures and catalysis. —*The Financial Times.*

AN ELECTRIC BEDWARMER

An Inexpensive and Efficient Appliance for Home Construction

By A. F. BRENNAND

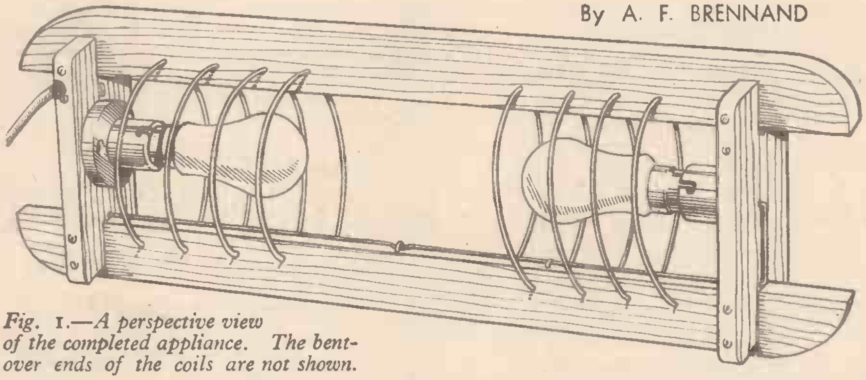


Fig. 1.—A perspective view of the completed appliance. The bent-over ends of the coils are not shown.

THE old-fashioned bedwarmer had much to commend it, and as a means of warming the bed before retiring, it was vastly superior to the little hot-water bottles which replaced it.

To-day a safer and more reliable means of heating the bed is afforded by electricity; but of electric warmers placed on the market in the past, most suffered from the defect of heating only a limited portion of the bed.

A simple if primitive warmer on these lines may be made from a large, square biscuit tin with lid removed and a pendant bulb-holder inserted in a hole in the bottom of the tin. With the tin on its side and using a 25-watt bulb, reasonably effective local results may be obtained.

At the other extreme the writer has heard of a home-made device consisting of a ½ kW. heating unit housed in a container in the bed and fed by a blower, which is said to provide the desired results in a matter of minutes. This, however, would seem an unnecessarily energetic attack on the problem, necessitating a special clause in the fire insurance.

The device described below, and shown in Fig. 1, which can be constructed in the matter of a few hours and uses very simple materials, has been found very effective and free from most of the failings of commercial appliances tried out. It will be found capable of inducing considerable and continuing warmth to practically the whole of a single bed.

Construction

The construction will be apparent from Fig. 2. The dimensions shown are those adopted for a number that have already been built, but apart from the overall dimensions which have been found to be the most practicable in use and should if possible be adhered to, the measurements may be adapted to the materials at hand. The only exception is that the width of the struts should be at least 2½in., as shown, if they are to accommodate the bases of the normal batten lampholders employed.

The appliance generates considerable warmth in use, and for this reason timber without knots should be selected if possible as the heat causes the resin in the knots to run. For the same reason the struts should be secured to the runners by the three-screw fixing shown, and should not be glued. If the notches in the struts are made a tight fit on the runners there will be no movement in use.

All outer timber faces and arrises should be well glass-papered, particularly the outer edges and ends of the runners which have to "run" between the upper and lower sheets of the bed.

Protective Coils

The protective coils for the lamps are formed of 10-gauge galvanised fencing wire by wrapping firmly by hand around a cylindrical former of suitable diameter—an aluminium saucepan was used by the writer—remembering that the coil will spring out to a diameter about ½in. greater when released. At least one more ring than seemingly needed should be wound to allow for this, and for end-lengths needed for fixing.

Here is a hint for threading the coils into the runners. If attempted directly it will result in distortion. After the timber frame has been assembled it should be dismantled, and after the holes shown are drilled for the coils, the runners should be laid side by side with the holes in register. The ends of the coils may now be inserted into the first holes through both runners, when the coils may be rotated and progressively threaded until fully entered, the two runners being all the time kept closely together. They may now be carefully separated around the coils and the whole frame reassembled. Holes 5/32in. dia. will be found best for wire of the above gauge; these will permit easy threading yet grip the wire sufficiently after the frame is reassembled. A little thought, by the way, is necessary in placing the runners in correct register for threading.

The ends of the coils can be most conveniently fixed as illustrated in Fig. 3. The free ends are carefully eased through and straightened and cut as necessary, the remainder of the operations (a, b and c) being with pliers and hammer.

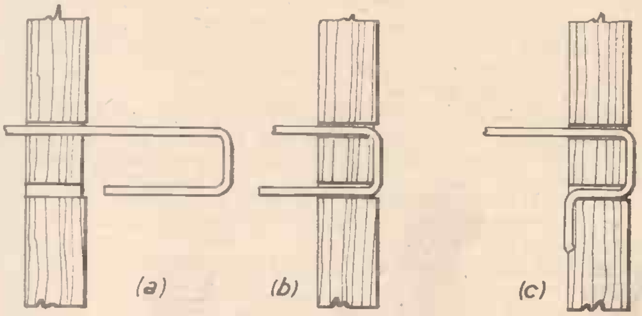


Fig. 3.—Method of fixing the ends of the coils.

Wiring

Wiring is done with any suitable 5 amp. flex, the free end being of the length required by the circumstances and being fitted with plug or bayonet connector as required. Great care should be taken to make all connections properly and securely in the terminals of the lamp-holders. The free flex (which is anchored through twin countersunk holes in the strut as shown)

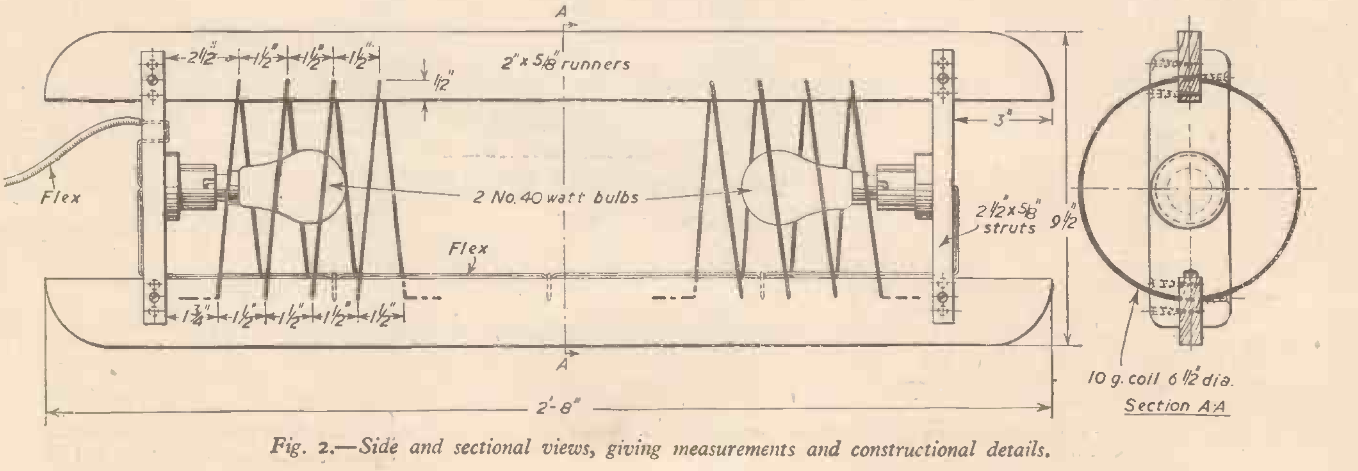


Fig. 2.—Side and sectional views, giving measurements and constructional details.

and the flex connecting in parallel the second lamp are junctioned in the terminals of the first lamp-holder.

To render the flex to the second lamp taut, disconnect the far strut and, by trial and error, make the connecting wire of such length that it will be taut when the strut is refixed. This flex is secured to the lower runner by two or three insulated staples.

If a three-way house circuit is available, brass batten lamp-holders may be used, and they and the protective coils may be earthed.

Using the Appliance

In use the appliance is inserted between the sheets, with the frame vertical, from the pillow end to about the middle of the bed, the opening at the pillow end being then closed. The upper bedclothes should be tightened to make as it were a tent over the warmer, permitting the whole width of a single bed to be warmed. After one hour's running the bed will be pleasantly warm; after two hours, assuming the normal bedclothes and eiderdown are used, it will be definitely hot, together with the underlying mattress, and will remain so for some time.

With two 40-watt lamps as indicated, the warmer may safely be left in operation all day if desired, although the reader would, no doubt, wish to verify this for himself! This makes a convenient and efficient way of airing the spare bed. It will not be found that there is any tendancy to scorch the bed-linen by overheating.

A Reliable Rear Light

Adapting a Neon Lamp for Use with a Cycle Dynamo

By E. W. CROWE

THE fragility of a conventional filament type rear light on a cycle has at some time caused most of us some embarrassment, and, more important, caused us to be in danger from overtaking vehicles. This danger has been greatly increased with the advent of power-assisted pedal cycles, since the extra vibration set up is liable to cause the rear light to have a much shorter life and finally to fail without the rider's knowledge.

If your cycle is equipped with a dynamo it is possible to carry out the following modification, which will ensure a more reliable form of rear light, for a few shillings. The only requirements, apart from those which are available amongst most handymen's "odds and ends," are:—

One neon lamp. The type I have used is one of two from an S.B.A. (Standard Beam Approach) Indicator—ex-Air Ministry and its reference number is 10E/5.

Two matching transformers. These again are ex-Air Ministry, and were for matching low impedance headphones to high impedance equipment or vice versa. Ref. No. 10K 584.

From the wiring diagram, Fig. 1, it can be seen that the primaries of the two transformers are connected in parallel so that the full dynamo voltage is applied to both transformers; the secondary is connected in series. This method of connection is necessary for two reasons, first, although one transformer is sufficient to light the neon lamp when the full 6 volts are being generated (i.e., when the cycle is being ridden at normal speed) it is not sufficient when the cyclist is "doodling" along; and secondly, with only one transformer the impedance of the primary does not permit sufficient current flow to light the filament lamps to a suitable brilliance.

But even with the two transformers it can be seen from the full scale views of the unit, Fig. 2, that its total size is much less than the size of the standard two-cell type rear lamp.

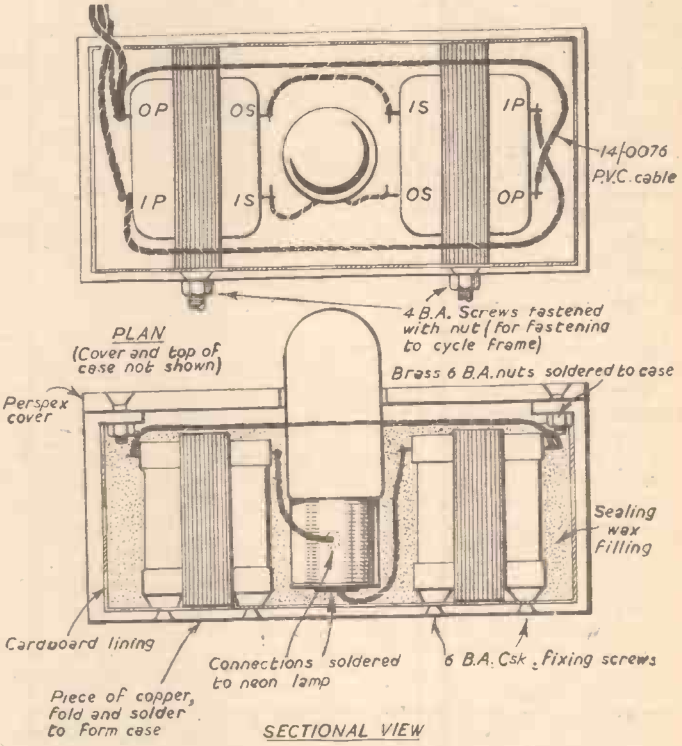


Fig. 2.—Plan and sectional views (just under full size) showing constructional details of the case, the connections and positions of the parts.

To ensure a rigid, waterproof and well insulated unit it is necessary to fill the case with melted sealing wax; this also holds the neon lamp—which is otherwise insecure—in place. To incorporate a lamp-holder would make the unit more bulky and still would require filling with a waterproof compound. It is advisable to check the circuit before filling with the wax.

With this modification there is a slight reduction in the brilliance of the filament lamps which could be ignored, but it can be improved by replacing the 6 volt bulbs by 4.5 volt bulbs.

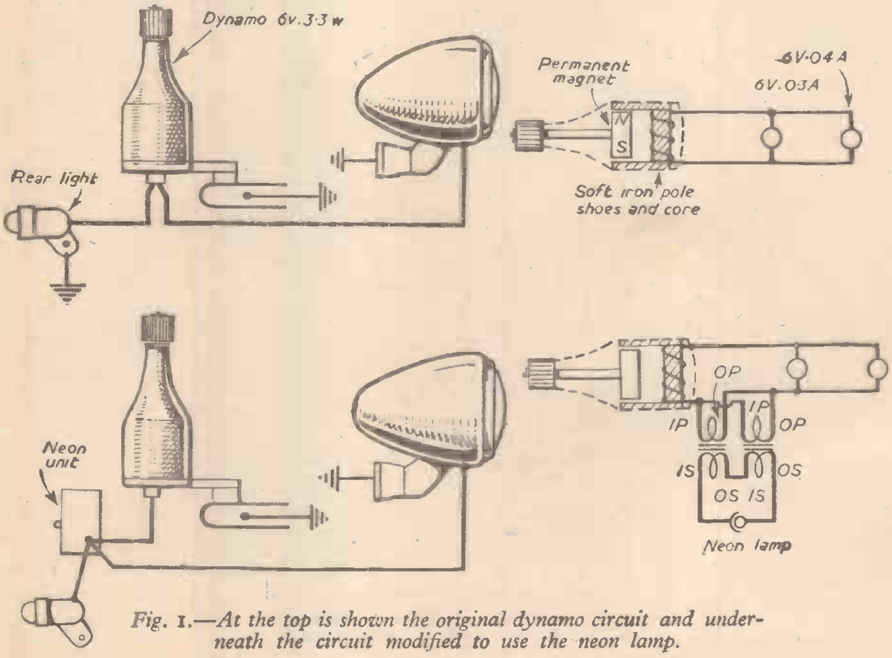


Fig. 1.—At the top is shown the original dynamo circuit and underneath the circuit modified to use the neon lamp.

WHAT IS FRICTION?

Is It a Blessing? What Would Life Be Like Without It? How Do We Overcome It?

We should be deprived of the violin's beautiful tone, were it not for friction.

YOU know without being told that friction is one of the curses of life. Experts in these matters have an expression for it: they say that friction is a force which opposes relative motion between two surfaces in contact. In fact, what the experts are saying is that any time you try to do anything, friction tries to stop you.

How pleasant and restful, therefore, how free from effort and fuss would life be, if there were no such thing as friction! In the motorist's dreams he would achieve a fabulous number of miles per gallon with his engine unhampered by the drag of friction. The cyclist also sighs for the beautifully easy travelling he would enjoy, if his machine ran without friction. The industrialist knows that it costs him huge sums of money every year to overcome it. Even in daily life at home friction levies its toll from the housewife, who is continually fighting to get rid of it in a thousand different ways. How nice to be permanently without it!

Of course, when man took to the water, he found that friction had apparently ceased to exist. He was wrong, though. Naturally, it decreases enormously in water, because the drag of a solid body against a liquid is the merest fraction of what it is between two solids. (This, incidentally, is the secret of successful lubrication.) But, even in water, there is still enough surface resistance to be noticeable. Rowing men do not insist on beautifully smooth boats for nothing, and most small boys at some stage in life find out by practical experience that the retarding effect of the rough texture of a bathing costume during swimming is noticeably and delightfully absent when it is removed.

"But surely," you will say, "surely the air has given us a friction-free medium in which to move about at will?" Intangible though it may be, air is still a fluid. As such, it opposes motion. Aircraft designers try to reduce its retarding effect not only by streamlining the shape of the aircraft, but also by using a polished surface for wings and fuselage. At near- and super-sonic speeds the effect of the air on the skin of an aircraft, due both to surface drag and to compressibility of the air, is very considerable. The whole aircraft is heated up, and unless the pilot were refrigerated, he would not be able to stand the heat.

So you can see from these few examples that in whatever element we move, our life is a never-ending fight against friction. How nice if we could only be rid of it! Just think. . . !

Just think, though, of the motorist. He might not after all be quite as happy as we imagine in a frictionless world. His tyres would not grip the road, so that however hard he pressed his accelerator, he would not move. Nor would the cyclist, however hard he battled. But that, after all, might be just as well, because neither would their brakes have any grip. They could neither stop nor, mercifully, start. This is in theory only, of course, because in fact without friction there would be no cars nor cycles anyway. It is friction that holds the nuts on the bolts and the screws in the metal, and so in our frictionless dream-world the car, the bicycle, the machinery, the trains and the aircraft could not exist and we would have nothing to work for us. Even the knots in the string which we might use in desperation to hold the bits together would not stay done up. Flies could not walk up window panes nor pencils write. Even the very act

It is friction wearing away the metal that enables us to obtain a sharp edge to our tools, etc.

Heat caused by the friction when the match head is dragged across a rough surface ignites the inflammable material of which the match head is made.

of walking would be impossible. Without friction between our feet and the ground we would just have to stay in the same place —until, that is, we were caressed by the gentlest little breeze, when we would sail away like thistledown without power to resist, happy perhaps, but no longer very useful members of society.

So perhaps after all friction is not exclusively the arch-enemy we suppose.

It is friction *in the wrong place* which causes the trouble. Like fire, friction is a good servant but a bad master. A substantial part of human effort from time immemorial has been devoted to overcoming it where it is not wanted; we use it, where it is wanted—that is, in almost every action and movement in our lives.

The conquest of unwanted friction is a threefold victory. Not only do we overcome resistance to motion; in addition, we defeat those two by-products of friction—heat and wear.

When two surfaces rub together, heat is generated. Savages and Boy Scouts make fire by rubbing two pieces of dry wood together long enough for them to get hot enough to burn. And, have you ever thought why a match lights? It is for the same reason. When the match is rubbed along the box, the friction makes one spot on the match-head so hot that it sets off the combustible element. Think of the sparks flying off steel on a grindstone or from a locomotive's wheels spinning on the rails—friction generated the heat to set them ablaze. But, whenever heating takes place as a result of friction, whatever examples of this sort one may quote, to a greater or lesser extent it means that surfaces are being worn away. That is how the other by-product, wear, comes into the picture. Wear and heat are inseparable companions of friction.

Where does the heat come from, and why does wear take place?

You have only to slide down a rope too fast to know where the heat comes from; also, unfortunately, perhaps to observe the wear on your hands. In fact, what has happened is that the energy which your hands have absorbed when your weight overcomes the frictional resistance of the rope has been converted into heat. In a rather more spectacular way, the energy released by cracking the atom is also converted into heat.

The conversion of energy into heat, incidentally, provides the real reason why no one will ever make a true perpetual motion machine. The idea has fascinated inventors and small boys for centuries, but no one has ever succeeded. As friction can never be absolutely eliminated, there will always be a tiny amount of heat generated by it in the working of the machine and a corresponding loss of energy will result. Slowly this robs the machine of the energy first put into it to set it off, and in fullness of time it runs itself down. Though the wear in this case may be infinitesimal, the energy eventually gives out. The laws of thermo-dynamics are too much for it.

Those then are the results of friction. It remains to explain what causes friction itself and then to see how we set about overcoming it.

The two so-called Laws of Friction, enunciated many years ago, but until recently not completely understood because they were arrived at quite empirically, stated that:

the force of friction is independent of the area of the surfaces in contact;

it is directly proportional to the weight which forces those surfaces together.

The intricate instruments of modern science have at last revealed the causes of friction. We know now that even the most highly polished surface, which to the unaided eye appears perfect, does in fact consist of little hills and valleys so minute as to be measured in millionths of an inch or even less. We see that the hills and valleys of two surfaces interlock when they touch, so that when sliding occurs the tops of some of the hills are pushed over or torn off. Sometimes they will weld to one another, owing to the heat momentarily generated on the hill-tops, thereby increasing the drag. As sliding continues, such welds are immediately torn apart and new ones form, only to be broken in their turn. All this is on a scale so minute that only the most refined instruments can detect it.

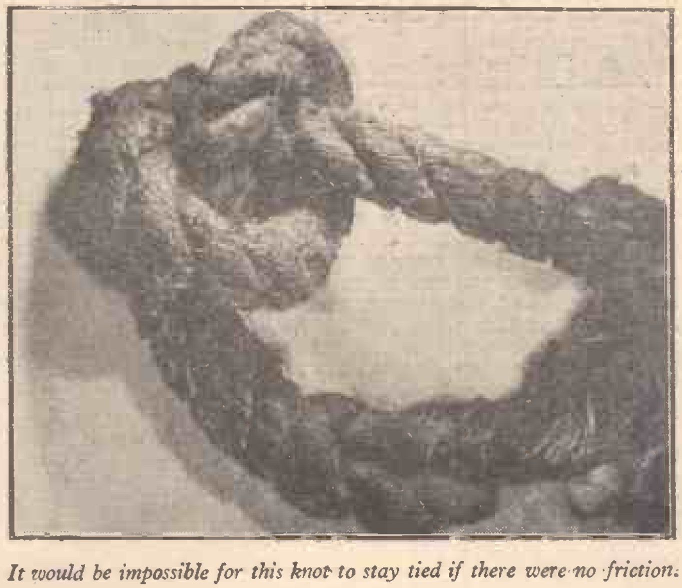
That is friction—the interlocking and momentary welding of two surfaces. That also is the explanation of why there is heat and wear. How, then, do we set about reducing it?

It is obvious by now that if we can keep the two surfaces far enough apart that the hills cease to knock one another's tops off or to weld to one another, then friction essentially disappears, and wear with it. And that is precisely the way in which all lubricants tackle the problem.

In lubrication the most important single property of an oil is its viscosity—in other words, its thickness. There is an optimum thickness for each job. If the oil is too thin it will not be able to keep the two surfaces apart. If it is too thick, although it will separate them completely, too much energy will be wasted in just churning the oil round and that will heat it up. Sometimes, of course, there are certain conditions of load and speed in a machine which are such that no ordinary mineral oil is capable

Wear, one of the results of friction, will no doubt be visible on the seat of this young man's pants when he goes home!

The action of the ordinary graphite pencil is dependent upon friction.



It would be impossible for this knot to stay tied if there were no friction.

of providing fully fluid lubrication at all. The surfaces are pressed together so hard that no film of oil can remain between them. Then it is that the chemist has had to come to the rescue and design "oiliness agents" which can be added in small proportions to the oil to make it more effective.

The molecules of mineral lubricating oil can be visualised as little threads, each only a minute fraction of a millionth of an inch long. Oiliness agents are threads of about the same size, to one end of which the chemist has fixed a sort of chemical magnet which makes that end of the thread stick much more strongly to the surface, thus producing on it a miniature "lawn" of molecules. Owing to their magnets these molecules are not easy to scrape off, and when the loads rise to danger point and the mineral oil is nearly squeezed out—that is, when a state of boundary lubrication is approached—the "lawn" still manages to keep the surfaces apart by acting as a cushion over them.

In some machinery, however, even this is not enough. Under extremely high loads, such as can be found in the hypoid rear axles of motor-cars, the oiliness agents get scraped off. So even more active chemicals have had to be devised which, when added to the oil, produce the so-called "E.P. Compounds." With these, when the high pressure gets so great that the hills start rubbing, the high temperatures at these points cause the metal to react chemically to produce a thin layer of material which is liquid at these spot high temperatures and so allows the conflicting hills to slide over one another without seizing or welding.

The range of lubricants available nowadays is vast. Each one is tailor-made for its particular application. The oil companies have continuously to be carrying out research in order to be able to solve the lubrication problems which arise in any mechanical operation—anything, for instance, from high speed cotton spinning to heavy colliery winding-gear. There even exist conditions in which no known lubricant made from oil is sufficient for the task. Especially is this the case with aircraft engines. Then our chemists have to step in and make one synthetically, as they have done for the latest jet engines. Whatever the stresses and the extremes of temperature encountered, the object remains the same: it is simply to overcome friction in the wrong place.

As we have seen, without friction at all life as we know it would be impossible; but without proper lubrication civilisation would equally come to an abrupt and grinding halt.

Reprinted from "The Esso Magazine," by courtesy of The Esso Petroleum Company, Ltd.

A Mechanical Stage for a Microscope

Constructional Details of a Useful Microscope Accessory

By S. M. CHARLETT, F.R.M.S.

MICROSCOPY is a very interesting and informative hobby, and the interest can be extended if you make your own aids and simple accessories. In addition to the interest in making these accessories, the financial side must be considered. The purchase of every necessity can be very expensive, and if as many as possible of these can be made by yourself, the money saved can be used for a greater supply of those things that must be bought, such as slides, cover glasses, and many others that cannot be made at home.

One of the most useful accessories is a piece of apparatus known as a mechanical stage, and this is simply a slide holder that fits on to the existing stage of your microscope, and which you can move, by means of a screw thread arrangement, very slowly and evenly, so that when you are looking at an object under the microscope it does not become lost, as is often the case when moving the slide with the fingers, by a sudden unintentional jerk.

