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EDITOR : F. J. CAMM

SEPTEMBER 1951

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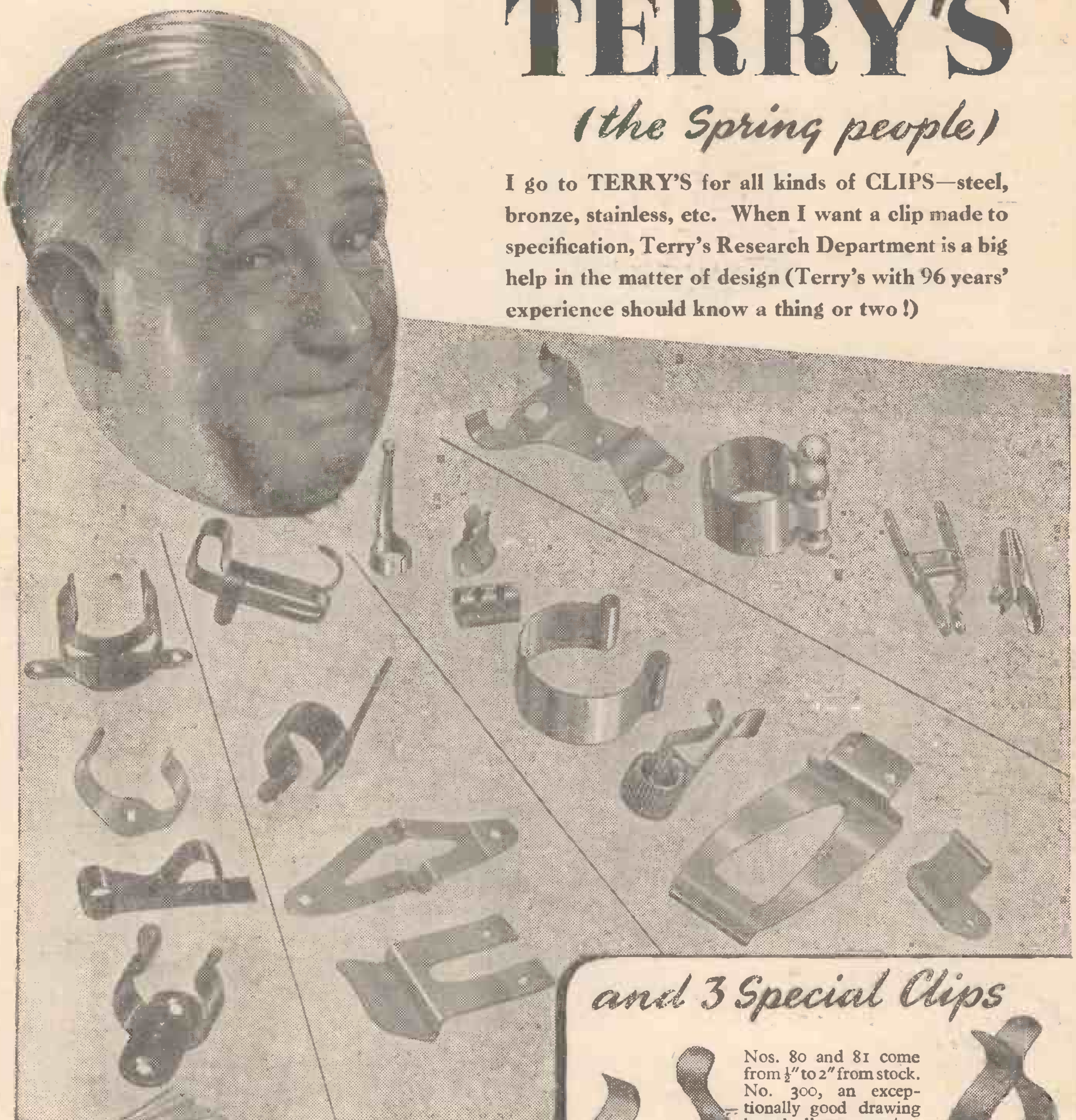

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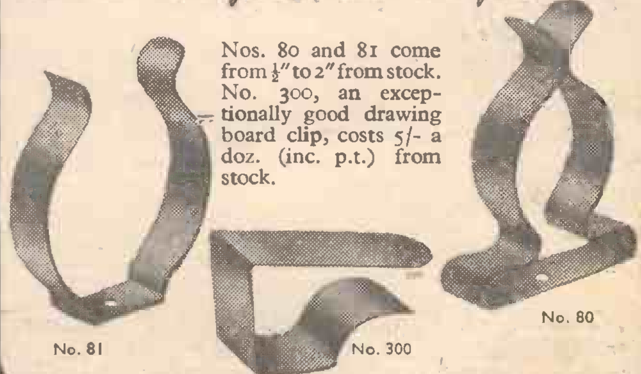

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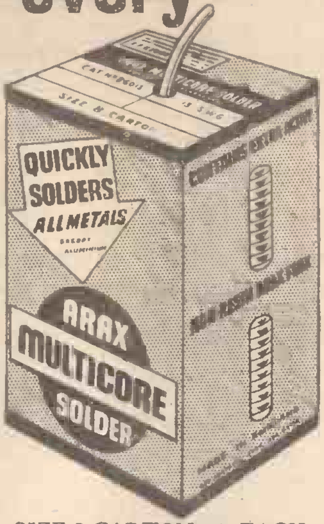

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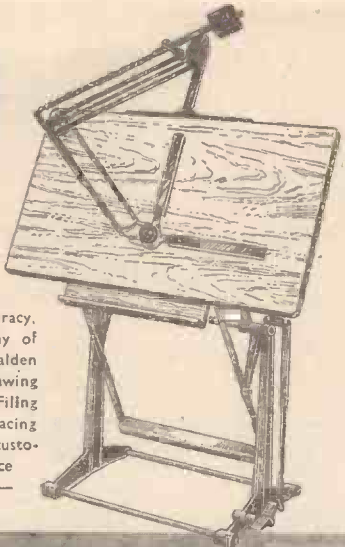

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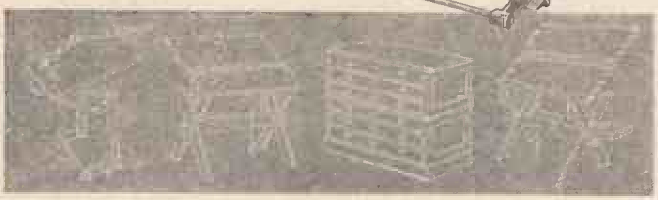

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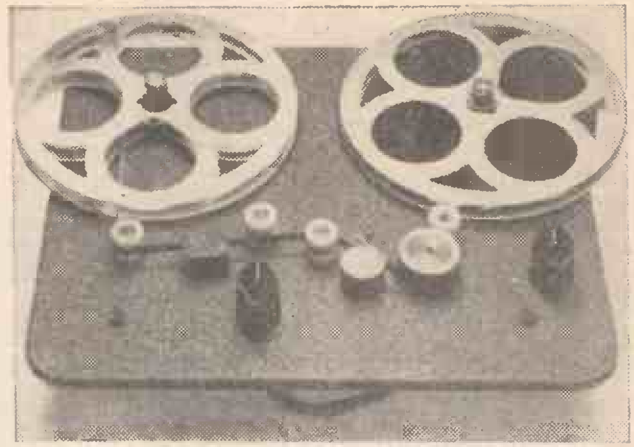

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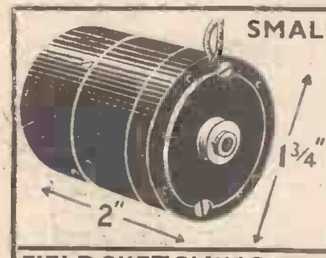

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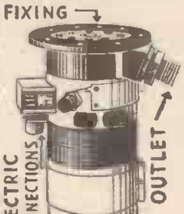

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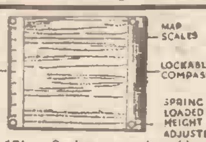

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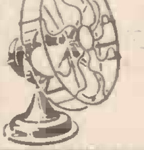

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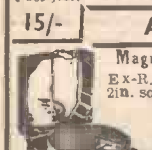

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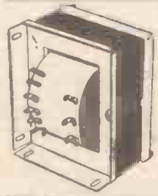

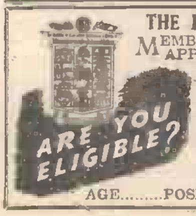

ARE YOU ELIGIBLE?

PRACTICAL MECHANICS

EDITOR F. J. CAMM

SEPTEMBER, 1951
VOL. XVIII. No. 213

Owing to the paper shortage "The Cyclist," "Practical Motorist," and "Home Movies" are temporarily incorporated.

FAIR COMMENT — By The Editor

Will the Steam Car Return?

THE Persian oil situation has revived interest in a form of road vehicle which preceded the internal combustion engine—the steam car. In the earliest days of motoring most cars were propelled by steam power, but it had a very short vogue after Otto and Daimler between them produced the internal combustion engine.

For a time, however, the adherents to steam and to petrol were about equal in number. The early internal combustion engine had hot-tube ignition, because coil ignition systems and the high-tension magneto had not been developed. In the hot-tube system of ignition a platinum tube was screwed into the cylinder head and was preheated—this ignited the charge on each compression stroke.

Whilst the steam car undoubtedly died, not through lack of merit of principle but through lack of development, the petrol engine succeeded because of its comparative simplicity, quick-starting and low running costs.

The great advantage of the steam engine is that it has no need for gears, and further advantages are that it can use cheap liquid fuel such as tar oil or kerosene, it is silent and smooth, has completely automatic control of steam pressure and temperature, it condenses the exhaust steam for re-use, has an explosion-proof type of modern steam generator and a highly efficient engine giving good mileage per gallon.

EARLY STEAM CARS

SOME of the earliest steam cars such as the Stanley, the Dobel and the White are still running; in 1906, the world speed records previously held by Serpolett were broken by the Stanley steam car at what was for that time the amazing speed of 127.5 m.p.h. In those days owners of these three makes of steam car were busily engaged challenging one another to speed races and to hill climbs, at which the steam car undoubtedly excelled.

It may come as a surprise to many readers to know that the steam car to-day is by no means dead, and that small numbers of power units are annually made for those who care to build their own chassis and bodies. There is also an association known as the British Light Steam Power Society whose primary object it is to encourage the use and development of steam power.

The starting effort of a reciprocating steam engine is greater than that of any other prime mover and, in fact, is greatest when the engine is stationary, which makes possible very rapid acceleration without the use of gears or other expensive transmission systems.

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COMPACT flash-steam generators in which there is no risk of explosion have a completely automatic control of steam pressure and temperature obtained by a simple electrical system. The modern steam car is entirely orthodox in appearance, and in America at least one manufacturer undertakes to fit a steam power unit into any existing internal-combustion-engined car. Development has continued in Great Britain and Germany.

The steam car compares favourably with a modern petrol engined vehicle from the point of view of starting, handling and maintenance. Starting consists chiefly of turning the ignition switch, when the fuel in the boiler is automatically ignited by means of a sparking plug and coil and steam is raised from cold in less than a minute. The car moves off on depression of the accelerator pedal, no clutch or gearbox being necessary. In addition to the accelerator and brake pedal a third pedal is often provided to control the stroke of the valve gear of the engine. The normal position of the pedal allows the valves the minimum of travel, so that steam is admitted to the cylinders for only a short portion of the stroke, the thrust being mainly provided by expansion of the steam. This position of the pedal suffices for all normal running and, of course, at the same time effects the greatest economy.

On depressing the pedal, however, the stroke of the valve is increased and the steam is admitted for a greater percentage of the down stroke of the piston. The valve stroke would be increased when restarting on gradients, or to ensure rapid acceleration. The effect is just the same as if a lower gear were to be engaged with the normal type of gearbox. The pedal can be operated at any speed without releasing the accelerator pedal.

LOW ENGINE SPEED

A FURTHER important feature of the steam car is that the engine runs at the same speed as the rear axle, or at a slightly higher speed. Even when running at a 25 per cent. higher speed than the rear axle the engine is normally turning over at only about 900 r.p.m. at 60 m.p.h.

In addition to effortless cruising the lower engine speed makes the engine almost everlasting, and repairs and adjustments are only necessary at very lengthy intervals. For example, attention to the piston rings is only necessary after 30,000 miles. Since there is no exhaust from the engine (the steam being passed back to the condenser which replaces the normal radiator), it is silent at all speeds.

The fact that the steam is condensed means that there is very little water loss. In a modern steam car, for example, the water tank capacity is only 10 gallons, sufficient for a journey of over 300 miles. Lubrication troubles are practically non-existent because the connecting rod dips into an oil bath, thus lubricating the big ends and valve gear, all of which operate at very low speeds. Running costs are, of course, ridiculously low.—F. J. C.

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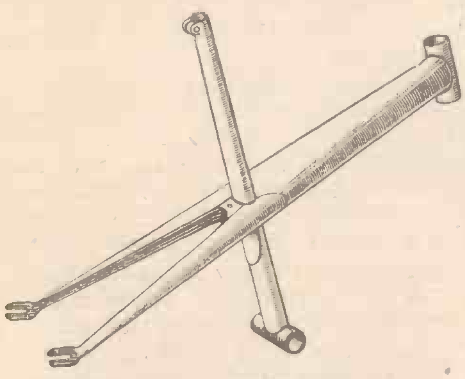
CYCLE FRAME DESIGN

With Notes on a New Type of Cross-frame

By Sir ALLIOTT VERDON-ROE

MANY years ago the writer did a considerable amount of cycle racing. The memory of broken frames and the report of breakages by others has prompted him to give the design of frames some thought, which may be of interest to readers of PRACTICAL MECHANICS. The standard frame is a well-triangulated and braced structure behind the seat tube, but in front is a makeshift; consequently ever since the "safety" cycle was introduced—called safety owing to the low seat position compared to its forerunners—the design of the frame has been a bit of a headache to those makers who are particular about the soundness of its mechanical construction.



Perspective view of frame to take brake.

Such makers have realised an inherent weakness in the standard frame, or rather an excessively stressed part where the top tube enters the lug on the steering head. Perhaps someone can explain why the top tube is only 1in. in diameter and the down tube $1\frac{1}{8}$in.; presumably it is a case of follow my leader. When frames break, the inch top tube generally goes first at the lug where there is a sudden change of section. Obviously, if there is any difference, the top tube should be the larger, as it has to take both the compression load plus the crushing through the bending stress, due to the frame not being triangulated. The down tube being chiefly a tension member.

Bending Stresses

In the case when the frame is twisted, which often occurs when a rider is finishing a race, or climbs a hill vigorously, leaning forward off the saddle, then there are heavy bending stresses both at the fore and aft ends of the top and down tubes. These stresses at the lug edges can be considerably reduced by cutting V-slots so that their edges have a saw-tooth effect, which avoids a sudden change of section. This is done by very few makers, while some lugs are cut to fancy flourishing patterns, a painful sight to those who possess a mechanical mind, although better than leaving the lugs with plain edges. Sometimes a U-slot is cut out of the lugs on either side, which is rather futile as it leaves a sudden change of section at a highly stressed top part. This unmechanical practice sometimes applies to chain wheels, when the rim is attached to the axle by the maker's initials or trade mark.

Failure of the top tube at the steering head lug is not so common as it used to be in the early days, due to the better quality of the tubing. However, cases have occurred,

Sir Alliott Verdon-Roe describes his new Cross-frame bicycle. Sir Alliott, the well-known pioneer airman and aircraft designer, will need no introduction to our readers.

and recently a rider in the Isle of Wight was taken to the hospital in serious condition through the top tube breaking. Many years ago the writer had a failure at the top lug, but the worst case occurred when the front forks broke off above the crown, which laid him up in bed for a week with concussion. Such failure is unlikely now, as a good factor of safety is allowed for above the crown.

Demonstration Model

A good demonstration indicating the excessive stresses which the top tube and down one have to withstand at the steering head can be obtained in a few minutes by cutting a small model out of cardboard (see Fig. 1). Cut out the front forks and steering head in one piece. Then the top tube AB and down tube CD. Pin or tack points B and D to a piece of cardboard leaving them free to pivot. Then insert a pin or tack through A and C from the underside and cut off the points. On moving the fork forward it will be observed that there is an excessive movement where the top and down tubes meet the steering head.

The seat tube is lightly loaded, also the tubes behind, but electronic tests have shown rather a heavy stress where the seat tube joins the bottom bracket lug when there is a 200lb. thrust on a pedal in the forward position. This being the case, anyone might think that since the simple cross-frame has no extra bracing tubes this would be a weak part. However, the greatly increased

A young rider with her new cross-frame bicycle.

diameter of the tube between the bottom bracket and main member is well capable of taking both the torque and bending loads imposed. In future the diameter of this tube will be increased from $1\frac{1}{2}$in. to $1\frac{3}{4}$in. when gusset plates should not be necessary.

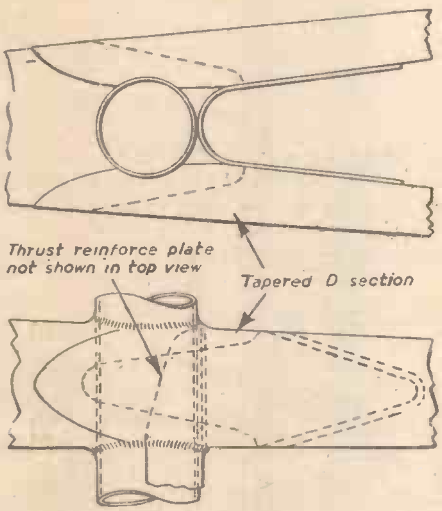
Side view of the new cross-frame bicycle, showing the gusset plate brazed on each side of the frame to give additional strength and rigidity.

Various Types of Frames

Pederson many years ago broke away from standard practice by building a cycle on highly mechanical lines, as in Fig. 2. It will be noted that practically all the tubes are either in compression or tension, rather like a bridge. This particular mechanical construction, although ingenious and light, was not suitable for cycles, being costly and cumbersome.

The frame in Fig. 3 is well braced, rather heavy and expensive, but capable of taking all loads, both vertical and torsional, with no undue stresses on the material. The frame shown in Fig. 4 has a simpler triangulated construction. The one seen in Fig. 5 is a better frame, as the extra tube not only removes bending stresses at the steering head, but also reinforces the inch-diameter top tube against torsion and compression loads, which relief it requires more than the larger diameter down tube. Fig. 6 shows a tapered tube arrangement, very strong for vertical loads, but weak in torsion at top and bottom of the seat tube. Fig. 7 overcomes this weakness, but is ugly and heavy.

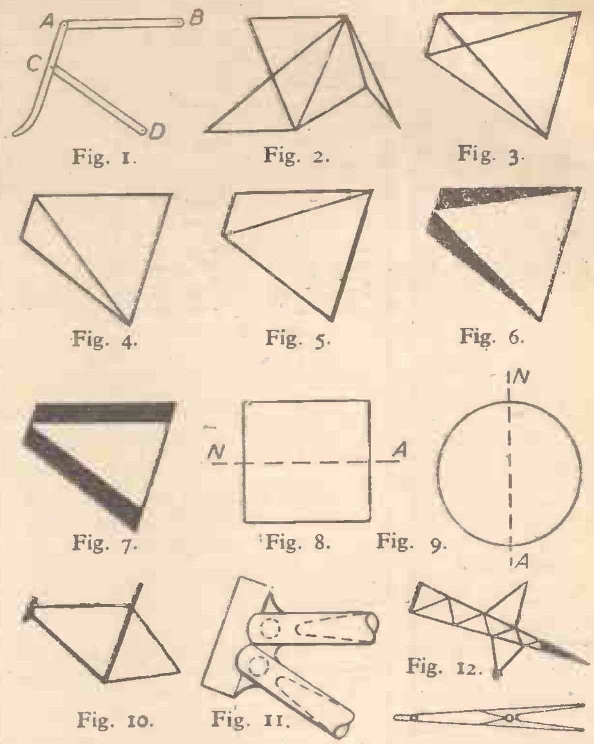
If the top and down tubes had 1in. and 1⅛in. square ends, they would be much stronger as there is considerably more material farther away from the neutral axis, which is horizontal for vertical loads and vertical for torsional loads. Fig. 9 illustrates a section of round tubing with the neutral axis vertical. Fig. 8 is a section of square tube, this latter being obviously much stronger. Since it is not desirable to carry out any of the above suggestions one must look elsewhere in designing a frame. But those who feel they must adhere to the triangulated frame could have one as shown in Fig. 10, with the seat tube extended above the frame. A lightened central plate helps to combine the top and down tubes to the steering head, being a little stronger than standard practice as the reinforcing plate extends farther down the tubes with no sudden change of section (Fig. 11). Even so, this layout will appeal to few, if any.



Figs. 13 and 14. Plan and side view of rear fork head for racing model.

Dural Frame

A very light and strong frame could be built up from 24 gauge dural, either in girder form (Fig. 12) or in stressed-skin box form, the latter being simpler and preferable. In both cases the Chobert riveting system could be used, which operates from the outside. However, such a frame is quite unsuitable for cycles, but a further development on these lines can produce a good frame by concentrating the metal into a more compact and neater form, with the metal well away from the neutral axis, which helps to reduce the stresses.



Various types of frames. The cross-sections of tubing shown in Figs. 8 and 9 are 1 in. square and 1 in. in diam. respectively.

The writer has had two cycles constructed by F. H. Grubb, Ltd., on the latter lines, in other words a simple cross-frame. One is a racer and the other a roadster. Some critics have been very pessimistic about the design; they thought the attachment to the steering head would be weak, that the frame would be whippy; but there are no signs that these fears are confirmed. Some also thought that the overhang of the seat tube below and above the main frame would be weak. These critics forget that there is considerable overhang below and above the crown of the front forks, likewise the handlebars. In the case of the new design, the offset loads are well provided for by large-diameter tubes.

As regards handlebars, in 1909 the writer was scorching up a hill on a road racer when the handlebars broke off suddenly, fortunately without accident, or even dismounting, and the journey was finished carrying the handlebars in the left hand, the lamp bracket was used for steering with the other hand when it was not advisable to ride hands off.

Three-quarter rear view of the new cross-frame.

Accles and Pollock very kindly accepted the small order for the special tubing used on the two prototype simple cross-frames, but unfortunately the seat tubing was not made to the drawing, as it tapered up from the bottom bracket to within three inches of the tube top, and these three inches were left parallel to take the seat pillar. This tube should have been the same diameter from the bottom bracket to half an inch above the frame. In order to allow for the reduced diameter to take the torque and thrust, two gusset plates were brazed on either side which has made a very strong job. In future cycles the diameter of this tube through the frame will be increased to 1⅜in.

Figs. 13 and 14 show a plan and side view of the cross-frame fork head, and these drawings together with the photograph will give some idea of the method of construction.

The strength of the main tube frame attachment to the steering head tube must be quite four or five times stronger than in standard practice when the same weight of material is used.

In standard practice the top inch-diameter tube is highly stressed, as has been pointed out previously, that is, there is a heavy compression load on a small amount of metal only half an inch from the neutral axis. Whereas in the cross-frame there is considerably more metal 1½in. from the neutral axis, and as regards resistance against twisting, generally called whip, there is also a great increase of material farther away from the neutral axis.

The strongest part of a chain is the weakest link, and so with a standard cycle frame; however rigid the structure behind the seat tube may be, the strength comes back to that top highly stressed inch-diameter tube.

Electronic Tests

One of the prototypes has undergone elaborate electronic tests extending over a period of five weeks. These tests have shown the joint at the head to be much stronger than standard practice and, considering the frame was a prototype, the tests have shown it has a good factor of safety and is no more liable to collapse that a standard frame as regards the other parts. By making some slight modification a frame of ample strength with less weight than standard practice is possible. The design also lends itself to the use of sheet metal in place of tubing, without any costly dies for double curvature. There is also the possibility of using light alloys which are not suitable for standard frames.

Making an Electric Washer

Construction Details of a Useful Domestic Appliance

By G. HEELAS

THE construction of an electric washer can be undertaken by anyone possessing a fair amount of patience and an assortment of tools. A small amount of lathework and welding is also required, but this can be done at the local garage for a few shillings. The washer described in this article is of the flush action type as this calls for the least amount of lathework and

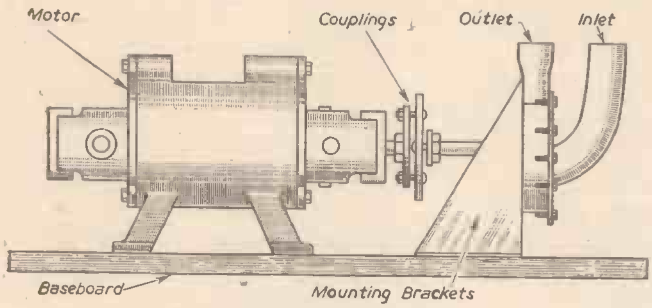


Fig. 1.—The motor-driven pump.

expense. The main components consist of a gas copper, type 29 ex-R.A.F. motor generator and a centrifugal pump.

Making the Pump

Details of the pump are given in Fig. 2. The shaft driving the impellor is a piece of ⅜in. diameter silver steel 3½in. long, and threaded both ends ⅜in. B.S.F. The bearing, with packing gland, is made from brass, and, if the constructor does not possess a lathe, a local garage would undertake the work.

The pump casing was made from a ring 11/16in. wide cut from a 3in. internal diameter pipe; also required are a piece of ¾in. I.D. galvanised pipe 3in. long, and a piece of 10 gauge sheet iron 4½in. square.

The ring has to have a piece cut out of it with hacksaw and file to allow the outlet pipe to fit in. One end of the pipe will have to be flattened for 2½in. so as not to exceed the width of the pump casing—otherwise the pump cover plate will not fit—and the end then has to be cut to fit the curve of the pump casing.

The ring, sheet iron plate and outlet pipe are now welded together, as indicated in Fig. 2. Eight ¼in. diameter studs are also welded into position. Next, drill a ⅜in. hole through the centre of the pump, and the four holes for mounting the pump on to the brackets.

Bearing

The bearing now needs to be made, as shown in Fig. 2, the thread for the retaining nut being a ⅜in. gas thread. I made my own bearing without a lathe by first cutting the ⅜in. gas thread on a piece of solid brass bar and then drilling out for the shaft and packing space, then finishing the remainder with hacksaw and file. This is a very tedious method and is not generally advised.

The bearing can next be sweated or brazed into position on the pump casing, the inside of which should now be given two coats of clear cellulose paint.

