'42 Back

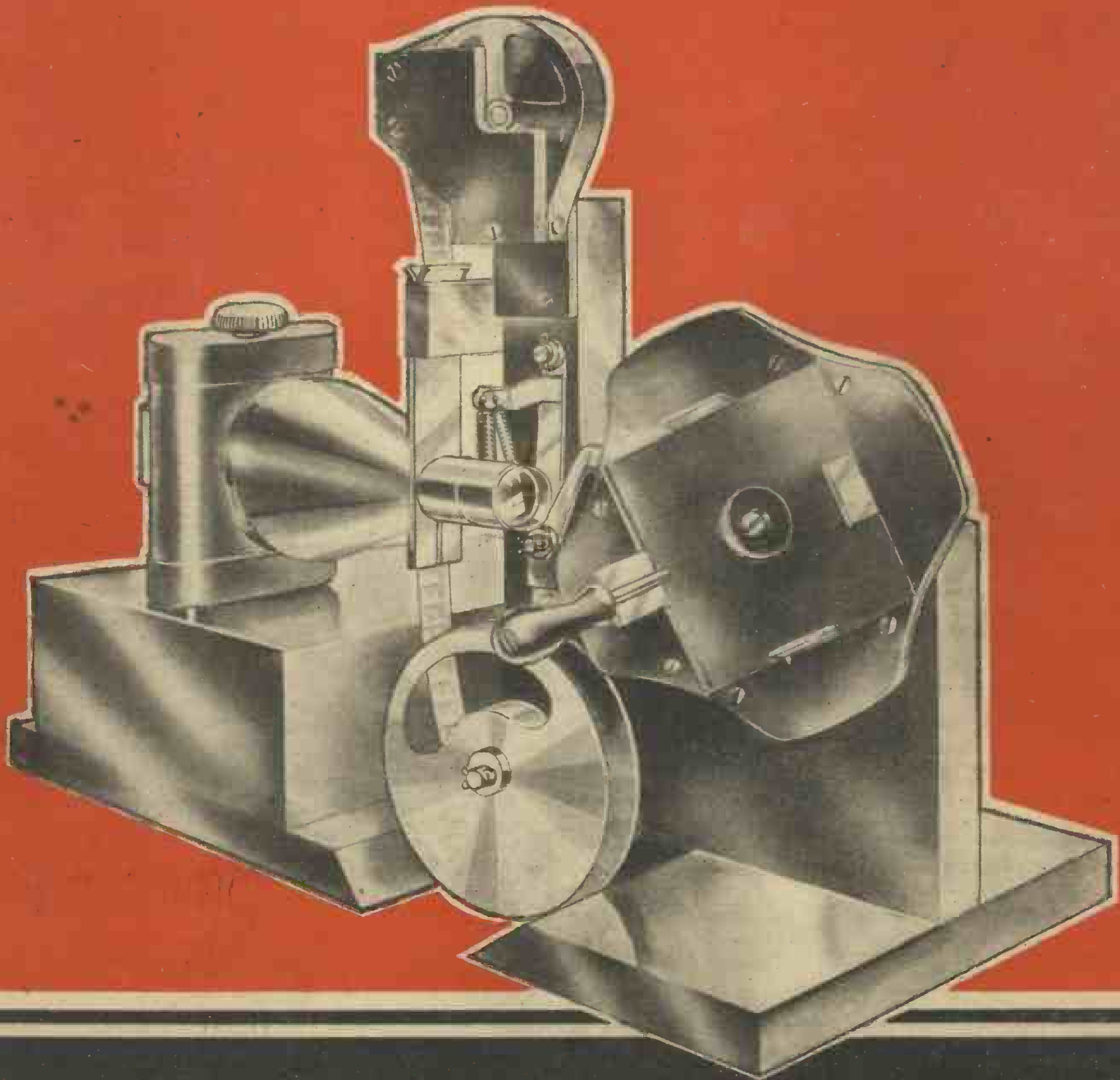
A 9·5 MM. CINE PROJECTOR

NEWNES

PRACTICAL MECHANICS

9D.

NOVEMBER 1943




DRILLING
Wolf
Electric Tools
WOLF
S. WOLF & CO. LTD., PIONEER WORKS, HANGER LANE LONDON, W.5, PERivale 5631-3

807

SUBSCRIPTION RATES
(including postage)

Inland - - - 10s. 6d. per annum.
Abroad - - - 10s. per annum.
Canada - - - 10s. per annum.

Editorial and Advertisement Office: "Practical Mechanics," George Newnes, Ltd. Tower House, Southampton Street, Strand, W.C.2
'Phone: Temple Bar 4363
Telegrams: Newnes, Rand, London.
Registered at the G.P.O. for transmission by Canadian Magazine Post.

PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. XI. NOVEMBER, 1943 No. 122

FAIR COMMENT—BY THE EDITOR

The Post-war Car

MR. P. J. NOEL BAKER, M.P., Parliamentary Secretary to the Minister of War Transport, in a most interesting speech delivered to members of the Roadfarers' Club last month, made some interesting comments on our post-war road policy, and the possible development of the motor-car. He said that we should be confronted with two new aspects of the problem, and the second was a resultant of the first. The first is that the war always brings technical developments, which, whilst primarily directed to winning the war, have a profound influence on instruments of peace. The last war developed radio-telephony to a point where it could be used for public entertainment. This war has developed television, and, no doubt, when the war is over, the sightless broadcast, as we know it to-day, will be as moribund as the silent films. Most of our broadcasts will be accompanied by vision, and this will mean the entire and extensive revision of broadcasting technique.

The war has also developed new processes and new metals and materials. We have learned through stern necessity to use old materials in a new way, so that we use less of them more efficiently. We have learned economy. We have learned how to produce things quickly and more cheaply. We have learned to produce synthetically such things as diamonds and sapphires. Plastics will be used in future years where wood and metal formerly held the entire field. Houses will be built in factories to precision methods, and will abolish the antiquated methods still adopted by the building trade. Welding has come into its own.

Scientific Development

NOW, all of these processes will have an effect upon roads, which, after all, are the national arteries of our life. The war has removed the brand of Cain from many industries, a brand which, in many cases, was firmly impressed by strong Government hands. Scientific development is always half a century ahead of legislation. Progress in science is always regarded by the State as regression, and something which should be suppressed. The motor-car was a good example; when it was first introduced it could not be used on the roads at a speed greater than 5 m.p.h., and it had to be preceded by a man waving a red flag! It was not encouraged by the State, and so the road policy of the day did not envisage the year 1939, when new motor-cars, capable of speeds up to 80 m.p.h., would be coming on to the roads at the rate of 400 a week. Our road policy was designed with no eyes to the future, but in the belief that horse-drawn traffic should continue in perpetuity. The only contribution the Government made to this new development was oppressive legislation in an endeavour to make our obsolete road policy work. Thus the development of the car did not encourage manufacturers or financiers to enter this new field, which was being developed abroad with a lively eye as to its use in possible wars. So this process of repression continued until, at the end of 1939, there were no less than 2,000 technical offences surrounding the use of a motor-car.

Post-war Cars

IT is very certain that, as a result of war-time development, especially in the metallurgical field, our post-war cars will be very different from those we knew in 1939. When the war is over it will take some time before materials are in free supply. Taxation will remain high, and measures of economy introduced during the war will need to be continued in a modified form. The post-war car will therefore be of low horse-power, and of low petrol consumption. After the last war cars of six and seven horse-power made their appearance to meet the need for economy. The post-war car will probably be of even lower horse-power. There will be one-piece plastic bodies, all-round vision through perspex windows, and high octane fuel, tank suspension, and super-charged engines. These improvements will provide fast, smooth and sound-proof cars at very low cost; but will not come immediately, for it will take some little time for motor-car manufacturers to change over from war production to a peacetime programme. We do know, however, that designers are at present considering four-wheeled drive, four-wheeled steering, engines over the back-axle (this, of course, is not a new idea, but it has never become popular), five-horse-power engines, super-charged engines capable of high cruising speed, and featherweight wooden bodies, grouted with plastics to eliminate body creaks. There will be central heating, air conditioning, fog piercing lamps, and built-in radio.

Four wheeled steering will, of course, provide easy manœuvrability in confined spaces such as garages and parking places. It will enable a car to move crabwise to and from the kerb without the usual see-sawing action, as with front-wheel steering. Sliding doors will be provided, and thus end a fruitful cause of accidents to cyclists. The engines will be designed for 100 octane fuel, giving at least 50 miles to the gallon. There may be aluminium bodies as well as plastic, and the tyres will certainly be of synthetic butane rubber, which has characteristics in many ways superior to natural rubber. Built-in jacks, devices for easy removal of the tiny engine, automatic gear changing, oil cleaners, and improved instrument panels, providing visual evidence of the functioning of the engine, are additional possibilities. No doubt, the post-war bicycle will also incorporate improvements which are long overdue, such as built-in gears, a method of making the machine thief-proof, and of making the accessories, such as lamps and pumps, thief-proof, a really efficient built-in stand, and a reliable means of dismantling the machine so that it may be packed into a small space. A really efficient dynamo, of the D.C. type, for charging a small stand-by accumulator, is needed and long overdue, as well as some means of damping out road shocks at other points than the saddle.

Concessions and Co-operation

WITH these improvements must come a change in road policy, and all sections of road users will have to make concessions. The eternal war between pedestrians, motorists, and cyclists must go. The speed-limit must be abolished; there must be a greater number of parking-places, and large numbers of the technical offences must be abolished. On a long-term policy horse-drawn traffic must be gradually withdrawn from the roads. Traffic lights must be removed from all crossings, except at major crossings. Traffic must be kept free-flowing, and the dams which keep traffic bunched together and reduce average speed, must go. We must have a standard road surface of a whitish colour and there must be improvements in road lighting so that cars do not need powerful headlamps. We must not permit the jerry-builder to hamper road policy by cutting spur roads into newly developed main roads. Speedy travel is essential. No doubt, commercial flying will compete with rail travel, for the war has brought into existence a large number of aerodromes which will link the country. The prospect is good, but, to bring it about will need the co-operation of all.

Building a Home Cine Projector

This Article is Reprinted from an Issue Now Out of Print, at the Request of Many Readers.

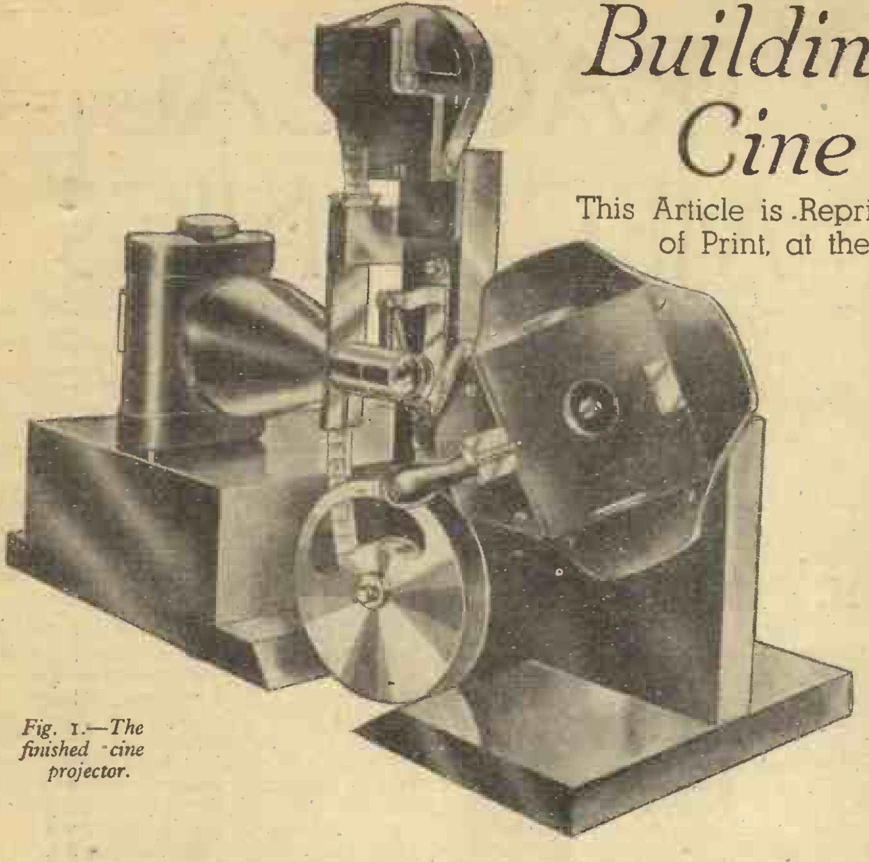


Fig. 1.—The finished cine projector.