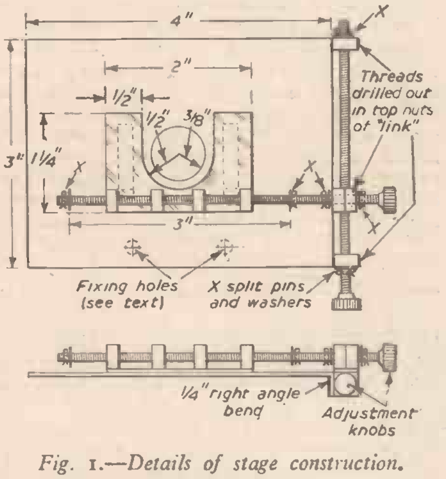


Fig. 1.—Details of stage construction.

The mechanical stage described here, and shown in Figs. 1 and 3, was originally designed for the microscope for which details were given in the excellent article by E. W. Twining, in the January and February, 1953 issues of PRACTICAL MECHANICS, but it will be found to be quite suitable for most types of home-made or professional microscopes. A professionally-made stage will cost anything over £5 whilst the one described here will cost only a few shillings and a few hours of interesting work.

Construction

The stage and slide carrier can be made from 1/16in. sheet brass and one edge of the stage is bent down as shown to take the bearings for the backward and forward movement. Sheet brass was chosen as it is easy to work, and yet gives the necessary rigidity of construction, and in addition the soldering that must be done will present no problem.

The connecting link between the two movements consists of two pairs of square nuts soldered together at right angles as shown in Fig. 2, the piece of 1/16in. brass which is soldered between the upper and lower pairs of nuts is to compensate for the thickness of the slide carrier, which would otherwise upset the transmission system.

The movement is produced by brass rods which have been threaded with a 4B.A. thread, and which, when turned, will drive the nuts attached to the slide carrier or the link. It will be seen that some of the nuts have had the threads removed, and this has been done to provide a simple set of bearings for the controls. Rigidity in the link is provided by the fact that the nuts bear slightly against the face of the turned down edge, as will be seen in Fig. 1.

The method of attaching the stage to a microscope is quite simple. The screws or pegs which hold the stage clips in place on the existing stage are removed. The hole in the centre of the mechanical stage is then located exactly over the hole in the centre of the existing stage. Two holes are then drilled in the mechanical stage to correspond with the old clip holes and the stage can then be firmly bolted in position.

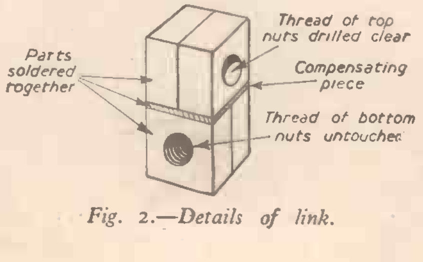


Fig. 2.—Details of link.

Miscellaneous Parts

The control knobs can be adapted from the spares box or suitable ones can be purchased for a few coppers from a dealer.

The clips on the slide carrier can be made as shown in Fig. 4, or the discarded clips from the original stage can be used. They are best soldered as, if they are bolted on, the transmission will be affected.

In the illustration, Fig. 1, "X" indicates the split pins and washers which are used at these points. The washers used on the forward and backward transmission are of the spring type, whilst those on the left and right movement are the normal washer.

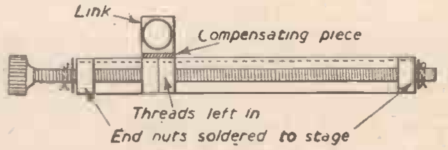


Fig. 3.—Details of forward and backward control.

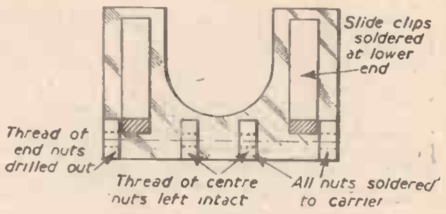


Fig. 4.—Further details of slide carrier.

If the stage is given careful use and not subjected to any undue strain it will give years of service.

The Atmos clock. It measures 9¼ in. x 8¼ in. x 6¼ in.

A Weather-driven Clock

The Driving Force of the Atmos Clock is as Near Perpetual Motion as we are Likely to Attain. It Relies Upon Changes of Temperature to Supply the Winding Energy

THE Atmos clock, strictly speaking, is not perpetual motion, but to all intents and purposes it can be claimed as such, because there is no necessity for winding it by hand, mechanically or electrically. It is propelled simply and surely, without any human intervention, by the variation of temperature and barometric pressure. The variations need only be minute. A change of 2½ degrees centigrade gives 41 hours winding power. The temperature is constantly changing and during 24 hours it is probable the clock is energised with a fortnight's reserve winding force. Even in centrally heated buildings this minute variation occurs.

Experience proves that throughout the world the daily variation of temperature is much greater than 2½ degrees, and it is obvious, therefore, that the winding power becomes accumulated. This is stored in a specially long mainspring which remains more or less under constant pressure at its maximum working capacity. With this reserve there is sufficient power to last one year even if the clock is placed in a vacuum where there is no change of temperature.

The Movement

The originality of the Atmos is not confined to the power unit. The movement itself is unique in that, owing to the extremely slow action of the moving parts (there is practically no wear and tear), together with the extra fine precision finish, the use of oil has been eliminated. This removes at once one of the most serious sources of trouble in the maintenance of clocks, as oil in time becomes dry and sticky, thereby necessitating a clock to be cleaned periodically.

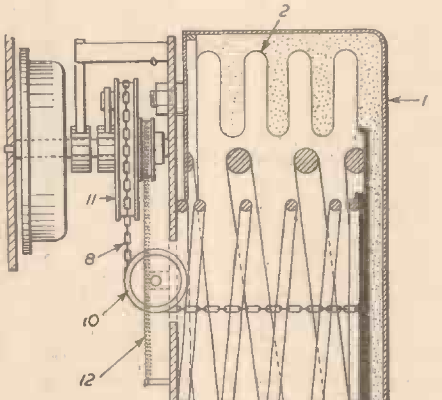
A very important advantage of the Atmos is the simplicity and precision of the means of regulation. Owing to the remarkable constancy in the power tension the regulation is very sensitive. One complete turn of the regulating wheel produces a variation of only 12 seconds per 24 hours. It will be seen, therefore, that the adjustment is almost micromic. The balance oscillations of the ordinary escapement clock are 432,000 per 24 hours, but in the Atmos they total only 2,880.

The Temperature Motor

The Atmos motor consists of a drum, marked (1) in the diagram, in the interior of which is assembled a flexible metallic bellows (2). The space between the bellows and the outer drum casing (4) is hermetically sealed and contains ether-chlorine in gas form.

With the slightest decrease of temperature some of the gas will liquify (at 3) and the interior pressure of the bellows will be lowered. A spring under compression (5) is mounted on the central surface of the bellows (6). This spring tends to keep the bellows in the open position as in the diagram. This is referred to as the "compression spring."

When, on the other hand, the gas pressure is increased, the spring becomes further compressed and the bellows close like an accordion. When the gas pressure falls, again the action is reversed—the springs expand, forcing the bellows open.



A sectional view of the motor of the Atmos clock.

Barometric Pressure

The change in barometric pressure also comes into play. If it is increased the compression spring is assisted in forcing the bellows to the open position. If the barometric pressure is decreased the internal pressure of the bellows has less exterior opposition. It will be seen, therefore, that the effect of barometric pressure, although of secondary importance in providing the winding power, assists materially in livening up the accordion-like action of the motor.

Working within the compression spring (5) is a smaller spring which indirectly provides the winding power. It is fixed to the body of the clock and the other end is free. The spring is always under compression. At the extremity, adjacent to the bellows, is fixed a fine chain (8) which passes over a pulley (10) and is then attached to a larger pulley (11). This is fixed with ratchet action on the spindle in direct drive with the mainspring of the clock.

Winding the Mainspring

A fine coil spring (12) is mounted on the side of the main pulley drive for the purpose of taking up the slack in the chain when the bellows are being compressed. As the bellows expand again the pull on the chain turns the driving pulley and winds the mainspring.

The centre surface of the bellows has an area of 80 sq. cms. A difference in temperature of 1 degree centigrade will cause a variation in pressure of 50 grms. per sq. cm. The working force, therefore, is 4 kilogrammes (8½lb.) per 1 degree centigrade change in temperature. The maximum compression of the bellows is 40 kilogrammes.

Provision has been made by which the clock cannot be overcharged with power. The maximum power of the intermediate spring (9) is lower than that of the clock mainspring so that if the mainspring is wound to full working pressure the intermediate spring can only expand itself to the point where it balances the mainspring and there remains. As the clock runs down so does the pressure of the mainspring fall. As there is a reserve in the intermediate spring the power is automatically returned to the mainspring which, therefore, must remain at a constant pressure. It could only be in artificial conditions that the intermediate spring fully expanded itself before the mainspring had reached its maximum working pressure. In practice the tension of the mainspring is maintained at almost constant pressure—a very great advantage for precision timekeeping.

Features

The advantage of the Atmos clock is that the pendulum is suspended on an Elinvar spring which is unaffected by temperature changes, thereby assuring accurate timekeeping in any climate. The constant driving force ensures maximum precision and it eliminates the human element—forgetfulness. There are no electrical problems, as with electric clocks, and there is no wear and tear on moving parts.

The Atmos clock is manufactured by Jaegar-Le Coultre, one of the largest and oldest established watch factories in Switzerland.

POLAR TELESCOPES

General Principles and Detailed Instructions for Making a Small One

By E. W. TWINING

To many readers this type of astronomical telescope will be unfamiliar and some may never even have heard of it. Yet, given optical perfection, or something approaching perfection, it is the most comfortable and convenient form of instrument which can be installed.

The ordinary types, whether reflectors or refractors, and whether mounted equatorially or otherwise, must be used in the open air, either uncovered or in some form of observatory. When used out in the open the person of the observer has to endure not only the awkwardness of attitude necessarily due to the angle of the telescope and the position of the eyepiece, brought about by the altitude of the object under observation, but the low temperature at night—especially in winter—as well. Even if the telescope is fairly large and fixed on the floor of an observatory, when the shutters of the revolving dome or roof are open however cold the night may be the observatory cannot be heated because of the disturbance which would be set up around the shutter opening. Unfortunately it is those clear frosty nights which are the best and most valuable for observation.

Advantages of the Polar Telescope

With the polar telescope not only can the room or observatory be warmed but the observer can be seated, can remain in a comfortable attitude, and can have an illuminant by which he is able to write notes and sketches of what he sees, besides being able to use his maps and star atlas and record the times of his observations. His attitude would be exactly the same as if he were looking down into a microscope, for the eyepiece and the barrel of the telescope never move; they simply rotate on the optical axis and they do so at the rate of one revolution in 24 hours.

The form of this telescope was first invented by the eminent telescope constructor, Sir Howard Grubb, and the first instrument built to the design had an aperture of 4in. Since then very much larger polar telescopes have been built. In Fig. 1 is drawn, more or less diagrammatically, the 12in. aperture instrument designed by W. P. Gerrish, of the Harvard Observatory, U.S.A., and this drawing will explain the principle of the mounting of the telescope. It will be seen that the instrument is pointing, not upward to the sky but downward, with the object glass, lettered OG, below; and that the optical centre line is really the axis about which the barrel, TB, rotates, which barrel is carried upon bearings, UB and LB, above and below. Mechanically, therefore, the telescope is its own polar axis. A flat mirror, M, the angle of which can be varied, reflects the image of the object to be viewed upwards into the object glass. The axis of the telescope must be so set up that it is exactly parallel with that of the earth; in which respect it is exactly the same as the polar axis of other equatorial mounts. Its vertical angle to the ground—or perhaps I should say to the horizontal—will equal the latitude of the place where it is erected, and its lateral angle must be such that the optical axis points to the true north and south. If the rotation of the telescope is driven by a clock in such a manner that it makes one revolution in 24 hours, the direction being of course contrary to that of the earth, any object reflected by the mirror, M, into the object glass, OG, will remain stationary in the eyepiece, EP. Furthermore, right ascension circles, RA, can be fitted and provided with a clamp so that any object can be found by means of the known sidereal time and the nautical almanac. The clock drive can be freed by means of a clamp.

The angle of the mirror can be controlled from the eye end of the telescope—and on large instruments such as this, which has an aperture of 12in. and focus of 16ft. 10in., circles are fitted for reading in declination. The angle which can be swept over by the mirror in altitude would be about 90 deg., that is to say from about 10 deg. above the horizon to about 10 deg. past the zenith.

Other items shown in the diagram are CD, the wheel for the clock drive, DW, the

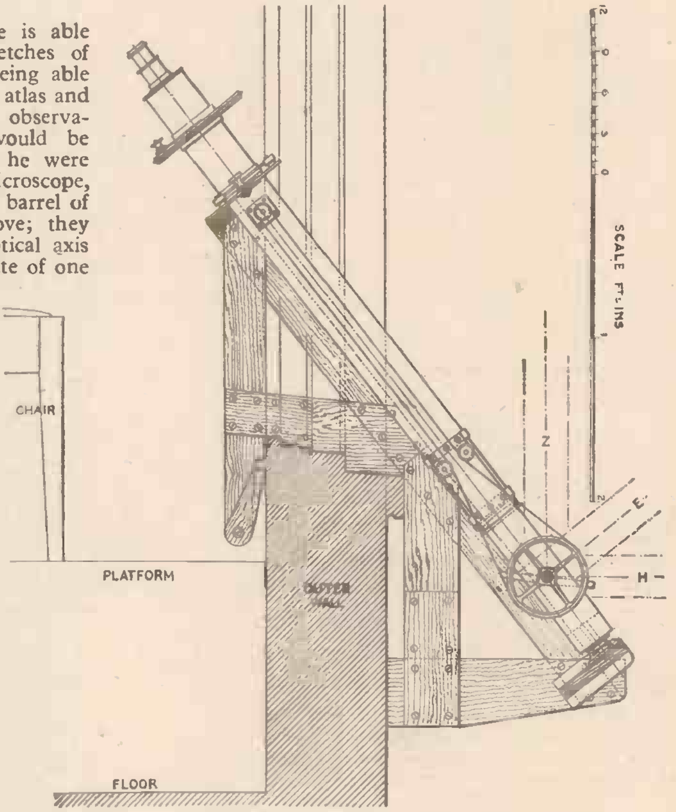


Fig. 2.—General arrangement of a 3in. polar telescope.

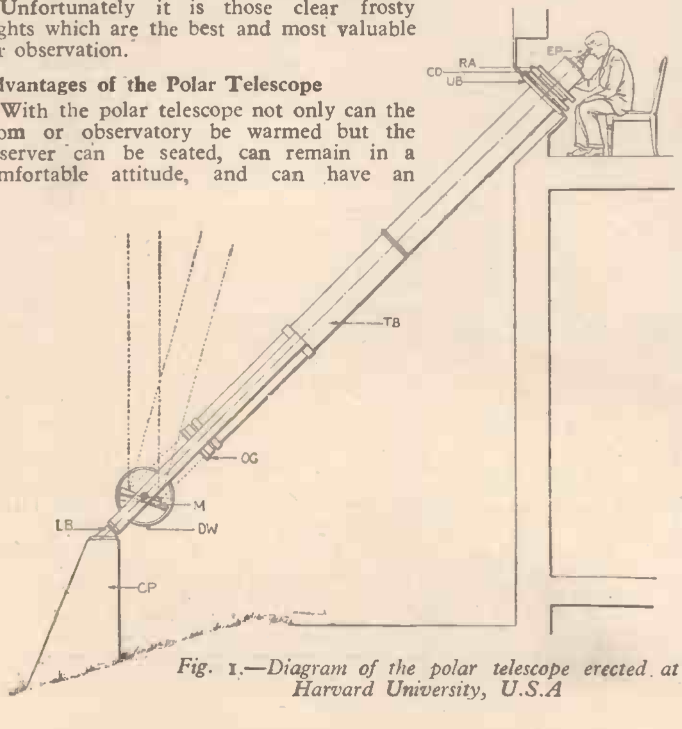


Fig. 1.—Diagram of the polar telescope erected at Harvard University, U.S.A

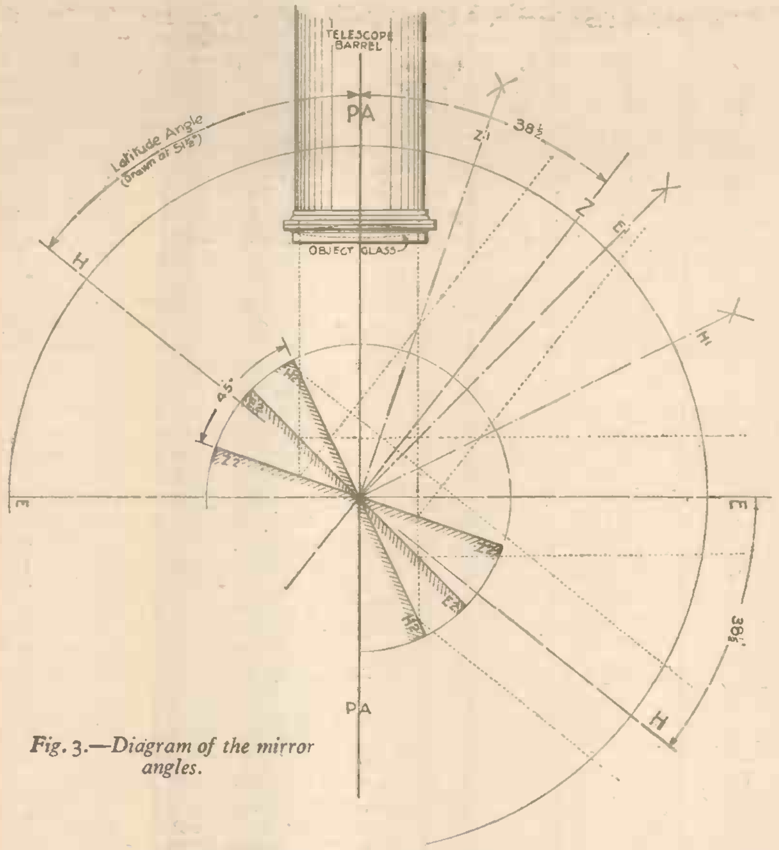


Fig. 3.—Diagram of the mirror angles.

driven wheel for the declination setting, UB, the upper bearing, which has to take a ring of full telescope diameter, and LB, the lower thrust bearing, carried by the concrete pier, CP.

Although it will sweep the heavens from west to east and from the horizon to beyond the zenith it can never reach to the pole, nor anywhere near it; but after all there is not very much either at or around the pole of telescopic interest. Fortunately we have the whole, or nearly the whole, of the ecliptic open to us, and so the polar telescope may find its chief use in viewing the moon and the planets.

A Small Polar Telescope

In this article complete drawings in detail are given, showing the construction of a small polar telescope of only 3in. aperture which, if necessary, can be made portable provided the maker has a window with a southern aspect in which it can be mounted. It will be clock-driven, with hand control for slow motion but no divided circles in right ascension nor in declination. Hand movement for the mirror is brought up to the eye-end so that it will not be necessary to go out of doors to make adjustments in the setting of any part of the instrument.

As will be seen from a reference to Fig. 2 the whole telescope with the bearings is carried in a wooden frame or cradle which is hooked over the sill in the case of an upstairs window, the lower sash of which is raised. If the window is a casement this is opened and the opening covered with fabric cut to fit around the telescope and attached at its outer edge to a light frame fitting the sash rebates or grooves. As will be seen, with the floor and window levels as drawn the eyepiece of the telescope is too high to allow of normal sitting in an ordinary chair, unless a platform is made on which the chair can be placed. The alternatives are either a high stool or standing whilst observing. In Fig. 2, and the several which follow, the wooden frame in an upstairs window is adopted chiefly for the use of amateurs who live in flats; I do not advocate this frame, but when a window of an upper-floor room has to be used for a small telescope there seems to be no alternative. If a 3in. telescope can be used on the ground floor of a self-contained house I would prefer not to use the frame but provide a suitable bearing at the eyepiece end, and a small pier of concrete or of brickwork set in cement at the lower end.

There are several arrangements that suggest themselves for housing the inner end of the telescope and its user. One which would be ideal, especially if the instrument were a little larger—say of 4in. or 6in. aperture—would be to erect on the flat roof of a single-car private garage one of the small wooden huts or tool sheds which can be purchased ready made. Let the eyepiece end be in this, together with a chair, an electric or oil heater, and other things which make for comfort, and let the mirror-end bearing be carried by a cast-iron pipe, or a drain-pipe, filled with concrete rising from the ground. Provided it does not interfere with the doors of the garage, or other buildings interfere with clear view, the orientation of the telescope can be what is required by correct positioning of the shed on the roof.

This matter of orientation is of the utmost importance and—reverting to Fig. 2—if the wall of the building and the window shown do not face the south then the two wooden side frames of the cradle or telescope support will have to be different as regards the amount they each project from the wall. What the difference will be will depend upon the angle which the southern aspect of the building makes with the meridian of the place where the telescope is to be set up. An angle of more than about 10 or 12 deg. east or west of due south would render the window scheme impossible, and some other place for the telescope would have to be found.

The Latitude Setting

The angle of the polar axis, which is the optical axis in this telescope, must equal the angle of the latitude of the place. All the drawings show 51½ deg., which is the latitude of London and of all places on the same parallel. The further north we go the steeper becomes the angle and southward will be less inclined. The latitudes of some principal towns are given below:—

Plymouth	50½°	Darlington	54½°
Southampton	51°	Newcastle on Tyne	55°
London, Bristol, Cardiff	51½°	Ayr	55½°
Birmingham	52½°	Glasgow, Edinburgh	56°
Manchester	53½°	Dundee	56½°
Preston, Leeds, Hull	53¾°	Aberdeen	57¼°
York, Harrogate	54°	Inverness	57½°

Other places will be found by consulting maps.

In Fig. 3 H is a true horizontal, and in this case it is the line of the horizon. PA is the polar axis—drawn at 51½ deg. The rest of the figure shows the angles which are taken by the mirror and by the incident rays from the heavenly bodies from the horizon to the zenith. E is the centre line of the ecliptic. Thus a beam of light from a planet on E would be reflected into the object glass when the mirror is at E2 and the bi-section of that angle is at E1. The light from a star at the zenith would reflect from the mirror at Z2, the bi-section being at Z1. Although it can never be very usefully used the mirror can reflect beams from the horizon, and the mirror angle is at H2. Not only is the atmosphere at the horizon too dense under the best conditions for good astronomical definition, but the perfection of the optical flatness of the mirror will almost certainly not be good enough to give a true image at such fine angles of incidence and reflection. It is of interest to notice that in sweeping over the 90 deg. from the horizon to the zenith the mirror moves through an angle of only 45 deg.

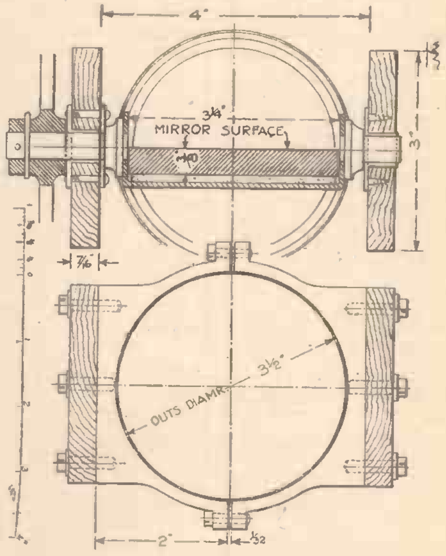


Fig. 4.—Cross sections through the telescope and mirror with one of the pairs of clamps.

Constructional Details

These are shown in Figs. 4 and 5, and it will be seen that the lower end of the telescope is supported by cheeks of hardwood—oak for preference—which, although closed by a crosspiece at the lower end to take the pivot for the roller thrust bearing, are usually termed "the fork." These cheeks are attached to the telescope barrel by clamps of brass or gunmetal, as in Fig. 4, both exactly alike. The cheeks have between them, and pivoted in the manner shown in the upper drawing, the tray to hold the mirror. The proportions, and particularly

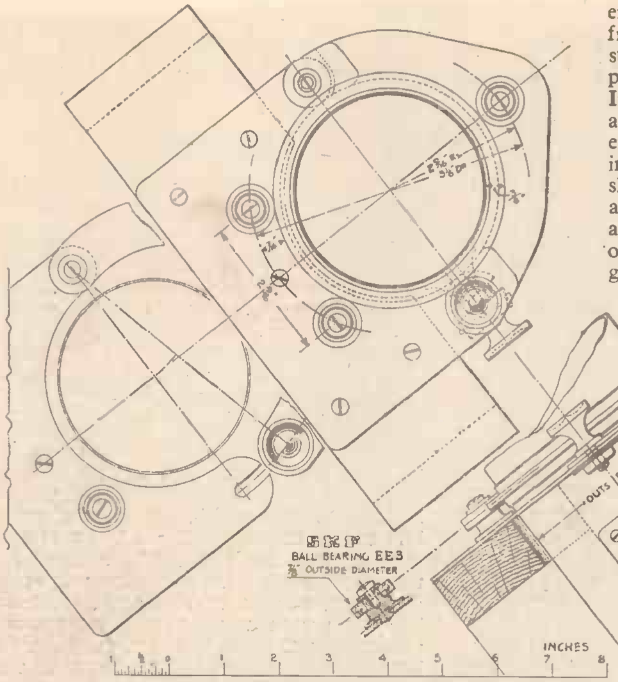


Fig. 6.—The upper bearing and chain adjustment for mirror.

the depth of the tray, must be such that the axial line of the pivots come in line with the upper or reflecting side of the mirror. The two drawings in Fig. 4 are cross sections, whilst Fig. 5 shows the whole of the details of the lower end down to the thrust bearing, in side elevation and plan. Here may be seen the means whereby the angle of the mirror is manipulated from the eye end of the telescope. A chain from a well-known construction kit is used and passed over sprocket wheels. In the large wheel the teeth are so spaced that they engage with every third link in the chain. On the mirror shaft the big wheel is fixed, and as the weight of the tray and mirror are off the centre of rotation the centre of gravity will require to be brought back to the pivot-centre. So in the wheel, on the opposite side to the mirror, a counterpoise is cast. The small jockey pulleys for the chain will need no teeth, only grooves.