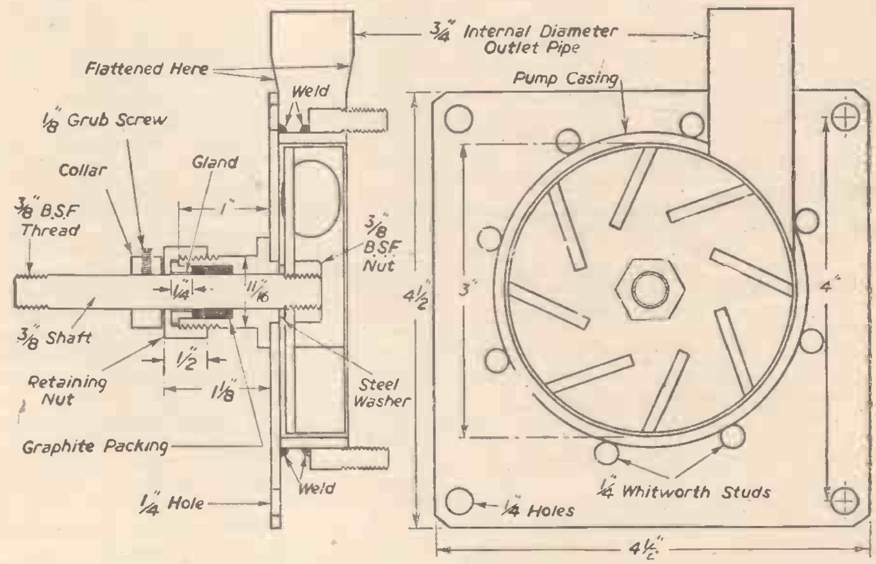


Fig. 2.—Section and side view of the pump unit.

The Impellor

The impellor is made from 3/32in. sheet brass. The blades are ⅛in. thick, and are soldered into position, as shown in Fig. 3. The method of setting out the blades is indicated by dotted lines, the slots for the blades being cut out with a hacksaw and finished with a fine file. A ⅜in. B.S.F. nut is soldered in position for mounting the impellor on to the shaft. Before soldering on the nut the centre hole must be drilled 5/16in. and then tapped out ⅜in. B.S.F.

Inlet Pipe and Cover Plate

The cover plate was made from a piece of sheet copper 4in. diameter by ⅛in. thick, and the pipe from a piece of copper pipe 1in. O.D. A 1in. diameter hole is first cut in the centre of the plate, next the holes were drilled to suit the ¼in. diameter studs around the pump casing. The inlet pipe bend was made by cutting eight saw cuts to half the depth of the pipe, and then bending the pipe till the cuts are closed up. If necessary saw again on the same cuts and close up again till the required bend is achieved. Clean and solder up the cuts, and solder the pipe on to the cover plate, as shown in Fig. 4. I only used copper for the cover plate as this material was to hand when making the washer, but brass or galvanised iron can also be used for the purpose. If galvanised iron is used, spirits of salts will have to be used as a flux when soldering.

Assembling the Pump

First screw the impellor tightly on to the shaft, taking great care not to mark the shaft where it goes into the bearing. Lightly rub the shaft with graphite and slide it into the bearing, after placing the steel washer between the impellor and bearing. Next, pack round the shaft with asbestos graphite packing, which should be of the kind that is in the form of cord. Cut this into separate lengths each of which will just go round the shaft once, making sure as each piece is placed into position that the cuts come opposite to each other. Only sufficient should be placed in position so as to allow the gland to be pushed home with the fingers; when the gland is in position screw on the retaining nut, slide on the steel collar and tighten up the grub screw.

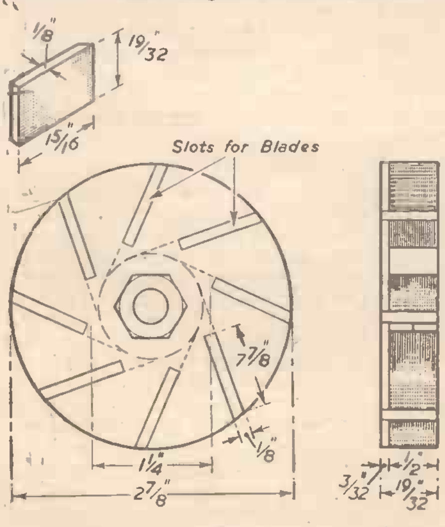


Fig. 3.—Impellor details.

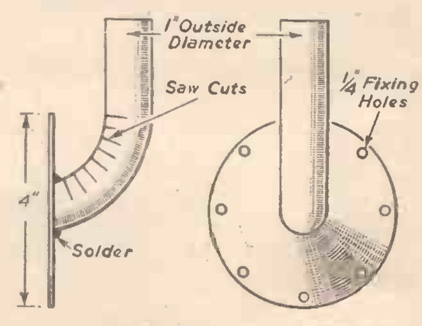


Fig. 4.—Pump inlet pipe and cover plate.

The collar can be made from a ⅜in. nut that has been drilled out, then drilled and tapped in the side for the ⅛in. grub screw.

The cover plate can now be fitted on, using as a joint a piece of 1/16in. thick sheet cork in the form of a ring.

Pump Mounting Brackets

These brackets were made from 10 gauge sheet iron; they should be cut, bent and drilled, as shown in Fig. 5, remembering to bend one left hand and one right hand. The holes in the front of the bracket should be slotted so as to allow adjustment to be made when lining up the pump and motor. Bolt the pump on to the brackets using ¼in. x ¾in. bolts.

Pump and Motor Couplings

The couplings are made from 2in. x ¾in. x

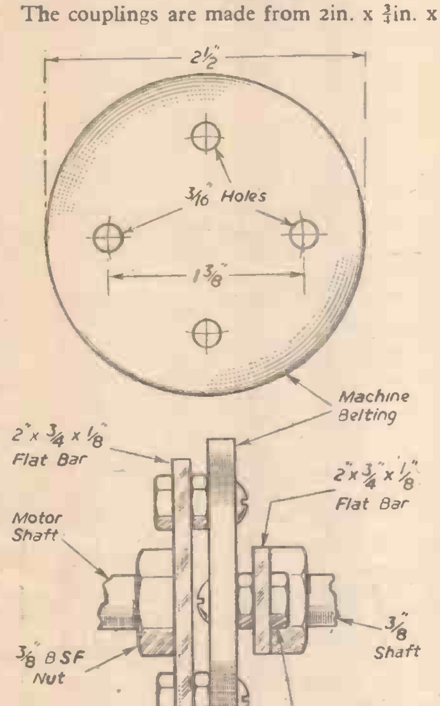


Fig. 7.—Coupling assembly.

⅛in. iron bar, two ⅜in. B.S.F. nuts, and a piece of machine belting, 2½in. diameter x 3/16in. thick. The pieces of bar and belting are drilled as shown in Fig. 6. The nuts are next sweated into position. The couplings can now be mounted, one on the pump shaft and one on the motor. The method of connecting the pump and motor are shown in Fig. 7.

The motor and pump can now be mounted on to a base board, which should be of plywood, 8in. wide and ⅝in. thick; the length depends on the diameter of the copper used. The motor and pump should be mounted

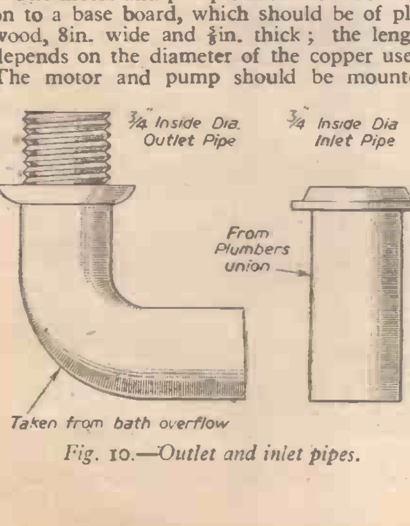


Fig. 10.—Outlet and inlet pipes.

on rubber and ½in. tap washers are ideal for this purpose. Drill the board for the motor and pump, and then fasten them into position as shown in Fig. 1, using ¼in. Whitworth bolts, taking care to get the pump and motor in line.

Adapting the Copper

Attention must now be turned to the copper. A minimum distance of 15in. is required between the base of the container and the floor, so remove the usual three feet and deplace with four 1½in. angle-iron legs, the length of these depending on the type of copper being used. About 5in. should be allowed on the length of these legs for bolting on to the outer casing of the copper; drill the holes as shown in Fig. 8. Two cross-irons are made and bolted on to the legs, opposite each other, in the position shown in Fig. 9, a ⅜in. diameter hole being drilled in the centre of each iron for bolting down the pumping unit.

Brass Bend

Obtain from your local plumbers' merchant a ¾in. I.D. brass bend of the type that is used on bath overflow fittings. Carefully cut a hole in the centre of the base of the copper the size of the bend, and solder into position, as shown in Fig. 9. An alternative method is to obtain a nut with the bend and screw on to the copper, using Boss White, jointing compound.

The inlet pipe was made from the shank of a ¾in. I.D. plumber's union soldered into position, 4½in. from the centre of the outlet. Details of the inlet and outlet pipes are given in Fig. 10.

The pumping unit can now be placed on the cross irons and the inlet and outlet pipes of the unit and copper connected together with 1in. heavy-braided hosepipe and fastened with Jubilee pipe clips. The baseboard can now be bolted to the cross irons. The purpose of conecting with hosepipe is to cut out a lot of awkward pipe work, and also to reduce noise and vibration between unit and copper.

Distribution Pipe

This pipe was made from a piece of copper pipe of ¾in. I.D. bore, 12in. long. On one end was soldered a nut that fitted on to the outlet bend, the other end being sealed up by soldering on a disc, cut from a piece of brass. Four lines of 3/16in. holes have now to be drilled, as shown in Fig. 11, eight holes in each line. The lines of holes have to be spiralled one quarter of a turn. The bottom two holes of each line have to be forced in at the top and out at the bottom so that the water is forced out at about an angle of 45 degrees. This can be done by placing a 3/16in. rod in the holes and slowly forcing it upwards. The bottom holes of each line must be a minimum distance of 2¼in. from the base of the nut.

The Water Collector

The water collector was made from a piece of duralumin, 8in. diameter, with a piece, 2in. x 2½in., protruding from it, as in Fig. 12. A 1in. hole is cut in the centre to fit over the distribution pipe. The outer edge was made from heavy gauge meat safe gauze, bent and bolted on, as shown in Fig. 12. A rubber rim can be fitted on the bottom edge, of the type that is fitted on windscreens of lorries; it can be stuck on with Bostick. When placing the water collector in the washer the blind spot has to cover the inlet pipe.

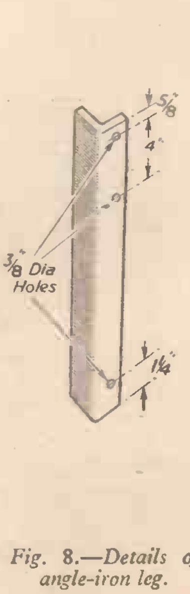


Fig. 8.—Details of angle-iron leg.

The electrical connections for the motor are as shown in Fig. 13. Make sure that the motor is properly earthed, and also the frame of the washer.

To prevent condensation dripping on to my

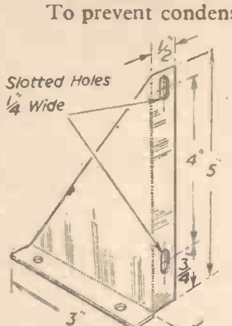


Fig. 5.—Pump mounting bracket.

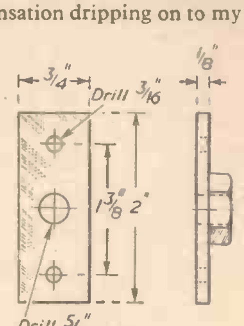


Fig. 6.—Details of coupling.

own motor I made a cover out of two 1-gallon paint cans, by cutting the tops and one side off each and soldering together, then fitting four lugs and bolting down.

Notes on Operation

When using the washer the water level should not be below 3in. from the top of the distribution pipe and not above the top holes.

The washer will wash one full size bed sheet and four pillow cases at once, leaving them in about eight minutes. All washing should be rinsed in warm water. Clothes that are extra dirty, such as shirt cuffs and neck bands should first be wetted and rubbed with soap before placing in the washer.

On my own washer I fitted my wringer, I did this by bolting a piece of hardwood on to the top of the washer and clipping the wringer to it. As wringers vary a lot in size and type it will be up to individual constructors to choose whether to have theirs on a separate stand or devise their own mountings.

Materials

The motor can be obtained from Clydesdales, Ltd., 2, Bridge Street, Glasgow, or Auto Collections, Ltd., 15, Lawrence Street, Northampton.

The copper pipe, brass bend and union

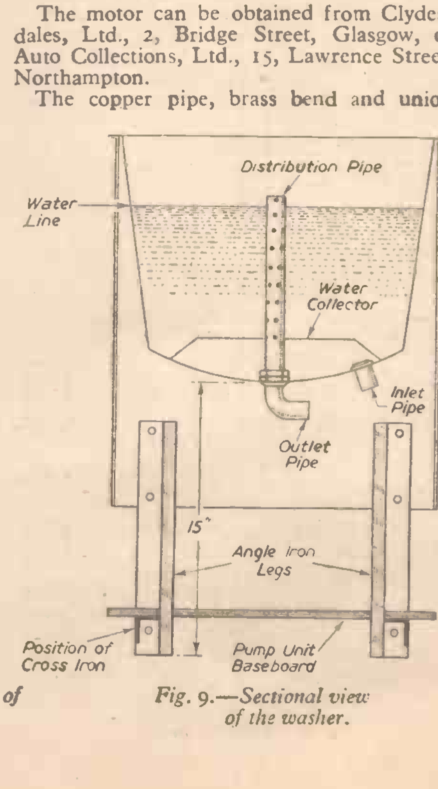


Fig. 9.—Sectional view of the washer.

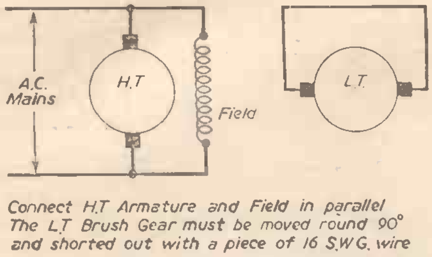


Fig. 13.—Diagram of connections for H.T. armature and L.T. brush gear.

from a plumbers' merchant. Nuts and bolts from hardware shops, tool shops or garages. Cork for pump joint from garages. Sheet iron and ring for pump casing from blacksmith and silver steel from tool shops.

With regard to the gas copper which forms the basis of the washer. If a disused one is not already available in the prospective constructor's home, a suitable one can be obtained at a reasonable price from many of the secondhand shops and small stores which deal in this kind of domestic article. If one has to be purchased, make sure that the copper pan is sound and does not leak, and that the outer casing is in good condition. The condition of the three legs is not important as these have to be removed in any case.

As previously mentioned, the construction of this washer comes within the scope of any handyman capable of using a few ordinary tools, and able to exercise a fair amount of patience.

If made in accordance with the instructions given in this article the resulting washer should prove efficient in use and well worth the time spent in its construction.

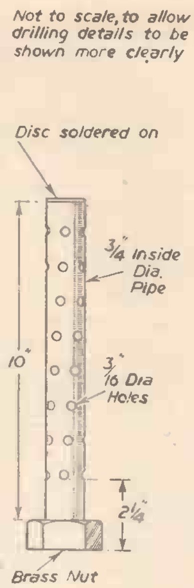


Fig. 11.—Details of the perforated distribution pipe.

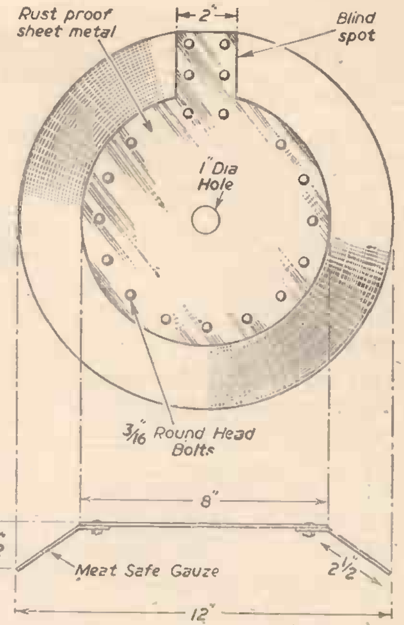


Fig. 12.—(Extreme right) Plan and section of the water collector.

A Chemical Garden

A Realistic Representation of the Sea Bottom in Miniature

By A. J. BACON

WHEN certain chemicals of a solid nature are placed in a solution of waterglass they commence to "grow" almost immediately.

The growths look like members of the vegetable kingdom, but really they are formed of crystals of the chemicals employed. There are different colours, which help to make quite a pleasing picture. If the various chemicals are scattered about the bottom of a glass tank containing equal parts of waterglass and water they will very soon grow into a forest of curious forms which, with imagination, one might liken to seaweed growing on the bottom of the sea.

Waterglass may be purchased at a domestic store in a tin containing ten fluid ounces for one shilling. It is used, normally, for preserving eggs.

Making the "Aquarium"

An aquarium may be had for less than ten shillings at a pet-shop, but it is an easy article to construct. Take strips of metal one inch wide, scribe a line down the middle, place in the jaws of a vice and hammer the projecting part down so as to form a right angle. Twelve pieces will be required, cut to the lengths desired. If the dimensions of the aquarium are made 5½in. by 3½in. by 3½in. deep its capacity will be that of one tin of waterglass with an equal quantity of water. These angle-strips may be assembled by soldering or riveting. The glass for the sides and bottom should be cut to fit easily.

A suitable watertight cement is made by mixing thoroughly litharge and glycerine to a consistency of stiff putty. The light yellow litharge is much better than the red variety for this purpose. When all is in place the "tank" should be kept thoroughly warm for an hour or two, but not so hot as to crack the glass.

The cement will set and be very efficient, but do not expect it to be as hard as stone; it does not need to be. It can always be marked by pressure of the finger nail.

Pebbles and Rocks

A layer of pebbles is now placed on the bottom of the aquarium. They should be very thoroughly washed, for if they are not, any fine sand which may be present will get suspended when the slightly treacly waterglass solution is poured in, and it will take days to settle out and get clear.

The rocks seen in the photograph are selected pieces of coal. They may be painted with anything except watercolours.

The chemicals may now be dropped in. They all sink so there is no need to bury them under the pebbles.

Chemicals Required

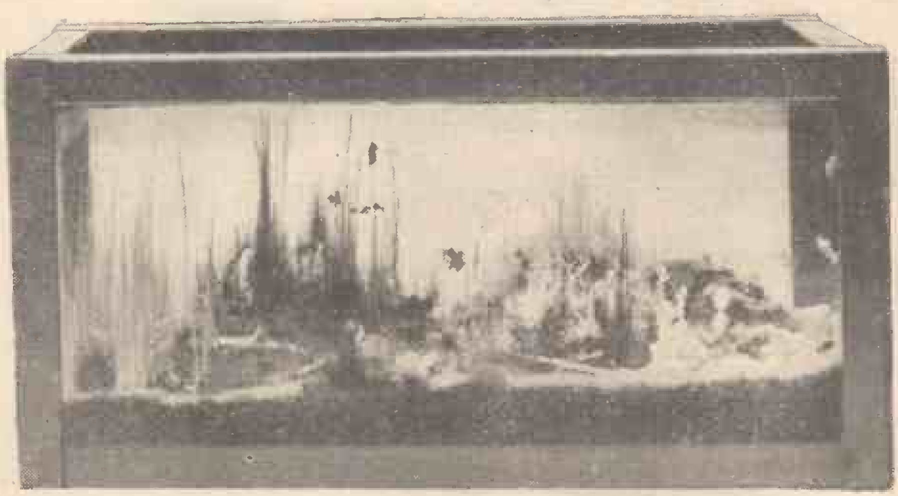
Viewing the photograph from left to right the growths might be described thus: chrome alum, a short growth (green); calcium chloride, long (white); iron sulphate, long, very fine threads (green); copper sulphate, short, (bright blue); magnesium sulphate, long (white with kinks in it); lead acetate, white (bulbous).

All these chemicals may be purchased from advertisers in this journal. For instance, Messrs. Beck and Sons, 60, Stoke Newington High Street, London, N.16 supply them in small quantities at about sixpence each portion. The chemicals can also be obtained from Messrs. Vicsons Ltd., 148, Pinner Road, Harrow, Middx.

A starfish adds to the realism. It is cut out of a scrap of sheet brass with the piercing saw, and trimmed up with needle files. It should then be made red hot and allowed to cool, when it will be just the right colour.

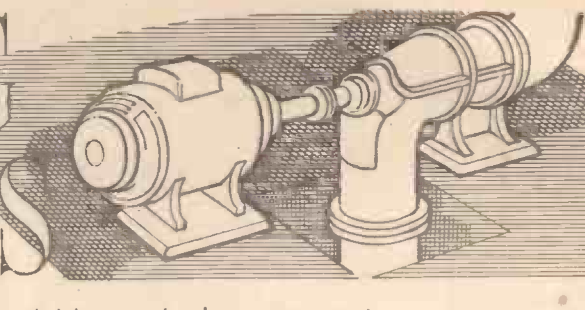
If it is intended to exhibit the model it would have to be made up on the site, and about twelve hours should be allowed for some of the crystals to attain maturity.

The arrangement of the features of this model of the sea bottom calls for imagination and taste. It may be caused to depict one's idea of the view that might meet the gaze of the deep sea diver.



A chemical garden. A miniature representation of the sea bed in crystals.

Small PUMPING INSTALLATIONS



The Various Types of Pumps Available, and Their Operation

By ROLT HAMMOND, A.M.I.C.E.

(*Continued from page 336, August issue*)

IN order to compare the performance of various types of centrifugal pump, we make use of the factor specific speed, but care must be taken not to confuse this with the specific speed that we use for the design of water turbines, which is quite a different thing. In the base of a centrifugal pump, specific speed is denoted by the sign N_s, which is not a measure of movement, but simply a number indicating the particular type of impeller; it is derived from the principle of similarity to impellers which are geometrically identical. In other words, they differ only in the ratio of their linear dimensions.

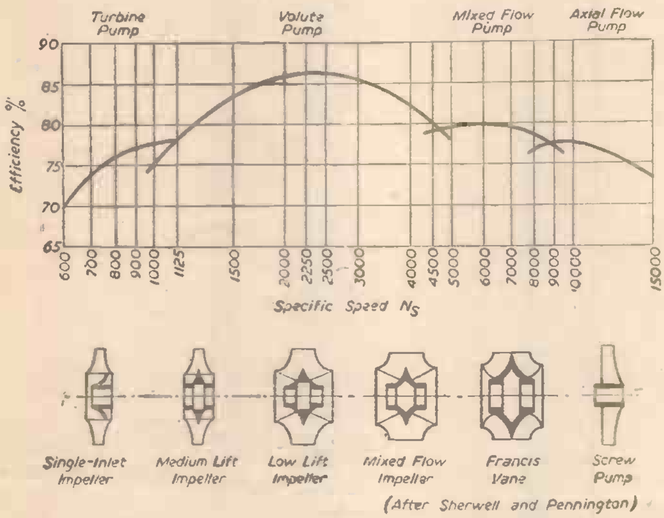


Fig. 5.—Various types of impellers and chart showing the efficiency of different types of pump.

Specific speed of a centrifugal pump is given by the formula :—

$$N_s = N\,Q/H^{3/4}$$

where N_s is the specific speed of the pump.

- N is the speed of rotation of the pump in r.p.m.
- Q is the output of the pump in gallons per minute.
- H is the total head in feet on the impeller.

Specific speed is often derived from different sources, and therefore we find that a British and American pump which may be identical in output and performance will have different specific speeds. Thus, if Q is taken in gallons per minute, values of N_s are 19.34 times greater than those obtained when Q is in cubic feet per second; if Q is in American gallons, the specific speed is 17.65 times the value of Q in cubic feet per second. The author has referred to this at some length in case any readers may have details of American pumps from which they may wish to select a pump for some particular duty.

Let us assume that we wish to design a pump to deliver 2,000 gallons per minute against a head of 50ft., including friction. It will be reasonable to allow 5 per cent. for leakage past clearances so that the impeller must handle $2{,}000 \times 1.05 = 2{,}100$ gallons per minute. If we assume a pump speed of 720 r.p.m., this being a standard speed for alternating current motors on a 50-cycle supply, we can now calculate the specific speed :—

$$N_s = 720\sqrt{2{,}100}/50^{5/4}$$

$50^{5/4}$ is 18.80, and the square root of 2,100 is 45.83 so that N_s is $720 \times 45.83/18.80 = 1{,}755$.

From Fig. 5, derived from a diagram by Sherwell and Pennington (*Proc. Inst. Mech. E.*, 1933), we see that for a specific speed of 1,755 we shall have a volute type of pump with an efficiency of about 85 per cent., with a double-inlet impeller, but to be on the safe side we shall assume an efficiency of 83 per cent.

$$\text{Water horse-power} = \frac{2{,}100\ (\text{g.p.m.}) \times 10\ (\text{lbs. gal.}) \times 50\ (\text{feet})}{33{,}000} = 31 \text{ horse-power.}$$

Since we have assumed an efficiency at the coupling of 83 per cent., the power required will therefore be $31/0.83 = 37.3$ h.p., so that we shall probably need a motor of 40 horse-power for this duty. From this example, we see how convenient it is to use the specific speed so that we can select the right size of motor and the most suitable type of pump for the job in hand.

The centrifugal pump of to-day is suitable for practically every type of duty, except for handling very viscous liquids, and it has many outstanding advantages. The flow is uniform with no reversal of direction, and the high speed of the pumped liquid enables smaller sizes of pipes to be employed for the same discharge obtained from a reciprocating pump. A centrifugal pump set is very compact, the smaller sizes being mounted with the pump and motor together on a single cast iron bedplate. Efficiency at high speed of rotation is good, so that a centrifugal pump may be direct-driven by an electric motor, oil engine or steam turbine. Experience has amply proved that the centrifugal pump has a low cost of maintenance, that it is silent in operation and free from vibration.

Certain precautions must be observed when installing centrifugal pumps. For example, soft packing only should be used in the stuffing boxes, because hard packings are likely to cause undue wear of the rotating spindles. There should always be small seepage of water visible to show that the packing is not being run dry, and that on the suction side, air is not leaking into the pump. Where grease is employed for lubrication, there must be sufficient pressure on the grease to prevent it being ejected by the hydraulic pressure acting on the bearing within the pump.

The great point to remember about a centrifugal pump is that it should never be started or run unless it is full of water. A suction foot valve is generally fitted to such a pump, and when the latter is being primed all the aircocks should be opened and the pump filled with water until there is an overflow at all the aircocks. They are then shut and the pump is started, and when nearly full, normal delivery pressure is reached and the delivery valve is slowly opened. Small pumps, with which we are mainly concerned, are generally fitted with a funnel for priming, but if there is a standing head of water in the rising main, they are primed by opening the delivery sluice valve slightly and allowing the water to run back.