A FEATURE of the projector shown in Fig. 1 is that it can be made without a lathe and without the use of toothed wheels; also, the mechanism has been specially worked out so that the accurate positioning of the film does not depend upon the accuracy of machined parts. Any person can therefore undertake the construction of this projector if he is handy with a drill, file, and soldering iron, and is blessed with a moderate degree of patience.

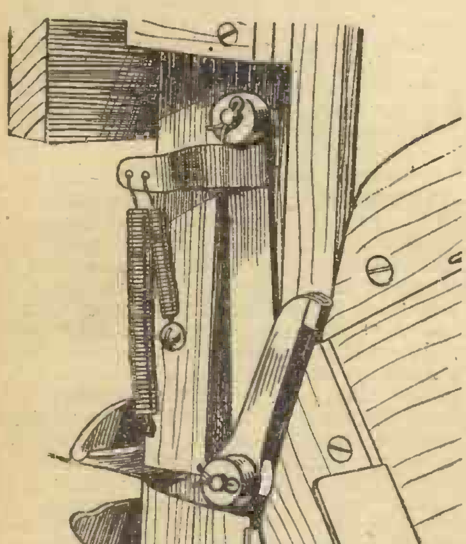


Fig. 4.—The mechanism which gives the necessary intermittent motion to the film.

The machine takes Pathe Baby Films, as these are reasonable in price, there is a good selection to choose from, and, also, they are non-inflammable.

It is advisable to study the photographic illustrations to get a clear idea of the working of the instrument before commencing construction. Fig. 1 is a comprehensive photograph, showing the general arrangement of the parts.

How to Operate

The metal case containing the film (every film is supplied in such a case) can be seen at the top of the picture resting in a wooden cradle and held in position by a rubber band. The film passes along a brass guide through the "gate" (i.e., the hole through which the light shines), and out on to the take-up reel, which is conspicuous at the bottom of the picture. On the right of the picture is a wooden disc—turned by a handle—which carries four brass cams screwed on to its face. These cams operate the mechanism which moves the film; each cam causes a picture to move out of the gate and a new picture to enter. Now the pictures have to be changed at the rate of twelve a second, so it will be seen that it is necessary to turn the handle at three revolutions per second to operate the machine properly. This is quite a convenient speed. While the picture is moving across the gate, the light is cut off by one of four flat pieces of metal which project from the face of the camwheel, and act as shutters. These shutters uncover the lens immediately the picture comes to rest in the gate, and allow the image to be projected on to the sheet for its allotted period of a little less than one-twelfth of a second, when the next change becomes due.

The Mechanism for Imparting Intermittent Motion to the Film

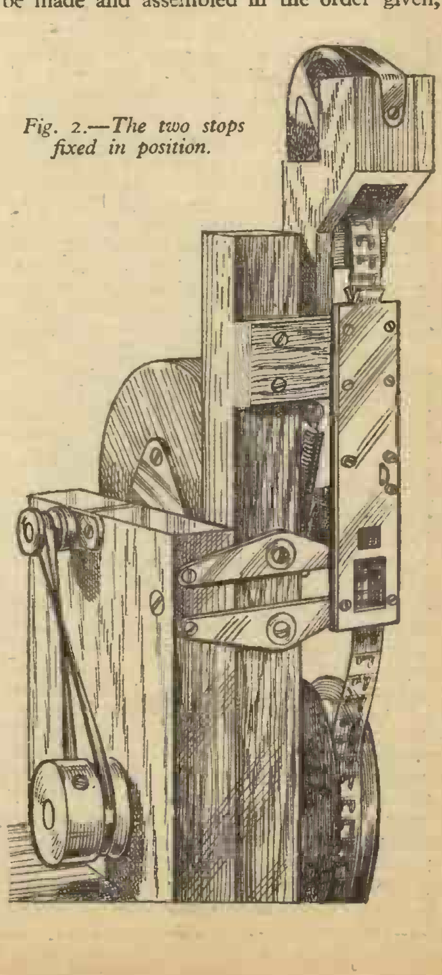
The mechanism which gives the necessary intermittent motion to the film is shown in Fig. 4, which is a "close-up" view, with the lens and gate removed to show the details more clearly than in a photograph.

Two "followers" will be seen in the path of the cam, which is assumed to be moving upward. The lower follower, pivoted near the top of the illustration, is just coming into engagement with the cam, which moves it about $^1/_{10}$in. towards the left; on this follower is pivoted a "bell-crank" lever, which is, of course, also moved bodily to the left, causing the tongue of metal on the extreme left to be pushed through one of the perforations of the film (not shown in the sketch). The cam, as it moves upwards, then comes into contact with the second follower—which has a movement of about $\frac{1}{4}$in.—and, pushing this to the left, moves the film downward through the medium of the bell-crank lever. The movement of the tongue is limited by two adjustable stops, and when the cam has passed, the tongue is withdrawn from the film, and the moving parts brought back to position ready for the next cam by spiral springs in tension.

Details of the Construction of the Machine

In describing the construction of the machine, only essential dimensions will be given, as it is intended that the parts should be made and assembled in the order given,

Fig. 2.—The two stops fixed in position.



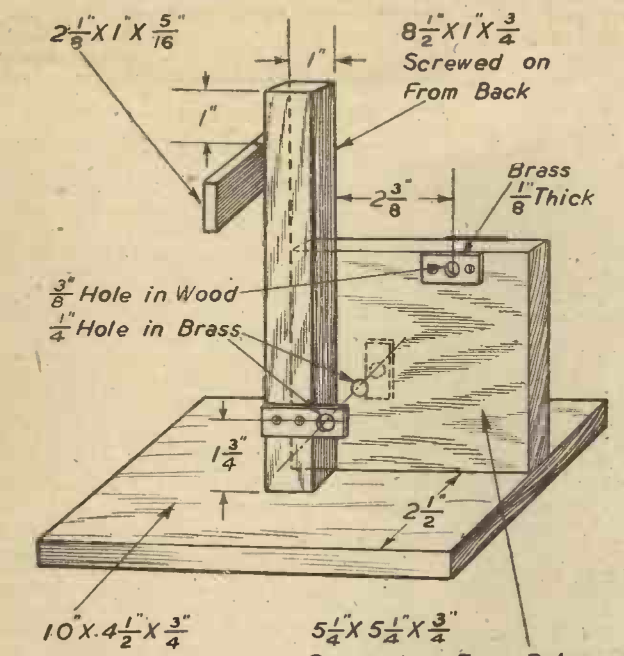


Fig. 3.—The framework of the machine.

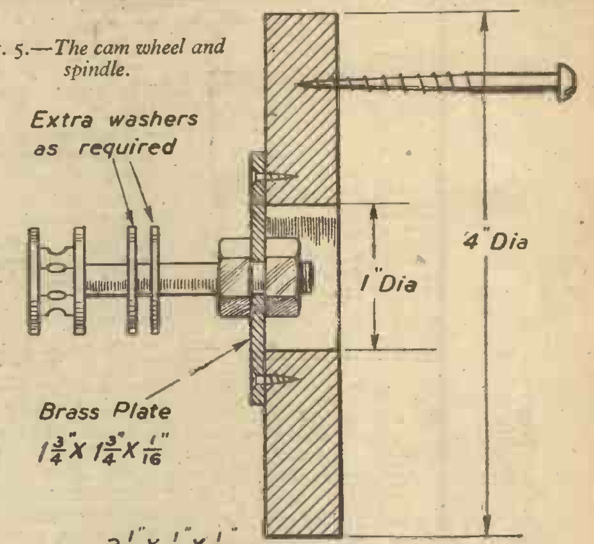


Fig. 5.—The cam wheel and spindle.

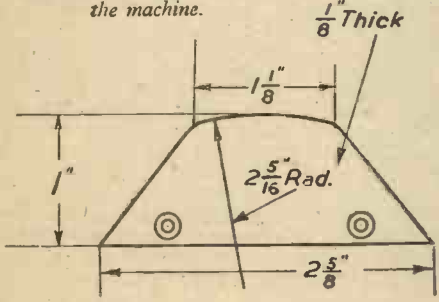
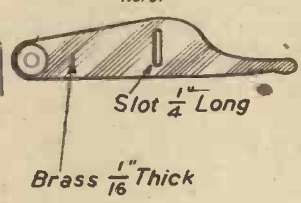


Fig. 8.—(Left) Details of the cam.

Fig. 7.—(Below) The up-and-down movement of the small tongue is limited by two stops, one of which is shown here.



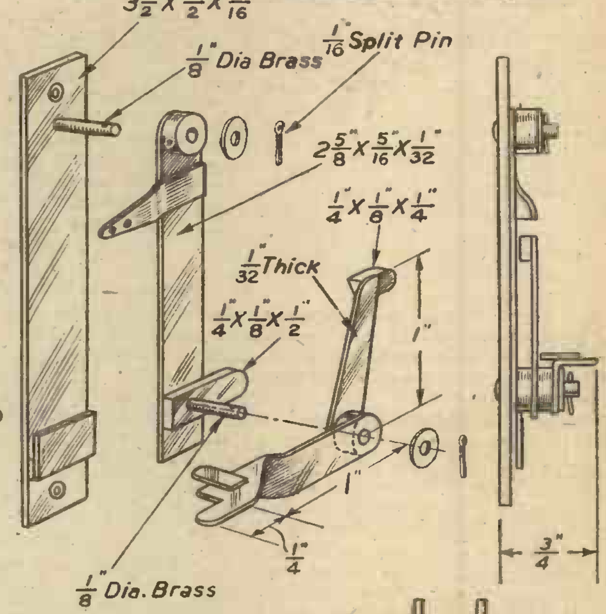


Fig. 6.—Component parts for making the film moving mechanism.

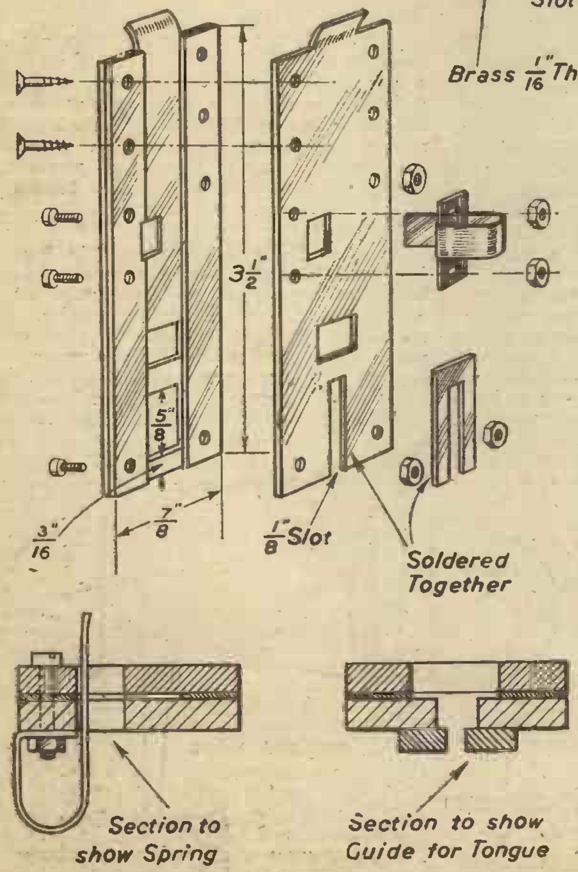


Fig. 9.—Details of the parts for making the film guide.