Fig. 6 shows the main upper bearing; this consists of three small ball bearings, all of them carried on special studs. Two of the studs are riveted into a plate screwed down to a cross-bar forming the top member of the telescope cradle, and the third stud is riveted in a plate which can be swivelled for removing the telescope complete with its mirror from the cradle. Below the bearing plate is the mirror control; the chain shown is that which passes down over the jockey pulleys and around the large wheel shown in Fig. 5. The small upper spocket is turned by a milled handwheel shown on the extreme right in Fig. 6.

The Mirror

The Harvard Observatory telescope has a circular glass mirror, notwithstanding that at only one critical angle can the reflected image be circular. A glance at Fig. 3 will show that the width of the image can at no one angle be greater than the diameter of the object glass, and there the mirror need be no wider than a small margin beyond this; yet if it were tilted to H2 or even E2 the field would be definitely elliptical. Thus, a circular mirror must have a diameter equal to length of the major axis of the longest ellipse, and then it will not utilise the whole reflecting surface. In Fig. 5, therefore, is shown a rectangular mirror measuring 3¼in. wide by 7in. long.

In most cases, I suppose, the mirror would—without its maker thinking anything more about it—be made of glass, silvered on the face by the Brashear or some very similar process in just the same way as the parabolic mirror of a reflecting telescope. But with a polar telescope, in which the mirror is wholly uncovered and exposed to the air, the coating of silver would last but a very little while. One or two summer nights of dew coupled with the acid-laden atmosphere near a large town, would be sufficient to tarnish it.

(*To be continued*)

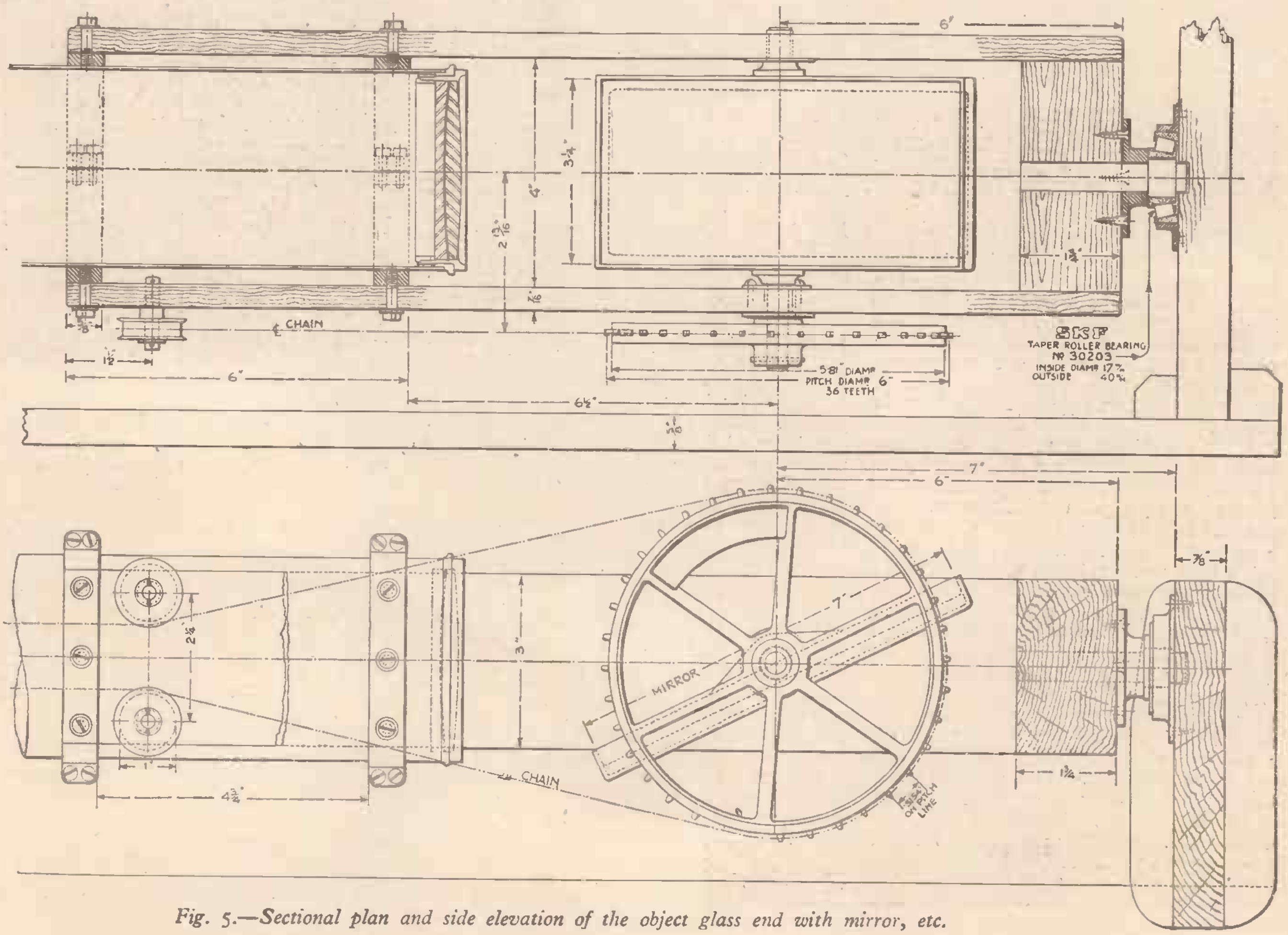


Fig. 5.—Sectional plan and side elevation of the object glass end with mirror, etc.

Chemicals From Petroleum

Some Facts About an Industry that is Playing an Ever-growing Part in the World's Chemical Production

THE past 25 years have witnessed the development of an important new industry—the petroleum chemicals industry—which, in the U.S.A., now provides an appreciable portion of certain basic chemicals required by a variety of industries.

This trend is already becoming apparent in other countries, and in Britain, for example, post-war plans for making the production of petroleum chemicals a major industry are already well under way. This British development was closely linked with the oil industry's programme for raising U.K. refinery capacity from the 1947 level of 2½ million tons of crude oil annually to some 20 million tons by 1952-53. In addition to producing a complete range of finished petroleum products, the new refineries should supply raw materials for the manufacture of synthetic chemicals. In several European countries similar chemical projects have been initiated.

Application of Petroleum Chemicals

The term "Petroleum Chemicals" means that some form of petroleum constitutes the chief raw material from which they are made. In most cases identical chemicals can also be made from other materials, for example, coal, or vegetable products such as molasses, grain and wood; but economic factors mainly determine which raw material is used commercially, and on these grounds the use of petroleum is at present rapidly growing.

A strict scientific division between petroleum products and petroleum chemicals is impracticable, e.g., gasoline components synthesised from refinery gases are not usually classified as chemicals, but acetone from the same source is normally described as a petroleum chemical.

Petroleum chemicals now enter into the manufacture of an increasing variety of products used in the home, in agriculture and in industry:—

The Research Centre at Thornton, Cheshire, is typical of many established by the oil industry for experimental work. The staff of over 800 includes engineers, chemists, physicists and statisticians who are engaged in scientific investigations. The work includes both fundamental research, for long-term development purposes, and the study of particular problems to meet the immediate needs of consumers. The photograph on the right shows the laundry where detergents are tested under practical conditions. This is an annexe to the laboratory, where research on detergents, mainly for domestic use, is carried out.

Solvents

Industries in general use a considerable number of solvents—liquids which will dissolve other materials. Among the many valuable solvents made from petroleum are acetone, incorporated, for example, in lacquers and nail varnish, and also used in making acetate rayon, and ethyl alcohol, used, among other purposes, as a lacquer solvent.

The photograph on the left was also taken at the Thornton (Cheshire) Research Centre and shows the fungicide wood block test taking place in the Chemical Products Section. The flask, which is being withdrawn from an incubator for examination, contains wood blocks which have been impregnated with experimental fungicides. After exposure to active wood fungi they are kept under controlled conditions of humidity and temperature for 12 weeks. The degree of deterioration of the wood blocks is used to assess the efficiency of the particular fungicide used.

Detergents

The valuable properties of synthetic detergents had already led to their use for a variety of industrial purposes, particularly in textile processing (scouring, etc.), but it was only in recent years, when their production on a large scale had been undertaken by the petroleum industry, that they became available in Great Britain for the manufacture of the now familiar "soapless soaps." The petroleum-based synthetic detergents, which in 1949 accounted for about 20 per cent. of total U.K. consumption of all soaps and detergents, are also used in many cases as "wetting agents," that is, products which enable water more thoroughly to penetrate and wet any material in contact with it. In dyeing textiles, for instance, their use prevents the dye "sitting" on top of the fabric as does water on a greasy surface.

Plastics

Many of the raw materials for plastics are now petroleum chemicals. Some of these plastics can be moulded into articles such as ash-trays and telephone receivers. Other possibilities include synthetic fibres, such as nylon and newer materials, which have added advantages, such as being particularly resistant to sun-bleaching and chemical attack, or are highly resilient and easier to manufacture in the form of fine fibre. The acetic acid used in manufacturing cellulose acetate rayons may also be derived from petroleum chemicals.

Synthetic Rubber

Synthetic rubber, the large-scale production of which was started in the U.S.A. during the war, is now almost entirely derived from petroleum in that country, and in Canada, too. Considerable quantities of the synthetic product are consumed in the U.S.A., chiefly a general purpose rubber known as GR-S, which, among other uses, is incorporated in motor tyres. Another synthetic rubber based on petroleum is "butyl" rubber, which has greater resistance to ageing and tearing than natural rubber when used for inner tubes. Other special synthetic rubbers are oil-resistant, or have exceptional electrical insulating properties. In Britain, natural rubber is still generally used for motor tyres, but various types of synthetic rubber are in demand for special purposes.

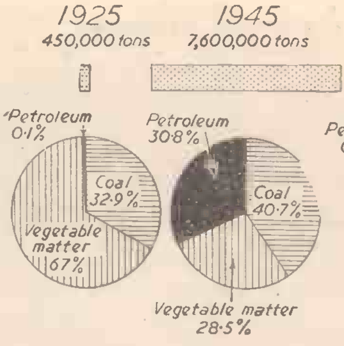


Fig. 1.—The growth between 1925 and 1945 of total output in the U.S.A. and the proportion derived from petroleum.

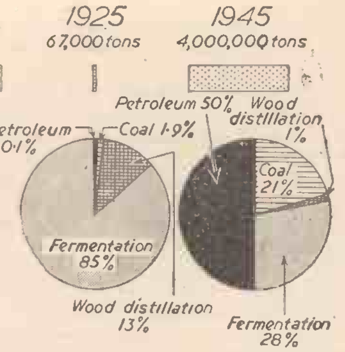


Fig. 2.—The position of the U.S.A. as a source of synthetic aliphatics in 1925 and 1945.

The blocks at the top of these diagrams show total production in each case.

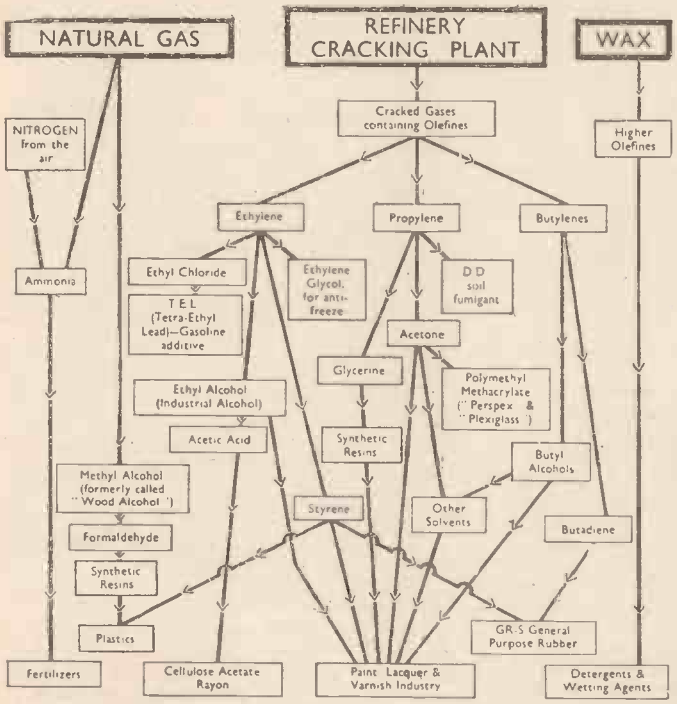


Fig. 3.—A few of the "routes" by which some of the more important chemicals may be obtained from petroleum.

Agricultural Chemicals

Increasing quantities of agricultural chemicals are being made from petroleum in the U.S.A. where ammonia and related fertilisers are manufactured from natural (i.e., petroleum) gas. Soil fumigants, such as "D-D" which destroys wireworm and similar pests, are also made from petroleum. D.D.T., the well-known insecticide, has hitherto been mainly derived from coal, but it could equally well be made from petroleum raw materials.

Glycerine

Glycerine is another product which has recently been produced from petroleum on a commercial scale in the U.S.A. The process used is based on a revolutionary discovery which is regarded as a major achievement of chemical research.

Many other chemicals are also derived from petroleum, for example, disinfectants, pharmaceutical products and anti-freeze compounds.

Petroleum Chemicals in the U.K.

Since the war considerable progress has been made towards establishing large-scale commercial production of petroleum chemicals in Britain, and several new plants have been completed. One of these, which began commercial operations early in 1949, will eventually manufacture up to 60 different chemicals for a wide range of industries. A second has been manufacturing synthetic detergents since 1942, and a third, only recently opened, is now mainly engaged in making solvents. Another plant operated by a textile company is producing the chemicals needed for the manufacture of rayon, and there are also plans for the construction of two plants to make styrene for the plastics industry.

When these new plants are in full operation the petroleum chemical industry, by providing other British industries with raw materials previously imported, is expected to bring about a considerable reduction in dollar expenditure. Three of these plants have been reported as capable of saving together a total equivalent of about £7½ millions per annum.

Other Countries

The U.S.A., the country in which the oil industry is most highly developed, holds the predominant position in the manufacture of petroleum chemicals, having also pioneered this industry. The production of petroleum chemicals in the U.S.A. goes back about 25 years, and is divided between a large company of chemical companies and oil companies.

Canada possesses the only synthetic rubber plant in the Commonwealth and also produces some other chemicals from petroleum. In Trinidad, oil-based chemical manufacture has recently been started.

In Europe, detergents and plastic materials are being made from petroleum in Holland, and the manufacture of petroleum chemicals in France, Italy and Germany is also being contemplated.

Petroleum Chemical Production Growth

In the U.S.A., in a period of only two decades, the supply of petroleum chemicals grew from an insignificant proportion to almost a third of the total production of organic chemicals. An organic chemical is any compound whose chemical structure is based on carbon, i.e., hydrocarbons and carbohydrates and substances derived from them. Crude oil and natural gas are mixtures of various hydrocarbons, apart from a few impurities. Fig. 1 illustrates the growth, between 1925 and 1945, of total output in the U.S.A. and the proportion derived from petroleum.

Petroleum is used in the production of synthetic rubber. The photograph was taken at a perbuanan plant, and shows the sheeted rubber being adjusted on to rollers as it comes from the mill.

This rapid growth is illustrated by the fact that, before the war, petroleum chemical plant in the Texas Gulf area (now responsible for about 80 per cent. of U.S.A. production) was worth about £16 million. During the war some £200 million was spent and about £75 million more in the first five post-war years.

In the U.S.A., petroleum has for some time been regarded as the main source of synthetic aliphatics—one of the two major groups of organic compounds, which includes industrial alcohol, glycerine, acetone and many others. Fig. 2 shows the position in the U.S.A. in 1925 and 1945.

The other main group of organic chemicals, the aromatics, has hitherto been based mainly on coal tar, the chemicals being produced as by-products. Rising demand, however, makes it likely that petroleum will be used to an increasing extent in manufacturing aromatic compounds. For instance, during the war large quantities of toluene, normally obtained from coal tar, were made from petroleum in the U.S.A.

Alternative Materials for Synthetic Chemicals

As already indicated, there are alternative sources for most chemicals. Among products now obtained from petroleum, acetone and certain plastics were formerly derived almost entirely from other sources. Chemicals such as ethyl alcohol (industrial alcohol) may come from molasses, grain, potatoes, etc., subjected to fermentation processes. Acetylene, derived from coke and lime, is another starting point for chemical synthesis. Acetic acid and methyl alcohol have both been produced by the destructive distillation of wood, though this is no longer much employed.

Petroleum Raw Materials

In the production of petroleum chemicals, the basic materials most generally used are natural gas and refinery gases. The latter are produced during cracking processes (in which heavy oils are subjected to a great heat and pressure in order to produce more gasoline from them) and they contain "olefines" *e.g.*, ethylene, propylene and the butylenes, which are more chemically reactive than the original components of petroleum, and are therefore specially suitable for synthetic processes in which a product is "built up" stage by stage.

An important group of detergents is derived from petroleum waxes, which are cracked to yield a product rich in heavier olefines from which the final product is prepared. In the U.K. detergents are also made from shale oil.

A few of the "routes" by which some of the more important chemicals may be obtained from petroleum are indicated in the simplified diagram (Fig. 3) together with some of the end uses of the chemicals.

Further information on refinery processes, the formation of olefines, etc., will be found in the article "Modern Oil Refining," in our October, 1953 issue.

(Reproduced by courtesy of the Petroleum Information Bureau.)

Back to First Principles

12.—Hitting the Mark

By W. J. WESTON

THE trouble is that, when our aim is perfectly directed to the mark, we must inevitably miss that mark. For, once we have propelled our missile it becomes subject to forces other than our force of propulsion. If only gravity had rested a while the Rugby place-kicker would have sent the ball well over the cross-bar, But alas ! it fell short. He had not catered adequately for the inescapable fact that during the flight towards the posts the force of gravity is ever acting. The propulsive force is resolved into two components: the horizontal component remains constant but for the resistance of the air ; the vertical component diminishes and too swiftly disappears.

Make the horizontal component greater and you lessen the time of flight. Make the vertical component greater and you lengthen the time of flight. The angle of propulsion that makes the components equal —45 deg., that is—sends the missile the greatest distance.

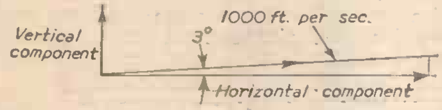


Fig. 1.—The factors of the first problem in diagrammatic form.

The Problem

Find to the nearest yard the range on a horizontal plane of a rifle bullet fired at an elevation of 3 deg. with a muzzle velocity of 1,000 ft. per second.

The Comment

To solve your problems about projectiles you need to have ready your equations about motion under the action of gravity. These are:

(1) $V=u-gt$: the velocity upwards, beginning at u becomes v in t seconds, g being taken as $=32$.

(2) $S=ut-\frac{1}{2}gt^2$: the height reached is the initial velocity upwards multiplied by the time less half the acceleration downwards multiplied by the time; and the latter soon overtakes the former.

(3) $V^2=u^2-2gs$: this is a useful deduction from the first two equations.

The Answer

The vertical component of the muzzle velocity is $\sin 3^\circ \times 1{,}000$.

The horizontal component is $\cos 3^\circ \times 1{,}000$.

$\sin 3^\circ = .0523$: $\cos 3^\circ = .9986$.

Time in seconds to destroy upward velocity $=$

$$\frac{\sin 3^\circ \times 1{,}000}{g} = \frac{.0523 \times 1{,}000}{g}$$

Therefore, time of flight $= \frac{.0523 \times 1{,}000}{32} \times 2.$

The range, therefore, is in feet

$$\frac{.9986 \times 1{,}000 \times .0523 \times 1{,}000 \times 2}{32} =$$

3,264.91 ft. = 1,088 yds.

The Problem

A missile is projected at such an angle that the horizontal range is three times the greatest height. Find the angle of projection. If, with this angle, the range is 400 yds., what is the velocity of projection and the time of flight ?

The Comment

The parabola of the missile is as shown in Fig. 2.

AB being the range, CD the height. By using our equation $h=\frac{1}{2}gt^2$, we obtain the time in terms of h. From this we calculate and compare the vertical and horizontal components, and so get the tangent of the angle of projection. The rest is easy.

The Answer

Greatest height $=h$. Therefore $h=\frac{1}{2}gt^2$.

$$t=\sqrt{h \div 16}=\frac{\sqrt{h}}{4}$$

The vertical component of the projecting force is, therefore, $g \times \frac{\sqrt{h}}{4} = 8\sqrt{h}$.

And, since the horizontal component $\times \frac{\sqrt{h}}{4} = \frac{3h}{2}$, then the horizontal component $= \frac{3h}{2} \div \frac{\sqrt{h}}{4} = 6\sqrt{h}$.

The vertical component is to the horizontal component as 4 : 3.

The angle, therefore, has the tangent $\frac{4}{3}$, that is 1.333.

Vertical component is therefore 1,600 in $\frac{\sqrt{1{,}600}}{4}$ seconds.

Horizontal component is 1,200 in $\frac{\sqrt{1{,}600}}{4}$ seconds.

Velocity of projection is 2,000 in $\frac{\sqrt{1{,}600}}{4}$ seconds $=200$ ft. per second.

Time of flight $=10$ seconds.

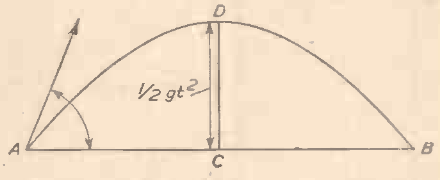


Fig. 2.—The parabola of the missile.

The Problem

The greatest range of a gun is 16 miles: what is the muzzle velocity of the shot ?

The Comment

The golfer knows that when he hits the ball at an acute angle it rises so little that its flight through the air is deplorably short. He knows, too, that, when he hits the ball at an obtuse angle, too much of his energy is expended in sending it towards the heaven ; again his distance is disappointing. He achieves the optimum when the angle is such that the vertical component is equal to the horizontal component of his blow ; and this angle is 45 deg.

The Answer

Let $v=$ muzzle velocity in feet ; and let $t=$ time of flight in seconds.

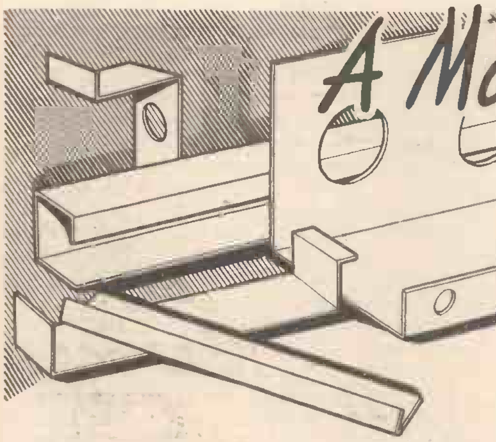
Then (from the horizontal component), $vt=16 \times 1{,}760 \times 3$.

Then (from the vertical component), $\frac{v}{g}=t$ or $\frac{v}{t}=32$.

Therefore

$$v^2=16 \times 1{,}760 \times 3 \times 32$$
$$=16 \times 16 \times 110 \times 3 \times 4 \times 4 \times 2$$

$\therefore v=64\sqrt{660}$ ft. per second.