In recent years, many different types of centrifugal pumps have been developed, one of the most remarkable being the Beresford-Stork, which is self-priming and can lift water through a suction head of 27ft. without

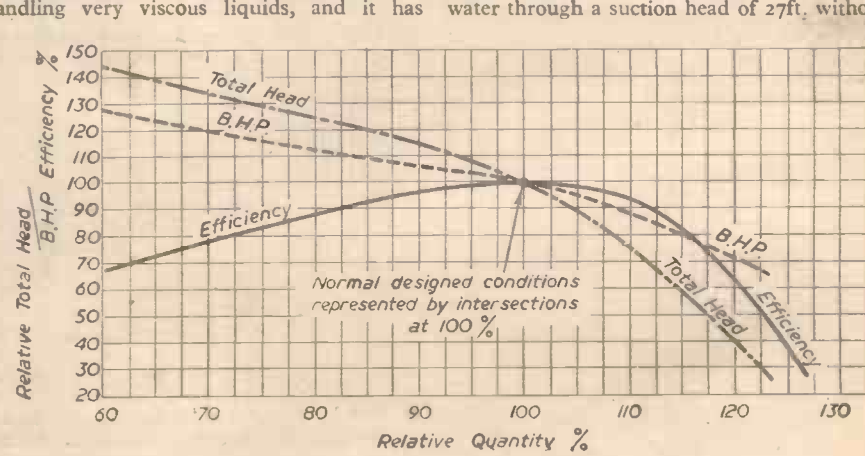
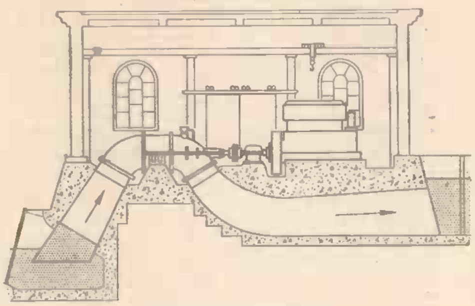


Fig. 7.—Characteristic curves for uniform revolution speed.

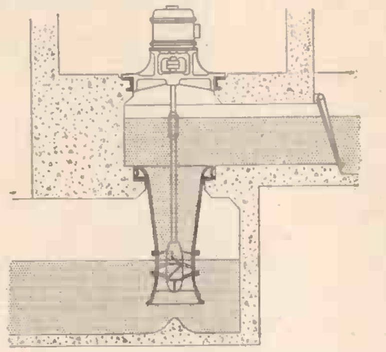
a foot valve. The Stereophagus pump, made by the Pulsometer Engineering Co., Ltd., Reading, has been specially developed for dealing with unscreened sewage and trade effluents, and the same firm makes pumps for mining duties to operate at heads ranging from 5 to 3,500 feet.

Rotary Pumps

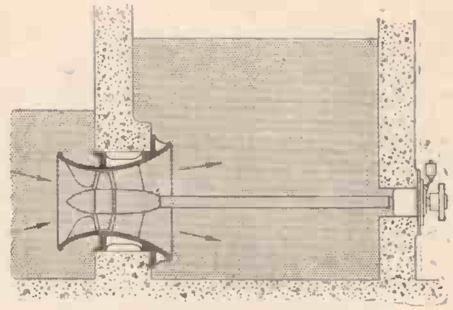
There are also many different designs of rotary pumps, the chief types being gear,



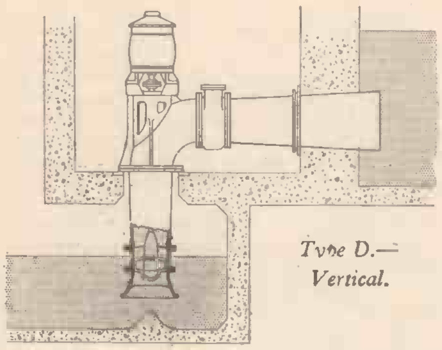
Type A.—Syphon.



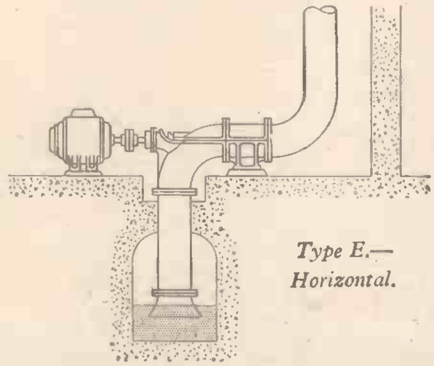
Type B.—Vertical : Open setting.



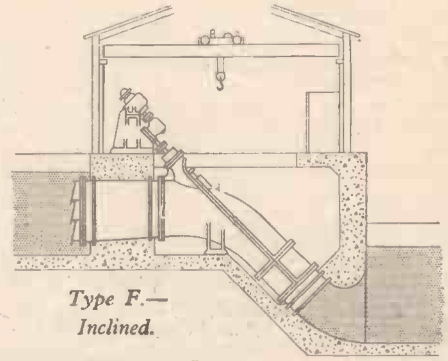
Type C.—Horizontal : Open setting.



Type D.— Vertical.



Type E.— Horizontal.



Type F.— Inclined.

Fig. 6.—Alternative settings of the Vickers-Gill propeller type pump.

lobar, screw and vane pumps, but the theory governing internal leakage and friction losses in such pumps is not yet perfectly understood, so that it is difficult to make a choice as between one design and another. In gear pumps, helical and double helical gears ensure quiet running at high speed, but in pumps of the lobar type, separate gearing is required to drive the follower rotor, except when helical lobes are used. This type is very suitable for dealing with large flows and with very viscous fluids.

Vane Pumps

In vane pumps, the most usual construction is to have a number of sliding moving vanes of radial type ; this type of pump is used in the smaller sizes for the operation of hydraulic presses and for controlling the movements of small naval gun mountings. Rotary pumps have in the past generally been considered suitable for the pressure range from 20 to 400 lb. per sq. in., but in recent years there has been a great improvemnet in the accuracy with which such mechanisms have been made, and special gear, vane and screw pumps have been developed for power transmission up to pressures of 2,000 lb. per sq. in.

The Vickers-Gill Pump

A very useful pump for various applications, and especially for dealing with large flows at low heads, is the Vickers-Gill propeller pump, different arrangements of which are shown in Fig. 6. This is an axial flow machine which embodies a multi-bladed rotor of special design, drawing the liquid between guide vanes on its inlet side and discharging it between guides on the outlet side. The inlet vanes are designed in such a manner as to prevent whirl which would adversely affect pumping efficiency, the function of the outlet guide vanes being to convert into pressure the residual energy of whirl imparted to the rotor by the water.

This pump is self-regulating, which means that at a constant speed of revolution any fall in head below the maximum specified condition, while accompanied by an increase in the volume of water pumped, will result in a decrease in the power required, and this is well shown in the characteristic curve in Fig. 7. This type of pump has the great advantage that the space which it occupies is the absolute minimum possible, and is no more than required by the pipe which would in any case be necessary for conveyance of the liquid. This is due to the fact that pumping speed is much higher than that required for a comparable centrifugal pump performing similar duties.

Self-regulation

The valuable feature of self-regulation means that there is no need to install a sluice valve on the discharge side of the pump. In practice it is generally possible to install these pumps without any valves, with the possible exception of a plain non-return valve at the discharge outlet. Some idea of the tremendous size to which these pumps can be built is conveyed by those installed by the Yorkshire Electric Power Company. Eight vertical spindle units are employed for condenser, air and oil cooler circulation ; the two 54in. bore main circulators each deliver 50,000 gallons per minute against a head of 19ft. These pumps are also available in very much smaller sizes.

Visit to the Ford Motor Works

ON Monday, July 9th, we accepted the invitation of the Ford Motor Company Ltd. and, together with other members of the daily and periodical press, made a tour of the extensive Ford works at Dagenham. Here, on reclaimed marshlands on the north bank of the River Thames, 15 miles east of the City of London, is the most self-contained motor-car factory in Europe, where the Ford Motor Company transmutes raw materials from the basic elements to completed vehicles.

The factory is supplied by its power house, in which enough electricity can be generated to meet the domestic needs of about 300,000 people. Here, also, is a gas-making plant and the only blast furnace in the British motor industry, which is capable of handling 1,900 tons of iron ore, limestone and coke every 24 hours to maintain a daily output of 600 tons of foundry iron.

During the tour of the works we saw the molten iron being poured into the moulds for forming cylinder block castings, and also the making of the cores of various engine parts.

One of the notable features of this huge organisation is the method of assembly of various types of Ford motor vehicles on the production lines, which are virtually slowly moving platforms. The well-known Fordson Tractor is assembled in this way. At one end of the moving platform the engine and transmission gearbox are assembled and bolted together. Then the chassis is fitted, followed by the various controls. After that the completely assembled tractor body passes through a spraying compartment, where it receives a coating of special paint. After passing through a drying chamber the tractor wheels are fitted, the engine is given a test, and after a final check up the tractor is driven off the still moving platform down a ramp, ready for delivery. Various types of private cars and commercial vehicles are assembled in much the same way.

To deal with the large output there is the 1,800ft.-long Ford jetty which spans the factory waterfront. Mounted on the jetty are two giant unloaders, handling 600 tons an hour to clear cargoes of raw materials at one end of the jetty, the finished products being shipped at the other.

Sherlock Holmes—Scientific Detective

An Account of the Recent Re-opening of No. 221B, Baker Street

By THE MARQUIS OF DONEGALL and Dr. JOHN H. WATSON, M.D.

DOCTOR WATSON has been nettled—I think, not without cause—by various statements which have appeared in the press, owing to the limelight suddenly thrown on the old premises which he and Mr. Sherlock Holmes occupied at 221B, Baker Street, London.

The St. Marylebone Borough Council has rightly seen fit to open it to the public, after so long a period of time, in the interests of the Festival of Britain, at Abbey House, very near Baker Street Station.

The re-opening of the rooms which Holmes and Watson decided to abandon *in statu quo* does not, however, excuse accusations against Watson that he knew nothing of flora or fauna, had obviously never looked at a map of Dartmoor before reporting "The Hound of the Baskervilles" and did not even know that a goose has no grit-bag when engaged on the case of "The Blue Carbuncle." Watson never said that it had. It was the crop that was in question.

In any case, as Watson pointed out on our way to the old chambers that he and Holmes occupied for so long, he found his brain too slow on occasion to catch up with the deductive reactions of Holmes.

The case of the "Empty House." Mrs. Hudson moves the bust of Sherlock Holmes in order to defeat the machinations of Colonel Sebastian Moran's murderous air-gun. At the time Dr. Watson reported the incident he did not know that Billy, the page-boy, was experimenting in photography. Billy had gone off to develop his film.

(From the archives of Dr. John H. Watson, M.D.).

Scientific Charts

As we come into the room there are, on the left, scientific charts on the wall. It was in the case of "The Masserine Stone" that Watson refers to certain scientific charts on the wall. "They were," Watson tells me, "geological charts from some of which Holmes derived his knowledge of clays and other geological matters, from which he *his* cap, anyway, and that Holmes was always borrowing it.

Then we come to Dr. Watson's top hat which has a dent in it because he kept his stethoscope in it. Dr. Watson, having come made his famous deductions about mud on the boots of his clients."

Continuing, we have a portrait painted by Vernet, great-uncle of Sherlock Holmes; his grandmother was Vernet's sister. Holmes was seldom voluble about his relatives. But Watson recalled that he said of his brother: "One has to be discreet when one talks of high matters of state. You are right in thinking that Mycroft is under the British Government. You would also be right in a sense if you said that, occasionally, he is the British Government."

Next comes the "V.R." in Holmes' bullets reported in the case of "The Musgrave Ritual." On the sideboard, of course, there is the gasogene which is a very early form of soda-water syphon, mentioned in the case of "The Masserine Stone." There is also the spirit case, referred to in "A Scandal in Bohemia," and Holmes' service revolver. The service revolver comes into the earlier part of "The Study in Scarlet," just before the arrest is made. The famous deer-stalking cap, which was never so-called, and the long grey travelling coat that Holmes wore in "The Boscombe Valley Mystery" hang near the door. Watson tells me that it was back into practice, bought a "modern" stethoscope which is exhibited with the hat. On the other hand, on the breakfast table is his old wooden stethoscope which made the dent, characteristic of medical practitioners of the period, in his top hat.

Coming round the room, we find next the portrait of General Gordon, killed at Khartoum, as mentioned in the case of "The Cardboard Box."

"The Empty House"

Directly under the picture of General Gordon we saw the bullet-hole made by Dr. Sebastian Moran's murderous air-gun in the case of "The Empty House." Not very far from the hole made by Moran's bullet we have the harpoon with which Holmes practised in the case of "Black Peter"; the settee littered with the original newspapers, and a bookcase on top of which lie the boxing-gloves that come in repeatedly as illustrating, according to Dr. Watson, Holmes' proficiency in boxing. The bookcase has the small medical shelf that Watson mentioned in "The Hound of the Baskervilles"; on the next shelf Crockford's Clerical Directory, 1897, and the Medical Register for 1896; on the bottom shelf the famous scrapbooks and the great index books referred to in "The Sussex Vampire."

Still going towards the right Dr. Watson and I came to the mantelpiece, and there we found, on the top shelf, the small ivory box with its deadly mechanism from the case of "The Dying Detective." On the right-hand side, at the top, the hypodermic syringe and the bottle of cocaine. Right in the centre of the mantelpiece, the jack-knife still transfixes the unanswered correspondence.

The Persian slipper containing the shag tobacco hangs vertically by the side of the fireplace. Holmes' night binoculars, used in "The Hound of the Baskervilles," are also on the mantelpiece with his pipe.

It was well known that in Baker Street they had gas and oil lamps as there are many references to them, and it was to be presumed that they had gas-brackets over the mantelpiece, as indeed, we found them.

The case of the "Solitary Cyclist." Miss Violet Smith leaving Charlington Hall.

(From the archives of Dr. John H. Watson, M.D.)

The "Stinks" Table

Moving again round the corner we get Holmes' table of "stinks." Over the "stinks" table is the cane rack of "The Red-headed League" where it is recorded that Holmes takes down his heavy hunting crop. There is Holmes' violin—a Stradivarius—and the code of "The Dancing Men," pinned up on the wall. "Holmes was bending for a long time over a low-powered microscope." (You can see it in the picture.) On Holmes' desk the cabinet photograph of Irene Adler left for him in "A Scandal in Bohemia." On this occasion that Watson and I visited the old rooms, we found the lamp-with-the-shutter on Holmes' desk, with the revolving office chair in red leather in front of it. The velvet-covered chair shown at the right of the bust is mentioned in "The Sign of Four."

Inspecting the breakfast table we discovered the burglars' kit in the butter-dish. (Butter-dishes were larger in those days!) It consists of a bunch of skeleton keys and some mysterious tools. The cigars were, as left, in the coal-scuttle and the famous pair of handcuffs used in various cases was on the writing-table.

The case of the "Solitary Cyclist." Miss Violet Smith's bicycle, discovered by Humber's, of Nottingham, as exhibited at Abbey House, 221B, Baker Street, in the Sherlock Holmes Exhibition.

Colonel Moran's Air-rifle

Now the air-gun for dealing death to Holmes at the hands of Colonel Sebastian Moran. "Holmes picked up the powerful air-gun from the floor and was examining its mechanism. 'An admirable and unique weapon,' said he. 'Noiseless and of tremendous power.'" This came in the case of "The Empty House." The air-rifle of Colonel Sebastian Moran was of a complicated type and prone to go out of order. The butt-section is an air-reservoir which can be pumped up by means of a small-diameter air-pump to a pressure of some 50lb. A large spring-controlled poppet-valve with a protecting steel shank contains the air in the reservoir. The outer barrel is smooth-bored and takes a small charge of shot pellets for use against small game. A breech-loading device for the use of spherical ball in the larger barrel is incorporated. The weapon has to be cocked against a very powerful mainspring by a detachable cocking-lever and is discharged by pressing on a small stud on the left-hand side with the thumb. Small fixed sights are fitted. The weapon considered as a rifle is as efficient as a revolver of equivalent calibre and is much quieter. As a shot-gun its performance is poor beyond twenty yards range.

But as a rifle, a range of over 150 yards is well within its capacity. Ten to twelve shots can be fired without loss of efficiency or repumping; but as pressure declines, some variability in penetration occurs.

At the end of our visit, Dr. Watson, whose wound from the second Afghan War still continues to trouble him at times, handed me the remarkable photographs—published for the first time—which you see here.

Miss Violet Smith

"Nobody knows," said Dr. Watson, "who took the picture of Miss Violet Smith. He or she must have been concealed behind the yew hedge which I described. It came anonymously into my possession quite recently and has obviously been copied with modern apparatus.

"The photograph of Mrs. Hudson was taken by Billy, our page-boy, who kept quiet about it because he had been ordered to go home. He is now managing director of a large firm of photographic suppliers and desires to remain nameless!" That Billy was in advance of his time as a photographer is obvious; hence his present position.

Motor-cycle Inter-communication System

Constructional Details of an Inexpensive but Efficient Unit

By K. S. DAVIES

ALTHOUGH the use of motor-cycle combinations appears to be still very popular, there is one serious disadvantage when compared with a car. This is the difficulty of communication between the driver and his passenger in the sidecar. In order to overcome this obstacle a simple but very effective inter-communication system was evolved and constructed by the writer.

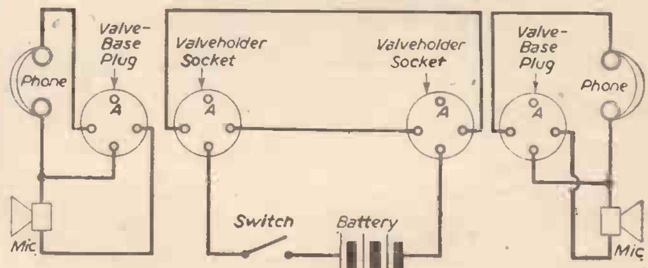
The circuit used is perfectly straightforward as the diagram shows. It is merely a three-wire telephone system. The possibility of using a two-wire system was not overlooked, but it was considered that separating the circuits gives more pleasing results.

All components used were either ex-Government or else salvaged from the junk box. The total cost was less than fifteen shillings. Low-resistance headphones were employed, those for the driver being the type fitted with noise-excluding rubber earcaps. The driver's microphone was of the carbon throat type, thus leaving his hands completely free. An ordinary carbon hand-microphone was used in the sidecar, although here again the throat type could be used if desired.

Head-sets

The head-sets used by both driver and passenger were constructed as separate units, being plugged into the circuit as required. These plugs were made from the bases of old four-pin valves. The leads from the phones and the microphones, after having been formed into a cable, were soldered into three of the valve pins. Each valve base was then filled up with pitch, making a strong and solid job.

Four-pin valve-holders of the base-board type were used as sockets. One was attached to a convenient bar near the saddle of the cycle, while the other was screwed on to the inside wall of the sidecar. The connecting leads followed the course taken by the lighting cable into the sidecar. It is essential that the plugs and sockets should be connected up exactly as shown. The circuit used makes it immaterial into which socket a head-set is plugged.



Circuit diagram for a motor-cycle inter-communication system.

Battery

Power is obtained from a 4.5-volt battery of the heavy duty bell-type which is fitted with terminals. Stowage for the battery can easily be found within the sidecar. A small switch, conveniently mounted, and breaking one of the battery leads, completes the job. This switch is not really necessary, however, since the removal of one of the plugs from its socket breaks the circuit.

Details regarding the exact placing of components must be left to the individual constructor, for it depends largely upon the design of the sidecar.

On test the apparatus has been found to be satisfactory in every way. The head-set carried by the driver is almost unnoticeable in use, particularly if a helmet or beret is worn. The connecting lead passes under the coat and plugs into the socket near the top of the left leg. Despite the earcaps it is still possible to hear the warning horns of other vehicles; while a perfectly normal conversation can be carried on either in traffic or on the open road.

Facts About Hydrogenation

The Importance of this Vital Industry

By Prof. A. M. LOW

FEW people bother to recollect that nearly everything they have for their personal health, comfort and amusement is the direct result of invention and scientific research, but it is by the very domestic manner in which hydrogenation can be used that everyone must know about a miracle which ranks with radio in industrial importance.

The word hydrogenation is perhaps a little unfortunate, although it is not nearly as complicated as it sounds. Hydrogenation means, not the reconstruction of the infinitesimal particles which form the atom, but the far more practical scheme of re-arranging the larger molecules from which the initial atoms are themselves made. Quite a number of examples of such a process are provided by nature, and if it were not for the extraordinary length of time necessary for their accomplishment in the history of geology all the resulting materials would seem fantastically impossible.

It is by an incredibly slow process of disintegration, as applied to trees and similar life upon the earth, that coal has eventually been produced through changes which are now partially understood under the title of colloidal, or biochemistry. It was probably seaweed which began this cycle when its patience enabled it to grow roots and live upon land.

Wealth of Coal

In Great Britain the wealth of coal which was originally responsible for the industrial success of the whole country is mainly due to these changes which take place in the living matter made up of carbon, oxygen and hydrogen. Coal itself approaches pure carbon in some of its harder forms, but there are quite a number of varieties in which the nature of the product itself depends entirely upon local conditions, and the time taken for the metamorphosis.

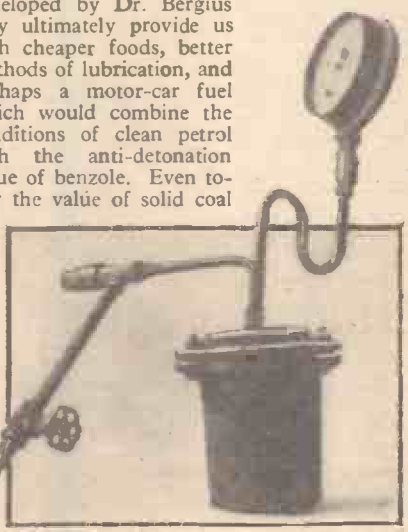
There are other similar cases of so-called elements which, basically the same from the chemical standpoint, are quite different in physical make-up. Carbon can be found in the form of graphite or diamond. Sulphur has also a number of formations known as allotropic, all of which are produced by various circumstances of temperature and pressure. These are really examples of some of the changes which can be made in the structure of matter, but the case of hydrogenation is different in that the alteration to the original substance is caused by the addition of hydrogen to the base which already contains a portion of this element.

It is believed by many people that the hydrogenation of pure carbon is a consequence of direct pressure changes carried on through millions of years, but it is probable that the action of sun upon seaweed deposited on land is a contributory cause. The net result is quite simple, for hydrogen has been added to the carbon to result in various hydrocarbons such as paraffin, tar and the innumerable aniline dyes and derivatives with which everyone is familiar. If hydrogen could be added to any substance as required, without waiting for the processes of nature, there would be no difficulty at all in producing laboratory oil, which would otherwise take many million years to form in the earth. As is well known, the gas itself can be combined with oxygen to form water, but the hydrogen can only be structurally added to substances which are weak in these elements and, therefore, anxious to obtain a larger supply from natural affinity.

It is nearly a century since the effects of hydrogenation were first discovered, but until the first Great War made its application necessary for the manufacture of nitrates very little practical success was achieved.

Modern Experimentation

As the result of modern experimentation it is now very probable that the principles developed by Dr. Bergius may ultimately provide us with cheaper foods, better methods of lubrication, and perhaps a motor-car fuel which would combine the conditions of clean petrol with the anti-detonation value of benzole. Even to-day the value of solid coal fuel is far less than its own by-products, and it seems quite possible that before long coal will never be used in its present wasteful form.



A pressure pot, for the solvent extraction of coal.

A great industry has sprung up around hydrogenation and, as it has been discovered that hydrogen can be attached to carbon itself by comparatively simple physical methods, it is more than likely that coal will become the source of various oils which, together, could make up the most important fuel civilisation has ever known. There seems little reason to doubt that industry in this country may receive a new lease of life for, if our coal resources can result in cheap home-produced oil, it will justify the ranking of this discovery with such epoch-making inventions as the X-ray, the aeroplane or the internal-combustion engine.

The application of this rebuilding chemical process to many of the common substances of everyday life is even more striking. Cotton-seed oil can be hydrogenated or hardened to a fatty material with the consistency of lard. Great success has resulted from experiments upon whale and herring oil, both of which have had hydrogen added to their formation, with the result that the final product loses all resemblance to the initial fishy base. All these oils have been used in place of cocoa butter for domestic purposes.

It is believed by many people, from preliminary tests, that sugar will eventually be reconstructed from sawdust, while such important natural solvents as turpentine can be made in synthetic form, or hardened and used with the by-products of fish in the manufacture of toilet soap.

The process itself which is responsible for all these seeming miracles is comparatively simple. It is accomplished in the main by the aid of high pressure and temperature changes in the presence of what is known as "catalyst." There are a number of substances known to science which are able to assist in the breaking up of molecular stability in some electrical fashion. These bodies are called catalysts because, although accelerating changes in other materials, they do not themselves suffer any alteration during the action. A colloquial example is that of a bridge which allows the atoms and molecules of certain chemicals to pass over it, forming other chemicals on the opposite side of the bridge, but not affecting the structure of the road over which the transition takes place. One of the most used of all catalysts is a derivative of nickel, which is now replacing the original so-called oxide of iron in the industry of hydrogenation, and in particular its application to the preparation of lubricants.

Hydrogenated Lubricants

In the running of any internal-combustion engine one of the most important factors for the maintenance of efficiency is the type of lubrication employed. Unfortunately, the engineer is faced by a great difficulty, for no ordinary test can indicate the complete stability, or otherwise, of an oil for each one of the duties it is supposed to perform. The ability of an oil to withstand high temperature without losing body, the lasting effect of its particles, the rate or pressure at which it will flow, resistance to carbonisation, and even the type of carbon formed in the engine, are all factors which can only be proved by long and costly experiments. In most common examples, lubricants are divisable into three chief classes: Vegetable oil, which is successfully used for racing, but which sometimes causes severe difficulties in starting and carbon deposition; the naphtha oils derived from coal products; and the ordinary mineral lubricants distilled from paraffinic material. Other types which are commonly blended for general use very

A lump of peat and one of coal seen side by side. Note the fibrous nature of the peat compared with the hard, shiny nature of the coal. Both substances have a common origin.

naturally combine the disadvantages as well as the advantages of both products.

It is not generally realised that a modern small engine often subjects an oil to far greater stresses than the large type of motor, which is only expected to run at full power for short periods. Small cars, for example, are fitted with high-speed engines working at a temperature and rate of stress reversal which demands an entirely different type of lubrication to that applied to any other machine. In spite of these difficulties very little change has taken place in commercial lubricants, and most oils can only satisfy very few of the general requirements. Naphthalic products are reasonably satisfactory in regard to carbon deposit, but may fail in viscosity at high temperature, whereas the paraffinic class maintains body and can be poor as far as carbonisation is concerned.

It is this very difficulty of preparing a suitable oil by blending which has been partly solved by hydrogenation, for the original oils are subjected to enormous pressures in specially prepared steel containers at a temperature which compares with that of the working conditions of an actual engine. In the presence of hydrogen and the catalyst, the oils actually break down and, as the hydrogen is added to their content, they form into a lubricant which is very much more stable, and in which some of the destruction by heat and pressure has already taken place in the retorts instead of in the engine during use.

These new oils can quite easily be built up in various grades, and are so stable that wear, due to formation of dirt, combination with water and other disadvantages, is almost entirely avoided, while it is claimed that the hydrogenated oil not only combines viscosity maintenance with the non-burning qualities of natural oil, but is also able to reduce friction.