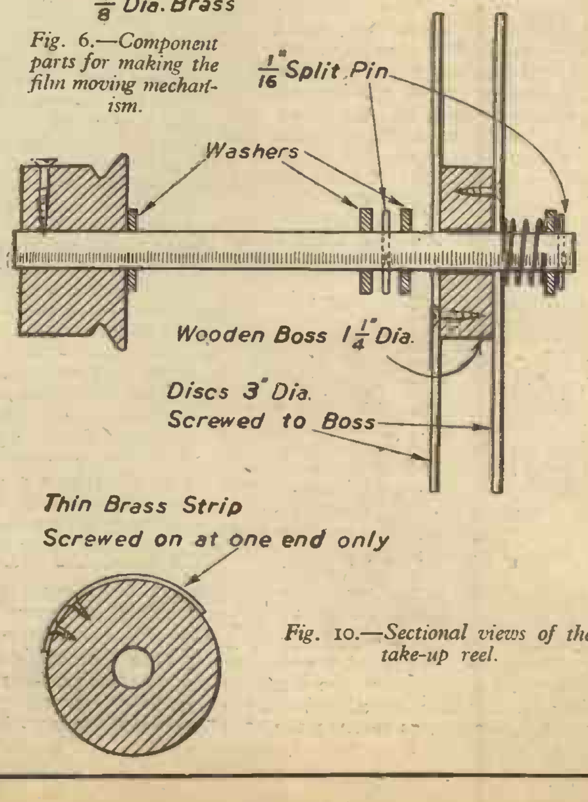


Fig. 10.—Sectional views of the take-up reel.

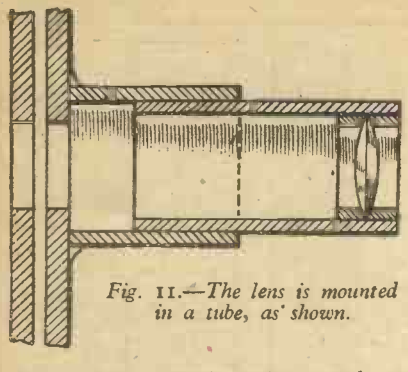


Fig. 11.—The lens is mounted in a tube, as shown.

each part being fitted to those made previously.

Commence by making the framework shown in Fig. 3 This does not require much description, but all the pieces of wood should be planed and fitted truly square or complications might arise during erection. Fig. 1 shows the baseboard cut away to clear the take-up reel, but this will not be necessary if the dimensions on Fig. 4 are followed.

The Cam-wheel and Spindle

These should be made next (see Fig. 5). The wood disc can be cut out with a fretsaw; the spindle is a $1\frac{3}{4}$in. by $\frac{1}{4}$in. B.S.F. bolt. A Whitworth bolt would do, though the finer thread is preferable. A washer is soldered on each side of the head to form a small grooved pulley for the take-up drive. Mount the wheel and spindle in its bearings, and fix a long screw into the face of the disc as a temporary handle. If the wood disc does not run true, the brass back plate can be taken off and refixed, and the face of the disc can be trued up by packing the wood away from the back plate as required. The face of the disc should stand out about 1/16in. beyond the tall upright of the frame.

The Film-moving Mechanism

This is shown complete in Fig. 2. All the separated parts are shown in Fig. 6, together with a side view of the complete assembly. The dimension marked $\frac{3}{4}$in. from the centre of the tongue to the back of the base plate is important, and should be adhered to. The protruding end of the tongue should be well rounded off to facilitate its entry into the film perforations, but its thickness should be as great as possible consistent with the free movement into and out of the film. The angle between the tongue and the point of contact with the cam on the other arm should be 120 degs., measured about the pivot, of course. This piece of mechanism is all built up from pieces of brass soldered together, and is quite an interesting part to make. It should, of course, work quite freely, and must be entirely without any tendency to sticking. When complete it should be screwed on to the tall member of the frame with the edge flush with the wood, as in Fig. 4, the vertical position being such as to bring the two cam followers equally above and below the horizontal centre line of the cam-wheel. After fixing this part, screw a small flat piece of thin brass on the other face of the upright member to act as a stop for the member carrying the lower cam follower; the end of this stop can just be seen in Fig. 4. It engages the lower end of the vertical pivoted member, where it works in the guide and prevents the member from coming out of the end of the guide.

The Two Stops

The up-and-down movement of the little tongue is limited by two stops, as shown in Fig. 7. These are simply flat pieces of brass, about 18 gauge, and are fixed as shown in Fig. 2. The slotted holes allow for adjustment, the screws through the slots being round-headed and fitted with washers. The two stops should be fixed in a position to allow the tongue a movement of about $\frac{1}{8}$in. above and below the horizontal (about $\frac{1}{4}$in. in all) when the screws are in the centres of their slots. The exact adjustment must be left till later.

The two spiral springs may now be fitted; the longer cam operating the bell-crank should be of a "light and lively" type, having a pull of between one and two ounces when fitted. The other springs must be definitely stiffer and stronger, so as to ensure the tongue being withdrawn from the film before its upward movement begins.

Now make four cams, as shown in Fig. 8. Fix one of these on to the face of the cam-wheel as in Fig. 4, so that the cam projects 5/16in. Turn the cam-wheel slowly and see that the lower follower is moved about 1/10in. by the cam; if the movement exceeds this amount appreciably, it should be reduced by filing down the follower a little, if less than 1/10in., shift the cam out to give the required movement. Next turn the wheel until the upper follower is fully lifted, and, leaving the wheel in this position, adjust the lower stop (Fig. 7) until it presses quite firmly against the under side of its lever, but leave the adjustment of the upper stop till later. The other three cams may then be screwed in place, taking care that they all give the correct movement to the lower follower. If everything has been done properly the tongue should move up and down too rapidly to be seen when the wheel is turned smartly by its temporary handle.

The Film Guides

Before starting to make the film guide shown in Fig. 9, the reader is strongly advised to buy a film and make sure that the parts fit the film as he proceeds. Short lengths of film can be obtained new or second-hand from dealers who specialise in film exchanges. A second-hand one should do for the purpose of fitting up, as it will probably become scratched or torn before the instrument is finished. The construction of this part should be quite clear from Fig. 9. The copper foil should be slightly thicker than the film, and the width between the two strips of foil should be very little greater than the width of the film, only just enough to allow the film to slide freely. The little bolts, 10 B.A. by $\frac{1}{4}$in., can be obtained from a model engineer's supply store. The little spring shown larger in the sectional view is to keep the film over to one side of the guide, and to steady the film by introducing a little friction; the blade that rubs on the film should be rounded off to prevent scraping, and slotted holes for the bolts allow the spring to be moved to increase or reduce the pressure on the film. The blade of the spring should project far enough to be pushed aside by your finger when the film is being threaded down the guide. The slotted piece of brass at the bottom is a guide for the tongue, which moves the film; it should fit the tongue closely, but not too tightly, and should be carefully centred before being soldered on.

The hole forming the gate should be left uncut for the present. Screw the film guide on to its wooden support (see Fig. 2) in such a position that the tongue works freely in its slot within the limits of the large holes opposite. Then adjust the top stop (Fig. 7) so that the tongue has exactly the required movement to bring it directly opposite to a perforation in the film. It should withdraw from one hole when at the bottom stop and come directly opposite the next hole when at the top. The position for the gate should then be marked out, so that when the tongue is in a perforation at the top of its movement, there is one picture between the tongue and the bottom of the gate.

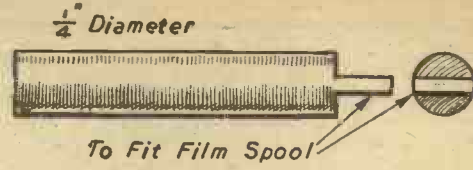


Fig. 12.—The key for rewinding the film.

The Lens

This should now be fitted. An ordinary magnifying glass of about $1\frac{1}{2}$in. focus will give a fairly good result, though, of course, a better lens will give a sharper picture. The glass should then be mounted in a tube, as shown in Fig. 11, this tube being a sliding fit (for focusing purposes) in another tube which is soldered on to the film guide centrally over the gate.

The Shutters

They are simply thin brass $\frac{1}{2}$in. by $1\frac{1}{2}$in., bent at right angles, and clipped under the cams. Position them so that they come opposite the lens while the film is being moved, but leave the lens uncovered when the film is at a standstill. A permanent handle can then be fitted tight behind one of the shutters (Fig. 1).

The take-up reel, Fig. 10, is simple, the centre is part of a cotton reel, and the cheeks of aluminium; the hole in the outer cheek is to allow the film to be pushed into its clip by one's finger. The pulley is the remainder of the same cotton reel fixed by a radial wood screw, and a rubber band serves for a driving belt. The take-up reel is loose on the spindle, and driven only by the pressure of the very light spiral spring, so that it can slip readily without putting appreciable tension on the film.

The Film Cradle

The cradle for carrying the film can be made of three-ply wood, as shown in Figs. 1 and 2. No spindle is required, as this is embodied in the metal case. For rewinding the film after a show, a key like Fig. 12 should be made. It can be "twirled" between the fingers, this being a quicker method of rewinding than a tiny handle.

The Lamp

A lamp of the type illustrated in Fig. 1, but provided with a "bull's eye" condenser, will give a good picture about 12in. wide. A condenser is an absolute necessity, and should be arranged to make the light converge right into the lens, as illustrated in Fig. 13. The more powerful the light, the larger the picture. A motor-car headlight could be arranged to give excellent results.

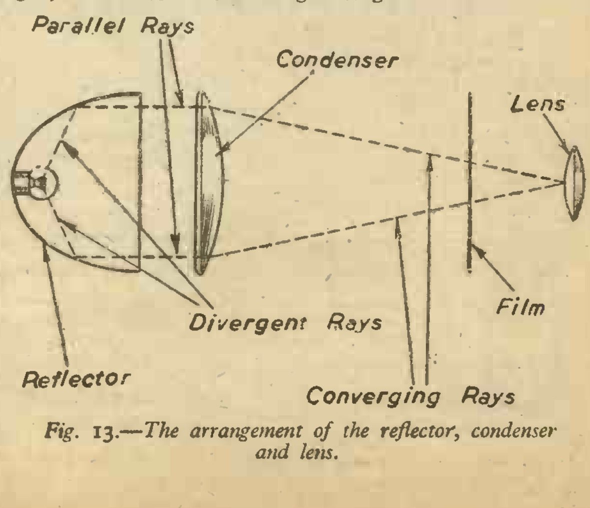


Fig. 13.—The arrangement of the reflector, condenser and lens.

The Camera Obscura

Its Operation and Uses, and Details of the Camera Lucida

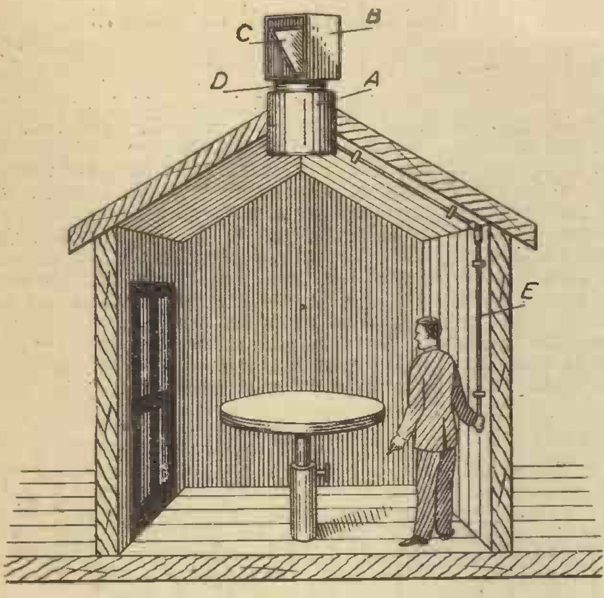


Fig. 1.—The interior of a camera obscura.

ACCORDING to one or two authorities, this interesting and useful contrivance was invented as long ago as 1589, by Baptista Porta.

A century ago, the camera obscura appears to have been a popular form of entertainment, the apparatus being erected in various parts of the country on suitably elevated spots in the grounds of well-to-do individuals. In later years the instrument was chiefly used for purposes of amusement at seaside resorts, and other places.

The accompanying illustration, Fig. 1, shows what the interior of a camera obscura looks like. A darkened room is used for the purpose, no windows being provided, because when the apparatus is shown at work the only light that should be allowed to enter the room is that which passes through the lens seen in Fig. 2. This lens, which is a double convex one, of about 6 or 8ft. focus, and 5in. in diameter, is mounted in a round cell, A, fixed in the roof of the chamber or room.

Adjustable Mirror

Immediately above the lens cell is arranged a square box, B, with the bottom and one side open, in which is placed a mirror, C, mounted on a pivot bearing at each side, so that it can be turned at different angles. The box B, usually about 6in. to 8in. square, has a circular projecting part, D, fitted to the bottom to allow it to turn round within the upper part of the cell A. By an arrangement of rods, E, which are connected to the bottom of the circular part, D, by means of suitable gearing, the operator in the room can turn the box, B, so that the mirror can face in any direction.