A Machine for Folding Sheet Metal

Constructional Details of a Simple Hand-operated Machine

By R. A. BARTHOLOMEW

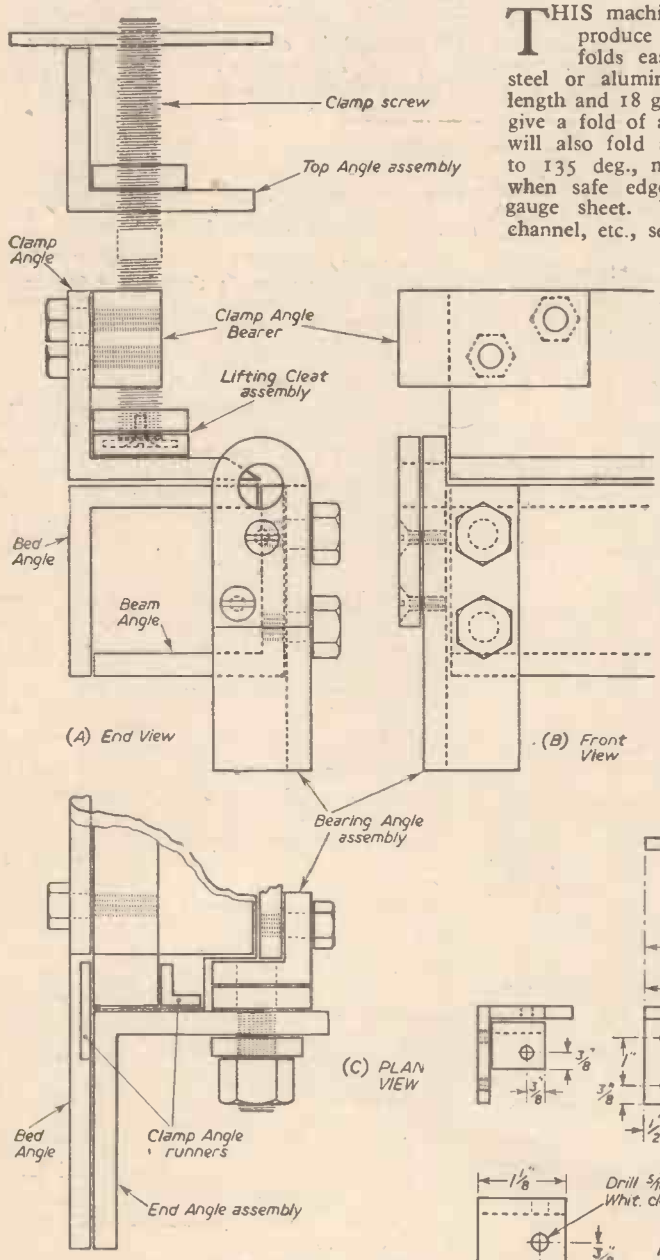


Fig. 2 (above).—*Sectional views with ends omitted.*

Fig. 3 (right).—*Details of bed angle and cleats.*

THIS machine has been designed to produce neat professional-looking folds easily and quickly in mild steel or aluminium of up to 18in. in length and 18 gauge in thickness. It will give a fold of any angle to 90 deg., but will also fold an edge up to ½in. wide to 135 deg., making it easy to flatten when safe edges are required on thin gauge sheet. Various sections (angle, channel, etc., see heading) and a variety of articles can be manufactured. Attachments can also be made from both wood and steel to increase its scope. It bolts or screws to any bench, overhanging the front about 1½in.

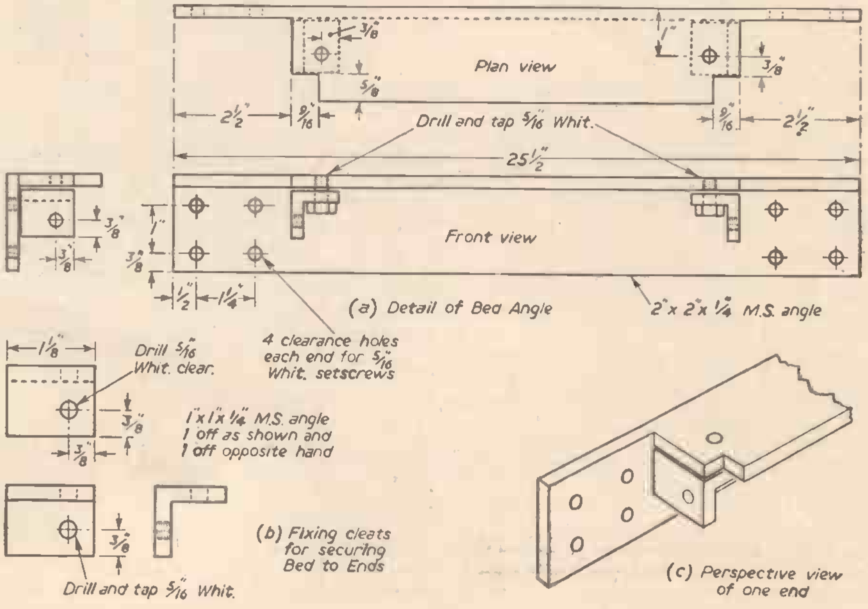
Working Principle

The principle on which the machine works is simple. The sheet metal is clamped between two angles, the uppermost of which acts also as a blade, the edge of a third angle rests beneath the sheet and is hinged to swing upwards, carrying the sheet with it and forming a crease along the blade.

The machine itself can be constructed with the minimum of tools, a hacksaw, file, drill and tap, and a bench vice. Standard bright mild steel angle and strip is used throughout which can be obtained from any good tool and hardware stockist. The total cost of the material, screws, bolts, etc., should be about £2 10s. to £3. Heavier thickness material can, of course, be used to make a sturdier machine, and the length can also be increased, but the cost would be proportionately higher.

The main parts consist of a bed angle, a clamp angle and a beam angle, with provision for the beam angle to swing upwards, and the clamp angle to tighten on to the sheet metal which rests on the bed. Two end angles take the top angle which adds rigidity to the structure and enables the clamp screws to be tightened down on to the bed. Two cleats mounted on the clamp angle enable this to be lifted and lowered by means of the clamp screws.

Fig. 1 shows a perspective view of the machine assembled except for the top angle, which has been left off in the interests of clarity. It will be seen that the clamp angle runs up and down in two guides which keep it in line with the bed. The bed is fixed directly to the two ends, being bolted through one web of each angle, and for extra rigidity a small cleat is screwed beneath the bed angle on to the end angle. The top angle is secured to the end angle by means of a cleat. The beam angle is hinged on two ½in. dia. pins screwed into the end



LIST OF PARTS

One Beam Angle.	Two Guide Strips.
Two Beam Handles.	Two Guide Angles.
One Bed Angle.	Two Clamp Angle Blocks.
One Top Angle.	Two Lifting Cleat Plates.
Two Top Angle Packers.	Four Lifting Cleat Packers.
One Clamp Angle.	Two Clamp Screws.
Two End Angles.	Two Washers.
Two End Angle Packers.	Two Tommy Bars.
Two Bearing Pins.	Two Bed Angle Cleats.
Two Bearing Angles.	Two Top Angle Cleats.
Two Bearing Angle Packers.	Two Fixing Angles.

MATERIALS REQUIRED

7ft. 6in. of 2in. by 2in. by ¼in. bright mild steel angle.
1ft. 6in. of 2½in. by 2½in. by ¼in. B.M.S. angle.
2ft. 9in. of 1in. by 1in. by ¼in. B.M.S. angle.
8in. of ½in. by ½in. by ⅛in. B.M.S. angle.
3ft. 6in. of 1in. by ¼in. B.M.S. bar.
8in. of 1in. by ⅜in. B.M.S. bar.
4in. of 1in. by ¾in. B.M.S. bar.
16in. of ⅜in. rod.
16in. of ⅜in. Whitworth studding.
4 5/16in. Whitworth 1in. long setscrews.
14 5/16in. Whitworth ½in. long setscrews.
4 ¼in. Whitworth by ¾in. long setscrews.
16 ¼in. Whitworth by ½in. long setscrews.
4 ¼in. Whitworth by ½in. long countersunk-head screws.
9 2 BA by ½in. long countersunk-head screws.
2 ½in. Whitworth by 2in. long bolts.

angles. The sectional views (Fig. 2) show the general arrangement of the various parts.

General Notes on Construction

As the ease of assembly and the efficiency of working depends largely on the accuracy of the drilling it is worth while taking extra care in marking out the position of the holes and cut-outs.

The end, bearing and fixing angles, together with the bed and top-angle cleats and the clamp angle blocks and guides, will have to be drilled to suit each end. This must be borne in mind when marking out these parts, and one infallible way of achieving this is to place one web of both pieces in a vice with the other webs facing opposite ways and then mark them both out together.

The Bed Angle

This consists of a single piece of 2in. by 2in. by ¼in. angle 25½in. long. The top web, which forms the actual bed, is cut away at each end to receive the end angles as shown in Fig. 2. A further cut-out is made on the front edge of this to clear the bearing angle and packer of the beam. Four 5/16in. clearance holes are drilled in the vertical web and a single hole drilled and tapped 5/16in. Whitworth in the other web at each end; the dimensions for these are shown in Fig. 3(a). The two fixing cleats are made from 1in. by 1in. by ¼in. angle 1⅞in. long (see Fig. 3(b) for drilling details). As the holes are not central, these will need to be drilled to suit each end and are secured in position as shown in the perspective view (Fig. 3(c) with 5/16in. by ½in. long Whitworth hexagon head setscrews, the head of the screw being placed under the angle, and any thread protruding above the angle cleaned off flush. The bed angle is now complete and is set aside until the machine is assembled.

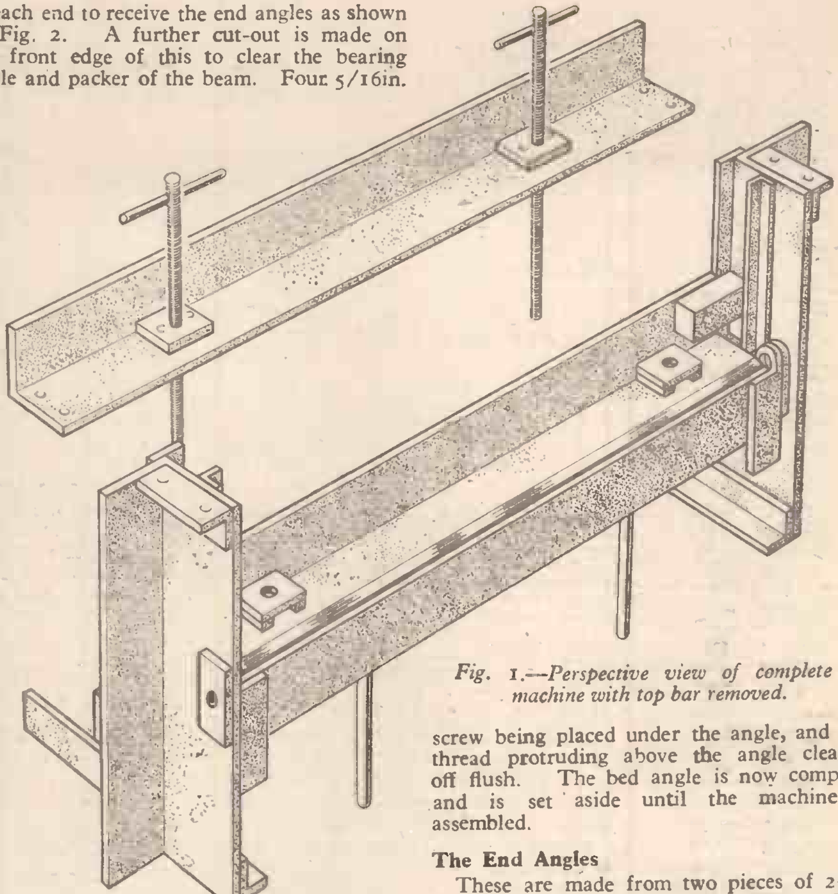


Fig. 1.—Perspective view of complete machine with top bar removed.

The End Angles

These are made from two pieces of 2½in. by 2½in. by ¼in. angle 8in. long. The hinge pins are screwed to them together with the clamp angle guides.

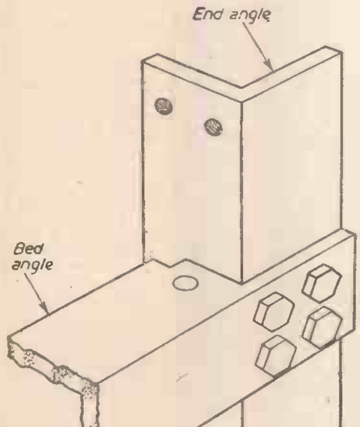
Mark off the position of the holes in each web (Fig. 4), taking care to make sure that you have one opposite to that drawn (that is, the webs face the other way). All the holes can then be drilled and tapped except the single ½in. diameter Whitworth tapped hole in each angle. This should be drilled and tapped when the packing piece is fixed to ensure that the threads are in line. Use two pieces of 1in. by ¼in. strip 2in. long for the packing pieces and drill two clearance holes in each and countersink to take ¼in. countersunk-head screws ½in. long. These holes should be ⅜in. from each end and ½in. from the edge of the strip. Check to see that they are exactly 1¼in. apart.

With the packing pieces screwed into position, and any excess thread filed off the hole for the pin can now be drilled and tapped, taking care to keep square to the angle or excessive wear on the bearing pin will result.

Hinge Pins

The hinge pins are ½in. Whitworth bolts 2in. long which have a thread 1in. long and the plain portion of which is also 1in. in length. Screw the bolt into the angle from the plain side, lock it by tightening a ½in. Whitworth nut on to the packer, then hacksaw the head of the bolt off ½in. from the angle, file the end square and chamfer the edge slightly. The hinge pins are now securely fixed, the tapped thicknesses of angle and packer, together with the locked nut, will ensure adequate strength for the beam angle to hinge on.

If it is desired to increase the wearing quality of the pins they can be made from ½in. diameter silver steel, threaded and hardened, or alternatively high tensile bolts can be used, but, especially as they can be renewed easily when worn, you will find ordinary mild steel bolts quite efficient.



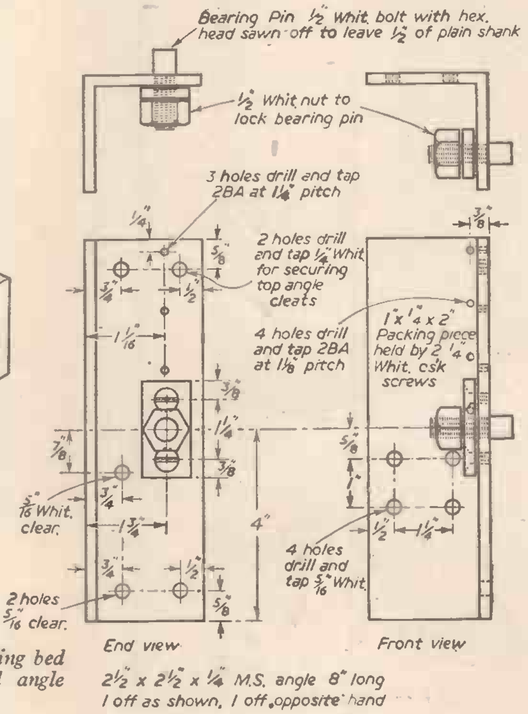
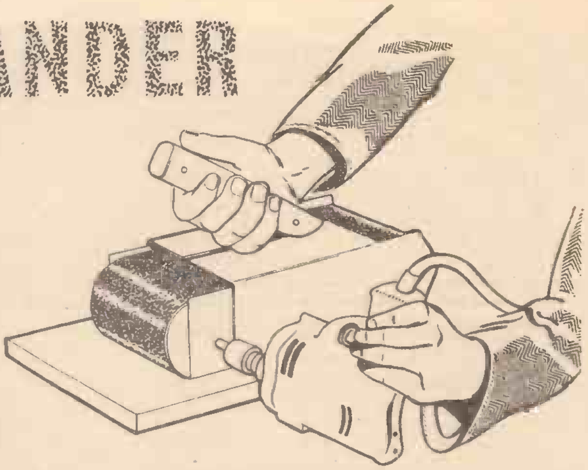


Fig. 4 (left).—Method of assembling bed and end angles and (right) end angle details.

(To be continued)

A Portable BELT SANDER



A Handy Accessory for an Electric Hand Drill

By T. W. MATTHEWS

MANY owners of the popular makes of ¼in. electric drills will have at some time or other experienced the want of another method by which they could sand down a surface of a job in hand, apart from the circular discs.

I partially solved the problem by making a sanding drum which had a centre shaft, one end of which was driven by the drill—the other end had a small ball race, the housing being fitted to a right-angle bracket, which was taken round to the drill handle, as shown in Fig. 1.

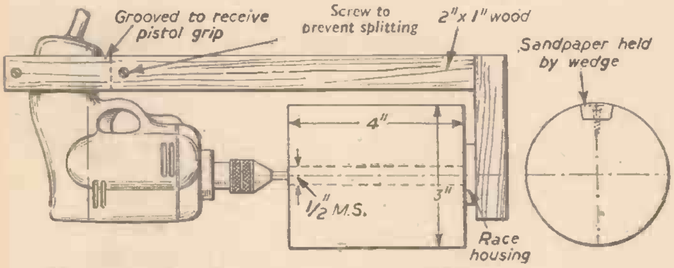


Fig. 1.—The original right-angle bracket arrangement.

This met with a measure of success on surfaces narrower than the drum, but owing to the ease with which the drum was able to be rocked it was not satisfactory on wider surfaces.

A much better design is the belt sander shown in Fig. 2. It has greater stability, cuts smoother and is easily controlled, also it can quite easily be made in the home workshop.

These belts are obtainable in many sizes, and the one selected was 4in. wide and 25¾in. in circumference; the price was 2/6. This size is used on the Bridges table sander.

Driving Shaft and Drum

The driving shaft (Fig. 3) is made of ½in. round M.S. 6in. long, centred at both ends, the right end being turned down to fit a ball race and 1/16th longer than the thickness of the race to ensure accurate fitting of housings to the side plates. The left end is turned to fit the other race, and both races have an inside diameter of about ⅜in. The remainder of the left end is turned down to ¼in. or to fit the drill chuck.

Next a 3¾in. square by 4in. long oddment of wood was drilled ½in. through the centre, the shaft being fitted through this hole and secured by a 2 B.A. bolt 2⅜in. long. Both ends of the shaft are sunk below the surface. The shaft was then placed between centres and the wood turned down to a 2⅞in. dia. cylinder and finished off with a slightly convex profile, to ensure that the belt remained central.

Rear Drum and Spindle

The rear drum was made by two pieces of wood 1⅞in. by 4½in., with faces planed flat and glued with paper between and allowed to set.

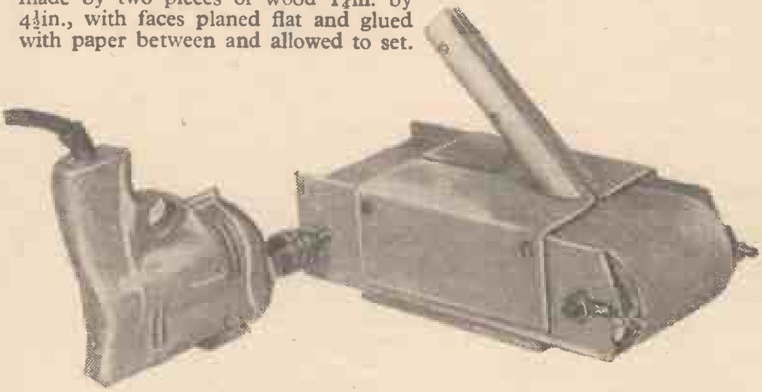


Fig. 2.—The completed belt sander.

The drum was then carefully fitted to a face plate and a hole bored through, and then counter bored one end to suit the bicycle hub which was used as the rear end shaft. The wood was then faced off, and a step exactly 4in. diameter was turned to fit a 4in. face plate. After removing the wood from the face plate it was carefully reversed on to the face plate and the reverse end counter bored. (Fig. 3.)

The spindle was then centred both ends and fitted complete with balls and cones into the hub. The bored block was then split and hub placed into position and then glued. Four screws were then put in each end through the spoke holes to hold firmly. When the glue was dry a piece of tubing large enough to clear the cones and lock nuts was placed over each end of the spindle, and a washer on to the ends of the tubing. These washers are held tight by nuts so that the spindle and block are a complete unit; the whole was placed between centres and turned down to the same dimensions as the front drum.

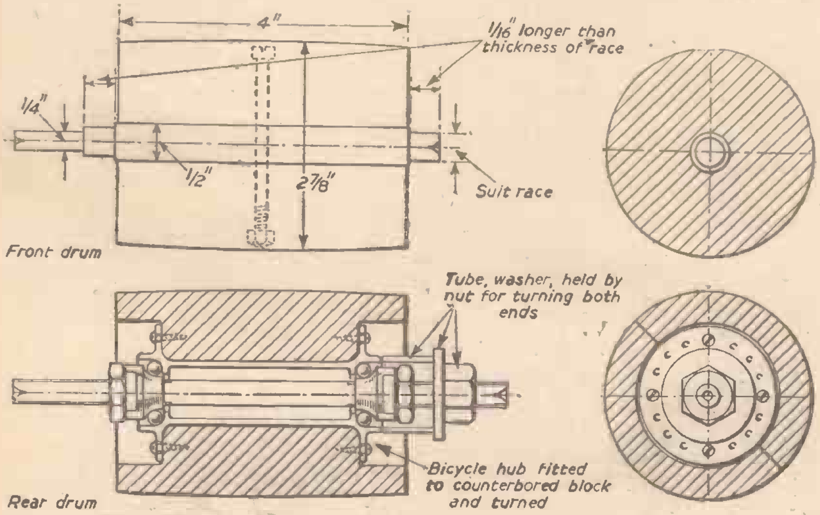


Fig. 3.—Details of the driving shaft and drum and the rear shaft and spindle.

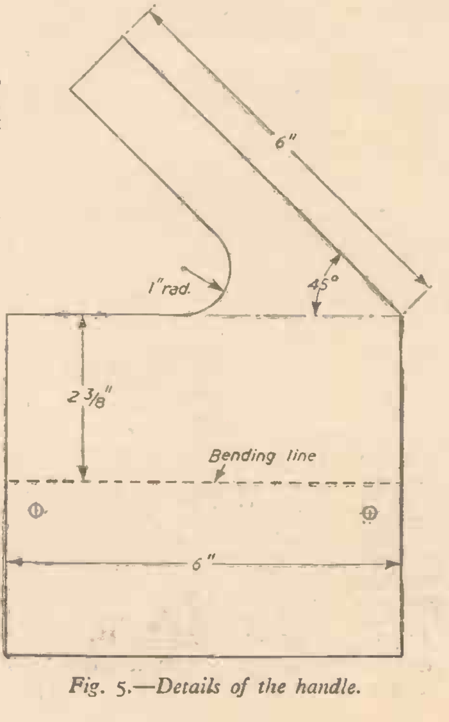


Fig. 5.—Details of the handle.

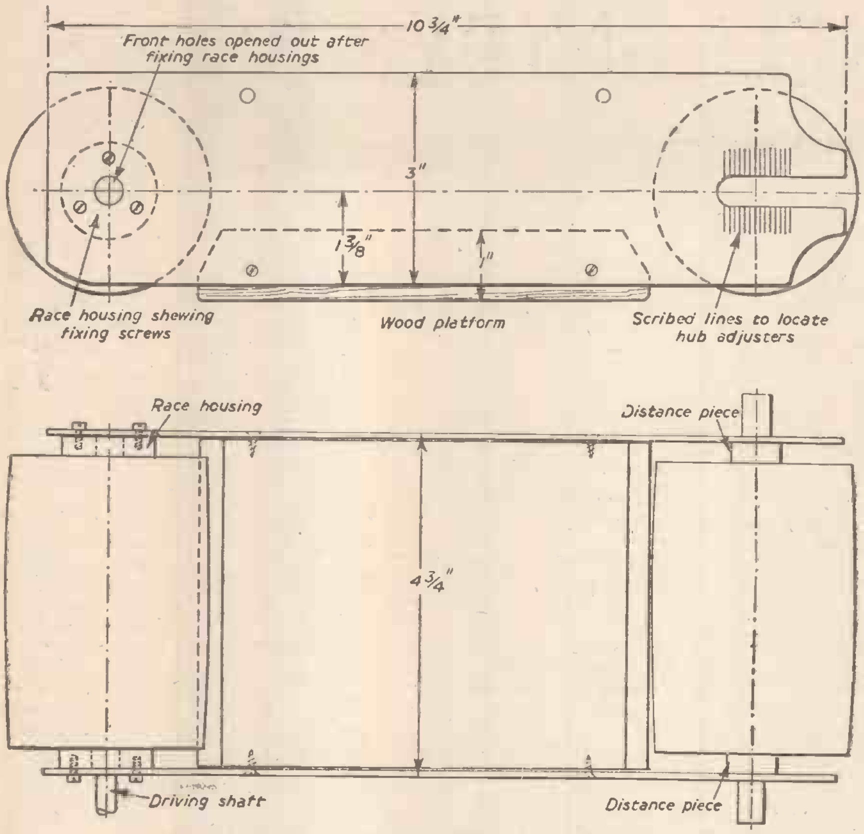


Fig. 4.—Views of the side plates and base platform.

The side plates are of $\frac{1}{8}$in. by 3in. mild steel 11in. long. The front and rear holes are drilled together $\frac{3}{8}$in. or the size to fit the hubs. The rear ends are then slotted and filed to a shape to fit the hub adjusters. Eight lines 1/16in. apart are scribed from the centre line of the rear holes towards the ends of the side plates. The adjuster rings have a line scribed in the centre to locate the correct position to enable both sides of the sander to be square. (Fig. 4.)

Base Platform

The base platform is then made with hard wood $4\frac{1}{2}$in. by $5\frac{1}{4}$in. by 1in. thick. A $\frac{1}{4}$in. rebate is then cut so that the side plates will sit on the rebate, the ends being chamfered to clear the drums. The platform is fitted to the side plates with the drums in position and the ends of the plates are checked with a square, both across the top and the front edges and then cramped. (Fig. 4.)

The outer housings of the ball races are then drilled and tapped for suitable size screws.

Handle

The handle is made of 14 s.w.g. plate and has a 45 degree angle and 1in. radius; it is then bent to shape to fit the outside of the side plates. This is shown in Fig. 5.

To improve the grip the handle has a wooden section 1in. dia. split down and screwed through, with the possible addition (not shown in Fig. 2) of a rubber bicycle handle grip.

To replace the belt. The right side plate is removed without difficulty.

Items of Interest

New Type of Storage Battery

A NEW type of storage battery, said to have a life expectancy of from 10 to 20 years, has been revealed by the Sonotone Corporation of Elmsford, N.Y., a company best known for its production of hearing aids. The battery uses nickel cadmium cells of a special sintered plate type in place of lead.