Conversion of Coal to Oil

One other aspect of hydrogenation which has recently become very prominent in connection with the preparation of motor spirit is the hydrogenation of coal to form liquid fuel. Bituminous coal consists mainly of carbon, hydrogen and oxygen in which there is usually a small impurity content of sulphur and other bodies. Oil is far more rich in hydrogen than coal to the extent, in fact, of 14 per cent., and the hydrogen in bituminous coal is in the neighbourhood of 5 per cent. An additional 10 per cent. is required for the weight of solid fuel.

The conversion of coal to oil is, in itself, not complicated. The solid fuel is mixed into a paste with about 40 per cent. of its own weight of heavy oil. The catalyst is added to this mixture and the whole is pumped into a heated vessel through which hydrogen is passing at a very high pressure. At the end of the operation during which the mixture is mechanically stirred, a thin, tar-like product can be separated, and from this liquid matter, fuel of a particularly satisfactory nature can be produced. As will be quite clear, the use of even 10 per cent. of hydrogen implies the manufacture of 40,000 cubic feet of gas to convert coal into one ton of petrol, but it has been estimated that in the case of English coal the cost of this process would be not much more than 7d. per gallon of spirit.

In making one ton of petrol, about four tons of coal are necessary on account of the various subsidiary processes, so that if the national consumption of petrol is taken at 3,500,000 tons per year, the coal required would reach the enormous figure of 14,000,000 tons in one year.

One striking feature is that, as in the case of hydrogenated lubrication, the ultimate product is sometimes more suitable for general consumption than that directly obtained by natural processes. It is no exaggeration to state that the effect of hydrogenation developments upon industry could prove a vital factor in British economics.

The National Physical Laboratory

Its Work in Connection with Modern Scientific Research

By THE MARQUIS OF DONEGALL

IT may be that some readers know little more of the National Physical Laboratory at Teddington than I did, myself, before my recent visit. Briefly, it was founded in 1900 in an old Royal Residence, Bushy House, which is now one of sixteen large and a number of smaller buildings occupying 50 acres of attractive gardens.

The Laboratory was controlled by the Royal Society until 1918, when it became part of the newly-formed Department of Scientific Research; but the Chairman of the Royal Society remains *ex officio* chairman of the General Board, and the committee represents both pure science and its application to British industry.

It is of interest to show the wide field covered and to list the major divisions: (1) Aerodynamics, (2) Electricity, (3) Engineering, (4) Light, (5) Mathematics, (6) Metallurgy, (7) Metrology, (8) Physics, (9) Radio, (10) Ship.

Coming in the main entrance from Kingston or Richmond, we come first to the aerodynamics section. This has been in existence since 1909 and is now under the auspices of the Aeronautical Research Council.

Here, in addition to a new whirling arm of about 60ft. diameter, revolving at half a revolution per second for the study of yaw and pitch in rotational motion, there are several tunnels of the return flow type, as well as the old compressed-air tunnel. The usual method of suspending models is from balances by wires. There is also the latest electrical measuring equipment for dealing with oscillating and rotating models for "flutter" and stability problems. Some work has already been done at supersonic speeds and researches are going on in the improvement of sonic and supersonic tunnels.

Engineering Division

About as vast as the aerodynamics building is the engineering division, to which we next come. This was one of the first branches of work to be made a separate entity of the Laboratory, and we see here a photo-elastic laboratory with a photo-electric photometer for measurement of photo-elastic patterns. The main object being to reduce the weight of products, photo-elastic stress patterns are made of transparent plastic for inspection in polarised light. It is then possible to see where strengthening is needed or where low stress will allow of reduction in weight. We pass on through dynamic calibration of fatigue machines, research on aircraft structures by panels fitted with electric resistance strain gauges and a phase-sensitive detector for A.C. bridges.

Then we come, in an adjacent building, to the tidal model laboratory. This section, under the responsibility of Sir Claude Inglis,

In the ship division. This picture is taken from the carriage which runs on rails along the whole length of the tank. On the left can be seen the apparatus for recording the behaviour of the model as it is drawn through the water. This tank is 550ft. long, 30ft. wide and 12½ft. deep, and the carriage is capable of a maximum speed of 25ft. per second.

C.I.E., Director of Hydraulic Research, I found fascinating.

There are two large models, one of the Firth of Forth as far as Stirling and one of the River Wyre, in Lancashire. The latter is about 60ft. long and 15ft. wide, with a horizontal scale of 1 in 1,000.

The river bed is reproduced in fine sand with a vertical exaggeration of the depths and slopes of 10 to 1. The tide, which in nature has a range of about 30 feet, is reproduced in the model by a periodic displacement of 3.6 inches in the level of the water at the seaward end. This is achieved by raising and lowering, on a hydraulic jack, a 2-ton plunger controlled by a system of cams through a hydraulic servo mechanism. This mechanism reproduces the variations in tidal range over the fortnightly cycle of spring and neap tides. A tide occurs in the model every seven minutes, so that a week's continuous running represents one year in nature. The main purpose of the model is to study various means for stabilising the course of the low water channel in the estuary. In the case of the Firth of Forth model the horizontal scale is 1 in 1,800 and the vertical scale 1 in 144.

Before finishing this quick glimpse—for that is all it can be—of the engineering division, we see what the Laboratory has achieved in development of bearings for gas-turbine engines. As gas turbines run at much higher rotational speeds than piston engines, special machines capable of running at 30,000 r.p.m. have been made for testing jet aircraft ball and roller bearings. Further research for the benefit of the automobile and aeroplane industries is going on in the fields of fretting, corrosion and creep in metals.

A walk in the gardens brings us to Bushy House, the original building. Here, among many other things, the testing of watches and chronometers is carried out. It is here also that comparison of radio time signals and standard clocks is carried out by cathode-ray chronograph and decimal counter chronometer.

In the radio section the cathode-ray direction finder exhibited is similar to the type used by the Meteorological Office in connection with the routine location of thunderstorms at long ranges. Such equipment was of very great value during the recent war, and has continued to be so, particularly in the problem of selecting the most suitable routes for aircraft over the Atlantic. The equipment has been designed and constructed in the radio division.

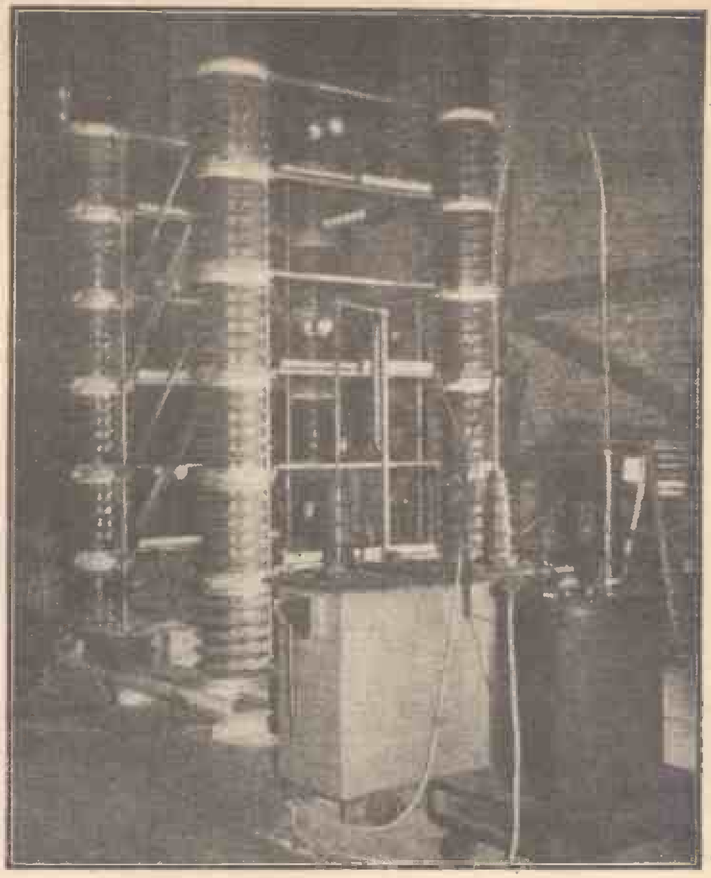
Precision Standards

At frequent intervals a film entitled *Precise Measurement for Engineers* was shown in the main physics building. It is at intervals of 10 years that the comparisons of standards of length and weight are carried out at the National Laboratory. The film shows how this is done and how angle gauges are received and tested for industry.

For the measurement of length and weight, science and industry are dependent on national standards. In the imperial system there are the Parliamentary Standard Yard and Pound, respectively of bronze and platinum, each of which ultimately defines its relevant unit. In the metric system the national copies of the international metre and kilogramme are of platinum-iridium. These national standards are compared with their respective principal copies at nominally 10-year intervals; but comparisons have just been made for the first time since 1932 on account of the conditions in 1942. The Laboratory is entrusted with both the imperial and metric comparisons and, using specially designed equipment, it has reached a precision surpassing anything hitherto attained.

Sets of angle gauges of 12 pieces are manufactured to N.P.L. design, ranging from three seconds of arc up to 41 degrees. They are so graded that any angle can be built up to within two or three seconds of arc. It is these angle gauges used by industry that are received for testing from time to time.

The comparator exhibited was designed and constructed in the metrology division to facilitate measuring these gauges. This is done by comparing them, piece by piece, with the corresponding gauge of a standard set belonging to the laboratory. The comparison is made with an autocollimator fitted with a micrometer-eyepiece, the drum of which is graduated to read direct to half second of arc. The two gauges to be compared are stood in turn under this instrument on a three-point support so that the upper gauging face of each reflects back into the instrument an image of an illuminated cross-line eyepiece. A micrometer reading is taken on the image formed by each gauge, and the difference between these two readings gives the difference between their angles to an accuracy of within half second of arc. A graded series of three-point supports is provided to accommodate the varying angles of the gauges in a set.



A corner of the high tension laboratory. High capacity impulse generator for producing voltage surges simulating those due to lightning.

Ship Division

Next we come to the ship division, which is occupied with the requirements of British and foreign shipbuilders. In the two tanks demonstrated we see the procedure by which the best forms of hull and propulsive efficiency, with regard to each individual case, are determined. The larger of the tanks has been equipped with a wave-maker of the "plunger" type to study the behaviour of ships in rough water. Vibration of ships' hulls, especially on passenger liners, has occasioned much full-scale research. Here we see the vibrograph and accelerometer with typical records taken at sea.

In the Lithgow water tunnel a propeller working under conditions of cavitation is demonstrated. To study this phenomenon it is necessary to scale down the pressure as well as the size of the propeller, which cannot be done in the open tank. To enable usual inspection of the cavitation to be made, the flash lighting is synchronised with the rotation of the blades. Provision is made for the measurement of the thrust delivered by the propeller and the shaft horse-power absorbed.

Finally, in the high voltage laboratory an impressive demonstration of what happens when lightning strikes a "grid" pylon was given to those with nerve and implicit faith in the ability of the technicians to control half a million volts and problematical amperage.

An experimental high voltage transmission line, similar to the conductors forming the "grid," had been erected in the Laboratory grounds. The result was, to say the least, an awe-inspiring flash. The high voltage plant consists of three transformers, each capable of giving 375,000 volts when supplied with power at 1,000 volts. They can be used in series to give over 1,000,000 volts.

Breakdown tests on insulators for manufacturers are part of the work of this section. Tests with artificial rain are carried out. There is also an impulse generator capable of developing 2,000,000 volts and a cathode-ray oscillograph for studying surge.

This has been merely a glimpse of a fraction of the exhibits, but it was certainly an interesting and instructive afternoon. I left with the conviction that the only grass growing under the feet of the personnel of the National Physical Laboratory was the attractive lawns with which the establishment is so well provided.

Telescope Object Glasses

Notes on Their Choice, Testing and

FROM time to time I receive, through the Editor, queries sent in by readers who require information relating to astronomical telescopes and nearly all of them concern the optical equipment.

A little while ago a reader stated that he had acquired an object glass of two inches diameter by eighteen inches focus and asked if he could obtain a power of 60 on this. Now the possible magnifying power of a telescope depends primarily upon two things: the quality of the object glass and the quality of the eyepiece, which latter is used to magnify the image brought to a focus by the object glass.

Taking the O.G. (object glass) first: its quality depends in the first place upon the nature and homogeneous structure of the two (or sometimes more) glasses of which it is composed; in the case of two, one of crown glass and the other of flint, and in the second place upon the grinding, polishing and final figuring of the surfaces. It must be understood, of course, that I am referring to object glasses which are achromatic; this is to say, free from colour. Single lenses are not achromatic and are useless for astronomical work, except to the beginner who is content to look at the moon only and be satisfied with an aperture to focal length ratio of not less than 60.

Freedom from colour or a chromatic aberration is never perfect in cheap O.G.s, even though they are composed of two glasses and called "achromatic," and if a lens is required for high-class work, free from both spherical and colour aberration, a high price must be paid for it. As a general rule it may be said that the smaller the ratio of aperture to focal length the higher is the degree of perfection required, in material and workmanship, especially in the final figuring of all the polished surfaces.

O.G.s are often to be bought second-hand, and here it must be pointed out that although the name of a good maker carries some weight, it does not always follow that the lens is still perfect. The glass is there all right, but the polish and figuring may have become ruined, or partly degraded, by careless or ignorant cleaning in the removal of dirt which should never have been allowed to accumulate. Therefore, in buying a second-hand O.G., whatever the price asked, it is well to make a thorough examination of the surface, especially of the outer convexed one of the crown, with a magnifying glass, looking for very fine scratches and abrasions and, if possible, make a trial sight on a star, using a good eyepiece for the purpose.

The point that I want to make is that: to buy second-hand a two-inch O.G. with focus as short as 18 inches and expect to be able to put a high magnifying power on that, can only lead to disappointment; unless the lens is by a first-class maker and in as-new condition. The only useful purpose to which such a not quite perfect O.G. may be put is to mount it as a following telescope on a larger clock-driven photographic equatorial.

A two-inch O.G., when it forms part of the only instrument possessed, should have a ratio of aperture to focal length of at least 1 to 15; that is to say the focus should not be less than thirty inches and it *should* then be capable of standing a power of 100 per inch of aperture.

Testing an O.G.

In order to judge the quality and condition of an O.G. a star of the third or fourth magnitude should be chosen; the telescope is pointed at this and focused to get the image as sharply defined as possible. Move the telescope so that the star image is seen at a number of different points in the field, or watch the star as it passes slowly across the field; the image should appear everywhere in the field as a spot, or tiny ball, of light with a number of perfectly circular and concentric diffraction rings of light around it, as at A in Fig. 1. If the image is distorted as at B or C then either the eyepiece or the O.G. is faulty. To check up on the O.G. revolve the eyepiece; if the distortion also revolves try another eyepiece and mark the first one for further examination. The probability is that the distortion will remain stationary and in that case the O.G. should be examined. In most good glasses the two lenses, the crown and the flint, each have a mark ground in their edges; see that these marks coincide when the components are in the cell and what is of greatest importance, see that the brass ring at the back of the cell is putting no pressure upon the inner, flint, glass; such pressure is bound to flex the glass and so impair definition. It is far better to allow a very slight looseness, so that the two glasses rattle slightly, when the cell is shaken, than to have them tightly gripped.

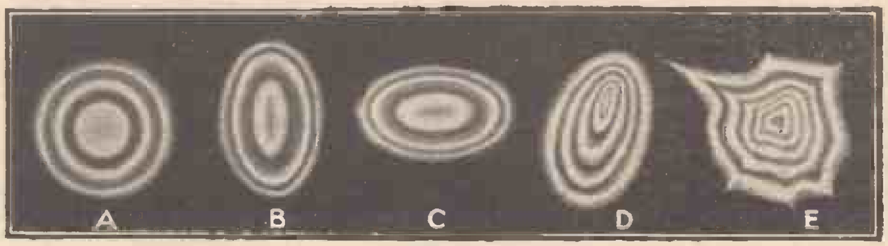


Fig. 1.—Star images, good and bad.

The sketches B and C, Fig. 1, show changes from one elliptical form to the other when the eyepiece is moved outside and inside of focus respectively. The shapes of the image indicate the presence of astigmatism in the lens. An eccentric image, such as D, may quite possibly be seen when first looking through the instrument and the fault will probably not be in the O.G. but in the adjustment of the cell in the barrel of the telescope. It shows that the cell is not correctly collimated; that is to say that the optical axis is not central or in line with the eyepiece. It must be adjusted by tilting in the right direction until the image becomes circular as at A. In good-class instruments push-and-pull screws are provided in the end fitting which carries the O.G. cell, to provide for correct collimation. The last sketch, E, in Fig. 1, shows the type of star image which is all too frequently found in cheap and damaged glasses; the two components can be loosened in their cell and the tinfoil separators looked to and if this does not correct the trouble then the objective is hopelessly faulty and is not worth purchasing.

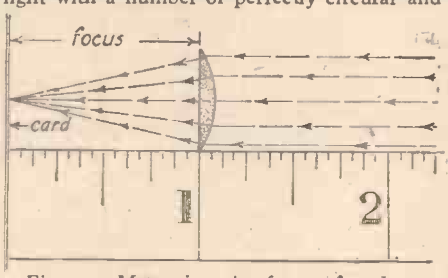


Fig. 2.—Measuring the focus of a lens.

Reverting to the choice of a star for test purposes it may be pointed out that the Pole star is perhaps the most convenient because it is practically immovable and therefore one has not to be constantly moving the telescope to keep it in the field, but the angle of elevation of the telescope—in Great Britain—is inconvenient for comfortable observation. I prefer an artificial star and make the O.G. test, and telescope adjustments, in daylight. This can be done by having the telescope laid horizontal, in a room or shed with a doorway or window opening facing toward the North. Choose a bright sunshiny day; get a piece of black velvet of about a foot or more square and in the centre of this mount, with a touch of liquid glue, a new bicycle ball of about three-sixteenths inch diameter; hang the velvet vertically, at a distance of not less than about 30 feet away from the telescope, out in the sunshine. The image of the sun reflected from a point on the ball will produce the required "star" and all tests and adjustments can be made in comfort and convenience.

Eyepieces

It is a fortunate thing that eyepieces for astronomical telescopes do not call for the high degree of optical perfection that is demanded for an object glass; therefore, they are much less costly, though not by any means cheap. Whereas in an object glass the value of the mount bears only a small relation to the cost of the optical work, in the eyepiece it is the other way round, for the metal portions with their number of screwthreads to be chased and other lathe work involves more labour than does the production of the lenses which have to go into them.

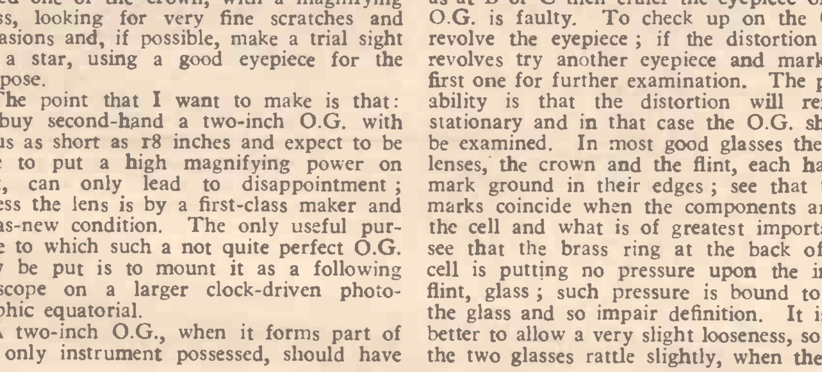


Fig. 3.—Longitudinal section through eyepiece No. 1.

and Eyepiece Lenses

Mounting

By E. W. TWINING

I am sometimes asked how simple eyepieces can be constructed suitable for home-made telescopes—eyepieces which can be made without a lathe and which do not involve the cutting of screw threads—so, believing that there must be many astro-telescopists who, having constructed a telescope, would like to make their own eyepieces I explain in this article how it may be done.

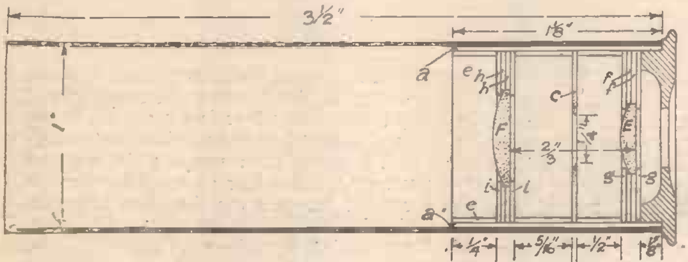


Fig. 5.—Section of eyepiece No. 2.

In the first place consideration must be given to the sliding draw-tube and to the breech piece at the eye end of the barrel in which the draw-tube slides. Whether the barrel is of wood or metal the breech piece can be of wood; good, dry hardwood, for preference, bored for receiving the draw-tube. The bore may be lined with a soft material such as leather or velvet so that a slightly elastic grip is given to the tube. If the tube movement is to be controlled by a rack and pinion for focusing so much the better, but the point is, that if there is to be no rackwork, there is not very much need to have one draw-tube into the outer end of which all eyepieces would have to be made to fit. Without rackwork there is no reason why the draw-tube should not be dispensed with and let each eyepiece slide directly in the breech piece. It only means that the brass tube, of which each eyepiece is made, would have to be somewhat longer than it would be if it only had to fit in the end of a draw-tube, because each eyepiece will have to be long enough to provide its own adjustment for focus. It must be noted that if this arrangement is adopted the lengths of the tubes will be in direct proportion to the focal lengths of the lenses which are to go in them.

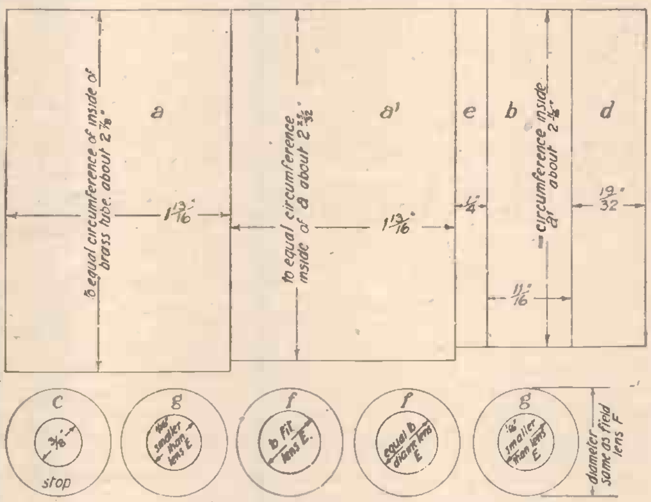


Fig. 4.—Linings and stops for eyepiece No. 1.

The eyepieces are of the negative type of what is known as the "Huygenian" form, after its inventor, Prof. Huygens. It is composed of two simple plano-convex lenses, each of different foci and one larger than the other. The larger, known as the "field" lens, is placed in front to come nearer to the O.G.; the other is called the "eye" lens.

For correct proportion the field lens should have a focus equal to three times that of the eye lens, and they should be placed a distance apart equal to one-half the sum of their foci. The lenses, both having one side flat and the other convexed, are mounted with the convexed sides towards the O.G., and the distance separating them is measured from one flat surface to the other.

The two lenses, in combination, will have what is known as an equivalent focus. To find the equivalent focus of any eyepiece multiply the focus of the field lens by that of the eye lens and again multiply by two. Divide the product by the sum of the focal lengths of the two lenses. The figure in the quotient then represents the equivalent focus, as if it were a single lens. Stated as a formula, it will read:—

$$\frac{fF \times fE \times 2}{fF + fE} = \text{Eq. f.}$$

where f is focus, F the field lens, E the eye lens, and Eq. f the equivalent focus.

To find the magnifying power of an eyepiece on any object glass the formula is:—

$$\frac{\text{f O.G.}}{\text{Eq. f}} = \text{P}$$

In this f O.G. is the focus of the object glass, Eq. f the equivalent focus of the eyepiece, and P the magnifying power.

Powers Required

Now we have to decide what powers we want to use on the telescope. If the O.G. is of good quality it will stand high powers, which will call for the greatest accuracy of workmanship in the making of eyepieces by the method to be described.

But it follows as a matter of course that much depends upon the focal length of the O.G. If this is short, say 18 or 20in., then it would be impossible for the amateur to make an eyepiece which will give a power much above 50, so for the purpose of any statement I may make, I am going to assume that the focal length of the O.G. is not less than 40in.; that is to say, a glass of 3in. aperture, which is, after all, generally accepted as the smallest practicable one for making a useful instrument. For this we will select three powers of 40, 80 and 106 respectively for eyepieces. In order to make these, the three pairs of lenses required will be as given in the table below.

These lenses should be obtained from a firm of good repute, and when they are received should be checked over for focus in the manner shown in Fig. 2, wherein the particular lens drawn is for the field, of 1in. focus, for the medium-power eyepiece. The test is readily made by bringing the image of the sun or the moon to the smallest possible sharply defined disc or point upon a piece of white cardboard and holding a rule alongside of the lens, as shown. The convexed side should be towards the light. If neither the sun nor the moon happen to be available and the test is made on the far side of a room the inverted picture of distant trees, buildings or hills can be projected on to the wall and the measurement taken with the rule between the wall and the flat side of the lens. The more distant the subject focused the more accurate will be the measurement of the true focus of the lens.

Making Eyepieces

To carry the lenses and convert them into eyepieces three brass tubes will be required and some pieces of Bristol board of the thickness known as "four sheet." What is actually wanted is a board of such substance that when four pieces of it are laid together

1 Low power e.p.	Field lens: 2in. focus,	diameter	⅞in.	Eq. f=1in.
	Eye lens: .66in. focus	do.	¼in.	
2 Medium power	Field lens: 1in. focus	do.	½in.	Eq. f=.5in.
	Eye lens: .33in. focus	do.	⅜in.	
3 High power	Field lens: ¾in. focus	do.	⅜in.	Eq. f=.375in.
	Eye lens: ¼in. focus	do.	¼in.	

Table of lenses required for eyepieces.

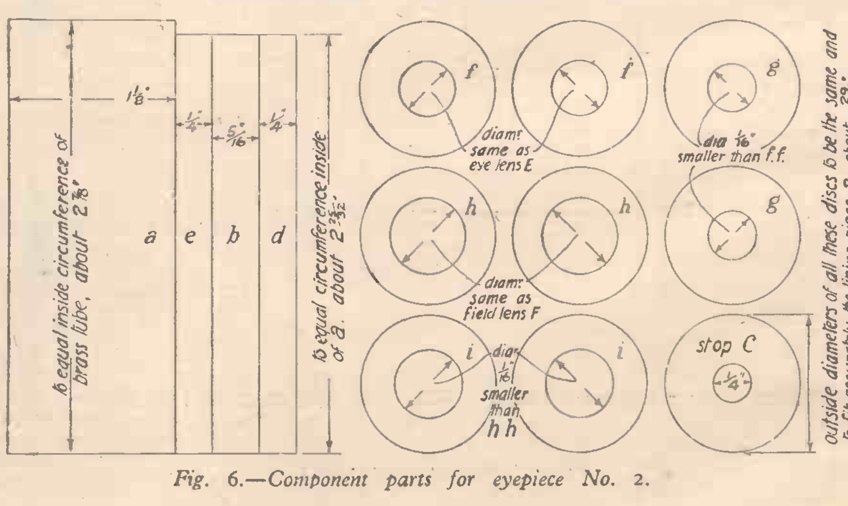


Fig. 6.—Component parts for eyepiece No. 2.