On the floor of the room, directly below the lens, is arranged a table with a circular top, about 3ft. in diameter, the centre leg of which is made telescopic, so that the height can be carefully adjusted to suit the focus of the lens. The top of the table is smooth and white, and in order to correct the indistinct images formed near the edges owing to the spherical aberration of the lens, it is usual to make the surface of the table top slightly concave

Operation

The action of the apparatus is as follows: Rays of light from distant objects facing the mirror are reflected downwards, as depicted in Fig. 2, through the lens, which projects the rays on to the surface of the table. Images of the objects reflected are thus formed in their natural colours on the white surface of the table top, and the effect is much the same as if one were looking at the focusing screen of a large camera, the screen in this case being circular instead of rectangular. By means of the rod E, the operator can turn the box B completely round, as before mentioned, so that objects in the near vicinity, in any direction, may be viewed according to which way the mirror faces. The mirror, being arranged on a pivot, can be turned at different angles from the horizontal for reflecting objects at varying distances from it. The greater the angle, the farther off will be the objects reflected.

Another use to which the camera obscura is sometimes put is for sketching purposes out-of-doors. A form of tent of opaque material is erected, in the top of which the lens fitting is mounted, and below this is arranged a small table carrying a sheet of white paper. The artist has simply to turn the mirror to reflect the required object on to the paper and then trace the image with a pencil.

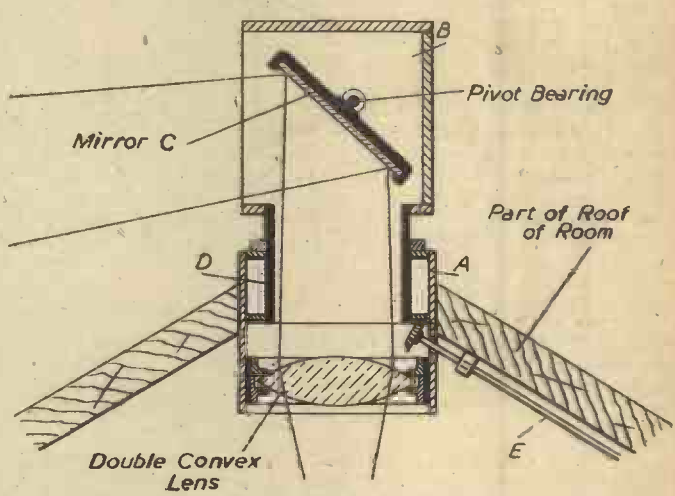


Fig. 2.—Section through the lens and reflecting mirror.

The Periscope

It is interesting to note that the modern development of the camera obscura is found in the periscope used in the trenches, and in the submarine. The same principle is also used in the ordinary camera. When viewing the subject to be photographed on the ground glass screen of a camera, the instrument virtually becomes a miniature camera obscura. The same principle is applied when using the small view-finder attached to a pocket camera.

Camera Lucida

Another instrument sometimes used to facilitate the sketching of objects from nature is known as the camera lucida. It relies for its action on the property of total reflection of a particular form of prism, a section of which is given in Fig. 3. A common form of instrument, introduced by Dr. W. H. Wollaston, in 1807, is also shown in the sketch.

The prism used has four angles, one of which is 90 degrees, the opposite one 135 degrees, and the other two each 67 degrees 30 seconds. One of the two faces which contain the right angle is turned towards the objects to be sketched. Rays of light falling normally on this face, as from A, are totally reflected at B to the next face at C, whence they are again totally reflected to emerge normally at right angles to the fourth face, as indicated in Fig. 3. If an eye is placed above the corner of the prism so as to receive the reflected rays, the observer will see the reflected image projected on a sheet of paper arranged below the prism for this purpose. The image can then be traced with pen or pencil.

For convenience of drawing the paper is usually fixed at a distance of about 1ft. from the prism, a small concave lens, having a focal length slightly less than 1ft., is fixed above the corner of the prism when drawing distant objects. By raising or lowering the prism on its stand (Fig. 3), the image to be sketched can be focused clearly on to the surface of the paper.

The prism is mounted so that it can be adjusted vertically or rotated in a horizontal direction, and the prism is usually covered with a movable blackened metal casing, having a suitable aperture near one end for the observer to look through.

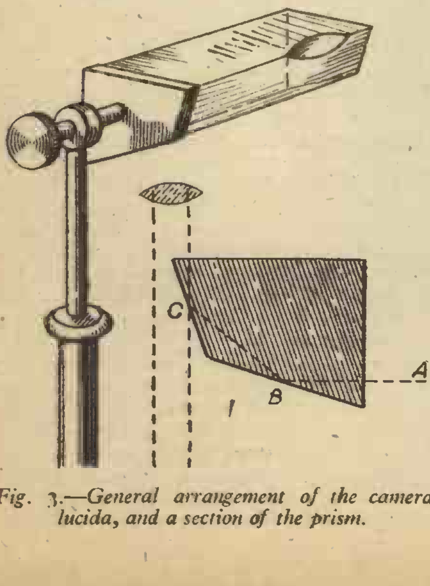


Fig. 3.—General arrangement of the camera lucida, and a section of the prism.

Making a Phono-fiddle

Constructional Details of a Novel but Efficient Musical Instrument

By A. L.

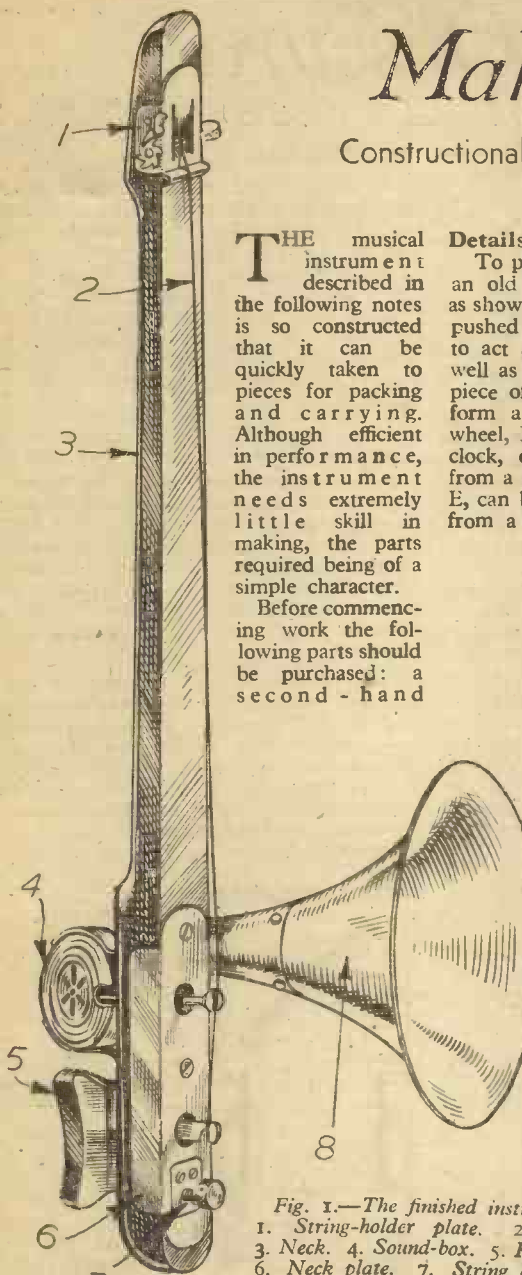


Fig. 1.—The finished instrument. 1. *String-holder plate.* 2. *String.* 3. *Neck.* 4. *Sound-box.* 5. *Knee-grip.* 6. *Neck plate.* 7. *String adjusting-screw.* 8. *Horn.*

THE musical instrument described in the following notes is so constructed that it can be quickly taken to pieces for packing and carrying. Although efficient in performance, the instrument needs extremely little skill in making, the parts required being of a simple character.

Before commencing work the following parts should be purchased: a second-hand gramophone sound-box; an old wireless loudspeaker horn of the type illustrated; and one banjo steel spring. Two pieces of wood will also be required, one measuring 10in. by 5in. by ¼in., and the other 30in. by 1¼in. by 1¼in. A few additional odds and ends will be required as the work progresses.

Details of Construction

To proceed with the construction, procure an old tin can, and cut, slot and bend it, as shown at A-B, Fig. 2. The slotted part is pushed in the hole at the top of the neck, to act as a sliding guide for the string, as well as to enhance the appearance. A short piece of spring wire is soldered on at C to form a ratchet spring. A small ratchet wheel, D, can be taken out of an old alarm clock, or a suitable one can be filed up from a brass blank. The ratchet-wheel catch, E, can be cut, drilled, and shaped as shown, from a piece of 1/16in. thick metal. The string rod F is a short piece of 3/16in. diameter mild steel rod, drilled in the centre, as shown. The end of the rod is threaded to take a small wing nut, G.

The Neck

In Fig. 3, two views of the neck are given, showing some of the assembled parts. Any kind of wood may be used, either hard or soft, and before drilling or slotting any holes, it is as well to make the small fittings first, as it will then be easier to mark out the exact positions for them.

Take the part B (Fig. 2) and drill the sides to take the string rod, F. It is preferred to have both ends of this rod threaded so that the ratchet-wheel can be tapped to screw on one end.

The 18in. part of the neck is shaped to a D-section (see Fig. 3) for easy sliding of the hand. The rounded part is the back of the neck. The slot C goes right through the neck, and this also applies to all the other holes and slots, which are governed by the fitting shown in Fig. 4.

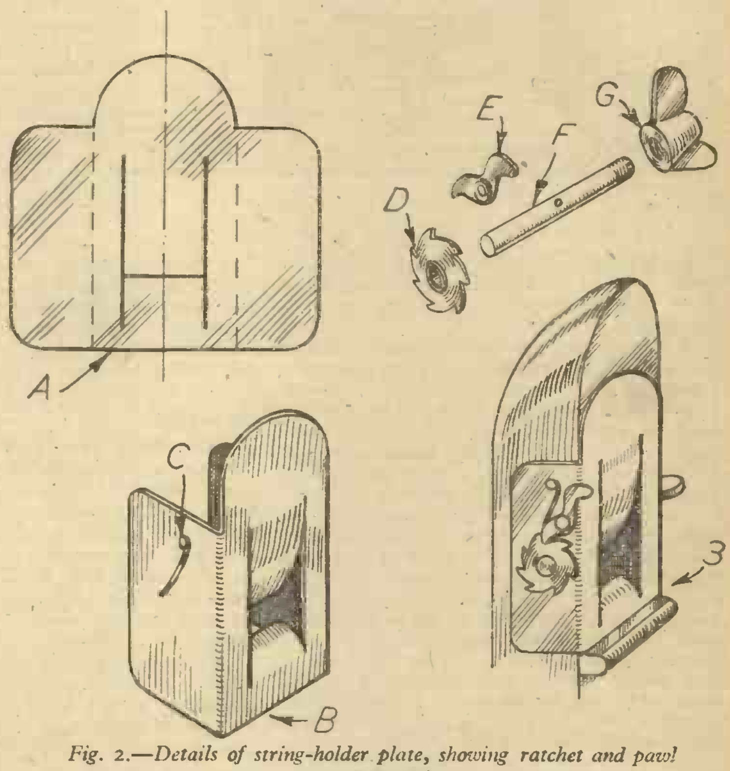


Fig. 2.—Details of string-holder plate, showing ratchet and pawl arrangement.

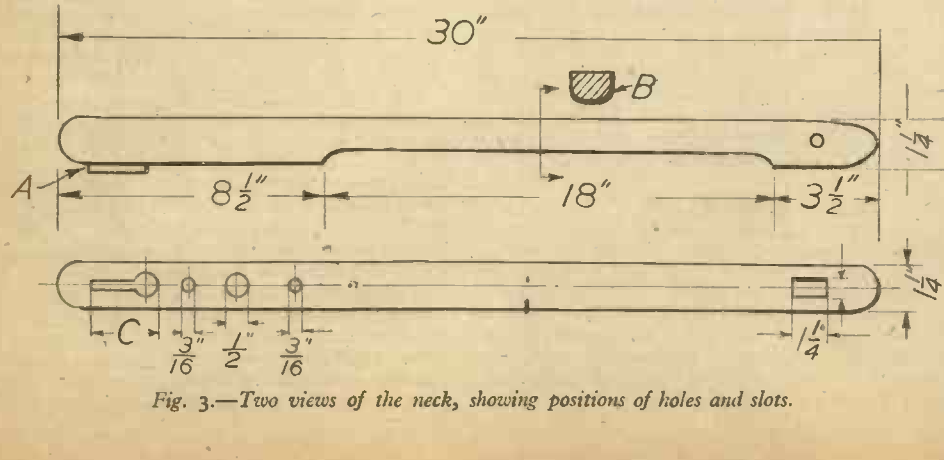


Fig. 3.—Two views of the neck, showing positions of holes and slots.