The principle of this battery is said to have been known for several decades. But production by Sonotone has been going on only since 1949. Until recently the U.S. armed services have been taking the firm's total output, and the development has remained secret. So far the company has produced some 60,000 cadmium batteries.

The battery is about half the size of a conventional storage battery. The initial cost of it is about two to five times that of a conventional battery, but because of its long life it is said actually to be about twice as economical.

Additional features add to its value. At the first demonstration given by Sonotone, a nickel-cadmium unit was frozen in a cake of ice, from which cables connected with a car motor. The battery repeatedly started the motor without difficulty.

It uses an alkaline solution instead of acid, requires only a few drops of water a year, and will operate at temperatures as low as 65 degrees below zero, Fahrenheit, and 165 degrees above. It is also unaffected by such factors as shock, vibration and short circuiting.

Underground for Istambul

IT is stated that Istambul is to have an underground railway. A French firm has been asked to prepare the plans.

Aircraft Exports

THE Society of British Aircraft Constructors have announced that exports of aircraft reached a new record total of £64m. last year, compared with £44m. in 1952.

They point out that since 1950 aviation exports have almost doubled.

Largest Oil Refinery in the World

THE Aden Oil Refinery at Aden, the largest new oil refinery in the world now under construction, is being built for the Anglo-Iranian Oil Company, at an approximate cost of £45,000,000. Engaged in this project are some 2,500 British and European technicians, together with 10,000 Arab and Indian workers.

When the refinery is completed, late this year, it will have a capacity of 5,000,000 tons of crude oil a year. Messrs. George Wimpey, the British firm, have secured the order for the refinery, estimated at £36,000,000, in conjunction with the Middle East Bechtel Corporation, and Messrs. Wimpey have also secured the order for constructing the port, at an estimated cost of £9,000,000, alone.

A link between Stockport and Aden is being provided by a 792ft. Bailey bridge, built by Thomas Storey, Ltd., Stockport.

The bridge clips 10 miles off the 29-mile road journey that had to be made by vehicles carrying plant and materials to the refinery.

Making Transformers

The Design and Construction of Small Static Transformers

FEW of the smaller electrical appliances within the scope of the amateur constructor offer a better return and surer results from his efforts than the transformer. Its design can be calculated and its working characteristics predetermined within close limits, while the constructional work it entails is of the very simplest.

Technically speaking the term "transformer" can be used to describe apparatus widely differing in principle and operation; there are rotary transformers, static transformers, voltage transformers, current transformers, etc., with further variations in the way of auto-connections and independent-windings. It is correct to speak of rotary transformers only for direct current operation, their purpose being to transform direct currents from one voltage to another. Static transformers are those which deal entirely with alternating currents or the transformation of one alternating voltage to another. Apparatus which changes the nature of the current itself, from direct to alternating, or vice versa, comes under the description of converters, and should not be confused with transformers.

Rotary Transformers

The rotary transformer, shown in diagram in Fig. 1, is used for stepping up or stepping down direct currents from one voltage to another, and is a running appliance similar in construction to a direct-current electric motor but having two windings on its armature. One of these functions as a motor winding, the other as a generator winding, the latter being connected to a separate commutator and set of brushes. By this means an output voltage differing from the input volts can be obtained according to the ratio existing between the turns in the two armature windings. Machines such as these naturally involve a considerable amount of work and skill in fashioning the running parts; also, they are subject to wear and tear which is absent entirely from the static or A.C. transformer. The latter is an absolutely stationary device; there are no moving parts. But energy in some form must be supplied to it as an input before any output is possible. If connected to a D.C. circuit it will not function as a transformer at all. What, then, is the form of energy communicated to it when connected to an A.C. circuit?

There is no visible motion with which we are accustomed in the case of most electrical and mechanical devices. The answer to this lies in the fact that although motion is unquestionably present it takes the invisible form of a rapidly oscillating magnetic flux in the molecules of the iron core, and these in their turn cause strong reactions in the stationary copper coils surrounding the core as the flux threads them first in one direction and then the other at a high rate of speed. In the rotary transformer it is the armature coils that move in a stationary magnetic field; in the static transformer it is the magnetic field or flux which moves through a system of stationary coils. The two ideas are expressed in Figs. 1 and 2. The D.C. rotary transformer in Fig. 1 shows two armature windings on one core, rotating together on one shaft, the motor commutator and brushes in connection with one set of windings, the generator commutator and brushes at the opposite end. The fields are excited by the input current which drives the armature also as a motor. Motion is represented by the curved arrow, and remains continuously in one direction. In Fig. 2, which is a conventional diagram of a static transformer, all the parts—namely, iron core, primary and secondary coils—are stationary, and it is the magnetic flux that moves rapidly to and fro through them with every reversal of current in the primary coil, and the rate of motion responding to the frequency of the supply, usually 50 cycles per second, or 3,000 cycles per minute. The flux speed is thus easily comparable with the rate of armature revolution in the D.C. type of transformer. If a static transformer were connected to a D.C. supply there would be no motion of the flux after the instant of switching on or off, hence there would be no reaction or transformer effect in the coils.

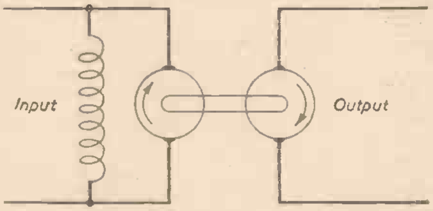


Fig. 1.—Diagram of a rotary transformer.

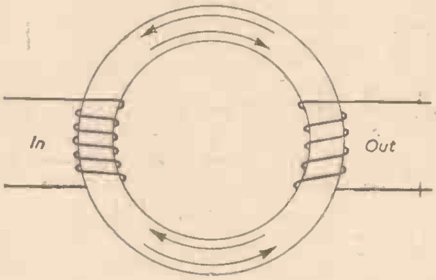
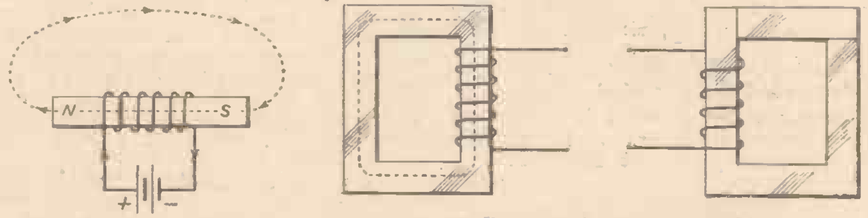


Fig. 2.—Conventional diagram of a static transformer.

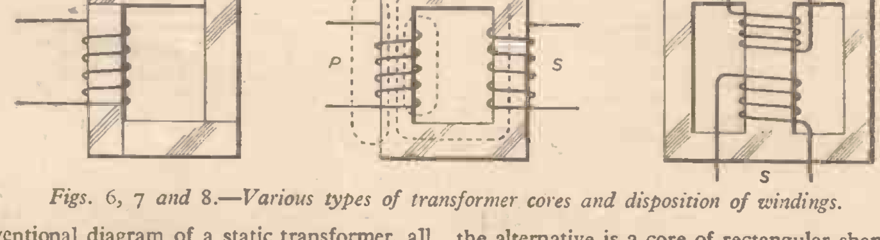
General Form

Confining attention particularly to the static transformer in the article, being the simplest of almost all electrical devices to build, one can next consider what general form they take in practice. The simple diagram in Fig. 2 represents a circular ring-shaped iron core, the most symmetrical shape that would naturally suggest itself, and, in fact, the one adopted by early experimenters. It presents rather obvious disadvantages, however, from the maker's point of view, when it comes to hand-winding a large number of turns of wire, all of which have to be threaded through the centre of the ring. This would take a long time, and inevitably lead to rather an untidy finished appearance as they could not lie closely on a curved surface. Practical considerations soon decided, therefore, that a plain straight core was necessary to accommodate the coils. Why not, therefore, a plain straight core like that of the induction or spark coil? This form proved easy enough to wind but resulted in unexpected difficulties, the chief of which was excessive magnetic leakage owing to the great air-gap existing between its two ends. Every magnetic line generated in an iron core by reason of current flowing round an exciting coil has a complete circuit of its own. Fig. 3 illustrates this. Current from the battery flowing through a coil wound over the iron gives rise to a magnetic flux, one line of which is indicated. All lines leave the coil at one end and re-enter at the other. In completing their circuits they find an easy path through the iron, but a much more difficult one where they emerge into the air, the result being to reduce greatly the number of lines set up by a given excitation. The same magnetising power of the coil can be used to far greater effect if the length traversed through air can be shortened. In other words instead of an "open" magnetic circuit a closed circuit should be aimed at, so that the lines encounter the least possible resistance. Since the circular form of closed core is open to objections already pointed out the alternative is a core of rectangular shape, such as Fig. 4. Here the magnetic lines have an all-iron path and the exciting coil lies on a straight limb, making it easy to wind, so that two distinct advantages have been secured. But still the transformer

(*Continued on page 309*)



Figs. 3, 4 and 5.—Diagrams indicating magnetic flux and shape of transformer core.



Figs. 6, 7 and 8.—Various types of transformer cores and disposition of windings.

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would not be easy to wind if the core were made in one piece, owing to the necessity of threading the wire through the centre opening. The idea of building the core in separate parts was the next step forward, the result being a two-piece construction, as Fig. 5.

Independent Coil Winding

This allows the coils being wound independently, insulated and afterwards slipped over the straight limb of the core, thus effecting a great saving of time. Eventually, it was found possible to further reduce the cost of construction by building up the sides of the core from straight slips of steel sheet, after the style of Fig. 6, since this entails the least possible waste of material and calls for no special tools or dies.

These are the stages by which the "core" type of transformer was arrived at, a form still very popular and as efficient as any. There is another form preferred by some, known as the "shell" type, Fig. 8. In this it is the centre limb that receives the coils and the magnetic flux after threading them divides up right and left at the ends, returning by the yoke or outer shell. Since the shell thus carries only half the total flux its sectional area can be reduced to half that of the centre limb. Stampings for these cores are obtainable in two forms, one a "TU" shape, the other an "EL" combination. Figs. 9 and 10.

The positioning of the two coils, primary and secondary, on any of the foregoing coils, is a matter of some importance. In the shell type both coils naturally are wound on the centre limb and there is no choice of position, but in the core type two arrangements are possible. For the sake of symmetry one would naturally incline towards putting the primary on one limb and the secondary on the opposite one, but there are objections to this course, not at once apparent. If Fig. 7 is examined, where this method is illustrated, with the primary and secondary coils separated on opposite

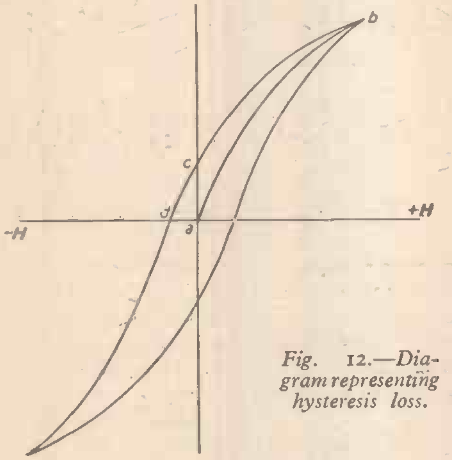
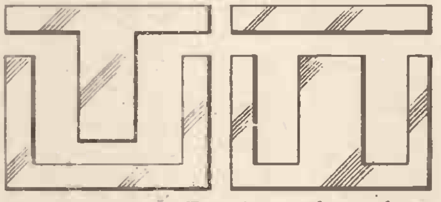


Fig. 12.—Diagram representing hysteresis loss.

limbs, it will be clear that the magnetic lines generated by coil P will have a tendency, when heavily loaded, to leak away as shown by the dotted lines, so that they do not wholly thread the other limb of the core but leak away on shorter circuits without threading the secondary coil S. Any loss so entailed upsets the true voltage ratio between the two coils and the "regulation" of the transformer suffers accordingly. The best practice, therefore, is to wind both the primary and secondary coils on one and the same limb; this restricts magnetic leakage effects to a minimum. With the same object in view, the secondary coil should be wound next to the iron core with the primary coil encircling it.

Laminated Construction

In all alternating current devices, and transformers in particular, there is a reason for using thin stampings instead of solid bars or castings, as a laminated construction checks the formation of heavy cross currents in the substance of the core when it is subjected to an alternating magnetic flux. These, known as "eddy currents," would cause serious heat losses, and it would be



Figs. 9 and 10.—Two forms of transformer stamping.

impossible to keep the temperature of the whole transformer down to a reasonable figure without this precaution. Currents

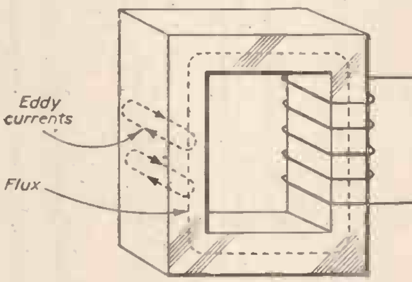


Fig. 11.—Showing the formation of "eddy currents" in a solid iron core.

such as these circulate in a direction at right-angles to the flux in the core itself (see Fig. 11) and as they are generated at very low voltages a relatively small resistance in their path reduces them to a harmless extent. When the stampings are sufficiently thin the natural scale or oxide on their surfaces forms almost sufficient resistance by itself, but in practice it is usual to give additional protection by coating one side of the stampings with very thin paper, or spraying them with a special insulating varnish.

Not only must the iron core be laminated, therefore, but the choice of material from which it is built is of importance. A definite magnetising force produces a much greater response in some grades of iron or steel than in others. Materials having a high "permeability" are, therefore, essential, and equally so is the ability of the iron to follow the rapid reversals of flux directions with as little lag as possible. Magnetic lag, or "hysteresis," means a loss of energy and lowers the overall efficiency as well as increasing the core temperature. Fig. 12 serves to illustrate both these points. An alternating magnetising force applied to the core first in the direction +H causes a response in the iron indicated by the curve a b. When the exciting current dies down again to zero before reversing, the magnetisation does not fall to zero but remains at some value c, a little higher than the point a where it is started. This is due to a certain hardness or "retentivity" of the iron. A further magnetising current, d, therefore becomes necessary in the opposite direction —H before the iron can be brought to zero condition again. The same thing happens with the second half cycle of magnetisation when current is reversed through the exciting coil. The results, if plotted out in the form of a complete curve, give a figure representing hysteresis loss in one complete cycle of magnetisation. The closeness or openness of this F-shaped curve represents magnetic friction and is a measure of the suitability of the iron for its purpose. The smaller the area enclosed by the curve the fewer watts will be wasted in iron losses and the higher the overall efficiency.

Material for Stampings

Although "Stalloy" must be regarded as a standard material for use in transformer cores, a good deal of interest centres round some of the newer alloys of nickel and aluminium with iron, such as "Permalloy," "Perminvar," "Mumetal," "Radiometal," etc. Some of these have extraordinarily high permeability values at the lower magnetising forces. Others possess an extremely small hysteresis loss, a feature which is highly important from the designer's point of view in connection with radio work. Here the frequencies are much higher than those met with in commercial transformers. Their use in such work also permits of a striking reduction in weight and dimensions. For instance, the drawing to scale in Fig. 13 shows the comparison between the sizes of stampings for two radio transformers of similar output capacity, the large one in ordinary silicon-steel and the other in special nickel-iron alloy. Their relative weights are as 24oz. to 0.64oz.

Permeability

A curious feature of some of these alloys is the way in which they are affected by the presence of the element nickel in varying proportions. The permeability of pure iron, for instance, is gradually lowered by adding from 10 per cent. upwards of nickel until a point where the nickel content reaches 30 per cent., where the alloy becomes practically non-magnetic. Further additions of nickel, however, have the rather surprising result of again increasing the permeability until a mixture of 78 per cent. nickel with iron gives an alloy superior in magnetic qualities to almost any other known substance. A small addition of copper, too, appears to

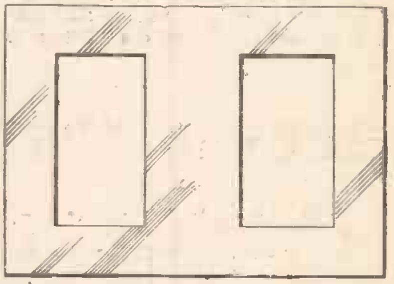
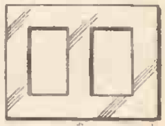


Fig. 13.—Comparison between the sizes of stampings for two radio transformers of equal capacity. The large one is of silicon steel and the other of nickel-iron alloy.



further improve performance and stabilise the properties generally. Special alloys like these, however, are expensive, and their utility lies more in the line of radio work where low magnetising forces, audio-frequencies and minimum possible dimensions count largely. For general industrial work, Stalloy or silicon-steel alloy practically holds the field.

(To be continued)

LETTERS TO THE EDITOR

The Editor does not necessarily agree with the views of his correspondents.

A 3-D Adapter

SIR,—It is a great encouragement to an old hand to see the articles on stereoscopy that you are so frequently printing in PRACTICAL MECHANICS, among them the article in your January number on the conversion of a quarter-plate focal-plane camera to stereoscopic.

Now that stereo cameras in the price range from £2 to £70 are rarely in the market, and then almost entirely secondhand, conversions fill a need. M. S. Ford's idea of converting a focal-plane camera is very welcome, avoiding as it does further shutter difficulty. However, I would not advise the addition of the reflecting arrangement, but would prefer that the lenses should be set on a plain panel with a separation of 2⅜in. This is not to avoid tricky workmanship, but in the interest of stereoscopic design.

The eye separation is generally agreed upon as 65mm., 2½in., or 1/5th part of a foot. No exactitude in this basic measurement, which is approximately that separating the eyes of an average man, is possible or even desirable. There is not even general agreement that the above values are, in fact, based upon reliable measurements. Nor is exactitude here necessary, for the eye cannot discern any aberration in stereographic slides caused by small differences in the separation; a 30 per cent. latitude is allowable there.

Regarding the focal-plane conversion we need only consider one effect of too large a separation. With a normal stereo camera it is advisable to keep out of the picture any object closer than 10ft. If such were to be included they would be difficult to "fuse," that is to say, with the gaze fixed on distant objects the foreground would seem "double," and vice versa. A conscious effort would be needed to bring the doubled objects into one; this effort is not only unpleasant, but it can lead to eyestrain and headache.

There is a well-known rule coupling that separation and the distance of the nearest object that can be included in the view; it is that *nothing closer that 50 times the separation of the lenses should be included.* In the case of the normal camera, that works out at 10ft.; that is a rule that all stereographers constantly bear in mind. With a smaller separation than normal, the nearest permissible object becomes closer than 10ft., and so a small separation can cause no difficulty of that sort. (The difficulty that might occur would be a lack of relief.)

But a separation as big as that shown in the conversion using reflectors, 4½in., makes the distance of the nearest permissible object 19ft. This feature would limit the utility of the conversion. The corresponding gain in relief would be slight in comparison. On the other hand, a separation of 2⅜in. is within 10 per cent. of normal, and the near limit will be that amount closer; the slight loss of relief will be impossible to detect by ordinary visual means.

All this is not just theory. Before the war the Thornton-Pickard Company put out their Stereo Puck camera, taking roll film, with a separation of under 2in., price £1 with a stereoscope included. This camera has a place in stereo history. One of the members of the Stereoscopic Society, Mr. R. Boswell of Coventry, still uses nothing else, regularly turning out slides of prime quality that gain the highest points in competition.

The stereogram accompanying the article in PRACTICAL MECHANICS, without being transposed, shows very well by measurement the effect of a wide separation. The distance on the print between two distant points (the church tower) is 32mm., the distance between two points on the chairback is 39mm.; a difference between the two of 7mm. In addition, the quarter-plate print is reproduced about ¾ full size, so that the difference on the original print would be 9mm. This 9mm. compares badly with the 2½mm. which is the greatest difference allowable in this case by the usual practice of stereographers. If this print were transposed and mounted as a stereographic slide the result on the stereograph would be a gymnastic exercise for the eyes, and not an exhilarating one. However, were the prints trimmed so as to exclude all window frame, the result would be very pleasant.

There is a camera newly arrived in the shops taking roll film and well furnished which is likely to prove a worthy successor to the Puck. This camera is the "Coronet," costing 36s. 11d. I recommend all newcomers to stereoscopy to make their early exercise with this camera before spending big money on a camera that may not suit them, for different people have different fancies; and it may be that the Coronet will not be laid by.

I like to see and hear of conversions, for there is great room for them. Stereo cameras of the 35mm. sort can be bought new at a price of about £80 upwards. There are secondhand cameras of the 2¼in. square type and smaller to be found at from £7 to £50, and usually very well worth the money. But whenever two stereographers meet together they talk of the possibility of converting 47mm. x 107mm. plate camera to colour film; some accomplish it, but not many.

Among the rules for stereography there are two that are of paramount importance: *nothing nearer than 10ft. in the picture, and no farther apart than 65mm. (2½in.) distant point to distant point on the mount.*—STEPHEN MOXLY (Hants).

"Electronic Brain"

SIR,—I have experienced trouble with the ball switches of the "Electronic Brain," and the method I have adopted, which is quite satisfactory, may be of use to other readers.

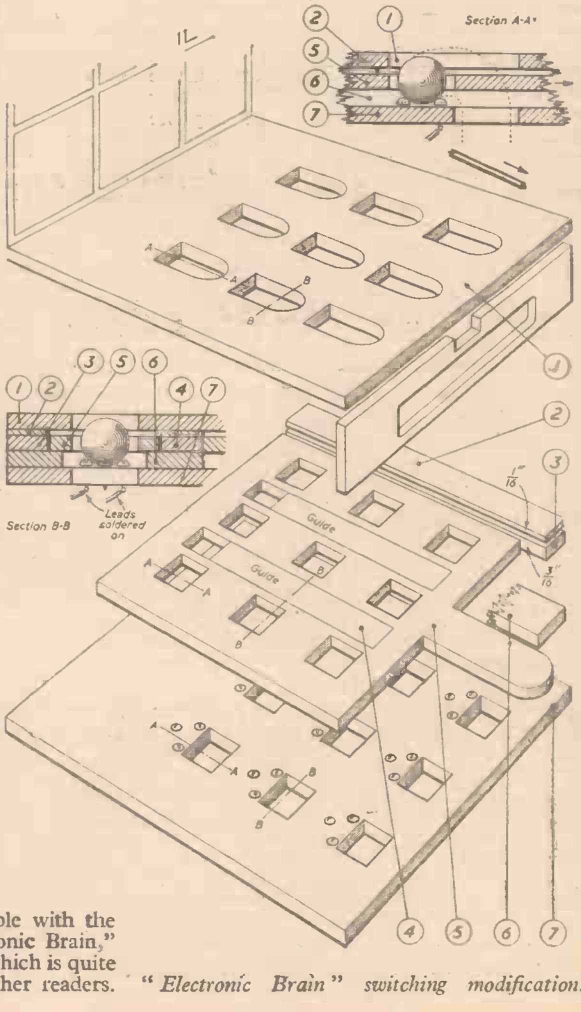
The sketches below should make my modifications clear. The advantage is that, although when the balls have once been placed they cannot be removed, should one be slightly greasy or dirty, and fail to make contact, a little pressure can easily be applied from above.

No. 1 in the sketch is the original top playing face with holes elongated to approx. 1⅛in. The sliding piece (No. 5) to remove the balls is held in position by pieces 2, 3 and 6 on each side. Those marked "Guide" are approx. ⅜in. shorter than the slot to allow movement forward. Similarly pieces Nos. 2 (1/16in.) and 6 (3/16in.) are also placed below the guides. Piece No. 7 consists of sets of three screws (⅜in.×4 brass), suitably adjusted so that the base of the ball just clears the plywood, the holes being cut just in front of the screws. The whole piece is fixed directly through the completed guide pieces (2, 3 and 6 each side, and 2, 4 and 6 in the centres) on to the top panel No. 1. The three leads as originally planned are soldered underneath the whole on to the protruding points of the screws. The entire set-up is constructed from 3/16in. plywood with the exception of four pieces of 1/16in. plywood (No. 2) used to increase the depth of the guides and ensure easier movement.

When in play, the balls are dropped directly through pieces 1 and 5 on to the three screws. To release the balls, simply pull the extended part of No. 5, when the balls are forced over the front two screws of each set and drop through to the sloping base.

In addition I have found it an advantage to have three batteries, one wired to each bank of lights. All three are accommodated under the sloping baseboard and make contact with rest of the wiring through

(*Continued on page 313*)



"Electronic Brain" switching modification.