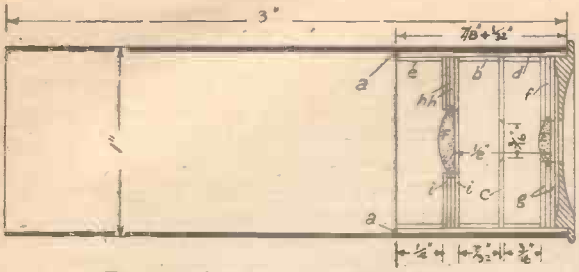


Fig. 7.—Section of eyepiece No. 3.

their combined thicknesses will measure 5/64in. or nearly 3/32in.

The brass tubes should be of the thin or mandrel-drawn kind, smooth both inside and out, should have an outside diameter of 1in., and be 4in., 3½in. and 3in. in length respectively for the low, middle and high powers. The ends of the tubes should be turned true, but if no lathe is available the truing may be done with a fine-cut file by the aid of a steel square. Remove the burr from the inside and outside edges with fine emery cloth and polish the tubes outside all over, but merely clean the insides with petrol; do not polish.

Now turn to the drawing-board, tee-square and set-square and pin down on the board the sheet of Bristol board which is to be used to make the mounts for the lenses.

Fig. 3 is a longitudinal section on the centre line of the largest, the lowest power eyepiece, which can be called "No. 1." From this it will be seen that the lenses are held by bands or rings and perforated discs. Fig. 4 is a lay-out of the bands and discs exactly as they must be drawn on the Bristol board, the measurements shown being faithfully copied exactly full size. The lines drawn must be fine and preferably be inked in after pencil work is completed. Each piece is shown assembled in its proper place in Fig. 3 and lettered, whilst corresponding letters are shown in Fig. 4, thus it should be quite possible to recognise the place in which each piece is to go when all are cut out and ready for assembly. Write the letters on the pieces before cutting.

Piece a is a lining for the brass and must be, when rolled, an exact fit in the internal circumference of the tube, the ends of the card butting together accurately. To fix it, the inside surface of the tube is smeared with an adhesive such as varnish or Japan gold size. Whichever is used, let it become tacky and then pass the cardboard cylinder into place, letting the end come flush with the eye-end of the tube.

If the field lens, F, for eyepiece No. 1—which is the one we are first dealing with—has a diameter of exactly ⅞in., as ordered, it should fit into the cardboard. If it does not fit snugly but is loose, then an additional lining a^1 will have to be put in and cemented to a in order to bring the inside diameter down to that of the lens. In both Figs. 3 and 4 I have foreseen this contingency by showing a double lining. The lens must be a nice fit without slackness or excessive tightness and the inside surface of the card must be cylindrical, which means that there must be no fullness due to the circumferential length of the card being insufficient to make the two ends butt together tightly.

Next cut piece b, roll into a cylinder and stick in the exact position in which it is shown in Fig. 3.

Midway between the lenses a stop or diaphragm, C, must be placed. This stop is shown as drawn on the Bristol board, Fig. 4; it must be cut truly circular and the ⅜in. diameter hole both true and central.

It will be found that the best plan is to cut all the cardboard upon glass, using a pointed knife having a keen edge, and in dealing with the stop and eye-lens apertures to cut them with a slight bevel.

Next cut and insert the cylinder d, which will hold the stop C in place. These pieces which are now in position should, at this stage, be painted dead black including the stop, and the field lens F can then be dropped into place and secured with the band e, which should be blacked before being inserted.

For mounting the eye lens E, four discs are required, two of them, f and f, having openings of the same diameter as the lens and two g, g, with openings slightly smaller.

The two f, f, are to be cemented together, and the edges of the openings blackened; then black the two gs and stick on one of them; put the eye lens in place and secure with the other disc g; thus a complete little cell is formed which is placed next to cylinder d with the convexed side of E towards the lens F.

The bare interior of the brass tube from e to the end must also be black and the eye

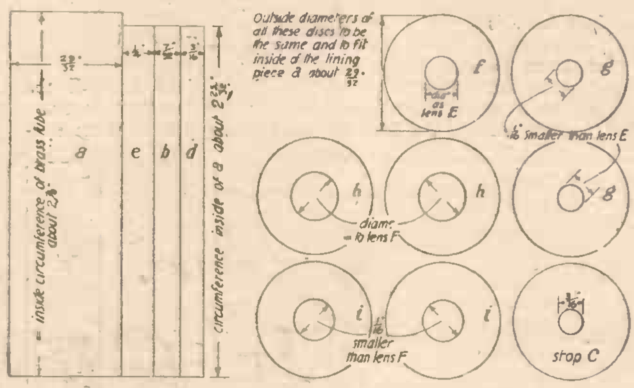


Fig. 8.—Bristol board parts for eyepiece No. 3.

end of the tube finished with the cap H, which will also secure the lens cell. Now this cap requires, if made as shown in the section, Fig. 3, to be turned in the lathe out of either black vulcanite or a hardwood such as box or beech and stained black. If the telescope builder has no lathe, nor access to one, and cannot get anyone to make caps for him, he may be able to adapt an already manufactured article for the purpose. I have before me as I write three glass bottles of different capacities and quite different contents, all with screw-on caps of black plastic, commonly referred to as bakelite. I find that all three have an internal diameter of one inch, so that they would be capable of servicing as eyepiece caps if they were drilled 5/16in. diameter at their centres and fitted over the tube ends instead of inside of them.

Eyepieces Nos. 2 and 3 are constructed in the same way as No. 1, except for the fact that no lens will come in direct contact with the main tube lining a and no second lining a^1 will be needed: it follows that in these cases both the field and the eye lenses have to be mounted in cells as described for the eye lens of No. 1; that is to say, each lens will be carried in four discs of cardboard.

Figs. 5 and 6 give a sectional view and the Bristol board lay-out respectively, for eyepiece No. 2 and Figs. 7 and 8 of the highest power eyepiece No. 3.

The making of both of these, and particularly of No. 3, called for extreme care and accuracy in handling and cutting the cardboard; there must be no burr on the edges of the cell pieces or the stops and all the discs must be kept dead flat. The cutting of small circular openings cleanly with the knife so that no burr is left is, as I have said, difficult, and it is a good plan to lay the cut disc on the glass and burnish it over with the polished handle of the knife. The object to be kept in mind is that the optical axis of each lens must be dead in line one with the other and both in line with that of the object glass. To obtain this result it is important to see that all openings in the discs are cut centrally and cleanly; that every disc is set square in the tubes and is kept free from buckles and warping. To avoid such warping do not use aqueous glue, but either oil varnish or celluloid cement for sticking the discs together.

A Terrestrial Eyepiece

Another question received recently concerned the lenses and arrangement of an eye-piece to give a picture the right way up for terrestrial viewing. My reply included a diagram which I now repeat in Fig. 9. From this it will be seen that to the ordinary Huygenian eyepiece, such as our No. 1, two additional lenses are required in order to re-erect the image A.B. which is normally inverted at the focus of the O.G. The light rays after passing through the erecting lenses C and D appear as B^1, A^1, and the image is then brought to a focus at the eye by the ordinary astronomical eyepiece. Lenses C and D should both be of equal focus and have the same focal length as the field lens F of the Huygenian. Lens C will have the flat side towards the O.G. as shown. It will be noted that with this arrangement of lenses the astro-eyepiece will be some distance removed from the focal point of the O.G., and that, therefore, a very much longer drawtube will be needed. The whole combination gives a much greater magnifying power than the astro-eyepiece alone.

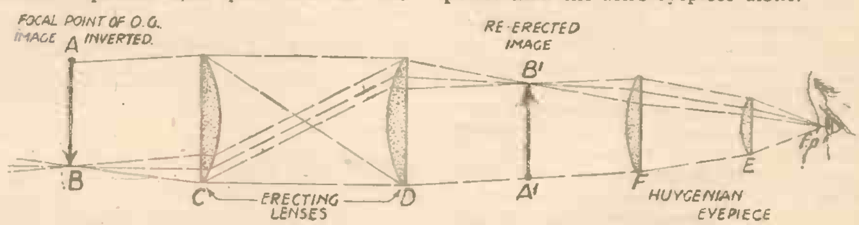


Fig. 9.—Arrangement of lenses in a terrestrial eyepiece.

Gardens in Miniature

MANY gardeners have an interest in things mechanical and conversely there are many mechanics who like to relax with growing things. A book has just been published which should please them both and bring a great deal of simple and inexpensive pleasure into hundreds of homes—the book is called "Miniature Gardens," by Anne Ashberry, and it is published by Pearson's at 15s. net, and considering how much one may expect from a £1 to-day it is good value in terms of the hours of amusement it will bring.

This miniature garden was specially designed by Miss Ashberry for H.R.H. Princess Elizabeth.

Another example of Miss Ashberry's realistic miniature garden work.

Miss Ashberry began making miniature gardens as a hobby in her flat—an amateur in the literal sense of the word—doing the job for the love of it. Now she has a little nursery in Essex and is selling her beautifully designed gardens, and the plants they contain, all over this country and, indeed, the world. Four of them are exhibited at the Festival Gardens, Battersea, including a replica of a 4ft. garden with lily pond specially made for Princess Elizabeth—so her book is really a blueprint for a successful and profitable hobby, specially for those with a flair for making as well as growing things.

The plants are not freaks or stunted specimens of normal-sized plants—they are naturally miniature—trees only 6 or 8in. high—standard rose bushes with nearly a dozen perfect blooms, each less than ½in. diameter, and with a scent; daffodils only 3in. tall; violets so small that you require a magnifying glass so that you see the complete perfection of each flower. It is truly gardening through the wrong end of a telescope!

Readers of this journal, however, will be particularly interested in the structure of the gardens and the exercises that can be made. "The ideal container for a miniature garden is a genuine old stone sink," says Miss Ashberry, but she gives details with diagrams of how to cast a suitable concrete trough. She also describes the making of a concrete window box to hold a miniature garden. The practical man will find much of the book suggestive, rather than precise in its details, but it is none the worse for that if he has the practical creative impulse. She describes the making of portable frames to shield outdoor gardens from the weather and greenhouses for the more delicate plants, but it is in the actual layout of the garden that the practical man will get his fun—he can create little ponds, little bridges, summer-houses—all in perfect scale with the trees and flowers. He can select suitable stones and rocks for the rockery and set them in concrete.

Realistic Settings

With Miss Ashberry's expert advice as a basis there is no end to the possibilities in this new hobby—fountains that really play, windmills that turn, mill-wheels, old water-pumps or wells and why not flood-light all on a miniature scale? and what a magnificent setting for the model enthusiast—your railway, harbour, airfield can be set amid growing plants—one might call them OO gauge flowers!

May I reiterate: The title of the book is "Miniature Gardens," the author is Anne Ashberry, the price is 15s., and the publishers are C. Arthur Pearson, Ltd.

Electric Eyes in Industry

FURTHER evidence of the way the electric eye has revolutionised industry comes from the canning trade. In the Workshop factory of Batchelors' Peas, Ltd., 24 of these machines now scrutinise 124,000,000 peas every 24 hours.

This examination ensures elimination of marked, stained or discoloured peas. Until the recent development it had to be carried out by a large number of female employees.

The peas are fed to a rotating bowl, automatically controlled through a photo-electric relay circuit. Near the periphery are rows of holes, through which light from a latch circuit lamp shines on to a photo-tube below. As the bowl fills, the holes become blocked, and finally the latch stops the supply of any further peas until sufficient have been carried away to clear the holes once again.

Each pea is now picked out of the bowl singly by one of 36 vacuum ferrules attached to a drum. These ferrules rotate anti-clockwise at 105 r.p.m., and, moving considerably faster than the bowl, will search for the peas and start picking them up when they come near the bowl. Since the change of direction needed is slight, only a low vacuum is necessary to transfer the pea to the ferrule, which by its rotation carries it through the lamphousing.

The lamphousing is a double spherical globe whose white walls reflect a soft indirect light on the peas passing through. Mirrors set at an angle of 45 degrees to one another serve to direct the total reflected light from each pea, first to a right-hand lens and then to a left, each lens obtaining an entirely different view, and having a colour filter which exaggerates blemishes. The total reflected light judged in relation to a given background—a grey disc carefully selected to reflect the same amount of light through the coloured filter as a perfect pea—against which the peas are viewed, is gathered by each lens independently and passed to its respective photo-electric cell, which measures the magnitude of light received. (If this is less than the light emanating from the background a different electrical current is produced.)

The change in electrical current is far too small in itself to be of any practical value so that a two-stage amplifier is necessary. This amplified current or signal from a discoloured pea is used to operate a condenser which holds the charge until the pea has passed out of the lamphousing, when it is dropped from the ferrule and falls freely in front of the ejector. The condenser, which until now, as it were, has "remembered" the pea, is used to actuate the ejector which flicks the blemished pea into a different chute from the perfectly shaded ones, which continue to fall and are carried away on a continuously moving belt.

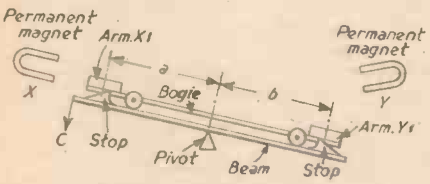
"Perpetual Motion" Devices

Some of Our Readers Make Suggestions for the Impossible

IN the issue of this journal for last May we commented on the centuries-old problem of perpetual motion, and invited readers to submit suggestions on the subject for the amusement of other readers. From the very large number of ideas sent in we have selected four which are described and illustrated on this page.

See-saw Action

MY idea for a perpetual motion device is depicted in the sketch. In the position shown the magnet X attracts armature X1 until the bogie wheels hit the stop but the



A see-saw action device.

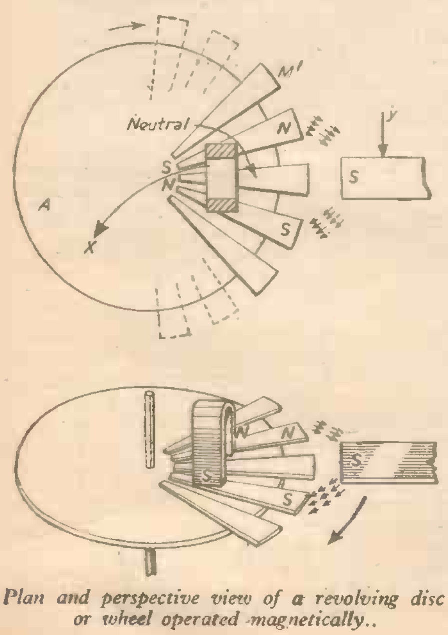
armature is just clear of the magnet poles. The distance A is now greater than distance B and a moment is now on the beam to cause rotation in direction of arrow C. *This rotation can take place by virtue of the fact that it is easier to slide the armature out of the lines of force than it is to pull it away from the magnet.*

The same thing takes place on armature Y1 rising to the magnet Y. The bogie moves towards the magnet, the moment is to the other side of the pivot, the armature *slides* out of the lines of force and the see-saw action is maintained.—J. G. BLACK (Greenock).

Revolving Disc

In response to your invitation, I submit the following idea for "Perpetual Motion" which may be of interest. Using mechanical movements alone renders the possibility of perpetual motion out of the question, but perhaps there may be something in the use of magnetism.

In the attached sketches I have endeavoured to convey my idea. "A" is a wheel of some non-magnetic material upon which are fixed radially a number of *soft* iron bars, M1. Suspended above and near to their inner ends is a horseshoe magnet, X. Facing the outer ends of the bars is a bar magnet, Y. In theory the magnet X induces the opposite polarity in the iron bars and they are attracted and repelled as indicated in the sketches. The bar under the centre of the magnet X should be rendered neutral until it passes the half-way position and becomes the repelling unit. The strength of the two magnets will have to be such as to render the effect of magnet Y upon the neutral bar position as small as possible.—F. LUCAS (Newcastle-on-Tyne).

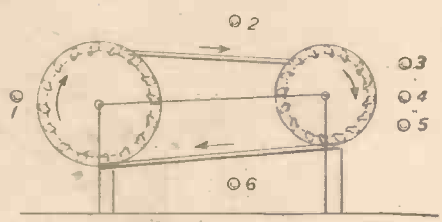


Plan and perspective view of a revolving disc or wheel operated magnetically..

Dual Balanced Wheels

In your article mention is made of the laws of gravity, which I tried to overcome by disassociating some moving weights entirely from the machine until they were needed, thus trying to avoid what I believe are called the laws of compensation.

The idea is that the motive force is divided up into six parts (ball bearings). There are two balanced wheels with cups round the



Balanced wheels contrivance.

outer edge, and two troughs, one near the tops of the wheels and one near the bottoms.

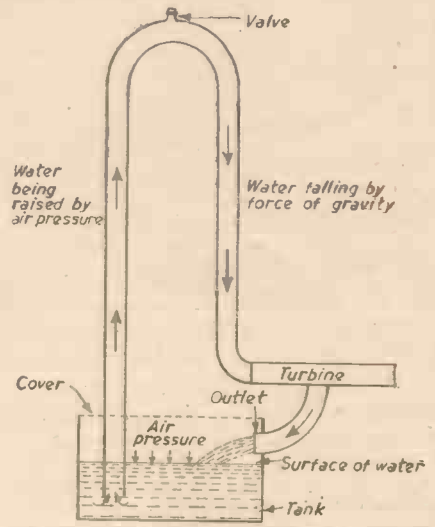
If three parts are always moving down on the right-hand wheel against 1 part moving up on the left one, and they entered the troughs one by one as one left, could not this ratio be maintained?

The troughs could perhaps be sloped to get the right speed, and one wheel might be a little smaller than the other, or lower.

Anyway, it seemed to me there would be no "drag" or important friction and the machine would in effect be fed from outside itself.—S. C. AINGE (Leicester).

Syphon Principle

The accompanying drawing illustrates my idea of a perpetual motion machine. It incorporates the principle of the syphon in that it uses the pressure of air to raise water, from a tank by a pipe, to a head. The water then returns by the action of gravity through another pipe turning a turbine as it goes.



A device for working on the syphon principle.

Though the head of water due to air pressure is 34ft., it could be increased by placing a cover over the tank and increasing the pressure.

I realise that this is not true perpetual motion as forces are in continuous operation to keep the machine running and that the bearings have to be replaced or repaired from time to time due to friction. But it is as near as possible.

I might point out that Nature does this on a large scale, i.e., it raises water by evaporation and then lets it fall as rain.—ALAN M. THOMSON (Portobello).

A Soldering-iron Stand

Constructional Details of a Handy Appliance for the Workshop

By R. D. PATERSON

AN important "accessory" for any soldering-iron is a safe place to put it on while hot, particularly when one is in a hurry. The simplest solution is a metal plate fastened to the workbench. A refinement is a cradle consisting of two vertical notched metal supports to prevent the iron from wandering, and even falling off the bench altogether. For the user of an electric soldering-iron there is another and better alternative. It is a box type stand intended to be fastened to the wall or the workbench and it possesses the following features :

1. An on-off switch with a neon tell-tale to indicate when the iron is switched on.
2. A heating cradle to support the iron while it is heating up.
3. A stand-by cradle on which the iron is maintained at a temperature high enough to melt solder but lower than normal with consequent economy in current consumption and slower oxidation of the tinned working surface of the iron. The economy is obtained by inserting a resistance in series with the iron. An ordinary electric lamp of suitable wattage is a simple and easily obtained form of this resistance, and has the added convenience that it can be easily changed to suit a different iron.
4. An automatic switch which short-circuits the series resistor when the iron is lifted from the stand-by cradle, thereby restoring full power to the iron.

Details of Construction

The box may be of wood or metal. Its breadth should be at least one-third the length of the soldering-iron. The other dimensions are not critical but should be in proportion to the remaining components. If a wire-wound resistor is used as the series resistance instead of a lamp, it is safer concealed within the box. In this case the box must be of metal and ample ventilation provided by drilling a series of small holes in the sides and top of the box.

The Sockets and Switches

The bayonet sockets need no modification and the three-pin switched socket only one. It must be opened and two lengths of insulated wire attached, one to each output socket. These wires eventually go to the socket for the indicator lamp, a 0.5 watt pigmy neon. A microswitch is used to short-circuit the series resistor. This type of switch has adequate current-carrying capacity, a quick make-and-break which prevents arcing and it is actuated, as its name suggests, by a very small movement of its plunger. The microswitch must be of the type which "breaks" the circuit when the plunger is depressed. It is fastened to the box by screws passing through the two holes in its sides. The plunger should be vertical and lie along the centre line of the front of the box. The switch is wired across the series lamp and short-circuits it when the plunger is released. If the terminals of the microswitch are unshielded, a cover will have to be provided for them as suggested in the illustration (Fig. 1) since they will be at mains voltage.

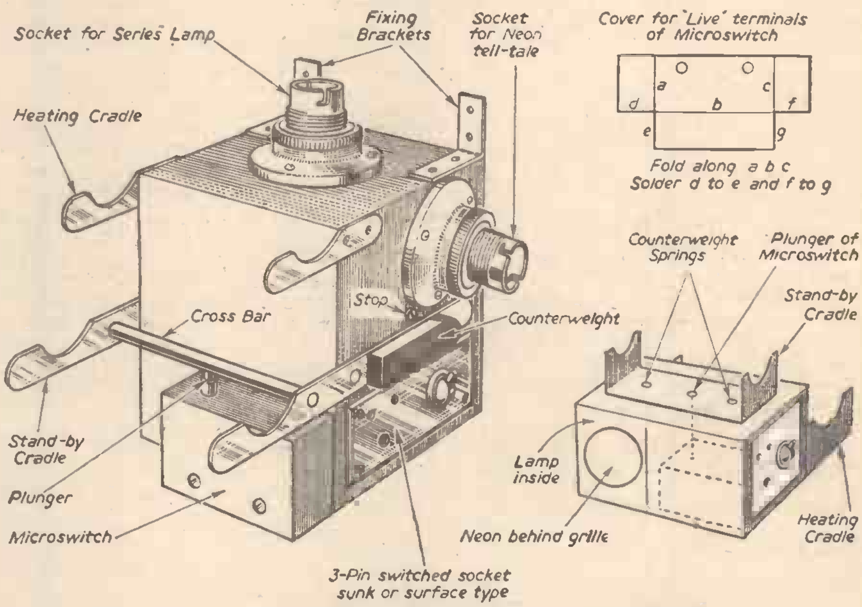


Fig. 1.—The completed stand, and details of cover for microswitch terminals. Fig. 4.—An alternative design of stand for use on the workbench.

The Stand-by and Heating Cradles

The stand-by cradle must be sturdy enough to stand the jar of having an iron hurriedly laid on it and yet be light enough to be raised by the recoil of the microswitch when the iron is lifted. It consists of two arms of flat strip brass, shaped as suggested in the illustration and joined by a cross-bar, a depression in the lower surface of which engages the plunger of the microswitch. The joints between the cross-bar and the arms must be strong. The strips should be pivoted to the sides of the box about half an inch from the front and at such a height that they are level when the cross-bar rests on the microswitch plunger without depressing it. The free ends partly counterbalance the remainder of the cradle and should be weighted with additional pieces of metal, soldered on, until the cradle swings freely on its pivots with only sufficient bias to keep the cross-bar and the plunger in contact. Depress the cradle until the microswitch is heard to click over. Mark on the sides of the box the position of the upper edge of the two counterweight arms, then insert a cheesehead screw on each side of the box to prevent the arms from rising above the marked position. This takes the strain off the microswitch. The heating cradle consists of strips of brass similar to the stand-by cradle except that they are shorter and are fixed rigidly to the sides of the box. They should be kept well out of the way of the stand-by cradle so that they do not interfere with laying down the iron.

Completing and Operating the Unit

Complete the wiring as shown in the "exploded" view (Fig. 2), and circuit Fig. 3, noting the connection between the earth of the three-pin socket and the sheath of the incoming mains lead. If the box is of metal, earth it also. The method of fixing the box to the wall is left to the constructor's ingenuity as it depends largely on local circumstances. The wattage of the lamp to be used as a series resistance is directly related to the wattage of the soldering iron and can be found only by experiment. Try a 75-watt bulb for a start. Put the iron in the heating cradle, switch it on and allow it to heat up to its ordinary working temperature. Transfer it to the stand-by crade and after five or ten minutes have elapsed apply some solder to the bit. If the solder does not melt,

(Continued on page 390)

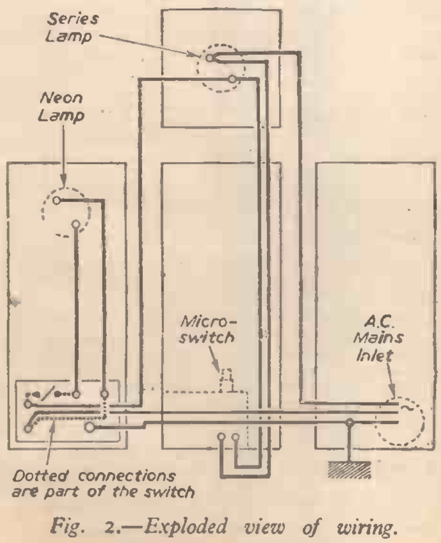


Fig. 2.—Exploded view of wiring.

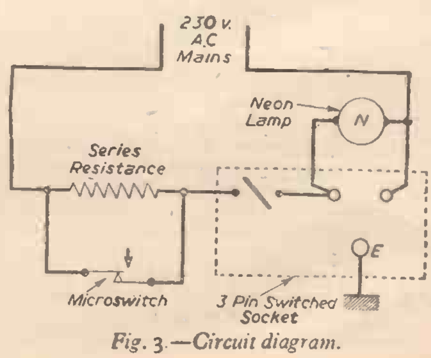


Fig. 3.—Circuit diagram.

A Garden Windmill

SIR,—The accompanying photograph of a model windmill I have constructed may be of interest to other readers.

The materials used were a mixed lot consisting of an old milk churn, a breast drill, some motor cycle parts, a hub-type cycle generator and cycle sprockets. The generator supplies light for the tower. The height of the mill is 6ft. 4in., the main sails being 5ft. across; there is ample power to drive the generator. The main windshaft runs on two ball bearings. The small fantail at the rear of the mill controls the direction of the main sails through suitable reduction gearing, which is about 50 to 1. The cap on top of the tower is made of wood and is hollowed out to accommodate some of the gearing and the spindle which carries the cap. The cap turns on five small rollers which run on a steel plate. The tower is painted black and the rest white.—R. ROODHOUSE (Doncaster).

Mr. R. Roodhouse's garden windmill.

Rubber "Tiles"

SIR,—In the July issue of PRACTICAL MECHANICS I noticed a query from C. Wilkinson (Blackburn) regarding rubber "tiles." May I point out that these may be obtained retail from Messrs. Lewis Ltd., Market Street, Manchester.