Fitting the Sound-box

Details of the sound-box and fittings are given in Fig. 5. Two pieces of 1/16in. strip metal are cut, bent and drilled, as shown, and are soldered to the rim of the sound-box. Two 3/16in. bolts with wing nuts are provided for the quick removal of the sound-box, when necessary. The string reed C consists of an ordinary nail, filed down at one end to fit in the needle holder. With a hacksaw a slot is made in the head of the nail for the string to rest in.

A second-hand gramophone sound-box can be purchased for about one shilling, the short neck on the back taking the horn. Make sure that the holes in the ends of the strips B are not drilled too close to the bends in the metal, otherwise you will not be able to turn the wing nuts. Make two or three nail reeds

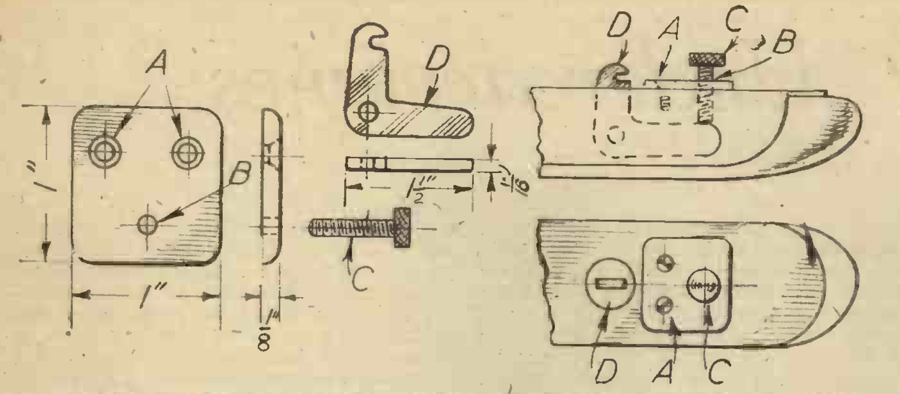


Fig. 4.—Details of string-adjusting fittings, and how they are assembled on the end of the neck.

in various lengths from 2in. downwards. The longer the reed the louder the sound.

Neck Plate

Another tin can will supply sufficient metal to form the plate A (Fig. 6). Do not drill the holes until the fittings shown in Figs. 4 and 5 are made. The two holes B are countersunk, after marking their exact positions, by using a large round-headed bolt and hammer, as shown in the illustration. Slowly turn the bolt whilst striking until the required countersinking is obtained. The plate can be nailed to the sides of the neck after drilling. It is important that the reed is arranged so that there is a clearance all round it in the hole in the metal plate through which it passes.

Fine Adjustment

The fine adjustment string holder is shown in Fig. 4. The small square plate has two countersunk holes for screwing the fitting to the top of the neck (see also Fig. 1). There is another hole, B, which is tapped to take a 3/16in. screw, C. The part D is cut and filed to shape from a piece of metal 1/16in. thick. A nail is driven through the neck from side to side and passes through the hole in part D so that the position of the latter can be moved at will by the screw C.

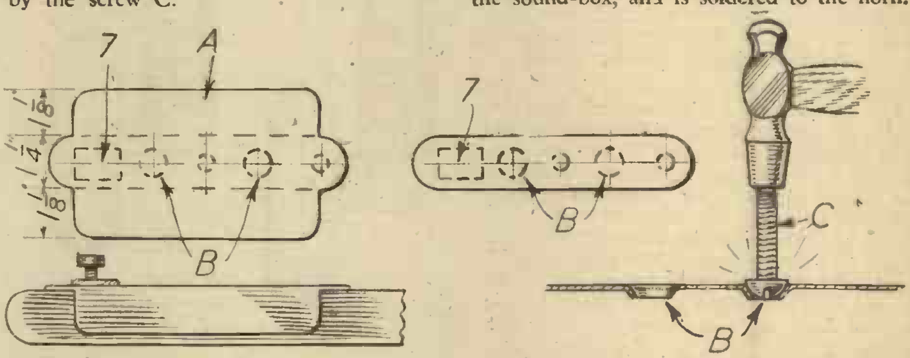


Fig. 6.—Details of plate shown in Fig. 4, showing how indentations are made.

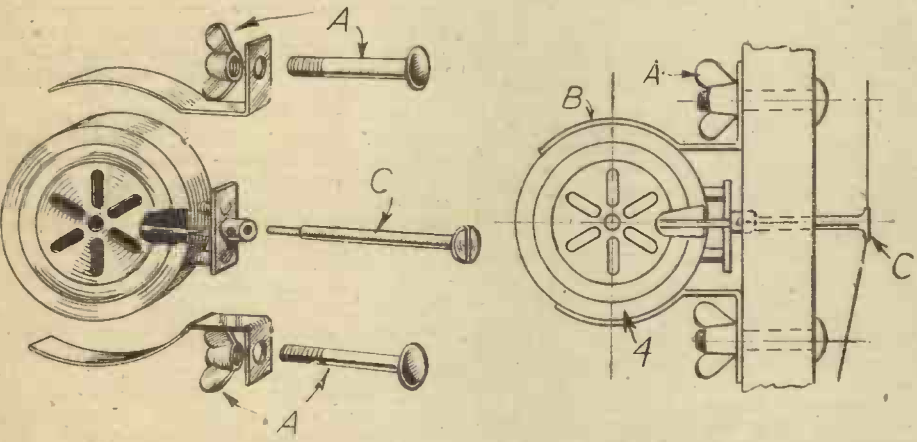


Fig. 5.—The component parts of the sound-box end fittings, and how they are fixed in position on the neck of the instrument.

The action is simple. The string is roughly adjusted by the ratchet at the top of the neck, and then the exact note is struck by turning the head of the screw C, one way or the other. This action pulls or slackens the string extremely slowly, and gives instant response.

Knee-grips

Details of the knee-grips are given in Fig. 7 (see also Fig. 1). The small plate B is screwed to the front of the grip by countersunk holes C. The holes D are drilled to clear the threads of bolts E, which attach the grip to the back of the neck. Assuming that 1/4in. thumbscrews are used for the fixing bolts E, the holes in the plate A (Fig. 3) will be tapped to suit.

The shape of the knee-grips can be varied to suit individual taste, but the shape illustrated will be found to suit most persons' requirements.

The Amplifying Horn

In the illustration, Fig. 8, details of the amplifying horn are given. The part A consists of an old gramophone elbow off a tone arm. This fits on the short neck of the sound-box, and is soldered to the horn. The soldered joint is at B. An old-time wireless or gramophone horn will be required, and this may be in two sections. If not, it can be cut in two pieces with a hacksaw, and the smaller part placed in the larger end and pulled down. When a tight fit is obtained both sections are drilled through at three points, and then fixed with small bolts and nuts, C.

A phono-fiddle does not need frets on the finger board, as very little practice will soon give the position of the notes. However, if the constructor thinks it necessary, the simplest way to do this is to press the string down, pluck it, and mark the position with a pencil. Continue this down the neck, and with a hacksaw blade groove the wood across and force in a piece of wire to suit.

The assembled instrument is kept upright to play, and gripped by the knee-grips, using a bow near the reed.

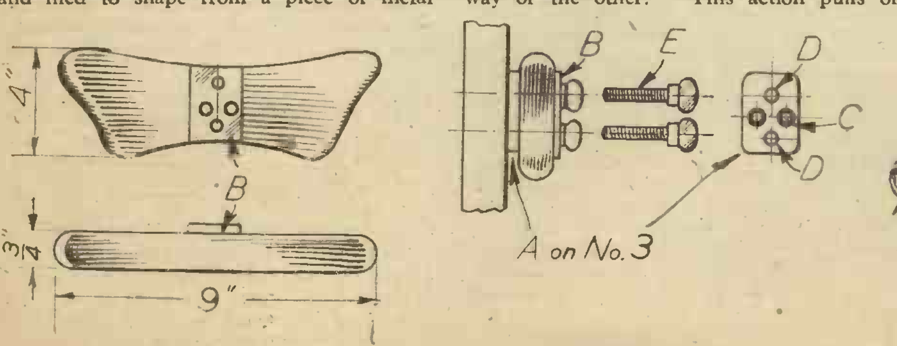


Fig. 7.—Two views of the knee-grip, and details of fixing plate and screws.

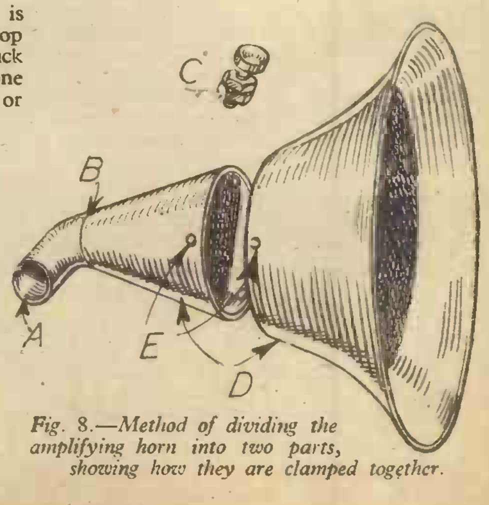


Fig. 8.—Method of dividing the amplifying horn into two parts, showing how they are clamped together.

Aircraft Undercarriages

Types and Principles

By T. E. G. BOWDEN

TO enable an aeroplane to taxi along the ground it is necessary to provide some form of structure fitted with wheels. The main requirements of this structure, or undercarriage as it is termed, are to absorb the shocks caused by landing or manœuvring on rough surfaces and to support the aircraft when it is not airborne. Vast improvements have taken place in undercarriage design, and the modern type is very efficient. The weight must be reduced to as low a figure as possible, as any excessive weight reduces the payload, i.e., the useful load which may be carried. Unfortunately, the present-day type is proportionately heavier when compared with the all-up weight than the earlier design, due to the complications introduced by retraction and higher landing speeds.

V-type

Fig. 1 illustrates the original type of undercarriage fitted to aircraft during the 1914-18 war and for several years afterwards. As will be seen, the structure consists of two main wooden V's, a steel tubular axle, and wire bracing. The V-struts are attached to the main fuselage structure by four pin joints. In some cases the round axle is fitted with a streamlined fairing to reduce the drag. The vertical load is taken by the V-struts and the side loads by the wire bracing.

In this design the method of absorbing the shocks is extremely crude. Part of the shock is taken by the tyre and the remainder by a length of shock-absorber elastic cord. This cord attaches the axle to the V-struts and allows a certain amount of movement to take place.

The disadvantages of using rubber are as follows. Firstly, it is perishable and requires replacement at frequent intervals. Secondly, it causes a tendency for the aircraft to bounce up and down instead of absorbing the shocks gently. If a heavy landing is made, i.e., if the aircraft pancakes from twenty feet, it will rebound into the air, and if the speed necessary to maintain sufficient lift is lost, a crash is inevitable. At the best, the structure is liable to be strained.

Another disadvantage of this type in which an axle is utilised is the fact that if there is any long grass on the aerodrome surface there is a possibility of the aircraft nosing over and possibly overturning on to its back.

Some of the earlier Avro types of aircraft were fitted with a strut under the fuselage projecting past the nose. The idea was to prevent nosing over. The skid was attached to the fuselage by means of V-struts and wire bracing, and the extreme forward tip was bent upwards in the form of a ski. This structure caused an increase in the drag and lowered the maximum speed by several miles per hour.

Oleo Leg

An improvement on the elastic cord method of absorbing shock is the oleo leg.

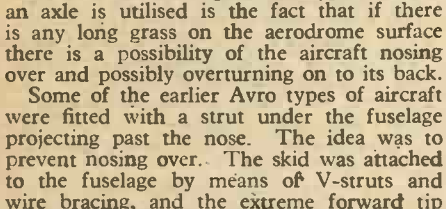


Fig. 1.—Original type of landing gear.