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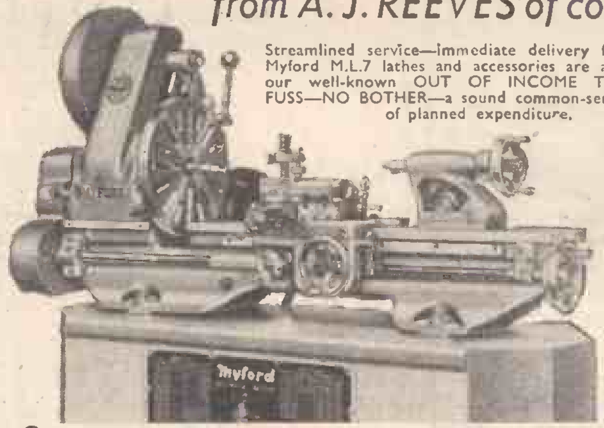

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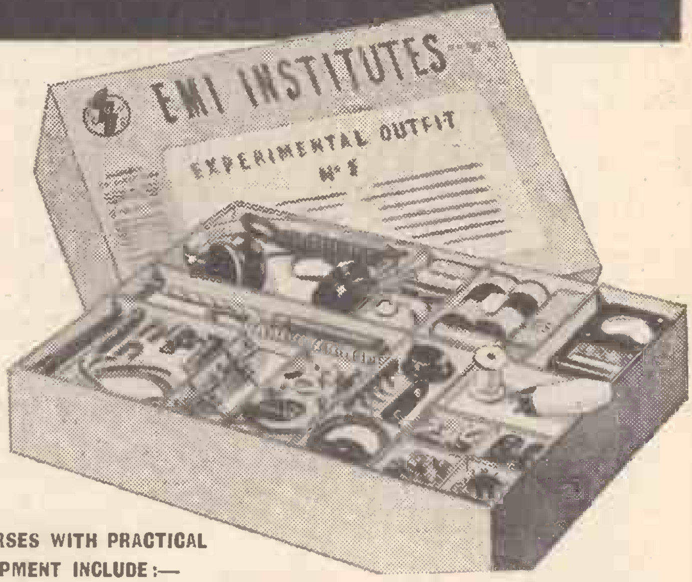

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springy brass contacts. This allows the base to be easily removed for inspection, etc., should the need arise.—R. D. WEST (Wilts).

"Have Space-ships Landed?"

SIR,—It is not possible to have much faith in "spaceships" when an ordinary three-bulb ventilated commercial-type electric light fitting is presented as a daylight photograph of one; bulbs as landing gear, suspension ring as a radar lens, ornamental rim as a power coil, etc., add to the "spoof." Any electric fitting manufacturer's catalogue will produce similar ships by the dozen.—A. E. HUNT (Middlesex).

SIR,—In your interesting and exhaustive review of "Flying Saucers Have Landed" in PRACTICAL MECHANICS for January, 1954, you briefly mention some points for discussion. On the face of it, it is difficult to believe that anyone would have the audacity to present such a story, in considerable detail, and in company with sworn statements by named witnesses, if it were not true; however, there were at least three additional points which I thought needed further explanation.

First, the author (Mr. Adamski) stated that aircraft were circling the large cigar-shaped ship (prior to his encounter with the Venusian) and then that several aircraft, including a B.36, were continuously circling the vicinity of the smaller "saucer." They had presumably seen something of interest; in fact, it must have been one of the best "saucer" sightings to that date with so many pilots as witnesses. Yet no record of subsequent cross checks with the U.S.A.F. was given.

Secondly, he stated that the Venusian made deeper impressions in the ground with his shoes because of the earth's greater gravity: this statement ignored the simple principles of mass and gravity. The impression the Venusian's shoes made would have been solely dependent on his mass (plus that of his clothes) irrespective of gravity values on other planets, and Mr. Adamski had no way of ascertaining this mass.

Thirdly, I thought it surprising that the Venusian did not mention his own name for the planet Venus after the explanatory gestures and his repetition of our name for it.

I wrote to Mr. Adamski asking for explanations concerning these points and the following is part of his reply:—

" . . . at the time of my first meeting with the man from Venus there were many questions that I failed to ask him. I believe you can understand this. He did not at that time give me the name of his planet which we call Venus; but I have learned since that all planets are known to them as worlds and are distinguished to them by their orbits. So it is natural that he did not give me their name since they have none. At least that is my understanding. As for checking up with the Air Force—have you ever tried to get information from any government source to verify one of your experiments? I stated, and I still maintain that our aircraft were circling both the large cigar-shaped ship and the smaller Scout in roundabout ways. This has been verified to me since that time, but I have not received any official information in this respect."

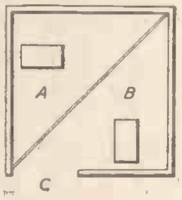
Unfortunately, I did not ask him about the gravity statement. The above explanation is unsatisfactory only in as much that the main question cannot be officially verified and still more points are brought up for discussion.—A. CARLTON SMITH (Stevenage).

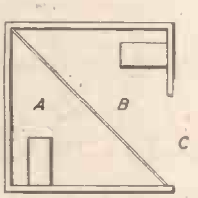
Pepper's Ghost

SIR,—Your correspondent (W. D. Barker, February, 1954) enquires about the working of a device which appeared to show the internal structure of a car battery. In all probability, this was Pepper's Ghost, an optical device invented by Dircks in 1858 and later improved by Pepper. It was used extensively on the South Bank and at South Kensington during the Festival of Britain.

It is essentially a box divided diagonally by a sheet of glass into two compartments, independently illuminated, so that the corner angle is 45 deg. Reference to Fig. 1 will make the idea clear: this gives a plan view. An onlooker at C, looking straight into the box while compartment A is illuminated, will see through the glass the object in that compartment. If this light be now extinguished while that in B is switched on, the onlooker will see instead the object B, reflected in the glass but apparently occupying the position of the original object. Dimmers fitted to the lighting will enable a gradual transition to be effected.

It is obvious that object B must be out of sight from the front, and for this reason a box divided vertically as in the elevation, Fig. 2, may serve better. The front view will then be as in Fig. 3. It may, of course, be necessary to paint at least part of the interior with photographic dead black, according to the effect aimed at. With alternate lighting, one object may be "changed" into another; continuous lighting in one compartment with





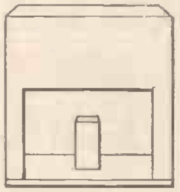


Fig. 1 (Left).—Plan view of box divided diagonally.
Fig. 2 (Below, left).—Side view of box divided vertically.
Fig. 3 (Below, right).—Front view of box divided vertically.

intermittent lighting in the other will produce "ghosts" through which furniture, etc., is visible, or even cause an object to appear inside a bottle.

There is one drawback: the glass must be very thin, owing to the fact that it reflects from both surfaces, producing a double image, the separation between which varies directly with the thickness of the glass. Hence, a sheet of very thin polystyrene or perhaps even a half-silvered mirror may help to minimise this effect. Originally a stage illusion, the device can provide a great deal of amusement in small peepshows with battery lighting.—JAMES MACFIE (Liverpool, 14).

Westminster Chimes Mechanism

SIR,—Due to the continued interest shown in the Westminster Chimes mechanism (PRACTICAL MECHANICS, February, 1954), the following points may be useful to readers.

There has been some doubt as to the function of the microswitch which is of the type that, when its metal switch strip is depressed, the switch is in the "off" position. The switch is held in the "off" position by the lever on the camshaft and when released, by depressing the push button, which "breaks" the switch, it will come into operation for one complete revolution of the camshaft, that is, for the chiming time of five seconds. When one revolution is completed the camshaft lever depresses the switch strip and the switch will remain in the "off" position until the push button is again depressed. This type of microswitch can be obtained through adverts. in these pages or from A. F. Bulgin and Co., Ltd., By Pass Road, Barking, Essex, for 5s. plus postage.

The speed control is a variable resistance in the motor circuit and any speed, that is chiming rate, from one to 10 seconds can be obtained.

To obtain maximum motor efficiency it is advisable to have accurate spring adjustment on the hammers. If not, then the motor will "surge" causing undue strain on it. Cut the springs all the same length and fit into position. Then lie the mechanism on its back and push the springs up the hammer rods until the hammer heads start to drop from the stop beam. If this is done all the springs have the same tension on them. By this means, using "Tufnol" or wooden heads, the motor load is even at 190 milliamps. This is good considering that the no load current (i.e., without gearing, etc.) is about 140 milliamps. The heavier the hammer heads the greater the motor load will be. Furthermore the spring tension belt is far better than an elastic band.

The case on my mechanism was made from bent plastic sheet. Here it is necessary to bend the sheet at right angles and this was done on a wooden former giving a bending radius of about $\frac{3}{8}$in. to $\frac{1}{2}$in. at the corners. The plastic was heated in the oven of a household electric cooker for a few minutes at 225 deg. to 230 deg. F. The plastic can easily be handled at this temperature. I have had no success with the boiling water method of bending plastic, moreover it is difficult to handle under those conditions.

The rheostat knob can, if so desired, protrude from the side of the case, or a flap can be cut in the case top for access to the battery and control knob. — "TEST ENGINEER" (Glenrothes, Fife).

Setting up a Barometer

SIR,—Periodically in your pages information is published on how to construct or repair mercury barometers, and recently in "Queries and Enquiries," a reply gave details of how to fill the tube by boiling the air out of it. When I constructed my own I followed these instructions and found them to work well.

All your contributors, however, seem to make the mistake of setting it by another barometer. This is, if I may suggest, entirely wrong as the mercury barometer is the standard by which other barometers are set. The difficulty is easily overcome by marking a zero on the board where the bowl will be, and making a small scale for about 3/10in. above and below, so that if an exact reading is required the correction may be applied. If desired, the correction for elevation may be applied and the level of the lower bowl set so that the instrument reads sea level pressure. In this case the scale is extended 3in. or 4in. above the zero, to facilitate setting. As a guide, the setting for 1,000ft. is 1.08in.; 2,000ft., 2.12in.; 3,000ft., 3.12in. above the zero. To set the barometer in this case, take it to a known height near the site of the barometer and read the scale. Then read the barometer in its final site and note the difference between the two readings. The interval of time should be as short as possible between readings. Then calculate the correction from the above table and add or subtract the difference as obtained above. If the site of the barometer is above the known height the difference is added to the correction, or vice versa. Conversely, the height of the site can be calculated from the difference measured. If this is done then the barometer will be reading in concord with the weather maps as published in the papers and other weather information.—D. C. RICHARDS (New South Wales).

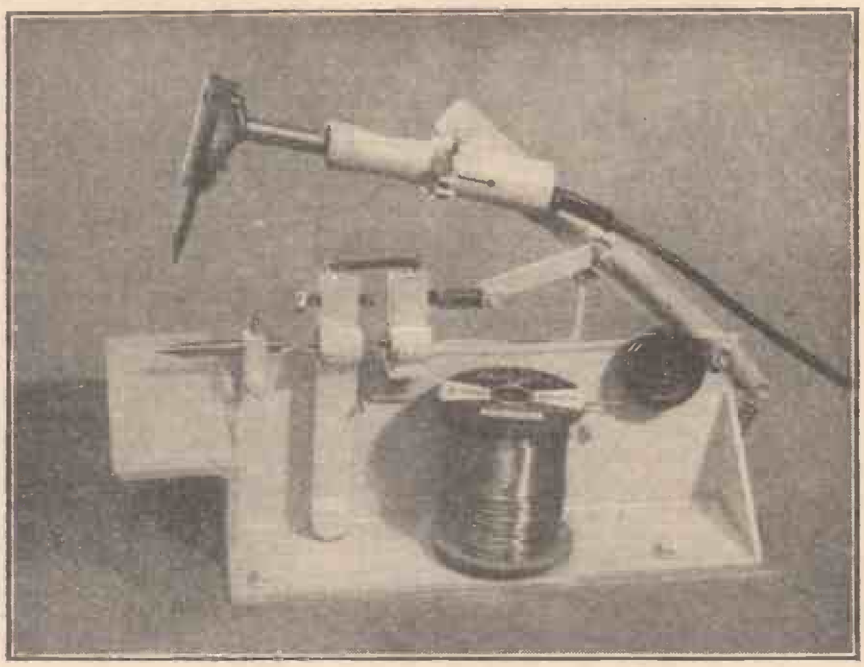
Trade Notes

Wolf Cub No. 8 Fretsaw Set

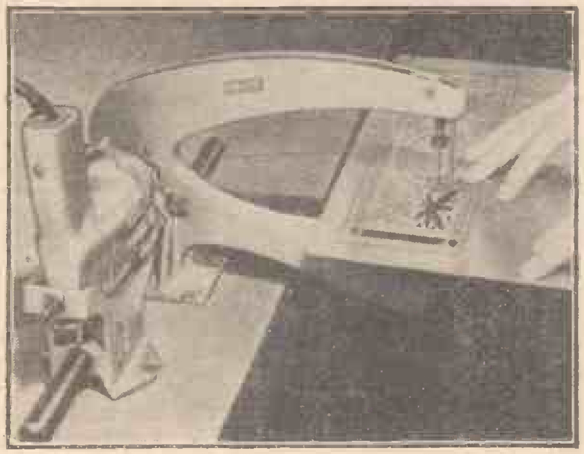
HANDYMEN, model makers and, more particularly, fretsaw enthusiasts will be interested in the latest addition to the Wolf Cub range of home constructor equipment—a fretsaw attachment for use with the Wolf Cub drill. The new fretsaw is of sturdy construction, possesses an operating speed of 2,000 strokes per minute and a throat depth of 8in.; enabling work to be cut to centre of a 16in. circle. Cutting capacity in wood is ½in. thick or ⅛in. in non-ferrous metal. Blades of special design and special steel exclusive to Wolf are employed.

Power is provided by the Cub drill, the drive being delivered by an eccentric arbor fitted into the drill chuck, through an ingenious rocker arm mechanism, thence to the saw blade by means of two pure nylon belts. Blade changing and tensioning are instantly and easily effected and the work table of pressed steel measuring 6in. square is mounted on a machined platform. An adjustable guard and workholder is mounted on the top arm of the fretsaw frame and this holds work down when cutting and protects the moving saw blade from breakage. Apart from occasional lubrication no maintenance attention is necessary.

The Fretsaw No. 8 set is supplied complete with 12 high-speed blades for wood, plastics, etc., and 12 for non-ferrous metals. It is priced at £3 15s. od. For those wishing to obtain the complete fretwork equipment, a fretwork kit which includes Cub drill, bench clamp and pillar can be bought at a cost of £10 19s. 6d. This latest addition to the Cub range now brings within reach of the handyman the means for drilling, sanding, polishing, wood turning, bench drilling, bench sawing, fretsawing, etc. Starting with the Cub drill, the necessary conversion sets for covering this extremely wide range of activities can be purchased in easy stages. The new fretwork equipment is now available from all leading tool merchants and descriptive literature is available from Wolf Electric Tools, Ltd., Hanger Lane, London, W.5.



New Multicore Automatic Soldering Head.



Wolf Cub No. 8 Fretsaw Set.

Multicore Solders

NEW ideas in solder and soldering will be featured on the Multicore Solder Stand at the 1954 Radio Components Show, which opens at Grosvenor House on April 6th. The main exhibit is, of course, devoted to the well-known Ersin Multicore Solder containing three cores of non-corrosive flux and, besides the usual tin/lead alloys, Ersin Multicore Solder will also be shown in extra high and low melting point solders and one containing silver for use on silver-plated ceramics. Standard gauges available range from 10-34 s.w.g.

A new type of Ersin Multicore Solder which will be shown contains five cores of a new Pentacol derivative non-corrosive flux, specially formulated for extreme soldering speed and used for jointing of extremely oxidised components. At present it is being supplied only to manufacturers. Many other special solder products will be exhibited.

Engineers engaged in planning repetition soldering processes of small parts will be particularly interested in a prototype model of the new Multicore Automatic Soldering Head. Multicore solder drawn from a 7lb. reel is automatically fed above the components to be soldered and an electrically-heated iron automatically descends and solders the components concerned. The machine will accommodate any diameter wire between 13 and 19 s.w.g. and feed any length of solder between 1/32in. and ⅜in. per movement. These machines are intended for manufacturing processes, including soldering, and are not suitable for radio servicing.

A wide range of packs for service engineers and workshops includes Ersin Multicore Solder, Arax Multicore Solder, Multicore Tape Solder, which melts with a match, and, in addition, the new Bib Wire Stripper which is being shown for the first time at an exhibition.

New B.E.N. Model "IM" Spray Gun

THE Model "IM" is a pressure-feed internal atomising spray gun designed to handle a wide variety of finishing materials, such as oil paints, distempers, cellulose and synthetics, and the new range of plastic emulsion paints.

By utilising the internal mix principle comparatively low pressures are required, ranging from 20lb. to a maximum of 40lb./sq. in. It consumes approximately 2 cu. ft. of air per minute and can thus be used with even the smallest air compressor.

A special feature of the "IM" gun is a small pressure relief valve which ensures that the maximum pressure of 40lb./sq. in., for which the quart cup is designed, is not exceeded.

The container is offset in relation to the gun body, resulting in the centre of gravity being nearer the handle. This gives a better balance and with the light weight of the gun makes it very easy to handle.

For spraying larger quantities of material than can be held in the quart cup, the Model "IM" Spray Gun can be adapted for use with a standard pressure paint container.

(Continued on page 317)

The B.E.N. Model "IM" Spray Gun.

READERS' SALES AND WANTS

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

FOR SALE

TYLER SPIRAL HACKSAW BLADES are "all-ways" sharp; cut intricate shapes in steel, wood, plastics; 12 Blades and Adaptors to fit Standard Hacksaw 5/6 from your local dealer, or 6/-, post free, from Spiral-Saws Limited, Trading Estate, Slough.

TRANSFORMERS, Rectifiers, Volt and Ammeters, Controllers, Cut-outs, Battery Chargers, Power Units; lists; s.a.e. Harry Gilpin, Manufacturer, Portobello Works, Walton-on-Naze, Essex.

PERSPEX for all purposes, clear or coloured, dials, discs, engraving. Denny, 15, Netherwood Road, W.14. (SHE. 1426, 5152.)

HOUSE SERVICE METERS, credit and prepayment; available from stock. Universal Electrical, 221, City Road, London, E.C.1.

ELECTRIC BLANKET; make your own in 5 minutes; we supply the interior element complete, 6ft. long, 2ft. 6in. wide, and 9ft. of flex attached; tested and guaranteed; 35/-. Dept. E.L., Brace, Dairy Green, Thaxted, Essex.

PLATED Nuts, Screws, Washers, Bolts, Soldering Tags, Hank-bushes, Self-tapping Screws, Grub-screws, Socket-screws, Wood-screws; large quantities or gross cartons. List sent post free. Sinden Components Ltd., Dept. E., 117, Churchfield Road, Acton, W.3. (ACOrn 8126.)

HIGH-SPEED LATHE TOOLS, set of 12, ⅜in. square, 40/-, p. and p., 1/-; 24 High-speed Drills up to ⅜in., 17/6, p. and p., 9d.; 5 pint Brazing Lamp, list £7/15/-, our price, 70/-, p. and p., 3/6; Surface Plates, 12in. x 8in., 40/-, p. and p., 4/-. Send 6d. for list of tool bargains. Mibro Equipments, 65, Knaresborough Rd., Harrogate.

STARLON PLASTIC ENAMEL PAINT in tubes, 1/- each, covering approximately 8 sq. ft., or complete cycle frame; suitable all paintable surfaces. Colours: rich brown, bright red, pink, bright blue, maroon, turquoise, cream, yellow, black, deep green, bright green, mid-grey, white and clear; home trade and export. Obtainable from Handicraft, Hobbies and other shops, or send 1/3 for sample tube and colour card, post free, to sole manufacturers: Starline, Southend, Essex.

COMPRESSORS for sale, 2¼ CFM, 180lbs. sq. in., on metal base, with driving wheel and receiver, price £3; ¼ h.p. Heavy Duty Motors, price £3; carriage forward. Wheelhouse, 1, The Grove, Isleworth. (Phone: Hounslow 7558.)

DYNAMOTOR UNITS, input 28v. D.C., output 150-300v.; easily convertible without rewinding to 21lb. enclosed electric motor, with short ½in. drive shaft, 200-240v. A.C.; unit comprises heavy gauge steel box containing motor, solenoid switches, heavy silver contacts, coils, chokes, suppressors, terminals, plugs and wiring; weight, complete, 35lbs.; price 37/6, carriage 5/- extra; 6ft. Flexible Shaft for above motor, complete with special drive fittings and drill chuck, 27/6. George Wilton, 92, Toynbee Road, Wimbledon, S.W.20.

NUTS, BOLTS, SCREWS, Rivets, Washers, and hundreds of other items for model engineers and handymen; s.a.e. for list. Whiston (Dept. PMS), New Mills, Stockport.

THE SCIENTIFIC SUPER-TONIC SUNLAMP giving very powerful ultra-violet rays and a marvellous tan; all mains; only 50/-, complete with goggles and instructions; p.p. 2/-; s.a.e. brochure. Dept. D., Scientific Products, Shipley, Yorks.

HARDENTAL BURS, Roundhead, Cylinder, Inverted-Cone Types, 8 sizes, all on 3-32in. mandrels; for model making, sculpting, mechanics; 3 dozen assortment, 10/6, post free. Metrodent (PM), 78, John William Street, Huddersfield.

FRACTIONAL SYNCHRONOUS GEARED MOTORS, 230v. A.C., S/Ph., 50c., final speed 1 r.p.h., and similar 2 r.p.h.; price 12/6 each, plus 1/- postage. Universal Electrical, 221, City Road, London, E.C.1.

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80W. BALLASTS, H.P.F., complete, 35/-; p. and p., 2/-. J. B. Electrics, 14a, Glading Terrace, London, N.16.

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STEAM Cars, Dimensioned Drawings, Books, Magazine on small units for cars, launches and stationary use. S.A.E. for free lists. "Light Steam Power," Kirk Michael, Isle of Man.

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TOY CASTING MOULDS, soldiers, sailors, airmen, etc.; moulds for plaster work, rubber moulding compound, granulated, ready for use, 8/6 per lb. Rubber Moulds from 2/- each; 9d. for catalogue; s.a.e. for list. F. W. Nuthall, 69, St. Mark's Road, Hanwell, London, W.7.

GROW Valuable Living Miniature Trees; wonderfully decorative; terrific new hobby; send s.a.e. for details: Miniature Trees, Dept. 90, Room Two, 3, Bloomsbury Street, London, W.C.1.

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BARGAINS FOR ELECTRICIANS.—Brand new Cables in 25-100yd. lengths; T.R.S. twin, 1/044, 42/-; 3/029, 60/-; 7/029, 95/-; 3/029 with earth, 72/6; 7/029 with earth, 117/6; P.V.C. twin, 1/044, 33/6; 3/029, 56/-; Transparent Flex, 14/36 twin, 17/6. All per 100yds.; carriage paid. Fully wired Ballast Units, 38/6; c.w.o.; request list. Jaylow Supplies Ltd., 93, Fairholt Road, London, N.16. (Tel.: STAmford Hill 4384.)

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MYBLO Ball-bearing Circular Saw-bench, 18in. x 13in. rise and fall table, ripp, and mitre fences, riving knife and guard, 9in. and 6in. saws, grooving cutters, sanding plate and discs, ⅓ h.p., 230v., A.C., single-phase ball-bearing motor, pulley and endless V-belt; all brand new; £25/10/-. P. Blood & Co., Wolseley Bridge, near Stafford.

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FUND RAISERS.—Club Badges, samples. 2/6. Bernard, 81, Abbotsbury Way, Ham Estate, Plymouth.

BOOKLETS, "How to use ex-Gov. Lenses and Prisms," Nos. 1 and 2, price 2/6 ea.; ex-Gov. Optical lists free for s.a.e. H. English, Rayleigh Road, Hutton, Brentwood, Essex.

"FORTUNES IN FORMULAS," 900 pages, 10,000 formulæ, processes, etc., 25/-; American Magazines covering every interest. Stamp for lists. Herga Ltd. (Dept. P.), Hastings.

PHOTOGRAPHY

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

EXPOSURE METER incident light photo-electric construction kits, 45/- complete; s.a.e. details. G.R. Products, 22, Runnymead Avenue, Bristol, 4.

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MUSICAL MECHANISMS. Swiss made, for fitting in cigarette boxes, etc., 22/6 each. Send s.a.e. for complete list of handicraft materials. Metwood Accessories, 65, Church Street, Wolverton, Bucks.

MAKE YOUR OWN MUSICAL BOX. Swiss made Movements, 22/6; s.a.e. list of tunes. Albert's Music Shop, 176, Heath Road, Twickenham.

RADIO

CAN YOU SOLDER? That's all you need to make a really good Radio or Tape-recorder from guaranteed Osmor components; send 5d. (stamps) to-day for free circuits and lists. Dept. P.M.C.I., Osmor Radio Products Ltd., Borough Hill, Croydon, Surrey. (Croydon 5148-9.)

TAPE RECORDER

HERE IS THE DISCOTAPE to convert your gramophone into a high fidelity Tape Recorder. The Discotape Kit comprises the Erase and Record Replay Heads, their mounting sockets and platform, main drive capstan, take-off/take-up spindles, driving belts, and complete ancillary mechanical parts ready for mounting on your gram. platform, converting it into the playing desk, plus all components, from the punched and drilled chassis down to the last nut, for a small (5in. x 5in.) easy-to-build oscillator/pre-amplifier unit which plugs into your radio receiver using it as the main amplifier. Does not preclude use of gram. or receiver for normal purposes. For Cine work, special adaptor is available for tape-to-film scene synchronisation. Building instructions written in non-technical language with clear, stage-by-stage diagrams available separately; price 3/6, refundable on purchase of Kit. Send for your copy now! Price complete kit, £12. N.E.A.L. Acoustics Ltd., Court St., Leamington Spa.

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MANUFACTURERS with world-wide Distributing Organisation and reputation, require Manufacturing and/or Marketing Rights for additional lines. Products mainly of interest to the Hardware, Building, Electrical and Engineering Trades preferred. Replies, which will be treated as strictly confidential, should be addressed in the first instance to Messrs. Rumble, Crowther & Nicholas Ltd., 184, Strand, W.C.2.