They are 12in. square and cost approx. 4s. each. The above firm also supply (to order only) rubber solution for fixing same, in 1-gallon drums.—G. FLETCHER (Hyde).

Squaring the Circle

SIR,—As a constant reader of PRACTICAL MECHANICS, I was very interested in your comments on "Perpetual Motion" and the squaring of a circle. Therefore, as you invite readers to submit suggestions on this subject of squaring a circle, for the amusement of other readers I append the following: The mensuration of surfaces and solids is well known. For example:—

The circumference of a circle = diameter × $\frac{22}{7}$ (or 3.1416):—

Area of a circle = square of the diameter × 0.7854, which is a variable owing to the ratio of the circumference over diameter being a variable, and in practice we strike an average. Therefore, it is quite in order to say that it is impossible to square a circle.

But when we come to the theory and practice of a true-helix in which as an airscrew blade, a marine propeller blade, or an axial flow fan blade, they are a section of a circle rotating on a cross section to the rotating axis, whereby we can define and express the definition of the term pitch of a propeller per one complete revolution. We are also able to define the square area of the rotating blade or vane, consequently we can compute the cubic capacity per minute, as the case may be. In other words, we are able to design for any cubic capacity per minute, at any velocity, in harmony with the revolutions per minute, number of blades and the diameter, which works out in unity in practice with the major governing factors.

For example:—

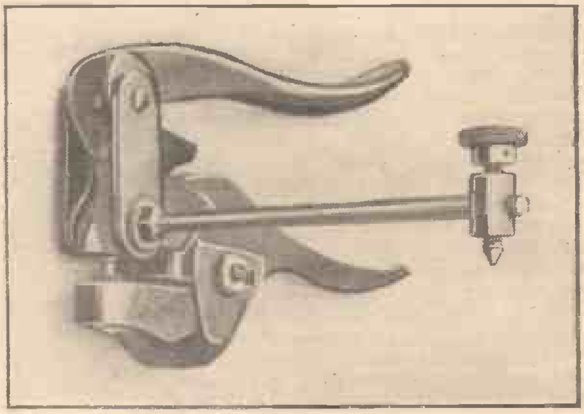
Weight of cruft (or resistance) (1);
Speed in miles per hour (2);
Horse-power (3).

For example: With any two of the three factors we can give the third factor, in which we are able to design to specification.—G. A. LOWE (Derby).

A Hand-punch Attachment

SIR,—The enclosed photograph of an attachment which I have fitted to a Parker-Kulan hand-punch, might be of some use to your many readers.

It consists of a ¼in. rod 6in. long with a ¼in. bolt welded at one end, which fits into the side of the frame after first removing the side link screw. A piece of round bar is then drilled to slide along the guide bar with a short ¼in. rod screwed in and ground off to a point, which fits into the holes made by the punch. The knurled thumb-screw holds the pointer in any position on the guide bar. To use the punch the pointer is set to the required pitch of hole from the punch after the first hole in the sheet of metal has been made. The pointer is then located in this hole and the next hole punched, and so on, down the sheet.



An attachment for a hand-punch.

I find this method saves time in marking out holes and it is also more accurate.—R. E. CRANE (Chatham).

Books Reviewed

The Wonderful Story of British Industry. Published by Ward Lock and Co., Ltd. 256 pages. Price 15s. net.

THIS book, which records the enterprise, skill and invention of the British people, has been prepared by a team of expert writers, and presents a colourful picture of Britain's achievements as an industrial nation. In addition to giving a panorama of the British industrial scene, the book also answers the reader's many "hows" and "whys." For instance, a chapter is devoted to telling how the power which drives the machines is generated. Another chapter describes the function and operation of the key machines in the workshops. The reader is also shown how science is geared to industry and, finally, a chapter is devoted to the subject of industrial design. A notable feature of the book is the large number of high-class photographic illustrations, many of them in colour.

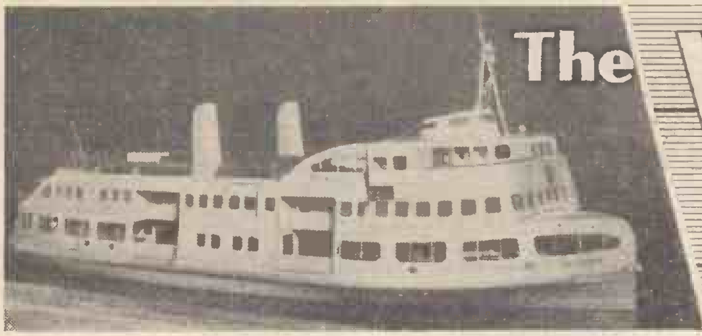
Miniature Landscape Modelling. By John H. Ahern. Published by Percival Marshall and Co., Ltd. 132 pages. Price 10s. 6d. net.

MINIATURE landscape and scenic work in all its phases is dealt with in a very lucid and comprehensive manner in this interesting and instructive book. The experienced worker will find the book packed with novel suggestions, and the author in treating his material has been mindful of the uncertainties of the beginner. Although the book has a strong appeal to the railway modeller, scenic layouts and details to suit amost every requirement, and a chapter on background scenery is included. The book is well illustrated with line diagrams and half tones.

Other books received from Percival Marshall and Co., are:

"In the Workshop." By "Duplex." (Vol. 3.) Price 9s. 6d. net.

"Models in Bottles." By R. F. C. Bartley. Price 7s. 6d. net.



The World of Models

H.M.S. "Vanguard" in Miniature : Model Tugboat

By "MOTILUS"

H.M.S. *VANGUARD*, although one of the most difficult warships to model, seems to attract amateur model-makers nevertheless. I recently received from Mr. G. H. Davis, of Brighton, a photograph of a finished working model he has made of this famous modern battleship. Mr. Davis started his ship-modelling hobby over fifty years ago when he modelled Britain's first destroyer, H.M.S. *Daring*. This first model was static, but later he progressed to working models powered with clockwork and then with steam and electricity.

The story of the *Vanguard* model started in 1946 when Mr. Davis had to make a drawing of the battleship in connection with his work as senior staff artist to a well-known illustrated periodical. By courtesy of the Directors of Naval Construction, Admiralty, he was allowed to make copies of the plans, which he found so interesting that he decided to make a model of the ship, to be driven by steam power. The steam machinery he already had available: a Stuart Turner twin-drum watertube boiler and twin-cylinder engine. The size of this steam plant influenced Mr. Davis in making the model just over 5ft. in length.

First of all Mr. Davis prepared photostat copies of the *Vanguard* profile, deck and superstructure plans and cross-section diagrams, to his working size, reduced from the Admiralty plans. From these he produced drawings showing every detail of hull and superstructure, true to scale. The beam of the model had to be slightly increased, because the steam machinery was proportionately heavier than the machinery of the prototype, but the increase was not sufficient to destroy the scale appearance.

Plywood Hull

Owing to difficulty in obtaining suitably seasoned timber, the model hull was made from plywood instead of from solid timber. The bottom of the ship was cut from planks of half to three-quarters of an inch thick, with pieces of timber cut to correct shape at bow and stern, slotted for the fitting in of the rest of the plywood hull. White lead was used on all underwater joints to ensure their being watertight. It was found that ribs were not necessary, despite the size of the ship, so that there was plenty of room for the machinery.

The *Vanguard* has four propellers, but Mr. Davis decided to use only two active screws on the model, with two dummies that revolve freely in the water. To enable the engine to drive the two propellers in opposite rotation, he constructed a four-gear-wheel gear-box, into which were fitted the brass-tube propeller shafts, the actual shaft having bearings at either end only.

Deck Fittings

Making the deck fittings was a test of patience, because there is so much detail on the decks of the *Vanguard* requiring much intricate work. Most of the superstructure is made of light tin, built up on wooden jigs. The main turrets are also of tin, although the turrets for the secondary armament were cast in aluminium from wooden patterns. All the guns were turned from aluminium rod. The ship's boats were made of balsa wood, so as to keep down weight. The funnels were made to scale, and because of this were not large enough to be used, so that heat from the blow lamp is taken through a concealed slot in the port side of the forward superstructure.

Fig. 1.—(Above) Mr. G. H. Davis's steam-powered model of H.M.S. "Vanguard," 5ft. long. All fittings for this model were made by the constructor.

When the boat was ready for the keel to be fitted, tests were carried out in a water trough specially made for the purpose. Then the keel was fitted consisting of sheet lead screwed to the bottom board and fully loaded so that the model floats true to the scale waterline. Then followed steam tests and all the work of finishing the model with the fixing of the numerous deck fittings, application of many coats of paint, etc.

It was suggested to Mr. Davis that he might try operating his model by radio control, and to do this he enlisted the aid of a friend conversant with radio. The receiver was fitted in the bows, with the minimotor and gear for moving the rudder installed aft. A detachable "whip" aerial was used. After experiment, however, it was found that this home-made method of controlling the model was not as satisfactory as expected, so it was eventually removed from the model. Since then, improved radio-control units have become available, so that Mr. Davis hopes to experiment further with this method for controlling model ships and is, in fact, installing radio control into his latest model of a cross-Channel steamer, *Invicta*.

Model Tugboat

More news of working ship models has come to me from Mr. C. Scrivener, of Kitwe, Northern Rhodesia. Mr. Scrivener has built a model tugboat, *Antoinette*, from the drawings of Mr. J. L. Langford. The model is built on the "bread and butter" system and is 53in. long. The deck fittings were purchased ready-made, being sent out to Mr. Scrivener by Messrs. Bassett-Lowke, Ltd., and comprising winch, anchors, bollards, davits, engineroom skylight, steering wheel, stanchions, etc. From the same company, Mr. Scrivener purchased a twin-drum boiler and "Eclipse" engine, which he geared down to 3 to 1 for his model and which he says gives ample speed and power.

Fig. 2.—(Right) Mr. C. Scrivener is seen here with his model tugboat, "Antoinette," which he built at his present home in Kitwe, Northern Rhodesia.

Trade Notes

Radio and Television Suppressors

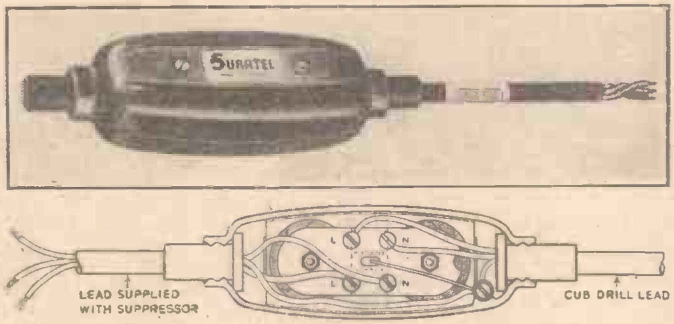
WOLF ELECTRIC TOOLS LTD. the manufacturers of portable electric tools, announce the introduction of "Suratel" suppressors for the Wolf Cub Home Constructor Drill, for both radio and television. Both suppressors are the successful result of prolonged experiment and research work in close collaboration with G.P.O. engineers.

The "Suratel" radio suppressor is guaranteed to eliminate interference on the B. B. C. broadcast wavelengths to the limits specified in B.S.S.800 and complies with B.S.S.613 and B.S.S.1082. It is of a neat streamlined design in an attractive black wrinkle finish, and weighs approximately 6 oz.

Compactly housed in a strong pressure die-cast casing which is effectively earthed, it is fitted at one end with a short length of TRS cable for connection to a three-pin plug. The other end is free to take the drill cable which is passed through a cable sleeve, and connected to the clearly marked terminal panel which is exposed by removal of the top half of the casing. All Cub drills in present production include tag eyelets fitted to the cable ends to facilitate this connection.

Iron-cored wave wound inductors are incorporated, and all electrical parts are well insulated making it completely safe from shock hazard.

Designed specifically for the Wolf Cub drill 200/250 voltage range and with a maximum current rating of one amp. it is, of course, most important that the "Suratel" radio suppressor is fitted and used only according to the instructions supplied. Properly connected it will eliminate interference even with a poor aerial installation. The "Suratel" radio suppressor is priced at 23s. 6d. each, and is obtainable from Wolf stockists and dealers throughout the country.



Exterior and interior views of the "Suratel" radio suppressor.

Unlike the radio unit the "Suratel" television suppressor is fitted *inside* the Cub drill body, as close to the commutator as possible in order to achieve maximum efficiency. Cub owners should return their machines to the nearest Wolf service depot where a "Suratel" will be fitted at a standard charge of 8s. 6d. including return postage. Similarly, when ordering a Cub drill the suppressor can be included at the extra charge mentioned. It should be noted, however, that they are available only for use with 200/250 volt Cub machines.

The Lubrication of Steam Turbines

DURING recent years there have been incessant demands for lighter, more powerful, and more efficient sources of power, and by far the most remarkable advance in response to this demand has been that of the gas turbine. Alongside this, notable refinements have also been achieved in steam turbine design. With the advance in turbine design, the importance of clean, efficient lubrication has become greater, but at the same time the conditions imposed on turbine oil in service have greatly increased in severity. In a 128-page booklet entitled "The Lubrication of Steam Turbines," produced by The Shell Petroleum Company, Ltd., an outline is given of the present-day technique of steam turbine lubrication. The booklet, which is well illustrated, is obtainable in the United Kingdom from Shell-Mex and B.P. Limited, Shell-Mex House, Strand, London, W.C.2.

The New Home Photography

JOHNSONS OF HENDON, LTD., Hendon Way, Hendon, London, N.W.4, have recently issued a new booklet bearing the above title, the chief aim of which is to help the beginner to take and process better pictures. The expert amateur will also find many useful hints included. The first section of the book deals with taking the picture, and the second half of the book is devoted to developing and printing the negatives. Numerous high-class half-tone illustrations are a special feature of this 96-page booklet, which is priced at 2s. 6d., and is obtainable either from any photographic dealer, or post free from the above address.

Club Reports

Aylesbury and District Society of Model Engineers

AT the June meeting of the club, Mr. Hasberry gave a talk to members on that very intricate subject, the locomotive valve gear. Mr. Hasberry talked from personal experience having had to modify the valve gear on the L.N.E.R. J.39 he is building. We await with interest the results of his experiments. At the July meeting of the society held on the 18th at Hampden Buildings, Temple Square, Mr. Forest gave members present a few hints on how to begin constructing a track working loco. He also pointed out some of the pitfalls into which the novice is likely to fall. Mr. Forest is thanked for a very interesting talk.—E. H. SMITH (hon. secretary), Mulberry Tree Cottage, Devonshire Avenue, Amersham, Bucks.

The Tyneside Society of Model and Experimental Engineers

THIS society will be holding its annual exhibition from October 1st to 13th inclusive, at the Chronicle Hall, Pudding Chare, Newcastle-upon-Tyne. In addition to a large display of models including steam and electric locomotives and rolling stock of all gauges from "000" to 5in., cars, ships, stationary engines, tools and workshop equipment there will be a live steam passenger-hauling track. There will also be demonstrations of radio-controlled working models, a workshop stand engaged in producing models, and a cinema show featuring work during construction, the opening ceremony and eventually models in operation on our 700ft. continuous passenger-hauling railway track in Exhibition Park, Newcastle.—Hon. secretary, L. JAMIESON, 34, Dorcas Avenue, Pendower, Newcastle-upon-Tyne 5.

A SOLDERING-IRON STAND

(*Continued from page 387*)

substitute a lamp of higher wattage and try again after a similar interval. If the solder melts freely, try a lamp of lower wattage, choosing finally the lamp of lowest wattage which keeps the iron hot enough to melt solder.

The routine of using the iron should now be obvious. Always leave it on the heating cradle when switched off. To use, switch on. The neon will light. When the iron reaches working temperature transfer it to the stand-by cradle, and leave it there between successive soldering operations. The correct functioning of the series resistance will be indicated by a more or less faint glow from the lamp when the iron is in the stand-by position.

The Workbench Model

In Fig. 4 is given a rough sketch of the alternative form suitable for mounting on the workbench. It is based on the familiar telephone cradle. Both lamps are inside the box making the unit rather neater than the first design, but it is more difficult to achieve balance between the cradle and its counterbalancing springs.

QUERIES and ENQUIRIES

A stamped, addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 88 (THE CYCLIST), 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.

Drilling Holes in Glass

I WANT to make a drill for drilling glass in a small workshop, and would like to know the angles of rake and clearance, and general outline of this type of tool.

The turning mechanism I have at present is an ordinary brace.

Could you let me know what is the best lubricant for drilling glass? The holes to be drilled are ¼in. and ⅜in. diameter.—D. H. Ryder (Preston).

THE most efficient way of drilling glass is by diamond-impregnated drills at high speeds. For instance, for a ¼in. hole, as indicated, the drilling speed should be at least 3,000 r.p.m. Failing this, as only an ordinary handbrace is available, it is suggested that small tube drills of brass or steel with a wall thickness of about 1/32in. be prepared and operated with a mixture of silicon carbide 150 to 200 mesh suspended in oil—preferably olive oil—or rape seed oil. The speed of rotation should be as high as possible, and very little pressure applied in order not to squeeze the abrasive grains out of the hole. Whilst with motor-driven operation, under above given circumstances, it may be possible to produce a hole in, say, five to 10 minutes, the hand operation may take very much longer.

Compression Ratio of I.C. Engine: Steam Temperature and Volume

WOULD you please solve the following problems?

(1) If the bore and stroke of an engine are 2in. and 4in. respectively, and the compression ratio is 40 : 1, how does one find the pressure in the cylinder when the piston is T.D.C., the engine being normally operated?

(2) Assuming the cylinder and piston to be of steel and the air entering to be 60 deg. F., what would be the temperature of the air when compressed to the pressure arrived at in the first question?

(3) If a quantity of water weighing .000063lb. is subjected to a temperature of 1,000 deg. F., what would be the volume occupied by the resulting steam, and what is its Ratio of Expansion in relation to the water?—R. Griffiths (N. Wales).

THE compression ratio mentioned is very high, the maximum in a high-duty aero-engine being in the vicinity of 12 : 1, while in a diesel engine it is not much more. Perhaps you are quoting a hypothetical case merely for the purpose of the example.

A compression ratio of 40 : 1 simply means that the cylinder pressure at the end of the compression stroke is forty times that of the initial pressure. If, therefore, the initial pressure is, say, ½lb. per sq. in., the pressure at T.D.C. would be 20lb. per sq. in. When the fuel/air mixture is sparked, of course, there is a rapid rise of pressure, this reaching, in a petrol engine, a value around 100lb. per sq. in. This would produce a total pressure on the crown of a piston of 2in. of about 314lb.

(2) This is not a question which can be answered without making various assumptions, and the compression of the fuel/air mixture must be considered as adiabatic to avoid advanced mathematics. In practice a certain amount of heat is lost to the cylinder walls during compression.

The general equation governing the rise of temperature of a gass on compression adiabatically is:

$$T_1 = T_2 \left(\frac{p_1}{p_2}\right)^{\frac{y-1}{y}}$$

where T_1 is the initial temperature, T_2 the final temperature, p_1 the initial pressure, p_2 the final pressure, and y the ratio of specific heat of the gas at constant volume and constant pressure. For a petrol/air mixture this ratio would be about 1.33. Temperatures and pressures should be expressed in absolute values, when one would obtain a final gas temperature in the vicinity of 500 deg. F.

(3) At 1,000 deg. F. steam would behave as a true gas, having no latent heat, and being in excess of its critical temperature. There are two aspects of this problem: the volume of steam at 212 deg. F. and the expansion of that volume for an increase of temperature from 212 deg. F. to 1,000 deg. F. In the first instance the volume would be approximately .000063 x 27 cu. ft., or 0.0017 cu. ft. As an approximation one could then use the gas equation PV=RT, which would give an ultimate volume of about 0.004 cu. ft. at 1,000 deg. F.

Keeping Pool Clear of Algae

OVER the past 18 months the youths of our hostel have built an open-air swimming-pool (capacity 60,000 to 70,000 gallons). This is filled by means of a pump and pipeline from a well in the grounds. We have attempted to keep the pool clean by pumping a "wellful" of water in each day. For about a week the water kept perfectly clear and then it turned green and murky-looking. On close examination it seemed that there were thousands of small jelly-like fronds growing from the sides and bottom of the pool. We emptied and cleaned the pool by brushing this stuff off and then painted the whole with Snowcem. After a time, however, the pool was just as bad as ever.

Can you give me the name of any chemicals that we can use to keep the pool clean?—A. Lawtey (Alsager).

YOUR problem is a common one with all owners of open pools. The green jelly-like material which grows in the water is one of the numerous species of filamentous algæ. These forms of plant-life grow in the warmer months of the year, particularly in strong light. Sometimes they are brown rather than green in colour, but there is no difference between their mode of growth.

Under the natural conditions of an aquatic pool, i.e., one containing fish and insect life, water snails, etc., their growth would be kept down, but in a clear swimming pool, conditions are much different, for the water never becomes properly "balanced," that is to say, its oxygen intake never equals its oxygen output, and thus the water gets "out of condition," as it is said.

The question arises as to whether the algæ originate in the supply well itself or in the water after it gets in the swimming pool. Our opinion is that the growths originate in both the pool and the well. Fortunately, the growths can be kept down (if not entirely eliminated) by the use of copper sulphate at low concentrations.

A good plan would be to clean out thoroughly both the well and the pool, removing as much of the algæ growths as possible. The walls of the well and of the pool should be scrubbed down with a lysol-water mixture or with a carbolic solution. A fine filter should be fitted in the supply line between the well and the pump to keep back as much algæ-bearing material as possible. Tie up in a strong linen bag about 1lb. lump copper sulphate, and lower this bag into the well on the end of a rope. Then fill up the pool in the usual manner. When the pool is full, tie up 2 to 3lb. copper sulphate in a similar bag attached to a rope and, once every week, throw the bag into one end of the pool and drag it slowly across the length (or breadth) of the pool in a zig-zag manner. Possibly all the material will dissolve out of the bag in this process. The result will be that the pool water will carry a very low concentration of copper sulphate which will greatly inhibit the growth and development of the algæ. The concentration of copper sulphate will not be sufficient to render the pool water toxic or even irritant to the swimmers, but it is essential that the well water should not be used for cooking purposes. Some experiments will be needed in relation to the number of times which the copper sulphate bag must be dragged across the pool to keep down the algæ. Only the "technical" grade of the material is necessary and it may be obtained from Messrs. Vicsons, Ltd., 148, Pinner Road, Harrow, Middlesex.

The alternative is to make use of chloride of lime in a similar way, or to obtain a cylinder of chlorine gas (from I.C.I., Ltd.) and to discharge some of the gas into the water at intervals. Both these methods of chlorination are effective, but they are apt to give the water a bitter taste if overdone.

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.

Cement Coating for Asbestos Sheeting

I AM constructing a small bungalow, using asbestos sheet outside. I wish to plaster the outside to render it completely weatherproof, to disguise the asbestos, and to render a pleasing appearance. Will you please advise me on the materials required and the method to apply?—N. Dunton (Alvaston).

FOR your bungalow you will have to use a cement mixture, since ordinary builder's plaster softens in contact with water and would, therefore, be entirely unsuited for your purpose.

Use the following mix: Portland cement, 1 part; clean, sharp sand (NOT sea sand), 2 parts; fine, light-coloured filling material (ground stone, etc.), 1 part; coarse material, such as light spar (in particles about ½in. to ¾in. diameter), 1 part. Mix all the dry materials well together, then slake to the usual cement mixture consistency. Wet the wall with water, and apply the cement mix as a thick paint or a thin plaster coat. If you want a smoother surface, leave out the coarse material.

Before embarking on the job, make an experimental test on some odd corner of the wall so that you will be able to assess how the various ingredients of the mix influence the colour of the coating.

Polish for Bowls

CAN you inform me what is the most satisfactory polish and method of application for polishing bowls used on outdoor bowling greens? I have polished many, using french polish, and get a very satisfactory surface, but it will not stand up to wear and soon gets badly marked.—S. Extence (Weston-super-Mare).

A GOOD polish for your bowls can be made by dissolving shellac in about an equal volume of warm methylated spirit. When cold, the resulting solution will have set semi-solid. This is the polish. Take a little of it up on a small handpad made of soft cloth and wipe the cloth gently round the bowl. Apply a thin coating only, then put the bowl away for a few hours and repeat the process. The process may be repeated a third time, if desired. This will give a fine, glossy coating on the bowl which will be water-and damp-protective. If you wish, you can dissolve a little spirit-soluble black dye in the methylated spirit used for dissolving the shellac, and this will ensure the bowls being kept to a black surface without the slightly brownish cast which the use of too thick a shellac coating would develop. Bowls treated in this way should last for a season or two. If and when the polish shows signs of wear, it can be removed entirely by going over the bowls with a cloth charged with methylated spirit.

If you prefer, you can make use of one of the new hard varnishes based on bakelite. Such a varnish can be obtained from Messrs. Smith & Walton, Ltd., Haltwhistle, Northumberland, but this varnish may take a week or more to harden-out properly. On the whole, we think that you will find the above shellac polish method quite satisfactory.

Lacquer for Plastic Materials

CAN you please tell me how to make a quick-drying lacquer for use on plastic materials? What pigments should I use to obtain black, white, and the primary colours?—H. McKeen (Newark).

THERE is no all-round lacquer suitable for all types of plastic materials. For example, a celluloid lacquer would not be suitable for coating a perspex resin, which latter would require a solution of perspex in trichlorethylene. However, for *average* purposes a solution of about 20 parts of Gelva Resin 7 (polyvinyl acetate) in 80 parts of warm methylated spirit will give a suitable lacquer medium.

Gelva Resins are obtainable from Shawinigan, Ltd., Marlow House, Lloyd's Avenue, London, E.C.3. These solutions can be coloured with spirit-soluble dyes, thereby giving coloured, transparent films. For pigmenting with opaque pigments, you can use any of the artist's watercolours which are made up in tubes, grinding together equal parts of the tube colour and the resin solution above prepared. If you wish to use the dry colours, here they are:

BLACK: Carbon black, ivory black, drop black, lampblack.
WHITE: White lead, titanium white, barytes, zinc white, Blanche fixe.
RED: Iron oxide synthetic, Indian red, Turkey red, Venetian red, red lead, vermilion, cadmium red.
YELLOW: Cadmium yellow, Aureolin (cobalt-potassium nitrite), Naples yellow (lead antimionate) lead chrome, barium chrome, yellow ochre, zinc chromate.
BLUE: Ultramarine, Prussian blue, indigo, cobalt blue, cerulean blue, monastral blue.
GREEN: Chromium oxide, monastral green, viridian green, terre verte (green earth), cobalt green.

Freezing Temperature of Fire Extinguisher Solution

WHAT is the freezing temperature of the solution used in a fire-extinguisher of the "Minimax" acid-alkali (not carbon tetrachloride) type? Would it be safe to install a 10-pint extinguisher of this type in a building where the temperature often drops to 26-28 deg. F. in winter, or is the extinguisher likely to burst?

Also, do extinguishers of this type remain in good condition indefinitely? The one in question was last filled about 1930, and I have some refills of the same date.—J. R. Millburn (Aylesbury).