The principle of operation is very simple. One of the main supporting struts is divided into two portions. These portions are designed to telescope into each other when landing, and when they do so, oil is forced through a series of small holes. The shocks are thus absorbed without any tendency for a sudden return of the leg to its original position, i.e., no bouncing occurs. This

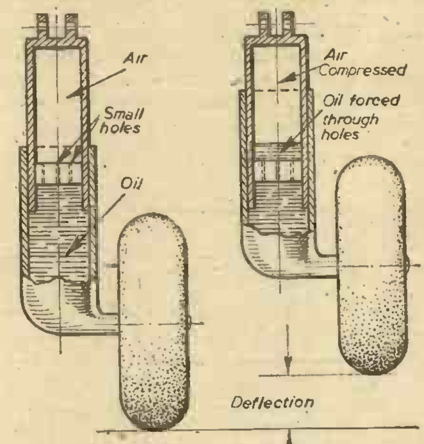


Fig. 2.—Simple oleo leg (diagrammatic).

characteristic is, unfortunately, a disadvantage, as the leg tends to remain in the contracted position until the weight of the undercarriage draws the leg downwards again. Thus, if no other means are adopted, this system is inefficient.

To overcome this disadvantage many ingenious ideas have been developed to return the leg to its original position. Compressed air is now chiefly used, rubber blocks or steel springs have also been utilised.

Fig. 2 illustrates diagrammatically a simple oleo-pneumatic leg, which, as its name implies, employs both oil and compressed air. On the compression stroke the oil is forced through several small holes. The air is gradually compressed in the top portion of the leg as the oil, being a fluid, cannot be compressed to any noticeable degree. On the return stroke the air forces the oil back through the holes, thus returning the lower portion to the extended position. The oil dissipates the energy, and thus any tendency to bounce is avoided owing to the fact that the oil being forced through the holes by the compressed air restricts the velocity, depending upon the size of the holes.

The previous paragraph describes only the basic principles of an oleo leg, and other additional devices are commonly fitted.

Usually a small springloaded valve is incorporated which allows the oil to pass through a larger orifice only on the upstroke and forcing the oil to flow through the small holes on the return stroke. This gives a satisfactory damping effect. The air in the upper portion of the chamber is compressed to several hundred pounds per square inch when the oleo is fully extended, and the required pressure is stated by the manufacturers. Valves are fitted to allow the oil to be poured in and the air to be fed in under pressure.

In order to prevent the wheel rotating, as would be liable if the two tubes were allowed to slide freely, special precautions are taken. One method is to provide a series of splines in the tubes which mate up with each other. An alternative design is to arrange exterior torsion links connecting the upper fixed tube to the lower free tube. Other means have been devised to prevent any "shimmying," which has caused a great deal of trouble in the past. Friction dampers have been found successful.

An interesting design which incorporates an oleo-pneumatic shock absorber is an aircraft wheel which does away with the need for the conventional oleo leg. The shock absorber is fitted inside the wheel profile. The method of functioning is similar to the ordinary shock-absorber, and this type is particularly useful for aeroplanes fitted with fixed undercarriages. The drag is very small, and the whole installation extremely neat.

Several oleo legs are designed so that, as the movement approaches the limit, the space through which the oil passes is gradually reduced, thus providing more resistance. This allows the landing load to be more or less gently absorbed.

Pneumatic Shock Absorber

Although air is compressible, there have been one or two legs which depended wholly upon the cushioning effect of air for their operation. The usual method is to divide the leg into several compartments. When the pressure reaches a certain figure a valve opens and allows the compressed air to enter another chamber, thus absorbing energy. To prevent rebound, the air is forced to pass through a series of small holes on the return stroke, as in the case of the oleo-pneumatic leg.

The German type of undercarriage shock-absorbers depended till fairly recently upon springs rather than oleo-pneumatic methods. A spring used in a normal manner is not satisfactory for aircraft undercarriages as their returning velocity is too great. The Germans designed their legs so that energy was absorbed by the friction of two springs passing over each other when being compressed. All the latest enemy types have abandoned this design, which has not proved very successful for modern fast-landing heavy aircraft.

For the smaller type of aircraft in which complicated oleo legs would increase the cost, undercarriage legs using a series of rubber blocks are often utilised. This design is suitable for light and medium weight aircraft only, and is not used for larger transport aircraft.

Wheel Brakes.

All modern aircraft incorporate braking systems in their landing gear. They allow the landing run to be reduced by a considerable margin. Another advantage is the ability to test the engine revolutions at full

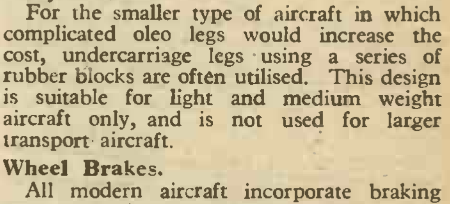


Fig. 3.—Simple retracting mechanism.

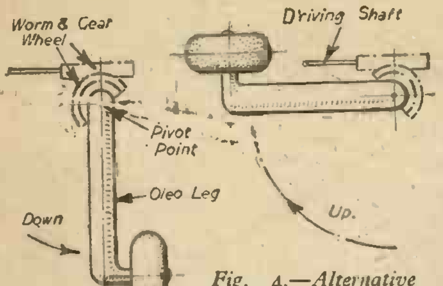


Fig. 4.—Alternative retracting mechanism.

throttle when the aircraft is at rest. By fitting differential controls, allowing one brake to be applied harder than the other, steering on the ground is made easier.

Either compressed air or hydraulic power are utilised for the operation of aircraft brakes, the design of which varies considerably. Normally they are of the internal expanding type as fitted to motor vehicles. The differential effect is obtained by operating the rudder bar in the normal manner, i.e., if a turn to the right is desired, the right foot is pushed forward, causing the right brake to come into operation. With the rudder bar central both brakes are equally applied.

Retracting Undercarriages

Despite the fact that with careful fairing and streamlining, the drag of an undercarriage could be reduced to a very low figure, the loss in speed caused by the head resistance demanded that undercarriages should be made retractable. The undercarriage does not perform any useful function when the aircraft is in flight, and is an unfortunate parasite that must be carried. By carefully retracting it and reducing the drag to a minimum, the performance of any aircraft can be improved considerably.

Fig. 3 illustrates the principle and operation of a simple retracting undercarriage. As will be seen, the wheel is mounted on to the usual oleo leg, which is hinged at the point of attachment to the wing or fuselage. Two folding links and a hydraulic jack hold the leg in position. When the leg is retracted, the jack pulls the links out of their original position, and, due to the geometry, the leg is pulled backwards and upwards into its housing.

There are very many designs of retracting landing gears, and some are simple, whilst others are extremely complicated. Legs are retracted sideways, forwards, backwards and upwards. Some combine two of these motions and others fold backwards and at the same time allow the leg to twist round, thus allowing the wheel to be flat and require a lesser depth of housing.

An extremely simple design is illustrated in Fig. 4. In this case a worm of the usual design is geared to the leg. The worm is driven by a motor, usually electric, and causes the leg to fold inwards. Metal doors are usually arranged to fold over the legs when they are fully retracted, so that the profile of the surrounding structure is not interrupted. It is important that there should be no air leaks between the upper and lower surfaces of a wing, otherwise the lifting properties are affected.

On some aircraft a small portion of the wheel is left outside the wing, and this allows landings to be made should the undercarriage jam in the up position. The modern practice is to fully retract the wheel so that the drag is kept down to a minimum.

Hydraulic power is usually used for operating the retracting mechanism, although electric power is proving a serious rival. The modern systems are complicated and always incorporate an emergency method of lowering the undercarriage. Hand power or compressed air are alternative methods.

In order to prevent the leg from collapsing and to hold it in the required position locks are always fitted. There are as a rule hooks held in position either by springs or hydraulic jacks.

Tricycle Undercarriages

The ordinary arrangement of the landing gear, i.e., the two main wheels situated forward of the aircraft's centre of gravity and the tail wheel positioned at the rear end of the fuselage, is being superseded by the tricycle arrangement. Fig. 5 illustrates a typical design; in this case the aeroplane is of American design, the Bell Airacobra.

In the tricycle arrangement the two main wheels are aft of the C.G., and the tail wheel is replaced by a nose wheel. From the illustration it will be seen that the normal attitude of the aircraft on the ground is practically the same as that which occurs when it becomes airborne. This is a good point when taking off. The pilot's view from his cockpit is also improved as the nose of the aircraft is approximately horizontal. Many otherwise efficient modern aircraft fitted with a normal undercarriage arrangement are notorious for the poor view possessed by the pilot when the aircraft is on the ground. The fitting of a nose wheel also prevents nosing over.

The main advantage of the tricycle system is the fact that when the aircraft is travelling at the high speeds required for taking off and landing (100 m.p.h. approx.), three wheels are supporting it instead of only two. This fact increases the directional stability to a considerable degree.

When landing, the wheel brakes may be applied with greater force than would normally be safe in a tail-wheel undercarriage design. This allows the landing run to be reduced, thus requiring smaller runways. The amount of braking is limited by the strength of the tyres, and this fact is likely to be a source of trouble in the near future.

The speed at which an aircraft lands when fitted with a tricycle undercarriage is greater than that of normal aircraft, as it is not in the almost stalled position adopted by tail-wheel aircraft.

To facilitate manœuvring on the ground the nose wheel may be made movable under the control of the pilot. The development of this idea has not yet gained a satisfactory degree of efficiency, as trouble is experienced with the nose wheel tending to shimmy and cause vibration. At the moment they are usually allowed a certain amount of travel. Oil dampers are fitted to limit the movement and reduce the shock loads.

The Americans have been the chief experimenters in tricycle undercarriages, and little notice of this design was taken in England until fairly recently. Double-nose wheels, i.e., two side by side, have been tried out and found satisfactory, e.g., the Lockheed Constellation. It is interesting to compare this with the twin tail wheels fitted to the Short Stirling bomber and the twin tread tail wheel of the De Havilland Mosquito fighter-bomber.

Some of the very first pioneer aircraft were fitted with tricycle undercarriages, and

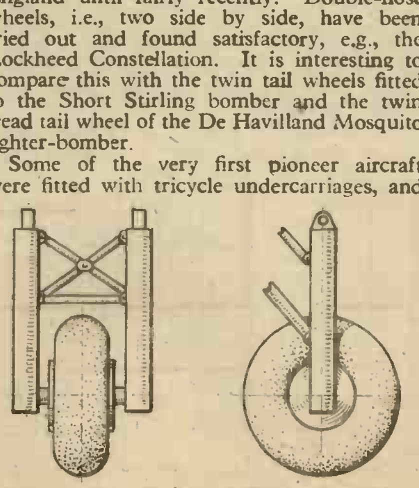


Fig. 6.—Twin oleo legs.

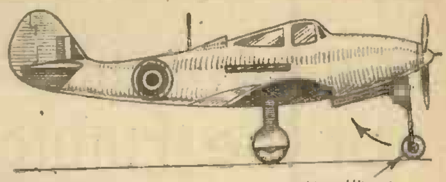


Fig. 5.—Typical tricycle undercarriage.

from the present trend of design it appears as though all future designs will be fitted with this type of landing-gear arrangement.

A disadvantage is the fact that the airscrew blades are brought nearer to the ground, thus reducing the clearance. This limits their diameter, especially in the case of an aircraft fitted with low wings and may call for undercarriages with increased heights to provide the necessary clearance. The manner of entrance into the aircraft with a tricycle undercarriage is liable to cause complications due to the height of the fuselage above the ground. In a normal aircraft in the tail-down position, the entrance door is within a reasonable distance of the ground level.

Indicators

A very necessary instrument which is required on all aircraft fitted with retractable undercarriages is an indicator which shows the position of the landing gear. This instrument is usually electrically operated. A typical design consists of the usual circular case, in which three spaces are illuminated by electric bulbs. When the undercarriage is in the up position the three openings labelled PORT, STBD, and TAIL WHEEL, are coloured red. With the undercarriage down and safely locked the light changes to green.

If the aircraft is liable to fly at night, it is usual to provide a dimming device to prevent the pilot being dazzled. As an alternative to coloured lights the words UP or DOWN may appear in the appropriate spaces. In this case solenoids are used to operate small flag-type signals.

An additional warning device fitted to many aircraft is a klaxon horn, which operates should the pilot throttle down and leave his undercarriage in the up position. A switch is situated so that the pilot may cut out the horn should he close his throttle when not intending to land.