WANTED

WANTED, PRACTICAL MECHANICS, April, 1948, containing article, "Making A Telescope Reflector." Gill, 125, Harborough Road, Oadby, Leicester.

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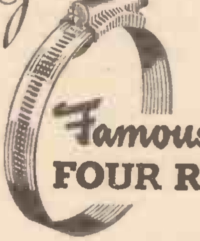

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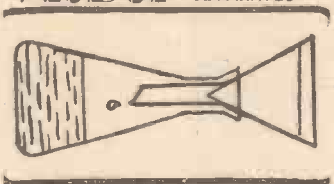

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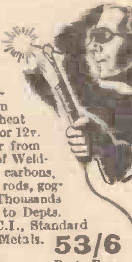

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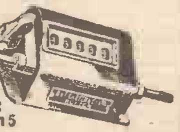

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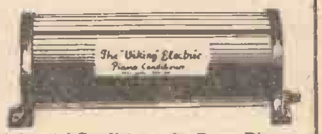

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The Model "IM" Spray Gun will be found useful for interior and exterior decoration, bronzing and lacquering, stencilling, cellulosing, and for factory, farm and estate maintenance. The maker's address is B.E.N. Patents, Ltd., High Wycombe, Bucks.

Duraplug Rubber Plugs and Sockets

WE have received samples of the following additions to the Duraplug range of unbreakable rubber plugs and sockets:

- 13-amp. 3-pin fused plug, fitted with 13-amp. fuse to BSS.1362. The retail price is 4s. 3d. each.
- 5-amp. 3-pin panel mounting plug. This is designed for mounting permanently on the side of apparatus, etc., and which can be used in conjunction with weatherproof cable coupler socket. The retail price is 4s. 6d. each.
- 5-amp. cable coupler socket cover. This is for rendering a live socket portion safe when not in use. The cover fits snugly under the skirt, giving complete protection. The retail price is 2s. 6d. each.

These plugs and sockets are made by W. W. Haffenden, Ltd., Richborough Rubber Works, Sandwich, Kent.

New Pressure-feed Paint Roller

THIS device is claimed by the makers to be the cleanest method of painting known and all smooth surfaces, such as ceilings and walls, are quickly given an even coat of paint. Operating details are simple: the container is charged with paint, air pressure is applied with a tyre pump or the Compton air compressor (an air pressure of about 10lb./sq. in. is adequate for most purposes), the regulator is turned on and the work started. Positive and accurate finger-tip control of the paint flow is provided by this graduated regulator. Cleaning after use is easily effected and the apparatus is simple to dismantle. The makers are Messrs. Dawson, McDonald and Dawson, Ltd., Compton Works, Ashbourne.

The "Editor" Tape Recorder

TAPE RECORDERS (ELECTRONICS), LTD., 3, Fitzroy Street, London, W.1, have supplied us with details of their new "Editor" suitcase tape recorder which they claim the smallest mains-operated fully automatic tape recorder made. The following is its specification: tape speed, 7½in. per second; Mullard miniature valves; twin track heads; three high-grade specially designed recording motors give fast forward run and 50-second rewind without unlacing tape; independent bass/treble controls for recording and playback; negligible wow and flutter; overall negative feedback; 1,200ft. reel of tape gives one hour playing time; amplifier may be used independently for very high quality record reproduction and public address; high-fidelity record head; special high-grade speaker; provision for external speaker; speaker muting switch; extremely high output—brilliant reproduction; compact for ease of handling—only 16¾in. x 12in. x 7in. (with lid); operating height only just over 5in.; positive servo braking on all functions; weight 33lb. The "Editor" should find favour in commercial, domestic and professional spheres, and it is priced at 45 guineas.

Compton Pressure-feed Paint Roller.

Lasuds Sets

THESE sets will be of interest to the lathe owner who wishes to install a system for supplying liquid coolant and cutting fluids. All the parts are available separately or the complete set may be supplied, price £12 12s. 0d., including postage, packing and c.o.d. charges. The parts listed as an example of a typical layout are as follows: Centrifugal type pump, with body clip, pivot bolt, nut and washers, which can be driven by machine motor. Pump bracket, securing pump to cabinet or stand. V-type pump pulley, screwed to pump shaft. Heavy gauge steel tank with welded joints, 1¼ gallons capacity. Two heavy gauge steel straps to encircle tank. Tank "T" piece, taking drain from tray and feeding pump. Stand pipe of heavy gauge steel with integral tap and bracket. Stand pipe swivel bracket with bolt, nuts and washers. Drain tube, taking drain from tray. Six feet of flexible tubing. Six feet of belting for pump drive. Stand pipe flexible nozzle, 12in. long, metal braided. The set may be adapted to a wide range of machines and applications. A list may be had on request from the manufacturer—Leonard A. Schofield, Peter Street, Yeovil, Somerset.

Club Reports

New Holloway Group

WE have recently formed a group interested in the making of model power craft.

This group enjoys the use of a well-fitted workshop complete with lathes, power-drilling machine, grindstone, suitable benches, tools and equipment. Instruction is by a qualified power craft expert, and it is felt that enthusiasts might like to avail themselves of these facilities which are available at the enrolment fee of 4s. per term, that is, from Christmas to Easter, and from Easter to mid-summer. Refreshments are also available.

Our group has already succeeded in placing a number of craft on the water, and the two photographs below are of models made by our members. Inquiries should be addressed to The Principal, Islington Men's Evening Institute, Robert Blair School, Blundell Street, Holloway, N.7.

QUERIES and ENQUIRIES

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.

Focal Plane Shutter Details

PLEASE give me details of a focal plane shutter in its simplest form, giving a fair range of speeds.—R. S. Humphris (Liverpool, 5).

THE focal plane shutter of a camera is a roller blind of perfectly opaque black fabric. This blind is rolled upon two rollers, one at the top of the case on the camera back and the other at the bottom. Running across the whole width of the blind, parallel with the rollers, there is a slit in the fabric, the breadth or height of which slit is adjustable. Inside one of the rollers there is a long spiral spring, which can be wound up by hand to any desired tension according to the speed required of the shutter. The tension is indicated upon a calibrated scale. In addition there is a trigger release for setting off the shutter at the desired moment. From this it will be seen that there are two means by which the exposure can be regulated: one by the tension on the spring and the other by the width of the slit, which slit, when the shutter is fired, passes vertically, usually in an upward direction, immediately in front of the plate or film. So, it will be seen that the whole of the sensitised surface of the film is not exposed all at one time, but only to the extent of the portion uncovered by the slit, consequently when photographing your rapidly moving objects the effect of movement is neutralised.

Brake Stop Lamp

I AM planning to fix a small pilot lamp on my car dash to show that the brake stop lamp is working. With the pilot lamp in series with the stop light (on the earth side) I find that my stop light does not light up but the pilot does. The lamps are rated at six volts, six watts and 8.9 volts, four watts, respectively. Can you say, please, what ratings would give approximately the same illumination in series as the above give normally on the six volt circuit?—K. N. Howard (Hants).

WHATEVER size of lamp you fit in series with the brake stop lamp the illumination of the stop lamp will be reduced unless you use three volt lamps for the stop lamp and the pilot lamp. For equal illumination of the stop lamp and pilot lamp, both lamps should be rated at three volts and have the same wattage, but you will probably find it impossible to obtain three volt lamps of sufficiently high wattage.

A possible solution to your problem would be to connect an ammeter of low resistance in series with the stop lamp. If necessary a contact could be made between the needle of the ammeter and a pin in the instrument when the needle is deflected by the stop lamp current. The contact could be arranged to light a six-volt pilot lamp, of any wattage, from the battery.

Choosing Binoculars

PLEASE give me some advice on choosing a pair of binoculars as I know little about them. Why can some glasses of 15-20X magnification be sold at approximately £20, whereas others of lower magnification cost much more? What advantages do "bloomed" lenses give?—J. D. Taylor (Northumberland).

THE matter of price compared with magnification of binoculars depends upon many factors, but chiefly upon the design and optical perfection of the lens components and the perfection of the mechanical portions.

In choosing a pair of binoculars the selection should depend upon the class of observation for which they are to be chiefly used. If viewing at night or in twilight is important, then the aperture of the object glass should be large and the focus of the eyepieces fairly long, since light gathering power must be paramount; the use of a prismatic instrument is a decided disadvantage. If on the other hand use in brilliant daylight is the main object, the focus of the object glass can be long and the overall length of the instrument shortened by the use of trains of prisms. Such prisms not only cut down the amount of light reaching the eyes, but do not improve defining power. Instruments with triple achromatic object glasses and achromatic orthoscopic eyepieces with no prisms are, we think, to be preferred to any other type, though they are much more bulky. Bloomed lenses have the effect of cutting off all light rays except those passing directly through the object glass. The blooming has no effect on the useful light rays.

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

Pattern Contraction

WILL you please tell me the contraction rate for patterns producing "Mechanite" castings.—M. W. Reade (Hants).

WE suggest you allow ⅛in. per foot on your patterns for this material. Of course, you will appreciate that this information is given subject to the usual proviso that the castings are of reasonable section and not comprised of long, narrow projections.

Electric Airing Cupboard

I WISH to make an electric airing cupboard for the drying of washing and sweaty clothes (track-suits, sweaters, etc.). The size will be 72in. high, 21in. wide and 14½in. deep.

Would plywood be suitable, and how should it be painted to protect it from heat and moisture? How could I obtain the necessary ventilation without excessive loss of heat? What should be the size, type and position of the heating elements and how should I protect them and the electrical circuit from moisture?—B. Cox (Droitwich).

WE do not recommend plywood (a) from fire risk or (b) from warping, but suggest the use of thin sheet metal, aluminium is suggested, sprayed or painted with one of the glossy heat-resisting celluloses, obtainable in most colours from any hardware merchant.

Ventilation should be through a series of holes or one narrow slit at the top of the cabinet. Free movement of heated air (circulation) is relatively of greater importance than high temperatures within the cabinet. The cold air inlets should be below the heating elements and about two-thirds of the area of the vents at the top, because the air will expand on heating. This will ensure speedy removal of the humid air.

The heating unit should be in two units, each of 1 kW. and wired so that you can have either one or both in action. Arrange a grid of metal, such as wire netting, at least 12in. above the heating elements (which should be of the black radiation type) as a guard against the possibility of clothing falling off the horizontally arranged bars in the upper part of the cabinet. With such a design as you have in mind you must put the clothing, if very wet, through a wringer, for you must not risk actual drops of water falling upon the heaters.

Glass Flower Making

I WISH to make glass flowers and small ornaments from waste glass. Could you supply formulæ for colouring glass in as many colours as possible? I want to have both transparent and opaque colours. I propose to melt the glass into moulds and colour it at the same time, in small quantities. Then the various pieces would be assembled with a blow-pipe and the whole piece mounted on a glass powder-bowl or similar articles. Would it be necessary to anneal the glass after processing? Will an electric domestic oven be suitable for annealing? To what temperature and for what time should I set the oven?—F. G. Seymour (Natal).

(*Continued on page 320*)

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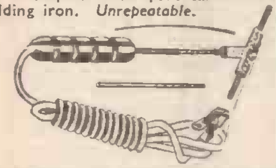
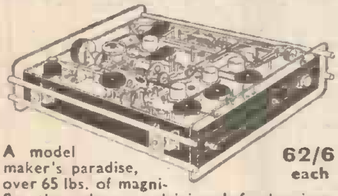


BOMB SIGHT COMPUTOR



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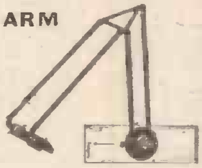

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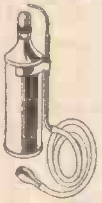

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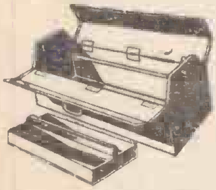

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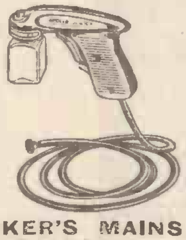

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STEP-DOWN TRANSFORMERS, input 180/230 v. a.c., 50 cycles, output 4.2, 4.2 v., 10 amps., ideal for soil heating, spot welding, etc., 35/- each.

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GLASS is coloured by adding various substances to the fused glass. A list of such chemicals with the colours they produce is given below. *Small* quantities of the necessary chemical are well stirred into the molten glass. If too much of the chemical is used the colours will become almost black. Opaque milky glass is produced by the addition of calcium phosphate to the melt, and coloured opaque glasses by the addition of a chemical plus calcium phosphate.

Red : cuprous oxide.
Green : chromic oxide.
Yellow : cadmium sulphide.
Violet : manganese dioxide.
Blue : cupric oxide, or cobalt oxide.
Black : large quantities of ferric oxide and cupric oxide.

Annealing the glass after processing is a very necessary operation. The final stages of the annealing can certainly be carried out in an electric oven. The oven is brought to as high a temperature as possible, and the glass after preliminary slow cooling is placed in the oven. The door of the oven is closed and the power switched off. Owing to the lagging which is present in electric ovens the time taken to cool is considerable, and the glass is thus cooled slowly.

With regard to fixing the completed decorations to the top of glass boxes, it is suggested that this is done by the employment of a suitable cement, as, in general, the tops of such boxes are of thick glass and are not easy to operate on.

"Easing Oil"

I AM troubled with the familiar white corrosion which occurs around screws (steel) and instruments themselves of aluminium when the bezel and body are both of the same metal.

Could you suggest a recipe for an "easing oil" for loosening stubborn threads ?—J. Scott (Fareham).

THE white surface corrosion of which you complain will, more likely than not, be found to consist of aluminium oxide. It is due to dampness, but it is of no great consequence and is readily removed from the metal by any gentle abrasive treatment. The best way to keep it at bay is to smear a little oil or vaseline over the metal surface.

What you call an "easing oil" (i.e., a penetrating oil) can be made very readily by mixing approximately equal parts (by volume) of methyl salicylate (oil of wintergreen) and any good light machine oil. This will loosen stubborn threads quickly.

Removing Watermarks from Polished Slate

COULD you please inform me how to remove watermarks from a polished black slate switchboard panel ? —I. Christie (Nottingham).

THE problem of removing the watermarks from the polished slate depends entirely on the nature of the polish which has been put on the slate. Unless we have this information, we cannot direct you precisely as to the method of removing the marks. Many black polishes on slate are produced by means of an ordinary black stoving enamel, and in this instance, damp marks can often be removed by rubbing the surface of the slate heavily with precipitated chalk which has been damped with methylated spirit. If the slate has been cellulosed, whitish marks indicate an actual perishing or deterioration of the lacquer, in which case little can be done other than to remove the whole of the lacquer with acetone and, afterwards, to relacquer the surface with an ordinary cellulose paint.

A careful examination of the marks on the slate will indicate whether they are due to the absorption of damp or whether they are caused by some deterioration of the lacquer or enamel. In the latter instance stripping and re-enamelling is indicated, but in the former case some sort of abrasive treatment with methylated spirit and a fine inert powder will often restore much of the original appearance of the plate surface.

Pottery Kiln Design

I AM contemplating making a kiln for the firing of pottery, as per sketch, Fig. 1.

I am using an old gas stove and lining this with ordinary firebricks. For heating I had thought of using one or two of the large brazing lamps, as advertised in "Practical Mechanics" and I wondered if these would generate sufficient heat for my purpose, i.e., 1,000/1,200 Centigrade. The inside dimensions of the kiln would be about 15in. by 12in. by 9in. The door would be lined with firebrick carried in a frame, to fit inside the opening of the kiln as shown. Would there be too much heat loss here, and would I have to seal the outside rim of the door with clay during firing ? Would any flue be necessary ? The ordinary peep hole would be provided in the door for observation, which could be sealed when required.—R. Reed (Blackpool).

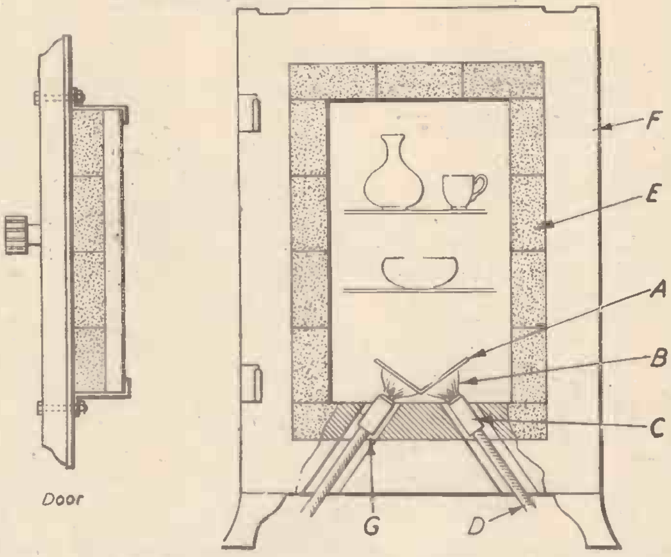

Fig. 1.—Reader's proposed pottery kiln design. A—Baffle plate in sheet steel with or without fireclay backing. B—Flame. C—Burner nozzle. D—Fuel pipe. E—Firebrick. F—Old gas stove. G—Holes cut through firebrick for burners.

BRAZING lamps would probably be far too severe for firing pottery as shown. The sheet steel (A) in Fig. 1, would last no time at all. Use firebrick (H) (Fig. 2), and put burners in one behind the other, instead of side by side. Seal door with asbestos rope.

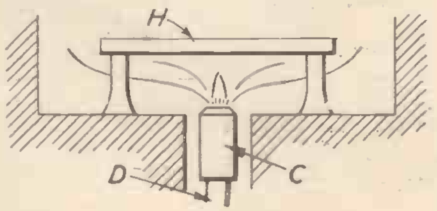

Fig. 2.—Suggested modification to reader's design.

An exit flue as well as ample air inlet is most necessary. With these changes your kiln should work.

Moulding Bulb Bowls

WITH your obviously large file of information would you kindly inform me as to the best composition to use for the moulding of some bowls for bulbs, or the appropriate people to approach with a view to purchase ? My moulds are hardwood, metal faced, and I am not unduly concerned with the colours.—J. M. Batchelor (Birmingham, 30).

WE find that "Pyruma" moulding composition is as good as any other for the small-scale moulding of bulb bowls. This is universally obtainable from hardware dealers and similar shops. Otherwise, you will have to use ordinary clay hardened by subsequent baking.

You cannot use any synthetic composition for the purpose because all such compositions, when hard, are non-porous. It is imperative for the soil or fibre in the bowls to be aerated by slow passage of the air through the walls of the bowls. For this reason, it is essential to have a slightly porous material for the making of the bowls. This requirement at once confines you to burnt clays, plasters and similar mineral materials.

You can obtain such bowls from any firm of nurserymen and seedsmen, from horticultural dealers, and often from ordinary flower shops.

Information Sought

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

Mr. T. W. Pearce, London, E.18, asks for: "Details of construction and measurements for a low-pitch recorder. Lathe available."

Mr. G. Bryson, of Enfield, says : "I am interested in making an 'Electronic-Tortoise.' Several were once demonstrated by Dr. Bronowski on television, and I also saw these at the Science Museum, Festival of Britain Annexe. Can you help me with circuit diagrams, and tell me where suitable photocells are obtainable, etc. ?"

Mr. L. E. Hickin, of Redditch, writes : "Could you let me have working details to enable me to make a bathroom weighing machine—either the smaller compact machine with a round dial, or the type as used in schools with the balance-arm and sliding weights ? Probably the latter kind would be the easier to make. I wish this to weigh up to 16 stone."

Mr. F. Hutchinson (Co. Durham) writes : "Could you give me instructions to make a reel for a sea-fishing rod ? I have a piece of mahogany 6in. × 2in. × 6in. and the lathe for turning same. I have made rod of greenheart and I should like to insert ball bearing in reel."

Mr. A. Thompson, of Liverpool, 5, asks for : "Details of how to make an air pump for a fish aquarium."

THE
Cyclist
Editor: F. J. CAMM

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COMMENTS OF THE MONTH

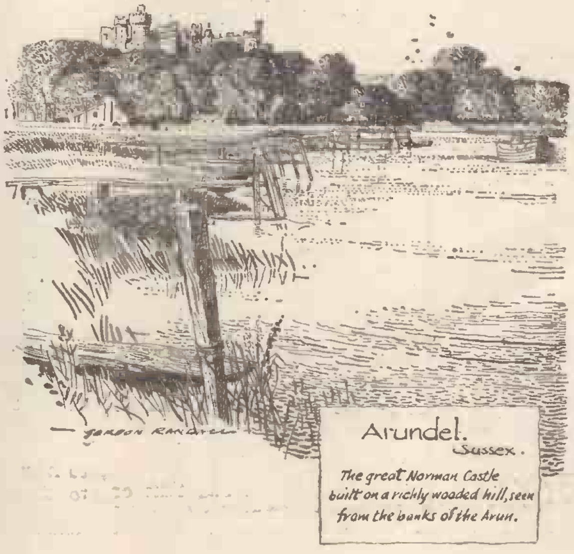
By F. J. C.

A Straw in the Wind?

AS we go to press we learn that police authorities in the south of England have declined to give their approval of a road race, and in some quarters this is taken as indicating that this is the thin edge of the wedge of the abolition of road racing altogether. It should be remembered, however, that there is no duty or onus upon a promoting club to ask permission of the police to run a cycle race on the roads, for the simple reason that road racing itself is not illegal. For many years some of the less knowledgeable leaders of the cycling movement promoted the belief that it was; certainly the N.C.U. said so over a long period of years, and it was this journal which took up the matter very strenuously with the Home Office and asked them to quote any statute which made cycle racing on the roads illegal. They could not do so and finally had to admit that they had no power to stop it. Of course, the police can trump up a charge of obstruction, careless riding, or something equally frivolous. If they have made up their minds to bring a prosecution they can always frame a charge.

The fact that the police in this particular case declined to give approval merely means that they have declined to give something which they do not possess the right to give anyway. It is nice, of course, to seek police co-operation in such events and indeed most clubs do so. If such approval is declined, however, the race need not be abandoned and the police should be tactfully asked what they propose to do about it. Under the rules of road racing we can see no reason for the police adopting an unfriendly attitude. We do not think that it is the thin edge of the wedge. It is a purely local incident. Had the police in this case been inspired from higher quarters a much larger event would have been selected. There would have been a general statement from the Government on the matter. Last year the three bodies were invited to express an opinion on recommendations drawn up by the Ministry of Transport concerning road racing. They suggested that courses should be selected well away from built-up areas, circuits should be from 15 to 20 miles and starts should be early in the morning. A sub-committee of the M.O.T. Road Safety Committee has carried out an investigation into road racing under its general terms of reference "to examine the safety aspects of mass start cycle racing on the public highway." The report is expected shortly. That report could mean a remodelling of the whole road racing programme and we think it most unlikely that the police would act in advance of its publication. In view of the recommendations quoted above it is somewhat surprising that the N.C.U., one of the earliest and most vicious opponents of road racing in all its forms, should seek to promote the first road race of the season through the Norwood Paragon C.C. and hold it in the *afternoon*, and it is probably this which caused the police to suggest that the race should not be held. They said, in effect, that they could not offer facilities for cycle racing on the main road as traffic is expected to increase considerably this year and other road users must be kept in mind.

Once again, therefore, the N.C.U. has put its foot in it. Had it arranged to hold the race in the early hours of the morning no doubt the police would have granted facilities. The Sussex police were a little more helpful. They merely affirm that it is the duty of the police to see that the roads in their area are as safe as possible for all road users. They admit that there is nothing to prevent road racing from taking place, as it has not been declared illegal.



Arundel. Sussex.
The great Norman Castle built on a richly wooded hill, seen from the banks of the Arun.

R.R.A. Changes

SOME of the old men of cycling sport (yes! and old "women") who have been imposing their will on cycling far too long must have been chagrined at the result of the R.R.A. Annual General Meeting. At that meeting the Norwood Paragon delegates proposed that a helping motor car should be allowed to pass an unpaced record breaker, and their proposition was approved by a vote of 77 to 8. It is not difficult to identify who those eight were. One defect from which the R.R.A. suffers is that the same group of officials with very minor changes continues to direct its affairs. The proposition was made by Frank Cleeve and seconded by the redoubtable Frank Southall. The arguments against were laughable. They crystallised themselves into one main objection—they have never permitted it; let us continue to control records under the same rules as hitherto. We are glad that this stupid rule has been brushed aside; we could wish that some of the other rules had been brought more into line with 1954. That, however, may come when fresh blood is injected into this somewhat archaic, fusty and suspicious organisation.

The new rule reads: "At the discretion of the official timekeeper, or, if none, the official observer nominated to the Association at least 24 hours in advance of the start, one motor vehicle may pass the rider or riders not more than once each 50 miles. The motor vehicle shall be nominated before the start to the authorised official, who shall be empowered to accept or reject the proposed approximate passing points, which shall be nominated before the start. No passing shall be permitted before the rider or riders have covered 50 miles. Substitution of the motor vehicle or passing points shall be allowed only in the case of mechanical failure of the motor vehicle nominated. Nominated motor vehicles passing the rider or riders under this rule need not carry an official observer." This rule applies to the one way place to place records, the 12 and 24 hours, and the 1,000 miles.