THE fire-extinguishers of the type you mention comprise two "elements," one a vessel of a weak acid (usually sulphuric acid) and the other a solution of an alkali carbonate or bicarbonate (usually sodium bicarbonate). The vessels are sealed, so that the two liquids only become intermixed (with the production of carbon-dioxide gas) when their seals are fractured by the operation of the device. Because of this, there is no evaporation of the solutions, so that they will remain indefinitely in good condition.

The freezing-point of solutions generally varies according to the amount of dissolved material—the more the dissolved substance, the lower the freezing-point of the liquid. For this reason, since we do not know the concentration of the solutions in your fire-extinguisher, we cannot tell you their precise freezing-points. It is not likely, however, that either solution would show signs of freezing above 18 deg. F., so that there will, in the instance which you quote, be no danger of the containing vessels bursting during any ordinary wintertime in this country in consequence of the expansion of frozen liquid.

Cherrywood Extract

I SHALL be obliged if you will give me the formulæ for imparting the "cherry-wood scent" to cherry-wood.—L. Frichett (Leeds).

YOU can make a cherry-wood extract by placing in a bottle powdered wild cherry bark (obtainable from most herbalists) and sufficient rectified spirit or iso-propyl alcohol to cover it. The bottle is corked and it is allowed to stand for 14 days, being shaken up every day. The extract is then filtered and then brushed on to the cherry-wood so that it is absorbed by the latter.

The above is a natural extract. A synthetic and imitation cherry-wood essence, and a much more powerful one, can be made up according to the following formula:

Amyl alcohol	6 parts (by volume)
Amyl buytrate	3 ,, ,, ,,
Ethyl benzoate	3 ,, ,, ,,
Oil of bitter almonds (free from hydrocyanic acid)	8 ,, ,, ,,
Oil of lemon	2 ,, ,, ,,
Oil of orange (sweet)	1 ,, ,, ,,
Oil of cloves	½ ,, ,, ,,
Glycerine	10 ,, ,, ,,
Oil of cardamon	6 ,, ,, ,,
Rectified spirit (or iso-propyl alcohol)	30 ,, ,, ,,

The above materials will be obtainable in your area from Messrs. Reynolds & Branson, Ltd., Leeds. Please note that rectified spirit, being subject to Excise duty, is very costly. Iso-propyl alcohol, price about 4s. lb., can be used in its place.

Colouring Unglazed Tiles

I WISH to stain a floor of buff-coloured unglazed tiles red.

Can you inform me of a suitable red stain, or formula for making one, that would penetrate the surface and be washable?—H. Young (Bristol).

THERE is no means by which you can get a really permanent red colouration on your buff-coloured unglazed flooring tiles. You can brush over the tiles a strong solution of a spirit-soluble or an oil-soluble red dye, and either of these will give a colouration which may or may not resist washing. The spirit-soluble dye is dissolved in methylated spirit. The oil-soluble dye is dissolved in white spirit. In either case, the solution should contain about 10 parts of dye dissolved in 90 parts of solvent. The tiles should be bone dry when the stain is applied in order to permit of maximum penetration by the dye solution.

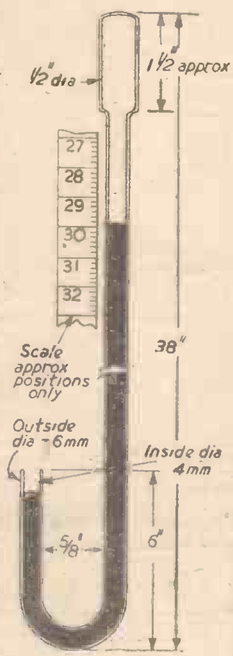
The application of any paint to the tiles is quite useless, because it will soon tread off. On the other hand, a fairly good result can be obtained by the periodical application of one of the red tile polishes which are nowadays available You can make such a polish for yourself by melting up ordinary floor polish and by incorporating with the resulting liquid about one-quarter of its volume of red iron oxide, subsequently allowing the mixture to cool and to solidify. If the resulting paste is too thick for your liking, melt it up again and add a little white spirit to it.

Filling a Barometer Tube

CAN you explain to me how I can fill my barometer tube (enclosed drawing gives sizes) with mercury? I have at my disposal 1lb. of mercury although I shall only require about ½lb. to fill it. I have tried two or three ways of producing a vacuum but have not been very successful. Also, please supply details of setting it, using a scale near the top, as shown in my drawing.—F. B. Mawbey (Allenton).

FILLING a barometer tube is not an easy business. An article on this subject appeared in the issue of PRACTICAL MECHANICS for March, 1937, and we hope to publish another article dealing with barometer filling in due course.

In the first place, both the mercury and the tube interior must be scrupulously clean and dry. The tube may usually be cleaned by filling it up with a solution of potassium bichromate, allowing it to stand for a week, and afterwards washing it out well with water, then with alcohol, and finally with ether.



Details of a barometer tube.

The tube is then gently warmed by being laid on a bed of warm sand. It is then upturned, and a little mercury is poured into the open end. As the tube cools, a partial vacuum will be created within its long limb, and the mercury will be pressed round the bend by the pressure of the external air. The tube is warmed again. More mercury is poured into the open limb, and the process is repeated until the tube is full. The mercury may often be jerked around the bend of the U-tube, by placing the thumb over the open end and sharply inverting the entire tube. This must be done fairly gently, otherwise the force of the mercury is liable to break the tube. This is an operation which calls for "knack" more than anything else. The aim must be to fill the long tube completely with mercury so that when the tube is inverted to its proper position (i.e., with the U-bend at its lower end and its closed end at the top), the mercury column will fall for a distance of about 30in. from the U-bend, leaving an almost completely vacuous space within the tube above the mercury level.

To calibrate the barometer, you must have access to another correctly working barometer and one which is located somewhere in the vicinity and at the same height above sea-level. You can usually find such an instrument in one or other public building or institution. All you need do is to draw accurately a graduated scale, marked in inches and divisions thereof. The mercury levels in your own barometer and in the "standard" instrument will be coincident in height at the same time. Hence, if the "standard" instrument has a mercury level of, say, 30in. you then affix your scale to your own instrument so that the "30" mark is coincident with the mercury level in your barometer. Provided that you have drawn your scale with strict accuracy, your barometer will now be calibrated, and will be reasonably accurate for any average use.

Painting Rubber Balls

I AM desirous of painting a large quantity of rubber balls in a "jazz" design, and I understand that the method is by floating a number of different coloured paints on a tank of water and then dipping the ball through the surface of the water; the paint should then adhere to the ball as it is passing through the paint film, producing a variegated colour effect.

I have tried this method, but so far without success, chiefly, I suspect, through not having the correct type of paint. Could you advise me as to the correct method of dipping, type of paint, and where it can be obtained?—H. Burns (Salford).

YOUR projected method is correct in principle, but not in detail. The liquid used for supporting a surface film of paint is not plain water but a solution of gelatine size, say, of strength 10 parts of gelatine in 90 parts of water. Sometimes solutions of Irish Moss or sodium alginate are used instead. Materials for these solutions can be had from Dryad, Ltd., St. Nicholas Street, Leicester or from Messrs. G. W. Russell & Sons, Ltd., Hitchin, Herts.

The paint is usually of a cellulose type. It is well stirred and then splashed on to the liquid surface. Then the surface is drawn out with a comb or a wooden stick to form various intermixing patterns. The ball is then carefully floated on the liquid, rolled about lightly and then withdrawn. It is then placed in a rack for air-drying. Ordinary oil paints may be used with similar effect but they do not adhere well, and they may have a deteriorating influence on the rubber of the ball.

We think that you will be able to obtain all detailed information and materials from one or other of the above-mentioned firms.

Arc-welding Plant

I WISH to construct a mobile electric arc-welding plant—powerful enough to deal with the normal run of repair-work. Can you tell me what amps., revs., voltage and type of dynamo I require? Also, what horse-power would be needed for driving the dynamo?—R. Melton (King's Lynn).

A DYNAMO which is capable of delivering about 250 amps. and has an open circuit voltage of about 70 volts can be used for a wide variety of repair work, and would be suitable for welding mild steel plates 1in. thick. The best type of dynamo for this purpose is one which has been specially designed for welding and which has a suitable "dropping characteristic," i.e., a dynamo in which the terminal voltage falls to about 40 when the arc has been struck. A dynamo of the required output, which has been specially designed for arc welding could be driven on full load by an engine developing about 21 b.h.p.

A somewhat similar characteristic can often be obtained from a compound dynamo by connecting the series field coils so that they oppose the shunt field coils. Alternatively, a shunt dynamo could be used with an external series resistance capable of absorbing about 30 volts on load. This arrangement, however, is not so convenient as a welding dynamo, by any means, and such a dynamo would require about 26 b.h.p. to drive it on full load.

Cleaning the Inside of a Water Tank

CAN you advise me on the cleaning of the inside of a 5-gallon tank, which is sealed, except for a 1½in. dia. cap? The inside is lightly rusted, causing water to become "dirty" after about five hours.

I may use about 50ft. of ½in. rubber tube to convey the water from the tank in the house. Is the rubber likely to affect the quality of the water?—G. Hughes (Ilford).

WE presume that your tank has contained water only, since the inside of the tank has been rusted.

If the tank can be moved about and is not used for holding drinking water, the rust can be removed by placing ½lb. charges of caustic soda in it, together with water, and then by heating the contents of the tank up, subsequently swilling out the rust-ridden liquid. Do this four or five times, every three days or so. Finally rinse out very thoroughly with plain water.

If the tank is used for holding drinking water, you cannot do this. You will have to use instead small amounts of sodium phosphate, or better still, of "Micromet," which is a slowly soluble form of sodium metaphosphate, and is obtainable from Messrs. Albright & Wilson, Ltd., Water-Treatment Department, 49, Park Lane, London, W.1. A small amount of this is added to the tank every week or so, and it will *gradually* get rid of the rust and other deposits.

A good-quality rubber tubing, provided always that it is perfectly clean inside, will not affect the quality of the water. But you do not say whether the water is to be used for drinking purposes. If the water remains standing in the rubber tube, it may acquire a slight rubbery taste, in which case you will have to discard such water, and run another supply into the tank.

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The Nucleave Press will save you time and money when working with metal, leather, plastic, wood or fibre board. A leverage of 100 : 1 gives a maximum pressure equal to two tons, enabling you to punch holes up to ¼″ diameter in almost any material including mild steel. Note, holes are punched cleanly *even through stainless steel :* no burrs or rough edges are left —no time is wasted in cleaning off.

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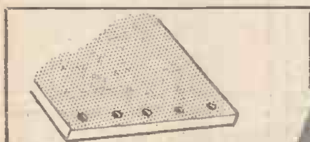
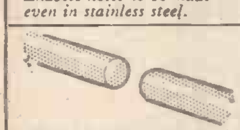


Enables holes to be made even in stainless steel.



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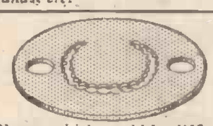

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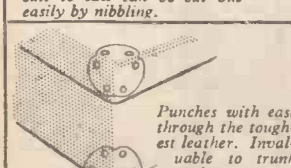

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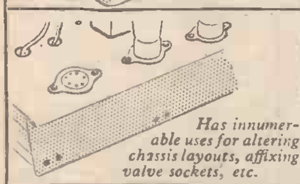

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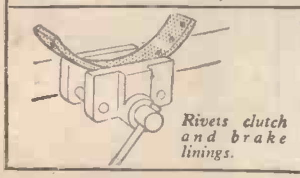

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THE Cyclist
Editor: F. J. CAMM
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Phone: Temple Bar 4363
Telegrams: Newnes, Rand, London

Comments of the Month

IT will be remembered that an invitation was issued to the Road Time Trials Council to meet the National Cyclists' Union's and the British League of Racing Cyclists' delegations to discuss whether some formula could be found whereby the rules of each would be mutually recognised. This invitation was declined by the R.T.T.C. and in a recent Bulletin circulated to clubs it gives its reasons.

They go over the same old ground, but briefly they are as follow:

"1. Because all the historical facts in the present statement which show the firm and unshakable attitude of the Ministry and their warning of ultimate action, the Road Time Trials Council could not allow their name to be coupled with the sanctioning of massed-start cycle racing on open roads, even if such racing were thought desirable, or necessary. The bunch cycle racing conducted to-day is an utterly selfish and irresponsible use of the roads which are the property of the public as a whole, and there can be no compromise with it.

"2. **Thus there could be no possible purpose in meeting the chief promoters of these mischievous activities** because the Council has no intention of agreeing to *a certain number of such races*. The policy of the Council is that all such racing should be stopped unless it can be held on roads which are closed to other vehicles. It is impossible to legislate for particular areas only.

"3. The National Committee cannot recognise the authority of any group of persons to speak on behalf of everyone who might organise a cycle race on the roads in conflict with the rules of the R.T.T.C. and the N.C.U. Still, if a meeting were called for the purpose of persuading certain promoters of massed-start races to discontinue them, **and there was a reasonable chance that the persuasions might be successful**, the National Committee would consider sympathetically whether it might assist in such discussions. If any considerable section of massed-start riders did decide to change over to recognised cycle sports the National Committee would take part in meetings to arrange the rehabilitation of these riders.

"4. The National Committee can see no likelihood that any such move will come from the ringleaders. These people have remained indifferent to any arguments, warnings, or signs of disaster to cycling as a whole through their activities. It has been said that they are people of 'misguided enthusiasm' who want to see 'International honours brought to this country.' Whilst this may have been partly true at the beginning, it has not been the case for many years. **The motive behind the majority of the ringleaders and their associates to-day is financial; the possibility of extracting sums of money from various unsuspecting commercial concerns or newspapers (to whom a distorted story has been told), and the further possibility that unsuspecting newspapers would give valuable free advertisement to trade**

An Offensive Bulletin

By F. J. C.

interests bound up with the promotions.

"5. **So long as these selfish interests are served the responsible parties do not worry unduly if their young riders are banned from all international sport, or if the 'races' are providing the most anti-cyclist elements amongst the police forces, and Government departments, with a powerful lever to be used against cycling as a whole; or if the said 'races' violate every one of the principles of clean amateurism, authenticity and regard for the public safety** that have built up cycling road sport.

"Such is the nature of the set-up which the National Committee were asked to join in round-table discussions. They refused, and they note with regret that the National Cyclists' Union Committee have nevertheless continued to hold meetings with the massed-start elements, although the clubs composing the National Cyclists' Union have never given their Committee a mandate to hold discussions without the R.T.T.C.

"**The National Committee will not be parties to any move by N.C.U. individuals to defeat the wishes or betray the interests of the clubs,** who, after all, are in most cases adherent to the R.T.T.C. as well as to the Union, and who voted solidly at the last N.C.U. Council meeting to preserve a 100 per cent. co-operation with the Council.

"As guardians of a sport which comprises 90 per cent. of the organised cycling sport in this country, and which is closely bound up with a pastime that is vital to millions more people, the National Committee of **the R.T.T.C. will not ally themselves with or condone in any way the selfish and unscrupulous promotions of bunched races on the open highway.** On the contrary, the National Committee will assist in any measures to stop it, and calls for the co-operation of all who have the welfare of cycling at heart."

The above bulletin, it will be remembered, is issued by a body which itself in its early days broke away from the N.C.U. and adopted exactly the same attitude that the B.L.R.C. is now adopting. The N.C.U. banned all cycle racing on the highway, and so the Road Records Association and the Road Racing Council (now the R.T.T.C.) was formed.

The highly defamatory statements made in that bulletin are not those which should issue from a body which claims to be responsible, and we can only hope that the R.T.T.C. took legal advice before issuing such a document making charges of a most serious nature against promoters of League events.

The use of such phrases as "*unscrupulous,*" "*extracting sums of money from unsuspecting commercial concerns to whom a distorted story has been told,*" "*unsuspecting newspapers,*" etc., imply dishonest motives on the part of the B.L.R.C.

As far as the N.C.U. is concerned it is true that it has every reason to wish for peace with the League; for, bereft of any interest in time trials and road records, its sporting interests are now confined to the control of a few hundred licensed track riders. Track racing has been dying expensively and beyond its means for the past 20 years. It would be a good thing for the N.C.U. if some formula could be found by means of which it could net the enthusiasm and ever-growing League membership. It has every reason to fear it, and possibly may be a little jealous of its success.

Apart from this, the bulletin issued by the R.T.T.C. is a mere recapitulation of the old arguments, raised 10 years or so ago when the League was born. After 10 years all of these prognostications have been proved false, indicating the unsoundness of the judgment of League opponents, whose real reason for opposing is that it might bring about a secession from their ranks. No doubt it is aggravating to these critics to find that their lugubrious forecasts of 10 years ago have shown them to be bad prophets.

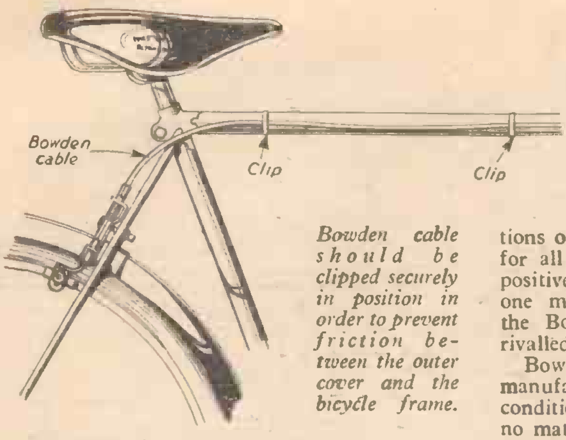
We maintain that the League after its trial period has earned and is entitled to international recognition. Opposition to it is fomented by the two opposing bodies and by one or two cycling scribes whose minds repose in the past and are not receptive to change.

As we have said elsewhere, it must be a source of chagrin to them to see their 10 years' opposition so unfruitful in its results. The fact that they have alienated the sympathies of many of their supporters, have indeed become hoist with their own petard, is a poetic justice which they have well merited.

Beddgelert N. Wales.
The bridge over the River Glaslyn near the lovely village.

About Bowden Cables

Some Practical Notes on the Care and Upkeep of an Important Cycle Component



Bowden cable should be clipped securely in position in order to prevent friction between the outer cover and the bicycle frame.

BOWDEN wire cables find considerable use on modern bicycles as brake and gear controls, yet, of all the average cycle's equipment, they are, on the whole, by far the most neglected.

Day in and day out, the Bowden cable linking-up brake lever and brake-band, gear control and gear mechanism is expected to function smoothly, efficiently and silently, and without hardly ever receiving any attention by way of upkeep. That such cables do in actual fact stand up to all sorts of adverse conditions is, indeed, a testimonial to their reliability. Nevertheless, no cable of the Bowden type can be regarded as being absolutely fool-proof and unneedful of attention. Wear can take place within such cables just as surely as it can occur elsewhere. What is more, cable wear usually occurs insidiously, so much so that the first signs of it which many a cyclist becomes aware of consists in the failure, total or partial, of the cable.

How They Are Made

The Bowden cable, as everyone knows, consists of a spirally wound length of wire which forms a flexible tube of narrow bore. This tube is surrounded by a waterproof casing and through the tube passes a stranded steel cable, the latter being of such a diameter that it fits the tube snugly, neither being too tight a fit nor too loose.

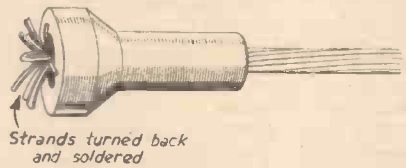
The strands of the steel cable are not only twisted together, but they are actually sweated in contact with one another. An ordinary stranded wire, the component strands of which have been merely twisted or plaited together, will stretch somewhat when subjected to pulling forces at either end. Not so a Bowden cable, however. Under all ordinary degrees of tension such a cable remains absolutely inextensible, and thus a pulling force applied at one end is transmitted faithfully and (theoretically) without loss to the opposite end.

The protecting tube of the Bowden cable, in virtue of its close spiral wound formation, is more or less incompressible. Hence, a pulling force applied to the end of the stranded wire cannot react and set up a compression of the outer cover. When a Bowden cable is properly fixed and adjusted, the slightest pull on one end of its inner cable produces the corresponding movement at the opposite end of it.

"Straight Runs"

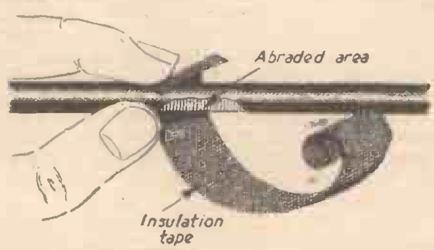
Naturally enough, for "straight runs" the function of a Bowden cable could be undertaken by a thin steel rod, and such, indeed, is the case with many front bicycle brakes. The Bowden cable, however, can transmit with facility a pull round corners and along long curves. To transmit such a pulling force by means of straight rods or bars would necessitate unwanted complications of mechanism. Hence it is, that for all purposes in which a flexible yet positive controlling connection between one member and another is required, the Bowden type of cable stands unrivalled.

Bowden cables are sent out by their manufacturers in a properly lubricated condition. It has to be recognised that no matter how perfectly made and carefully placed a Bowden cable may be there is always a certain amount of friction existing between the central stranded cable and the interior walls of its protective tubing. This friction is at a minimum when the cable is perfectly straight. It increases as the degree of curvature of the cable line is increased, and it attains a maximum in those places at which the cable is abruptly turned. Thus, when fixing up a length of Bowden cable between handlebar lever and brake or gear arm, the guiding rule should always be to keep the cable as straight as possible, and at all times to avoid abrupt bends and curves. By keeping to this rule, not only will the cable work more freely and with less pulling effort, but its life will also be prolonged very considerably.



How to attach a nipple to the end of a Bowden cable.

An occasional fault in a Bowden cable. An inner strand breaks and, sticking in the surrounding casing, causes the cable to function "stickily."



Frayed or otherwise damaged areas of Bowden outer casing should be protected by a thin wrapping of adhesive tape.

Oil Down the Cable

The practice of injecting oil down a Bowden cable is not usually an entirely effective one, simply because it is so seldom the case that the oil is able to penetrate along the entire length of the cable. The lubrication method adopted by the manufacturers of such cables is to wax the inner sides of the coiled wire casing and to grease slightly the inner stranded wire. For this reason the stranded wire should not be removed from its casing since, by so doing, much of its lubricant may be lost or contaminated. If, however, it is for any reason necessary to separate stranded wire and outer casing, it is advisable to pass the stranded wire through a bath of gently-melted tallow before replacing it.

So far as possible, the complete Bowden cable should be kept absolutely rigid by secure clipping in its attachment to the cycle frame. If this precaution is not borne in mind it will be found after a time that friction between the Bowden cable and some hard member of the bicycle has resulted in the outer protective waterproof cover of the cable being worn away in patches. Such frayed areas should be attended to immediately they are detected, otherwise dirt and dust will work their way into the interior of the casing and unwanted friction will result.

When fitting a Bowden cable, or in effecting a repair to an end of it, it is highly important to see that the stranded wire is not heated except at its extreme end.

Nipples are attached to the end of the stranded cable by the simple procedure of passing the end of the cable through the nipple, turning over the ends of the wires and then by soldering them in the little cup formed at the end of the nipple.

Loose Strands of Wire

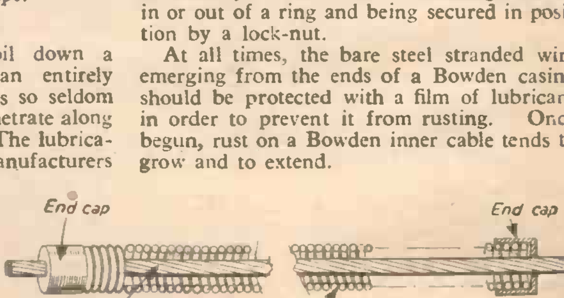
Occasionally, a Bowden cable will be found to function badly, despite the fact that it may outwardly seem to be in good condition and that its points of attachment are correctly made and adjusted. In such instances the trouble may often be traced to a loose strand of wire within the cable, which has broken and which has partially embedded itself in the casing. Needless to say, such faults never occur in cycle Bowden cables which have not been tampered with, although they are not infrequent in instances of "made up" cables, i.e., of Bowden cables composed of old and partly defective lengths of inner stranded wire cut from disused cables and inserted into old casings.

Bowden cable lengths are not expensive these days and when anything serious goes wrong with any such cable on a bicycle (which is not often the case) it is always best to discard the worn-out length of cable and to provide a new one in its place.

The extreme ends of the black outer protective covering of a Bowden cable frequently become ragged and frayed, particularly if the small metal ring or collar which fits over such ends has been tightly compressed with pliers.

By means of a cable adjuster, it is possible to alter the effective length of the outer casing of a Bowden cable within a limit of half an inch or so, a small metal sleeve being screwed in or out of a ring and being secured in position by a lock-nut.

At all times, the bare steel stranded wire emerging from the ends of a Bowden casing should be protected with a film of lubricant in order to prevent it from rusting. Once begun, rust on a Bowden inner cable tends to grow and to extend.



Showing the construction of a Bowden cable.

Cotters and Cranks

Unless They are Carefully Fitted, Cotters are Apt to Prove Extremely Troublesome

COTTERS should be carefully fitted. Fig. 1 shows the position of the cotter in relation to the bottom bracket axle and the crank. The flat, A, on the cotter should be quite flat. If the cotter has been plated after the flat has been machined upon it, it is advisable to file off the plating before fitting, otherwise it is apt to be dragged up when the cotter is fitted and may rumple between the cotter and the flat on the axle. If it does, the cotter will not lie flat and will slightly see-saw on the flat and eventually work loose.

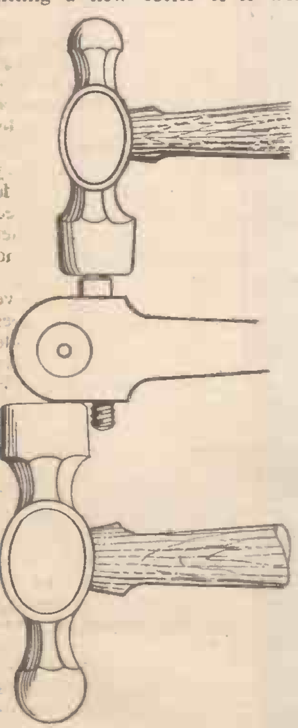
The cotter end, when the crank is quite tight, should pass the end of the flat on the axle as at A (Fig. 1). If not, it is apt to dig on the end, and may come loose and get worse with use.

There should be enough room between the face of the crank and the end of the flat on the cotter to ensure that the nut and its washer hold tight on to the crank, and do not tighten up on the end of the thread or the end of the flat.

Bad Fitting

Fig. 2 shows a cotter not fitting far enough along the flat on the axle. Fig. 3 shows a cotter with the flat filed down too much so that the cotter drives too far, and the nut and washer are not holding it. It can work loose by continual use, especially in the case of a machine which has no free wheel and where the crank is used for back pedalling when descending hills.

The thread on the cotter should fit the nut easily, but not sloppily, and before fitting a new cotter it is well to see that the nut will screw right down the thread. This is important.