Ski Undercarriages

To enable aircraft to operate in countries where snow is the general rule, ski-type undercarriages have been developed. As the name implies, the normal wheels are replaced by skis of varying designs. A typical ski fitted to the usual shock-absorbing oleo and bracing struts is constructed of wood (laminated ash), to which metal runners are attached to give protection against damage. The loading rarely exceeds 200 pounds per square foot, and a typical length/breadth ratio is 5 to 1.

Modern skis are streamlined with metal fairings, and reduce the drag considerably. The main disadvantage of this type of undercarriage is its weight, which is extremely heavy when compared with the normal wheeled design. The tail wheel is also replaced by a small ski.

An important device which is essential is the trimming gear. This alters the angle of the skis to agree with the line of flight and for landing purposes. The take-off run varies considerably according to the condition of the snow or ice. Wet snow will prolong the run. An important precaution when the aircraft is left out in the open is to raise the skis from the ground by means of poles. If this is not done, the skis will freeze to the ground and require chopping or heating in order to release them.

Engineer-built Houses of the Future—10

(*Continued from page 10, October issue.*)

The Wiles of Jerry Builders : Pre-built Upper Floors : Their Structural Essentials

By R. V. BOUGHTON, A.I.Struct.E.

FIG. 45 depicts a trench for a wall excavated, of course to a minimum width and depth, with the excavated earth thrown out on the side ready for returning, filling and ramming around the base of wall. It looks well, and the building inspector passes the foundation. Now see how the *foundation trick* works as right-hand of Fig. 45. By some unmagical means part of the excavated material from the top of the trench, or any old tin cans, rag, iron or bones get into the bottom of the trench as the concrete is being laid. This means that earth and rubbish which is practically valueless displaces comparatively costly concrete, and quite an appreciable amount of money can be saved by this wile. It may be of interest to state that as poor quality concrete, plus the foundation trick, is usually cheaper than brickwork, there is no object in reducing the thickness of the concrete-cum-earth base.

We now come to one of the "beautiful arts" known as the *surface concrete trick* which has often caused me to suggest that surface concrete could be applied with a distemper brush instead of by the normal method. Fig. 46 should be studied with care. It shows the jerried concrete base and wall, and level pegs set in position to comply with by-law requirements as to thickness of surface concrete. The building inspector examines the ground, tests the level of the top of the pegs, and if satisfied passes the lot and goes away. Then the "fiddling" starts. The pegs are either tapped down an inch or two or withdrawn, and a thin layer of earth or cheap ballast is sprinkled over the surface of the ground, the surface concrete is laid, and the result is as bottom of Fig. 46. Such concrete is intended to prevent rising dampness which is injurious to health and is one of the inducers of dry rot, and to support sleeper walls which carry the ground floors. It will be apparent that some of these tricks could be practised with concrete bases and rafts for engineer-built houses; but it can be stated that, although such work will be "site-work" executed by builders, engineers will probably adopt methods to protect their good work being spoilt by builders, and, also, it may be stated that there are now means of readily testing the thicknesses of concrete.

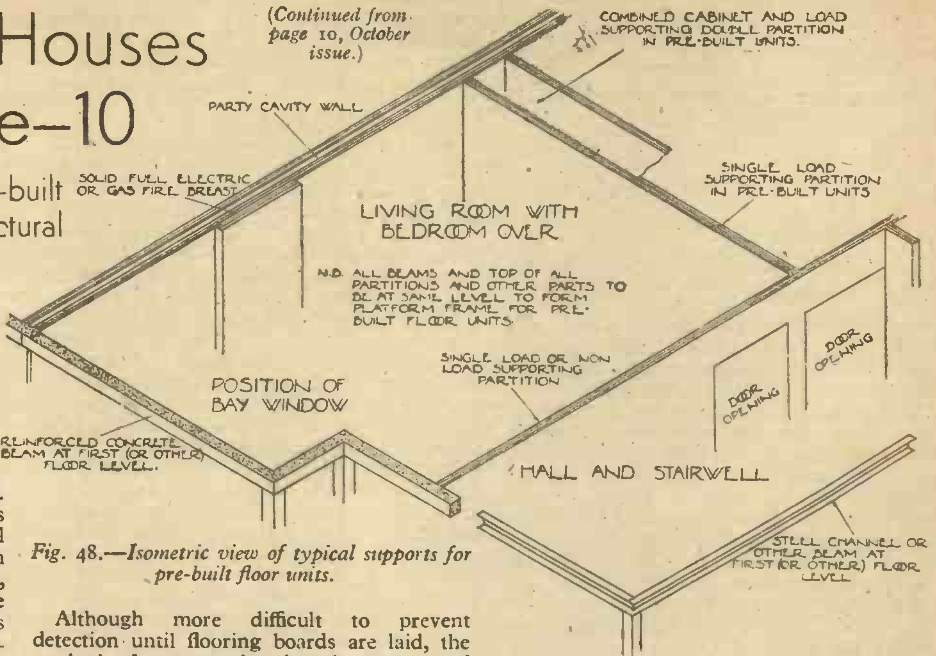


Fig. 48.—Isometric view of typical supports for pre-built floor units.

Although more difficult to prevent detection until flooring boards are laid, the method of constructing hearths to ground floor fireplaces as shown by Fig. 47 is well worth studying. Instead of building proper fender walls to contain the hardcore under the hearth, the space is filled with rubbish as shown, the concrete hearth laid on top of it.

Pre-built Upper Floors

Upper floors, such as the first floors of two-storey houses, are of exceptional structural importance, apart from their utilitarian value. A great amount of the general stability of a house, including walls, partitions, and even the roof structure, relies upon the manner in which the floor is designed and constructed. The function of the floor is not only to divide horizontally the storeys of a house and to be capable of carrying all normal loads, such as people and furniture; it must assist in providing lateral support to the external walls, and assist in binding together the various walls, partitions, and other parts. Engineer pre-built houses have external walls which are thin compared with traditional brick walls, so it is essential that there be a very close relationship between the designing and construction of floors and walls, so that they will help to strengthen each other and ensure the slenderness-ratio of the walls being within safe limits—this is a structural essential which should never be overlooked. The external walls of pre-built houses will be about four inches thick, and if they extended from base to roof of a two-storey house, a distance of about 18 feet, without being tied in at first floor level, it is almost certain that the walls would buckle and probably collapse.

Fig. 48 depicts a portion of the uppermost part of the ground storey of a house. It shows some of the beams that ring the house at first floor level, and which form the foundations for any of the many kinds of pre-built floors which are described in this and future articles. The stability of the external walls in the ground storey is assisted by the various internal walls and partitions which are bound to them: and the beams at first floor level also assist in giving stability; the horizontal structure of the first floor, if designed and constructed properly, will provide much additional strength.

The Floor Units

The units, like many of the other parts of engineer-built houses, should comply with those essentials which have been previously described, some in detail, and which are briefly as follows: stability, avoidance of excessive deflection, durability, transportability, thermal insulation, sound insulation, avoidance of vermin infestation, economic initial cost, economic maintenance costs, speed and ease of erection, light weight, and resistance to fire to a reasonable extent.

The important matter of stability and strength will be considered first. The existing building by-laws call for a super load on domestic floors of 40lb. per foot super, and, although I am tempted to suggest that 35lb., or even 30lb. (the latter, I believe, accords with the requirements of some continental countries) it is wiser to design according to present British codes of practice and allow 40lb. F.S. superload, which includes allowances for weight of furniture, persons, and concentrated and live loads, and to add for the dead weight of the floor units. Coupled with strength is the almost equally important subject of avoidance of too much deflection, and in this respect I do not advise any greater calculated deflec-

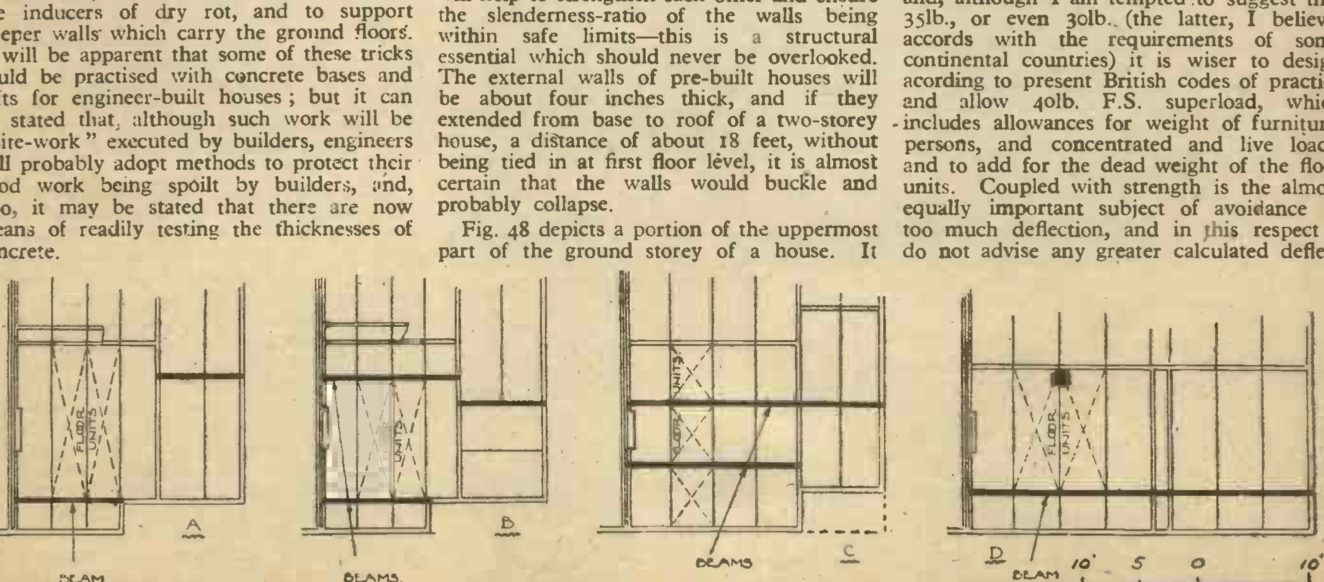


Fig. 49.—Four plans, A, B, C and D, showing different layout of floor units to accord with structural essentials as explained in text.

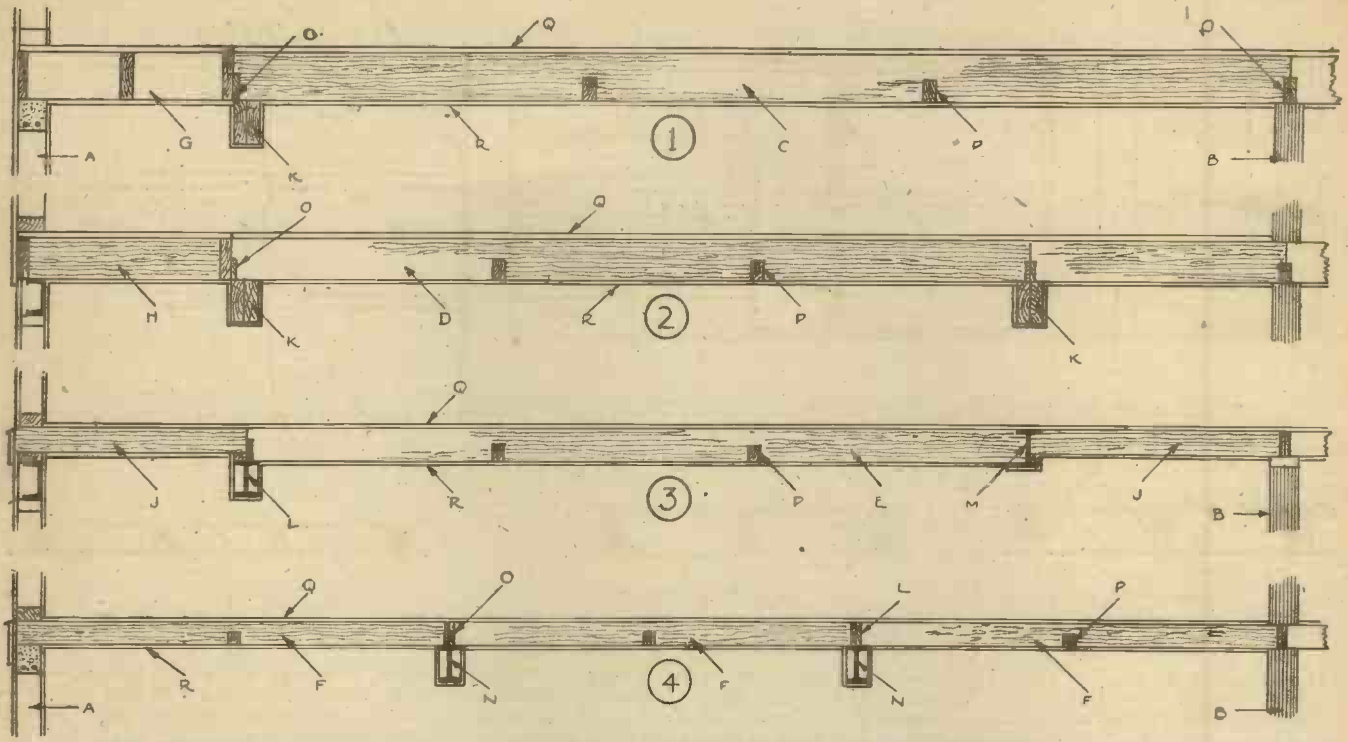


Fig. 50.—Four longitudinal sections (1), (2), (3) *and* (4) *showing how the introduction of beams affect the length, thickness and weight of pre-built floor units of timber construction.* (1) *Long floor units of considerable depth.* (2) *and* (3) *Medium length floor units of moderate depth.* (4) *Short floor units of small depth.*