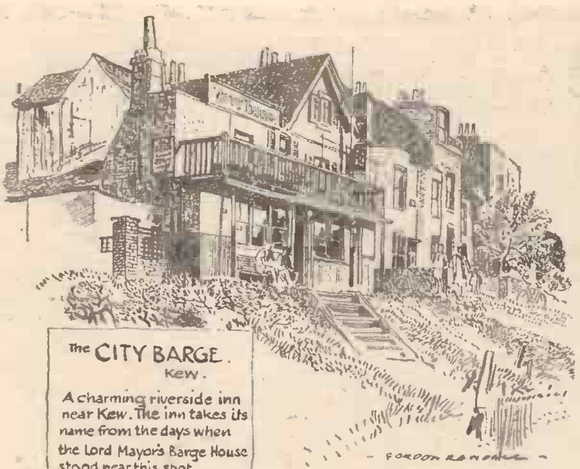
There is now no ban on "coaching by audible signal from following cars." Another 50 years overdue change is that which insists upon record aspirants being "inconspicuously attired." By this was meant that record breakers should make themselves the most conspicuous of road users by wearing close-fitting black racing tights. The idea behind the original rule was to hide from the police the fact that the cyclist was racing. All it did was to advertise to the police that he was doing so. Yet that stupid rule evolved by some half-wit has been rigidly adhered to all these years in spite of continued criticism. However, there are signs that the old influence is waning and that common sense on the part of some of the more progressive delegates is suppressing the pugnacity of the past.

Road Accident Increase

THE Director of Road Research, Dr. W. H. Glanville, of the Department of Scientific and Industrial Research, recently lectured on the subject of road safety to members of the Royal Society of Arts. He stated that if accidents continued at the average rate at which they have been increasing since the war, 350,000 casualties each year could be expected in 10 years' time and if the increase in accidents was directly related to the number of vehicles on the road, the figure would be 450,000. Thus by 1964, adopting the theory of probabilities, road accidents will increase by 40 per cent.

Wayside Thoughts

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



The CITY BARGE. Kew.
A charming riverside inn near Kew. The inn takes its name from the days when the Lord Mayor's Barge House stood near this spot.

All to Come

IT is a pleasant thing to ride down the lane and feel the warmth of the sun on the back of your neck and the mild stream of air running over your hands. Winter may bring its joys to the younger and hardier generation who scorn the weather and love the road, but I confess I prefer the warmer seasons and the lazy delight of browsing. Winter gave me some happy little jaunts and many a welcome fireside nook and I am grateful to my friends and the open character of the season, which never chained me to an armchair for too long a period; but when April laughs and frowns on me I love the laughter and know the frowns are only tantrums that will dissolve into the sunshine of June and the long, lingering days of beauty and joyous wanderings.

You need not be a cyclist to feel this accustomed uplift when the sky is blue and the sunsets golden; a glance at the people going to work shows the miracle of the change on their faces; but I submit because a fellow rides a bicycle he feels more deeply the sense of well-being when he goes out to meet and to revel in this change of seasons. I have seen and enjoyed many springs from the saddle of a bicycle, for their coming marked for me and my friends in the earlier years the time of week-ending and, in their train, the thoughts of holidays.

It is said by many folk that cycling is hard work, out of date and even archaic; but that is just impossible, when a reasonably fit fellow can wander off in silence to the old places and soak his soul in beauty; or, if he feels so impelled, go to watch the younger generation strenuously chasing Father Time down the road. The hard work is all nonsense, and cycling will never be out of date for the simple reason that there is nothing comparable to replace it.

Time to Learn

I HAVE been charged on occasion with a laughing, happy attitude towards the pastime of cycling, as if that condition was something to be almost ashamed of. True, the criticism has not come from practising cyclists, but the fact that it has occurred, and quite recently, is proof to me that the pastime is still misunderstood by more people than should be the case.

The fact that I am a happy cyclist is merely a reflection of the joy I obtain from the pastime, and I want to propagate that pleasure in a simple manner and without exaggeration for the purpose of encouraging other folk to try it out as a way of life, not just as a single ride, but for a month or so in easy journeys, to obtain saddle comfort—without which no one can be happy—and reasonable fitness of the muscles. For surely none of us expects to undertake an exercise without some preliminary training, so why should cycling be different? Unfortunately, in a way it is, for a bicycle is easy to ride a few miles however ill-fitting it may be to the rider; but extend that distance to 20 miles in company with a wrongly equipped machine and a rider ignorant of the fact and you have all the elements at work to disgust the tyro.

How important it is to choose the right bicycle and the degree of time to perfect practice is far too little known, and many a bright prospect of making life kindlier and merrier by the inclusion of cycling among its interests has been lost for want of sound advice in choice and use in the early stages of riding. We have to learn most things in life, and cycling is no exception; but once acquired—what a reward!

Too Little Known

THESE interests grow with you as you grow old at the cycling game. You start with the notion that the only thing worth while is finding out how fast you can travel under your own power and, almost unconsciously, how good it is to feel the pulse of that power. In mid-life you wilt a little, and the slow-down steadily increases with the years until with the help of the kindly philosophy of nature you accept the change and find new interests in the pursuit of an old game. That is one of cycling's greatest satisfactions, that you can play it to the very end of activity, retain your interest in its sporting side by proxy, and add a dozen quietly sober but intensely attractive things to its pursuit.

I have frequently said it is the most varied game in the world, and every passing week I am proving that contention to myself, and my great desire is to bring home the fact to other people. It is here that cycling propaganda has failed; there is too much racing and too little discrimination in what the pastime can mean to ordinary people who love the country and all it connotes. These are small things, the interests so happily related to the pastime, but in total they add up to a great attraction, quite apart from the health and exercise involved. They do not hit the headlines, and the young folk do not chatter about them because they do not know, and in the full flush of their youthful adventures do not want to know. But there they are, the simple things that make life worthy as one grows older, and they deserve a testimony because they enrich personality and add fragrance to living. Possibly you may think this an exaggeration with a purpose; the purpose is there right enough, but it is no exaggeration, but just a series of experiences.

Close to the Bone

CLUB life is running into a bad time or has already done so from the financial point of view. It is a curious thing that while we pay at least three times the price for most things to-day—including pleasures—how reluctant we are to foot the club bill and make things a trifle easier for honorary officials? Members expect the same service as in the pre-war days; indeed, most of the present generation expect more in the way of sporting events, and usually get their way, often oblivious of the added expense. The net result is that club finances as a general rule are in a precarious state and are only held above water by the older members putting their foot down, or in some cases the trade element helping the cripple to limp along for a short time in the hope that circumstances will change. I do not think they will greatly change in the matter of costs, and I do think the old boys will become tired of footing the bill, and the trade will also weary of a condition of constant club penury.

In my opinion, wisdom lies in facing the cash position, or, alternatively, increasing subscriptions to a point to make ends meet. The latter is far the better way, for not only does it relieve anxiety, but makes the club independent of its richer members' pocket searchings and of all outside influences. I know of one club trying to run a very full programme on a third more than its pre-war subscription rate, and, of course, it is just impossible; any more than any one of us could exist comfortably on a third more than our pre-war wages. The young folk say they cannot afford to pay more, which is nonsense, when you know their rates of pay and the money they spend on their bicycles and equipment. If we want club life—and I am all for it—we must be prepared to pay for it, and the sooner that is fully acknowledged the better it will be for organised cycling.

Coming Changes?

A YOUNG reader, absorbed professionally in the road problems of to-day and no doubt conscientiously endeavouring to find solutions, takes me to task regarding a recent paragraph I wrote on the question of road straightening, and defends the suggestion of straight progress from place to place as a means of eliminating road accidents, or some of them. He is a firm advocate of higher speeds on such highways as a means of more widely separating the vehicles and so giving a reduction to that form of irritation and frustration that is so fruitful a cause of accidents. He says that "our fine old highways" are a serious restriction on fast, cheap transport. This is the modern outlook of the commercial road user, and we, who love our roads as avenues to the countryside and a delightful means of outdoor enjoyment, are to be put in the strait-jacket of commercial efficiency, and all the amenities of travel, unless they relate to speed and "cheap transport," are to be destroyed, or perhaps it would be more fair to say steadily reduced. He also objects to my suggestion that the road is carrying too many warning signs, which so often seem to me to be an excuse prior to the accident, and after it a ready-made intention to provide blame for the road rather than its user. As I say it is this modern outlook with the tremendous power of the purse behind it, and no single thought or sympathy for any type of road user except the motorist. And yet the great G.P. does most of the paying and up to now has done it cheerfully, because, I like to think, almost unconsciously it has preserved the beauty of Britain from the arid despoliation of the ruled lines of highway.

Around the Wheelworld

By ICARUS

CRICCIETH, North Wales: *Looking across the fine bay to the old castle.(13th cent). The town faces due south, and is noted for its mildness of air . . . .*

Cheap Bulbs

MR. T. F. BEEBY, of Wallsend-on-Tyne, says that, as one who sells a large number of cycle bulbs each season, the remedy is to buy only well-known branded makes. He says, "the so-called cheap bulbs retailing at about 3d. each and sold by a well-known store are a complete waste of money." The complaints I have received about bulb failure in the main refer to branded bulbs of the correct rating and I do not agree with my correspondent that cheap bulbs are useless. On occasions I have used them with satisfactory results. Threepence is enough for a bulb anyway, and there is no reason why a satisfactory bulb should not be made for that sum.

Mr. Beeby says that the majority of failures occur in the dynamo tail lamp 6 volts 0.4 amp. bulbs, due mainly to faulty earthing of the lamp body. The idea of using the frame as the second lead for earth return is one of which I do not approve. Wherever possible use twin wiring. I cannot understand why dynamo makers knowing the trouble the single wire system gives continue to use it just to save the cost of another length of wire.

New B.L.R.C. National Secretary

MR. R. FROOD-BARCLAY, of 117, Hendon Lane, London, N.3, has been appointed National Secretary of the British League of Racing Cyclists. Mr. Frood-Barclay has been associated with the cycling movement for many years and his experience, I am certain, will be found of great value to the League.

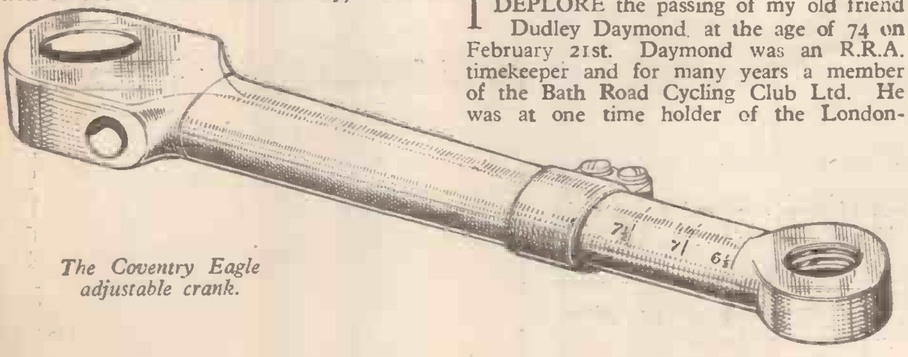
While I am dealing with League matters, I am asked to state that the list of events for the North London Section can be obtained for 3d., plus postage, from Mr. C. W. Messenger, of 1, Sheen Lane, S.W.14. The hon. registrar of the section is Mr. T. Saunders and the events secretary is Mr. Messenger.

Adjustable Cranks

MANY years ago Colonel Crompton started an argument on the relative merits of long and short cranks. He was in favour of long cranks and the arguments went on for months. Finally it was agreed to put the arguments to practical test. Crompton was to provide a racing team mounted on machines with long cranks and the opponents a team with short cranks. They were to race against one another, the winners to decide the point. Crompton, however, started to niggle. He wanted the riders tested by doctors before and after the race and to have the riders vetted in relation to basal metabolism. Finally, the race was called off. In point of fact, it would have proved nothing since it would be impossible to find two teams equally matched in every particular. It would seem that according to the laws of leverage less power would be required for the long crank, but whatever mechanical advantage accrues can only be obtained at the expense of power input. The legs have to travel a longer distance with a long crank. In other words more work must be put in.

Some manufacturers in the early part of the century manufactured bicycles with adjustable cranks and I show one below. It was fitted to the Royal Eagle made by the Coventry Eagle Motor Cycle Co., and is illustrated in their 1899 catalogue. It will be seen that is is telescopic "so that our friends may have the advantage of testing cranks of various lengths and deciding which sizes they consider most suitable to their height and build." The cranks could be varied from 6½in. to 9in. The Royal Eagle machine to which it was fitted had a frame specially designed to give an extended wheel base and a higher bottom bracket position, affording the necessary ground and front wheel clearance in connection with the length and play of the crank. The machine had a 9in. gear.

In the course of the years, however, experience taught that a 6½in. crank satisfied most needs, and it is almost standard to-day, although sometimes 7in. cranks are fitted.



The Coventry Eagle adjustable crank.

B.L.R.C. Handbook

THE B.L.R.C. Programme and Rule Book for 1954 has just been published at 1s. 6d. Copies are available from W. Thompson, 25, Chesterfield Road, Sheffield 8.

The Late J. Dudley Daymond

I DEPLORE the passing of my old friend Dudley Daymond at the age of 74 on February 21st. Daymond was an R.R.A. timekeeper and for many years a member of the Bath Road Cycling Club Ltd. He was at one time holder of the London-Brighton Cycling Record at 6h. 19m. 48s. He was a member of the Roadfarers' Club, the Tricycle Association and many other cycling organisations.

He resigned from the Bath Road Cycling Club Ltd. at the same time as many other members, including the late W. James (who was the sole surviving founder member at the time), in the early forties became he was dissatisfied with the actions of certain members.

Club Names

CANNOT the R.T.T.C. do something to add dignity to the names of cycling clubs? The general tendency to-day in some districts is to adopt slang titles, such as "Buckshee Wheelers," "San Fairy Ann" and similar names. Some clubs are named after pubs, and others after streets. The R.T.T.C. could refuse affiliation until the title was changed. The names I have quoted are cheapjack and do not suggest that they can be taken seriously.

N.C.U. Changes?

THE financial straits of the N.C.U. are responsible for the suggestions made by the executive committee that major changes should be made in the management and these suggestions have been put to the A.G.M. of the general council. The main suggestion is that five standing committees should be replaced by two—a financial and a general purpose committee and a racing committee. These would replace the financial management, legal and parliamentary, touring, racing and records and massed-start committees. It is unfortunately the case in cycling sport that all clubs are overweighted with committees and each committee is in itself too large. In a multitude of cycling counsellors there is not wisdom, only intrigue, cliques and factions spreading poison and dissension. No man should be allowed to serve on more than one committee for it is impossible with plurality of office to preserve the secrets of each committee. The large numbers and committees and committeemen have between them been responsible for the cumbrous and unwieldy rules which control cycle sport.

CYCLORAMA

By H. W. ELEY

Smiles and Tears

APRIL gives us both, and the kindly shower of rain which leaves its sparkling raindrops on the green hedgerow is soon followed by a burst of sunshine, and all the world of Nature is singing. It is a good month, and none better for a ride through the scented lanes and out into the heart of the countryside. There are shy primroses in the dell and on the railway-cutting bank, and the wallflowers in the cottage gardens throw off a wondrous scent. If one searches diligently in the banks of the hedges there are purple and white wild violets hiding modestly in the tangled green growth which is becoming more luxuriant every day. Yes, it is a month of smile, and the sweet harbinger of all the springtime glories to come.

It is the month of the singing birds; quite early in the morning the chaffinch sings merrily from the bough of the gnarled apple tree in the orchard, and all day long the cuckoo sends out his monotonous note. In my part of the world he generally arrives about the sixteenth of the month, to be with us until late July or early August. Blue skies, the song of a million birds, the fresh green of the hedges and trees—what better lure can the cyclist ask for to entice him out on to the winding immemorial road?

Lure of Lichfield

A LITTLE city is this cathedral city of St. Chad, but how full of beauty and romance! St. Chad, who here founded the diocese of Mercia in A.D. 669, was a Saxon known in his own day as "Ceadda." The present cathedral, built of a light red sandstone of a delicate bluish tint, is by common consent styled "The Lady of Cathedrals," and is of an airy grace, due partly to its three lofty tapering stone spires—one central and two at the west front. The cathedral belongs chiefly to the early English and Decorated periods of Gothic architecture of the 14th and 15th centuries. Lichfield Cathedral had its full share of troubles during the Civil War when, with the surrounding Close, it was fortified and held for the King. The little city itself declared for Parliament. The fortified Close was surrendered in 1643, again taken, and finally surrendered in 1646.

Lichfield was the birthplace of Dr. Samuel Johnson, and the old house in which he was born bears a tablet, and is now maintained as a Johnson Museum. A little city to linger in and love.

Those Inn Signs

SOME recent comments of mine about quaint and unusual inn signs brought me quite a little batch of interesting letters from riders who, like myself, make a study of inns and their signs. The ancient inn is not only found in some quiet county town or in some secluded narrow country lane, but can be found nestling among the factories and warehouses of a great city; it can be found at the lonely turnpike corner on some desolate heath—and, as one good correspondent tells me, it can be found in the modern suburb of a great city. "The Lad in the Lane" is an ancient inn, now modernised, which exists in Bromford Lane, Erdington, on the outskirts of busy Birmingham. I gather that the proper name of this inn is "The Green Man"—but it still goes by the more friendly name of "The Lad in the Lane." It has been a licensed house for many centuries, and I am glad to add it to my growing list of old and romantic inns. I am afraid that when some enterprising modern brewer takes over an old inn he smothers it with "amenities," but romance lingers still in spite of chromium-plated fitments and cocktail bars, and it is hard to kill the old-age spirit of an inn which has weathered the centuries and has its origin in the misty past.

A Veteran Rider . . . and a Veteran Bike

I MET the old man riding out of a farm gateway, closed the gate for him and fell to chatting. Hale and hearty, and pink of cheek was this old farmworker who informed me, as we talked, that he had begun work on a farm at the age of nine, and had never been anything else than an agricultural labourer; but what a fine and skilled old man of the farms and fields! Eighty-one years of age, and still doing a full day's honest work. His bike? That was a veteran, too, and the old man informed me that he had been riding it for well over 20 years. Now, I am constantly coming across ancient bikes which are still doing yeoman service, and their number and condition is a great tribute to the superb craftsmanship of the British cycle builder. Incidentally, British-built bicycles are being ridden in more than 120 countries, and surely no industry "carries the flag" more proudly and effectively than the cycle industry, with its honesty of manufacture, its flair for colour, and its constant improvement in design.

The general public are taking advantage of these design improvements too, and dynamos, speed gears and light-sided tyres are being fitted to cycles in ever-increasing numbers.

A Cycling Diary

IT is great fun keeping a diary of one's cycle trips and tours! I have had the "diary habit" for many years, and in consequence have a wonderful record of happy riding, with useful notes on places and scenes, curiosities of the roadside, old inns, old churches and cathedrals. When the summer season is over I can, on a winter's night, take out the records and live again those joyous tours in the countryside. I commend the habit to every cyclist: it adds to the joy and interest of cycling, and in my own case I find my diaries of great help when planning a tour. Some day, maybe, I shall assemble my rough and haphazard notes into book form and possess a permanent record of innumerable happy rides in many shires; of pleasant sojourns in many villages and towns; of golden hours amid the romantic scenes of beautiful Britain.

A Saxon Church

THERE are not many genuine Saxon churches left in our land, but I am reminded by a correspondent of the famous one at Bradford-on-Avon, in Wiltshire. Now I have happy memories of Bradford-on-Avon, and indeed of Wiltshire generally. It is a county I love for many reasons; I love the graceful spire of Salisbury Cathedral; I love the unsurpassed thatched cottages, and the rolling expanse of Salisbury Plain and the dim romance of Stonehenge. But to get back to our little Saxon church at Bradford-on-Avon. It was built in A.D. 705 by Aldhelm, Bishop of Sherborne, and is a wonderful example of Saxon ecclesiastical architecture.

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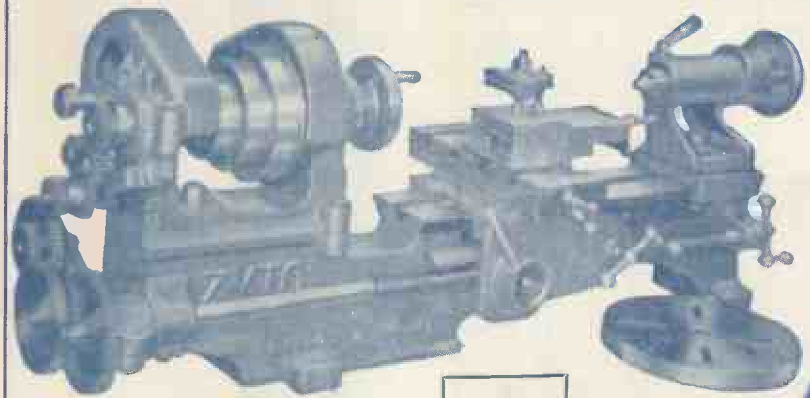

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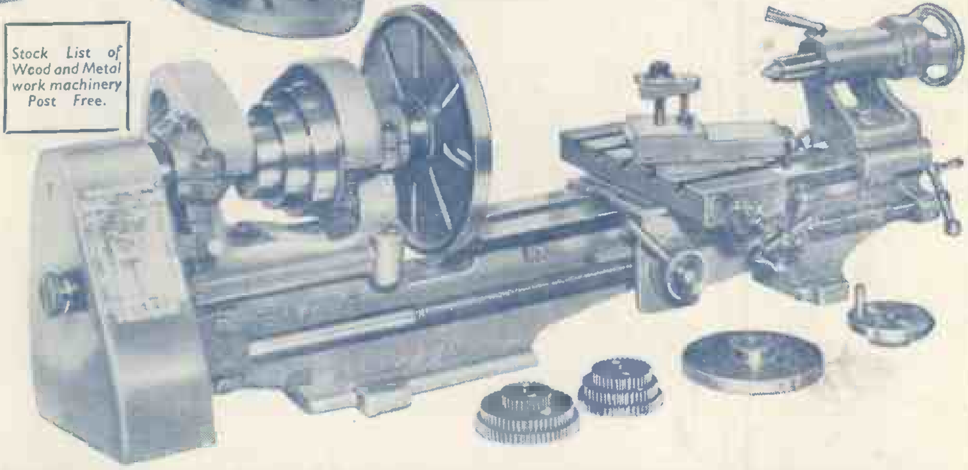

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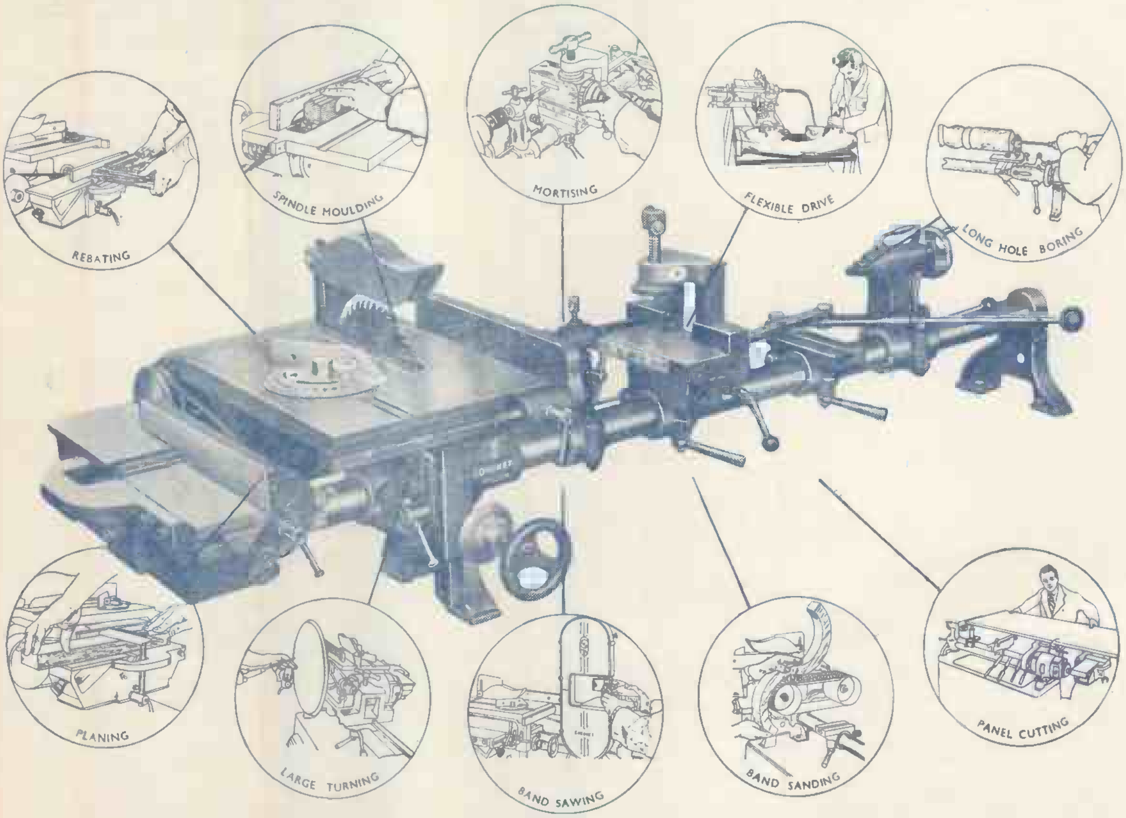

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