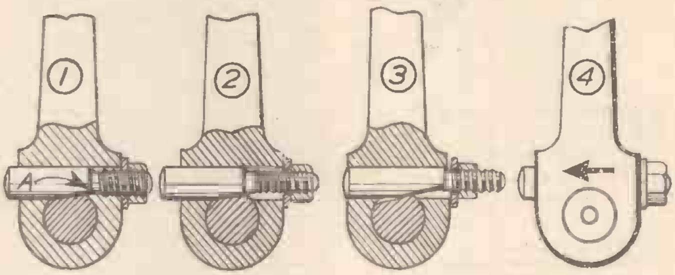
How to drive in a cotter by means of two hammers.

To tighten a cotter do not drive it down with a hammer without any support other than the bottom bracket. Such procedure may result in a broken ball or even a damaged bottom bracket cup. Hold a heavy hammer (or the side of a flat-iron) up under the crank as shown in Fig. 5 so that the weight of the blow is absorbed by this weight below and not by the axle and bearings. Do not strike many small blows when driving a cotter in, but give heavy sharp blows. These drive it tighter with less risk of damage.

Tightening the Cotter

Having driven the cotter tight, oil the thread and replace the washer and screw on the nut. To ensure the greatest tightness hold the spanner on the nut firmly and pull round in the direction for tightening, at the same time striking the head of the cotter some light, sharp (not slow, deliberate) blows on the head. It will be found that the nut can be pulled round, perhaps half a turn. A well-fitting cotter so tightened and with the cotter screw thread oiled will never come loose in ordinary riding.

Figs. 1 to 4 (left to right).—The correct positioning of the cotter. A badly fitted cotter. The flat of the cotter filed down too much so that the cotter drives too far. Showing the correct direction in which to fit the cotter.



Damaged Cotters

Cotters are often damaged when driving them out in cases where it is required to remove the crank. The threaded end is burred over by the hammer blows.

The blow should be very sharp and quick —not swinging blow. It is the sharpness of the impact on the end of the cotter thread which will best start the cotter without riveting over the head and closing the threads. In all cases of driving out a cotter a weight should be held up below (as in the case of driving one in) to take the blow. The cotters start much more easily if this is done and no damage to the bearing will result.

Use a Penny

A good plan is to use a piece of soft brass —a penny will do if a piece of brass is not available. The penny will be defaced but the price of obtaining a new cotter and the trouble of filing and fitting it will be avoided. Hold it on the end of the cotter and hit it a sharp, hard blow.

If a cotter has been burred at the ends, it can still be of service if a three square file (a small saw file) is used to file the end threads clean again to allow the nut to be screwed on. Do not attempt to force the nut on a burred cotter thread. The thread on both will be spoilt, and a new cotter and nut will be necessary.

The best plan is to have a couple of cotters with their nuts and washers always handy. They make the best job and prevent "bodging" the job with an old cotter which cannot be made to fit effectively. A cotter which fits up as far as shown in Fig. 3 should be scrapped. It will never hold tight for long and there is no workmanlike way of using it again.

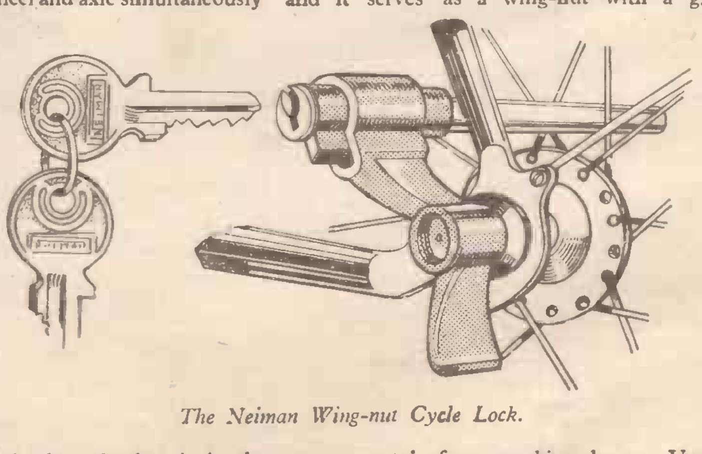
If the cyclist has taken off both cranks he should remember to put the cotters in the right way round. They should be fitted so that the strain of the crank on the cotter comes at the thickest part of the cotter. Fig. 4 shows the direction of rotation of the crank and the correct fitting. If a crank has stretched in the axle hole there is no real remedy or repair. It will continue to stretch in use and will be continually getting loose. The only remedy is a new crank.

Cranks should be a nice "twisting" fit on the bracket axle. They should not be loose enough to push on easily by hand, but should go on if a backward and forward twisting action is used. If a new crank is being fitted see that there is no plating inside the axle hole or the cotter hole. If there is, scrape it out.

A New Cycle Lock

THE illustration shows the Neiman Wing-nut Lock, marketed by Marklocks, Ltd., 91, Albert Road, London, N.22. As will be seen, it locks the wheel and axle simultaneously by means of a yale-type barrel lock and key.

To lock the wheel the bar is pushed home, holding it by the key, which is given a quarter turn clockwise and then removed. The bar is thus locked in place projecting between the spokes and prevents the wing-nut from being unscrewed. The key alone cannot be removed when the bar is in the unlocked position. It is well made in brass, bronze and steel, and there are no springs, hinges, or weak joints to wear out. It cannot jam or damage the spokes or enamel, and it serves as a wing-nut with a grip to prevent it from working loose. Under test we found it effective.



The Neiman Wing-nut Cycle Lock.

Off to Lapland! Right to Left: Trevor Laker (John Bull), Fred Bladon (Royal Enfield), Wally Summers (Captain), Steve Smith, and Richard Cockburn (Balham C.C.).

Around the Wheelworld

By ICARUS

To Lapland by Bicycle

ON July 21st, Wally Summers, Richard Cockburn and Stephen Smith set off from the John Bull Works, Leicester, to ride to Lapland on bicycles. These three riders are attempting a 4,000-mile ride into practically unknown territory in Lapland in order to demonstrate the reliability of the new John Bull Dual-purpose Tyre and the new All-welded Enfield bicycle. They were despatched by the Lord Mayor of Leicester and the riders proceeded to Harwich from whence they embarked by steamer for Esbjerg.

The John Bull people hope by this demonstration to persuade the cycling public that cheap tyres are dearest in the long run. The new tyre contains a very high percentage of new rubber, rather more than 80 per cent. Thus the new tyre is equivalent to the high quality which was available 50 years ago. Wally Summers is the captain of the team and he is now, of course, in the employment of the John Bull concern. Cockburn is the proprietor of the Beckenham Cycle Works, and he has toured extensively on the Continent and should be of great assistance because he speaks fluent French, German and Esperanto. Smith is a member of the Balham Cycling Club and has toured extensively in Greece, Dalmatia, Jugoslavia, Italy, France and Austria. The tour will proceed via Esbjerg, through Denmark, Sweden, Norway, Lapland, Finland, Jutland and Belgium, back to the Mother country. Much of the journey will be traversed over mountainous tracks and where roads are practically non-existent. The team are dressed alike in Royal blue sweaters, and they are to be fêted on route.

Whimper from Wimpey

IN *Wimpey News*, which is the house organ of the Wimpey concern, I notice the following, in a paragraph headed, "Motor Cyclists Cop it this Time." "Many thanks to your correspondent who points out the foolish practice of some cyclists who ride in the main road when there are special tracks provided for them. The figures of casualties among cyclists in the latest returns are amazingly high and should warn any intelligent road user to beware of cyclists anyway."

Here is a further example of the loose way in which statistics are used by those with warped judgment. There are only about 600 miles of cycle track in this country and the accident statistics relate to the whole of the country. There is no evidence to support the argument that cycle tracks have reduced accidents.

The fact that accidents have increased might indeed lead some to presume that they have increased them. If the Great West Road cycle tracks are an example one would be entitled to draw such a conclusion. There you see a cycle track broken up every few yards by runways from works to road, pedestrian paths and main road crossings where the cyclist is debouched. Nursemaids, dogs, or anyone else can use the cycle paths.

An Ingenious Cycle Stand

SIR A. V. Roe, the famous pioneer airman and aircraft designer, has lately been turning his attention to the improvement of the bicycle. His design for a cross-frame top-tubeless bicycle is described elsewhere in this issue. The photograph and sketch on this page shows his idea for a lightweight and unobtrusive and certainly efficient bicycle stand. As will be seen, it attaches to the pedal and flaps up out of sight when not required.

Of course, the idea of a cross-frame bicycle is not strictly new. Such a frame is described in Professor Sharpe's famous book on bicycle design, published in the nineties, and others are also dealt with in Wallis Tayler's book, published around the same period. Paul Renouf patented during the latter end of the last century practically every known possible combination of tubular bicycle frame construction, and he included the cross-frame. It would indeed be impossible today to design a cycle frame of tubular construction which did not employ one of his designs.

"Third Grade" Riders?

A CONTEMPORARY attacked the British League of Racing Cyclists on its Tour of Britain event, and suggested that "Third Grade" riders have left other bodies to join the League. William C. Rains, Hon. Gen. Sec. of the League, in an Open Letter replies to this criticism thus:—

"Your disparaging remarks hardly merit a reply as such gross distortion must include the numerous riders who came into the League ranks after representing England in international competition, which for them was their first taste of real road racing. And what of the dozens of championship class riders who after coming over to the League find themselves in the 'also-rans'? Incidentally P. T. Stallard, the prime mover in the formation of the B.L.R.C., represented England in 1933/4/5/7/9. Had you forgotten this?"

Pedestrian Crossings—New Regulations

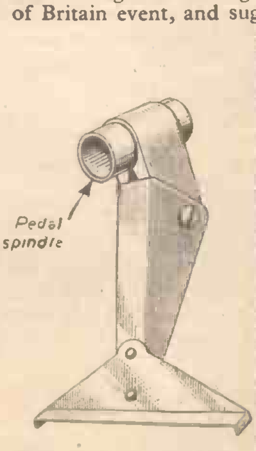
THE Minister of Transport, the Rt. Hon. Alfred Barnes, M.P., has made new Regulations governing the use and marking of pedestrian crossings. The new Regulations will come into operation on October 31st next, when all existing pedestrian crossing regulations will be revoked.

Under the new and simpler Regulations, pedestrians will have priority over vehicular traffic at uncontrolled crossings only. The pedestrian's precedence at controlled crossings (i.e., where there are light signals or police control) will be abolished, and the Highway Code will be amended to give road users guidance on the use and observance of such crossings.

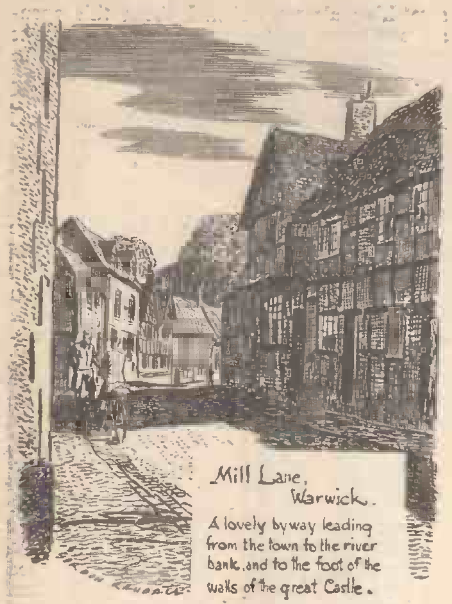
Uncontrolled crossings will be marked by a pattern of alternate black and white stripes. It has been decided to retain, for the time being at least, the use of studs in the marking of all crossings whether controlled or uncontrolled, and also the use of beacons for uncontrolled crossings.

"Scientific Training for Cycling"

DR. C. R. WOODARD has just written, and Temple Press, Ltd., has published at 3s. 6d., a valuable book under the above title. Dr. Woodard is, of course, an expert on physical fitness and training, and has written a great deal on the subject. The chapters which are listed below give an indication of the scope of the book: Scientific Training; Confidence; General Exercises; Special Exercises after Strain; Women in Cycling; Diet; Massage; Treatment of Minor Injuries and Cycling Complaints; The Personal Viewpoint, and The Ideal Athlete.



Sir A. V. Roe's new cycle stand. It weighs less than 1 oz.



Mill Lane, Warwick.
A lovely byway leading from the town to the river bank, and to the foot of the walls of the great Castle.

Wayside Thoughts

By F. J. URRY

Returning to Beauty

I HAVE lately returned from a cycling tour in south-west Ireland with my daughter as a steadying companion—her first visit to the area—and a fortnight was far too short a period to satisfy either of us. I visited the area first in 1898 when three of us rode nearly a thousand miles in seventeen days, and have been over on numerous occasions since, and always, even in the less comfortable days of the early part of the century, one wanted to return. Roads have improved considerably and accommodation greatly since my earlier visits, but if the tourist wants to see Ireland as she is, he must risk the bad road surfaces and the weather, and be prepared to take his fortune in his hand. Of the 350 miles of riding I should think 75 per cent. of it was over rough roads deliberately chosen, with accommodation places 25 to 30 miles between. That is why we took a primus stove and picnicking outfit, and believe me it is the best way to travel, despite the handicap of weight. We crossed from Fishguard to Cork, and rode out of that city on a fine windy morning with an easterly breeze to push us along. Up the shining river Lee we quietly climbed to Coachford where we wanted milk and butter; but was either to be had? Not a hope, for butter was rationed owing to the poor spring feedings, and milk went to the dairies to the last drop. If you are in any doubt in Ireland go to the police, and my interview with a cheerful sergeant resulted in a slab of butter and half a bottle of milk, so a few miles further our first picnic meal was on the bank of a small tributary of the Lee, twenty miles from Cork, and it was very good. A parted brake cable was replaced in Macroom, and a dozen miles further, just beyond the chain of Inchigeelagh lakes, we found a real Irish hotel at Bealarageary to give us a welcome as the first tourists of the year. There were basins with hot and cold water in the bedrooms, but the taps did not work, and the electric light must have been shut off at the Shannon end, so we went to bed by candlelight. But we were well fed and very much welcomed.

Into the Good Weather

WE left bad weather in England and stepped into sunshine and fair breezes. That wind abaft makes a difference to the heavily loaded tourist. On the detour to Gouganebarra, the ancient retreat of St. Finn Barr, it was warm, and the grim little lough locked in the hills was a reflection of the sky, and the gorse-bordered shores—the blue and gold of Ireland. Back to the main road, now rougher as it draws away from Cork, we were soon climbing Keamaneigh Pass, a picture postcard gap in the hills running down to Pierson's Bridge along a road ribbed cross ways with the traffic cutting away the soft earth. This was nothing to what I knew was coming if we followed the suggested route. After Pierson's Bridge and its comely waterfall, Snave Bridge and then the sea, nearly at the last bend of Bantry Bay, here filled with islands glowing in colour, and the tang of the waving seaweed in our nostrils. This was the place for lunch, lamb chops and a tin of pineapple, both expensive, but worth it. On our grassy bank above the tide it was too hot to be comfortable, so we packed and slipped into Glengarriff in the early afternoon. A long laddie from Sussex joined us on a trip to Garnish Island, ten minutes out in the bay, where the late Lord Bryce made a garden worthy of its surroundings. We were back in time for tea at Eccles, and then our young friend left us to scamper over the Caha Mountains and make Kenmare for the night, what time we lingered at the Blue Pool and sat on the river bridge until the gnats drove us in. Eccles is a good old-fashioned spot if a trifle expensive, excellent food and a kindly welcome. Next morning a ride up to the Tunnel Pass, seven miles of steady grade through the Caha hills over an excellent road; how different from the mountain track I knew forty years ago. What glorious visions there were on either side, wild and wide on the Kenmare slopes, and fair and far, with the jewel of Glengarriff below you on the Cork side. We rolled slowly down to lunch stopping frequently to better impress our memory.

Over Tim Healy

ANOTHER lovely morning as we took the Berehaven road to Adrigole over the long spur of the hills and through a rough country of scattered rocks. But the sea was always in sight winking at us in brilliant flashes from its wind-whipped wavelets. It must be a six miles glide from the summit of the spurs of Caha to Adrigole, six miles of almost perfect travel, the only snag being patches of ribbled surface to slow the speed for the sake of comfort. Then we turned inland up a great valley bare except for its bosses of gorse, for the Tim Healy crossing. To the foot of the zigzag you can ride in slow comfort; then the grade stiffens and above you—seemingly so near—is the shrine marking the head of the pass. We rode and walked, and the road surface for such a grade was excellent. The backward view was wild and wide, relieved by the shimmer of Bantry Bay; but once over the summit you enter County Kerry and the rough red track of a mountain road. But the contrast of the scenes either side of the pass is remarkable. Here on the Kerry side is Lough Glanmore lying in the cradle of the Dereen estate, one of the scenic gems of this area, lately owned by Lord Lansdowne. Circled by mountains, coloured with every tint of spring, nutty with the scent of gorse, it is the type of vision you dream of and do not believe to be true. We lingered long over lunch by a torrent leaping down to the lough, too long indeed to comfortably make the thirty and five miles still to go to Parknasilla which we had promised ourselves that morning. But it was so beautiful we couldn't feel regretful.

Adventure Travel

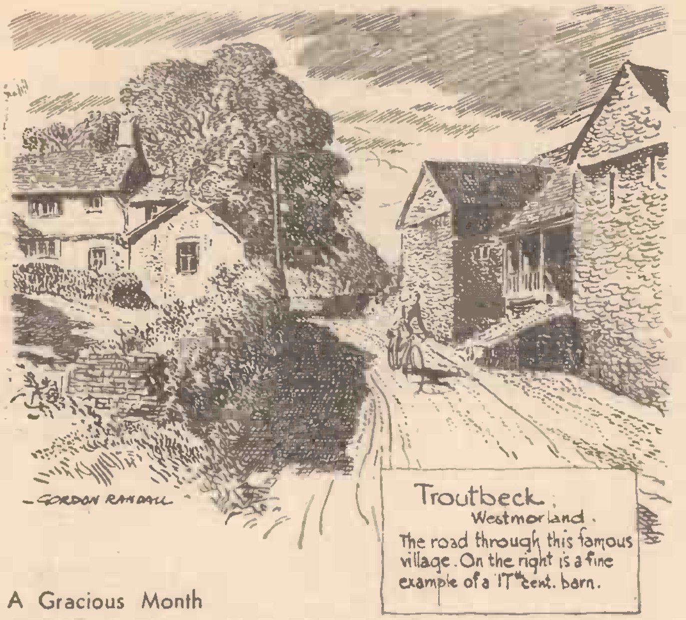
ON our way to Kenmare we came to the little harbour of Kilmakilloge where one O'Sullivan keeps a pub-cum-shop, and it occurred to me that if we could 'phone Parknasilla to fetch us over the five miles of Kenmare River, it would be a good idea. O'Sullivan told us his fishing boat would be in at five o'clock—he hoped—and it would take us over for a consideration; but the Irish hope is not to be depended on too much. So would we 'phone. But the 'phone was four miles back along the road we had come at a place called Lauragh. "Hop in the car, I'll take you," said O'Sullivan. We got to Lauragh and the 'phone, and without our local guidance would never have found the P.O. It was an experience well worth while, and the aquatic journey to Parknasilla was a delight, for the evening was sheer loveliness falling so softly radiant on the river and mountains. We stayed three nights at Parknasilla, and then went over the Coomakesta to Waterville and on the way visited Daniel O'Connell's house (The Liberator) at Darrynane Abbey, but our visit was a rest in a riverside paradise.

Into the Wild

FINALLY, we tore ourselves away one lovely morning to cross the hills by the Ballaghbeama Pass into the scattered country the west side of the Macgillycuddys, that perfect specimen of a pass, all of which is rideable except the last short mile. It was an ideal day for such a journey, and though the roads were rough and stony all the changing visions were delightful. Almost under the shadow of the Reeks we lunched and lazed, and when we came to pack and pick our way by Glencar—the vale of the lovely Caragh river—there was a drawing-pin right through my rear cover. An easy mend, but fancy picking up a drawing-pin in that type of country! Just after five o'clock that evening we made Caragh Lake Hotel with its wonderful views of the Reeks, and from the lawn saw a stormy sunset paint the land. That promise was duly fulfilled, for the rain came in the night and stayed with us until well after noon. But the wind was behind with a hard road beneath, so we made good running to Killorglin where market-day was in full swing, and my daughter got herself tangled amid the pigs and cows and donkeys, and thoroughly enjoyed the hour. Castlemaine came and went, a rather dreary ride when all the hills are shrouded, and then, three miles out, the hard road became sand and rock, often rim-deep in mud, all the way to Inch. It still rained, so the Strand Hotel gave us lunch to the roar of the breakers along that curious peninsula which makes the little harbour of Castlemaine. Two miles out of Inch a shaft of sun came out of the clouds, and in half an hour we were bounding over the hard dry road from Tralee to Dingle between the flowering hedges of fuchsia. There is only one hotel at Dingle—Benners—and it is very good and typically Irish, and here we booked for a couple of nights to make the round of Slea Head on the morrow and return to Dingle.

CYCLORAMA

By H. W. ELEY



Troutbeck, Westmorland. The road through this famous village. On the right is a fine example of a 17th cent. barn.

Thoughts on Oil

YOU can think about oil in terms of vast refineries, or as a question of international importance, or as a potential cause of war between nations, or—you can think of it in terms of the little oil-can which can wield such a magic touch with almost every form of machine. I thought of it in terms of the oil-can recently when I was spending a quiet week-end at a country-house. One day, the owner decided on the final cut of the spacious lawns, and out came the lawn-mower . . . such a squeaky mower that I writhed as I heard its abominable music. Wasn't there an oil-can in the place ? A hunt followed, and an oil-can was found . . . but it was empty! I cycled two and a half miles for a replenishment, because I just couldn't stand that squeaking ! And, out of curiosity, I asked when the cycles of the establishment were last given any oil. Nobody knew. Ye gods ! how strange it is that intelligent folk will so spare the essential oil. Before I left that stately home on the Monday morning, I had given three bikes a dose of oil . . . and cured the lawn-mower of its ghastly groaning !

A Gracious Month

THE title can justly be bestowed upon the mellow month of September, and I fancy that it is a month much beloved by cyclists. Usually, the sultry heat has gone, melting into serene temperatures, not too hot for riding, yet full of kindly warmth. In many districts there is the glory of uncut corn . . . golden fields of wheat and barley, hiding places of the thousands of rabbits which will fall to the farmers' guns when cutting time comes round. In many an English orchard the apple trees are bowed down with rosy fruit ; across the meadows, early in the morning, there are mushrooms to be gathered, and in the tangled lanes the nuts are ripe. A goodly season, and no wonder that many out-o'-doors lovers choose it for holidays ! "A Fortnight in September"—to quote the title of a famous novel by R. C. Sherriff—is no bad tonic to set one up for the long winter . . . and I must try and plan a little holiday tour before the month is out. Maybe a ride through Shropshire, and over into Wales, would be a joyous experience, and add to the good memories I have of that pleasant land. Shropshire itself can yield delights enough, and it is an age since I wandered in Ludlow, and glimpsed the grandeur of Church Stretton.

Britain's Best Bicycle Customer

IF I had been asked to name the best customer for British cycles, I should have guessed wide of the mark, for I certainly should not have named Malaya. And yet Malaya heads the list—she took £639,789 worth during the first quarter of the year, followed by Brazil (£404,237) and India (£330,004). These are impressive figures, and form part of the grand total of cycles and motor-cycles sold overseas during the first three months of 1951 . . . £6,375,069 worth ! If it is true that we live by our exports, then it is evident that the cycle and motor-cycle industry is contributing in no small measure to our national survival. All power to those who control the industry and do so much for the national effort in export markets.

Brealey of B.S.A.

I WAS glad to note from an advertising trade paper recently that Noel Brealey, that popular and energetic advertising manager of the B.S.A. Company, had been elected as President of the Birmingham Publicity Association. It is an honour well deserved, for Brealey has served advertising with distinction for many, many years. I recall serving with him on the Propaganda Committee of the Cycle and Motor Trades Benevolent Fund . . . and it is typical of the man that whenever he had anything to say, he said it with vigour, and only spoke in debate after due thought. H. N. Brealey will make a notable president.

The Lure of the Open-air Market

I HAVE always loved the little open-air markets of the country towns of England. They smack of a more leisurely age, of an age when the vast chain-store was unknown. And it is my happy lot to be able to visit two of these survivals of a more serene age . . . Uttoxeter and Ashbourne. The latter is held on the "cobbles" of the ancient market-place, and the stalls offer an astounding assortment of goods: flowers and vegetables, women's dresses, boots and shoes, kitchen ware, buckets and mops and brushes, clothes-lines, curtains, boot polish, sweets . . . all are there, set out on the stalls, and as I wander through the busy scene I am always deminded of the East . . . there is something almost Oriental about this open-air selling, with its colour and its chatter and laughter. And there are bargains to be had ! Did not I buy a wondrous bowl of golden daffodils on a rainy day in spring for less than half what I should have paid in a "proper shop" ?

Place-names

HOW fascinating they can be . . . these names of obscure English villages and hamlets ! How good it is to dismount at some cross-roads, and read, and read again the names of the villages to which one can journey ! There is a whole field of absorbing study as to the derivation of many of the names, but whether one is prepared to go deeply into the matter or not, there is no doubt of the charm of the names. Some are musical to the ear ; others are almost grotesque; some indicate famous families and long lines of country squires . . . long since disappeared into the mist . . . leaving their ancient homes as crumbling monuments of a glory that has gone ; the chimneys the haunt of the jackdaw, the gardens reverted to jungle. Sometimes I ride to Marston Montgomery, and always find the name alluring; Kirk Langley conjures up visions of Scottish Elders, and of John Knox thundering from a Presbyterian pulpit. Barrow-cum-Twyford never fails to intrigue me, and, somehow, Mugginton brings a smile. My particular countryside is not, perhaps, very rich in lovable place-names, but there are plenty which make me muse upon their meanings, and gaze long at the sign-posts as I take my leisurely rides.

The Friendly Inn

MY recent comments about old inns and country taverns evoked responses from several readers, and it is evident that the inn occupies a warm place in the hearts of many cyclists. One of my correspondents —like myself—is a student of inn signs and names, and mentions, among others, "The Running Mare" near the village of Stock in Essex, and the "Pretty Pigs" near to ancient Tamworth in Staffordshire. I am always happy to add to my records of inn signs, and for long I have toyed with the idea of writing a book on this fascinating subject. The literature on inns and signs is pretty voluminous already, but possibly there is room for a further appreciation of inns, which have played such a vital and valiant part in our long history.

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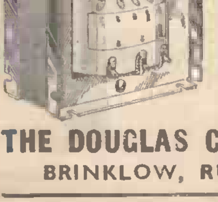

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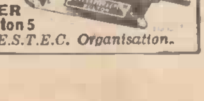

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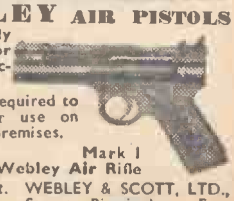

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