A—External wall. B—Partition. C—7in. x 2in. timber joists. D and E—5in. × 2in. joists. F—3in. × 2in. joists. G—Floor unit spanning width of a bay window. H—This floor over a bay window may be in small units if desired with joists running in direction shown. J—As H but thickness of unit reduced owing to small span between wall and steel beam. K—Timber beam. L—Rolled steel beam below ceiling level and at level of general platform frame. M—Rolled steel beam placed in thickness of floor. N—Rolled steel beams. O—End binding boards ¾in. or 1in. thick. P—Noggings or bearers. Q—Flooring. R—Ceiling covering.

tion in floor units, or any beams which support them, than 1/360th of span, which is required by most building Acts. The limit used to be 1/480th, which was deemed advisable to avoid inconvenience and cracking of plastered ceilings. With the above loads and deflection limitation in mind, it is possible to consider good designing principles, and for this purpose the four typical plans, as Fig. 49, should be studied. At A is shown what appears to be a very simple design for the units, but an investigation will prove that the span of the main units makes it necessary to use joists of a depth as shown at (1) in Fig. 50, which is excessive according to pre-building codes; such depth not only causing the units to be heavy, but may increase the height of the whole building by a few inches more than it need be if other methods of designing the units are adopted. B depicts the inclusion of two beams over the living room, positioned so as to provide a ceiling of neat beamed appearance. In this case the length of the main floor units is considerably less than those at A, and the depth of joists which may be used are shown at (2) Fig. 50. At C is shown what I consider to be a very economical design of the floor units. The units are of short span, which permits the use of 3in.-deep joists, and a total thickness, including flooring and ceiling covering, of about 4ins., and, the units are light in weight. This layout is shown particularly to illustrate the good results which may be achieved by the careful use of beams; it must not, of course, be overlooked that beams may be rather costly items, but against this cost is the saving caused by a reduced height of building due to the floor being 4ins. instead of a greater thickness, that is, if the beams are allowed to project in the normal storey height. At D, Fig. 49, is shown another layout of beams and floor units. In examples A, B, C and D, the beams are parallel to the front wall, or width of building, and are separate to the floor units: there is another good method of construction where the beams are incorporated in the sides of floor units and run from front to back of the house, or in any other desired direction—this method, as well as the stressed-skin, composite, and others, will be described in the next article.

Structural Details of the Floor Units

In this article I am limiting the descriptions to the main structural essentials, and leaving until later the important and interesting subjects of thermal and sound insulation, floorings and ceiling coverings. Fig. 50 depicts four ways in which timber-framed pre-built floor units may be designed. Fig. 51 should be studied with Fig. 50. At (1) Fig. 50 is depicted floor units which are intended to span the whole of the length or breadth of an ordinary size room, excluding any bay window space across which usually is placed a beam as shown. It will be noticed that the floor units are deep, and will be heavy and rather cumbersome to handle. Although not recommended by me, the design is shown for several reasons. One is to show that designers should not take liberties with deflection; an examination of some of the really excellent general systems of pre-building which have recently been in the limelight have depth of floors which are too little to comply with the *strength* and *deflection* codes previously explained. It is obviously wrong to design floors which will be too weak, and will deflect to such an extent as to cause them to "rock." The floor unit as (1) have 7in. x 1½in. side joists of Douglas fir, or "1,200lb. extreme fibre stress in bending" timbers where they adjoin other units, and 7in. x 2in. main or intermediate joists. These sizes are in conformity with the L.C.C. by-laws for timber construction, which by-laws are followed by many local authorities outside London. If ordinary non-graded redwood (800lb. f.) is used, the depth of the joists would need to be increased to 8in.

Now study the effect of introducing beams as (2) (3) and (4) Fig. 50. Beams, considered with great care, and placed in proper position, will break down the spans of floor units to an extent which can cause much economy in the use of materials, labour, and transport, ease and speed in handling, and erection. The depth of joists as (2) is 5in.; of (3) 5in. and 3in., and of (4) only 3in.

Building by-laws stipulate minimum heights for habitable rooms—in London, 8ft. for rooms in the topmost storey, and 8ft. 6in. for storeys below; outside London it is 8ft. for all storeys. Beams, as a rule, are allowed to encroach into "the storey height"; but, of course, in this respect beams should not be too deep, because if they are they would not only have a heavy appearance, but reduce the head-room too much.

When designing floor units which have timber joists—or joists of any other material—it is essential to so regulate the spacing of the structural members as to make them suitable for the permissible spans of the thin flooring or ceiling material which is used. There are many kinds of floorings which will be described, such as ordinary softwoods, hardwoods, hardboards, composite materials, and others, all of which must be treated as little slabs subject to strength and deflection codes of practice.

As a general, but by no means inflexible, rule, it is advisable to place beams so that their tops are at the general *platform frame level*, i.e., at the same level as the top of the main beams which ring the building at floor level. There is a good reason for this rule: it allows the floor units to be placed with ease on top of the beams. Another method, which certainly has advantages, is to allow a little of the depth of the beam to be in the thickness of the floor; this neces-

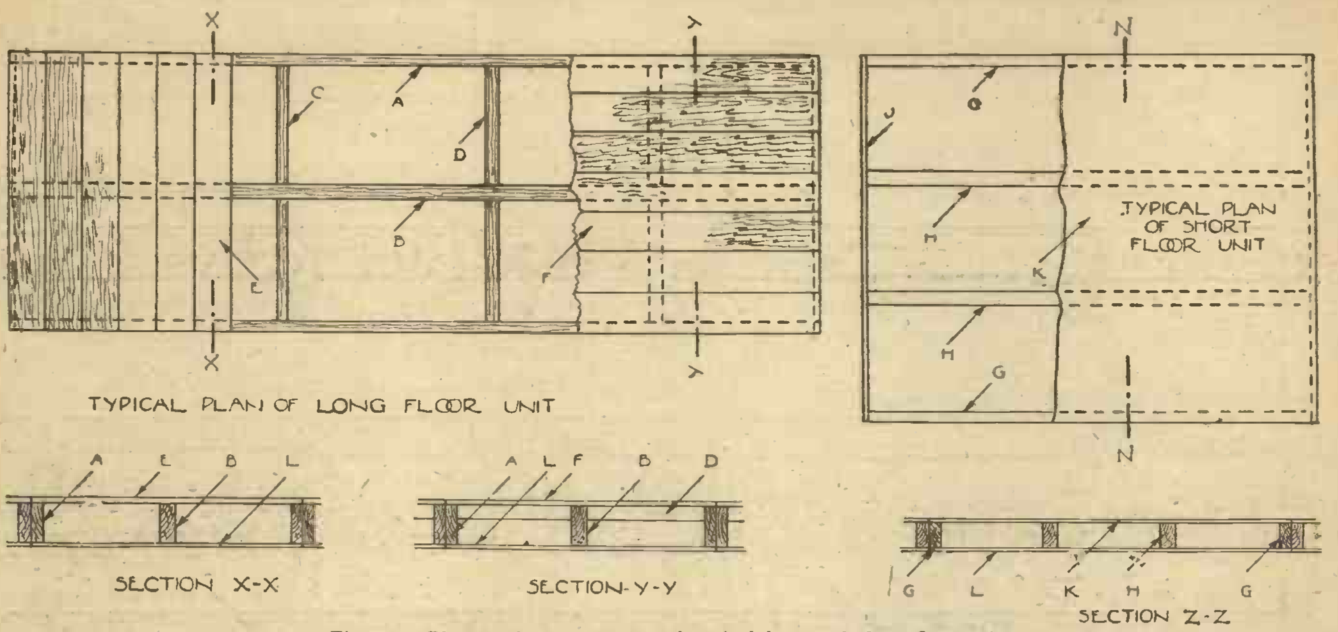


Fig. 51.—Plans and cross sections of typical long and short floor units.

A—Side joists 1¼ or 1½in. thick. B—Main joists 2in. thick. C—Noggings or bearers to stiffen floor and to form partial support for ceiling covering. D—As C but at distances apart to suit span of flooring. E—Flooring boards running across width of floor unit. F—Flooring boards running in direction of length of floor unit. G—Joists as A and B but of reduced depth owing to short span. J—End binding board. K—Hardboard or other sheet flooring. L—Ceiling covering.

sitates notching the ends of the floor units, but has the advantages of reducing the depth of beam below ceiling level and assisting in binding the floor units and beams laterally together. Any notching should not exceed, as a rule, about 2/5ths of depth of floor unit, otherwise the timbers in the units may be too weak to resist horizontal shear stresses. At (3) Fig. 50 is shown a method of beam designing where a rolled steel beam R S B) is placed in the thickness of the floor. This method is good provided it causes no difficulties in inserting the floor units in between the webs of the steel beams—a difficulty which can arise if the units have to be fixed between two beams which are immovable.

Fig. 51 shows plans and cross sections of typical timber-framed floor units. The *long floor units* should be limited to about 3ft. wide; the *short floor units* may be up to 4ft. wide, owing to their lightness in weight. It will be noticed that flooring boards may be laid either parallel or at right angles to the length of the units; some designers believe that the former gives a better appearance to the flooring; in my opinion, if ordinary redwood floorings are used, the direction of the boards does not matter very much, as the flooring is usually covered either wholly or mostly with carpets or other floor covering. If choice hardwoods are used, and which are not usually covered, then the boards are better laid with their length parallel to the length of the units. When sheet material, such as hardboards, is used, there is not much question as to how it is laid, as jointing does not affect æsthetics.

Another vital structural essential is related to binding together correctly the floors and walls, and to ensure that there shall be no pivotability between them. Traditional houses, and especially the jerry-built ones, with brick walls, etc., and their "boxed" construction and no "triangulation of the general structure" to meet certain stresses, suffered very badly in the blitz. Even a "250 pounder" made them fall like nine-pins. If the walls and floors of those traditional houses had been bound together properly a different result would have been probable. Engineer-built houses should ensure the application of the best structural mechanical principles and details to ensure complete rigidity and consistent strength in the whole of the structural and other parts of the houses. An ordinary house, apart from its pitched roof (if a flat roof is not used) consists of a number of rooms and compartments which are like boxes, with vertical walls and partitions and horizontal floors joining each other at right angles, which latter are very liable to be pivotal or to rotate, with weakening and even disastrous results to the whole structure. It is for this reason that great care must be exercised in designing and fixing the junction of floors with walls and partitions to prevent any rotation at angles, to ensure the walls receiving proper lateral support, to avoid them buckling, and, what is of extreme importance, to resist any swaying of the whole house by heavy wind forces, which are really powerful foes to resist. Fig. 52 depicts two ways by which the angle between a floor and wall may be stiffened by triangulating the angle in a neat manner that will not spoil the appearance of a room.

All floor units must be connected together at the ends and sides: at the ends to form continuity of the units to ensure that they will all "pull together" and so bind the building; at the sides for similar purposes, and also to ensure that the sides of adjacent units will be at the same level—a heavy load on one unit will make it deflect below the adjacent one and cause a very inconvenient break or ridge. Fig. 53 shows two methods of connecting the units. It is important to understand that if floor units are made complete with flooring and ceiling coverings it would be necessary to remove part of the covering to allow the bolts to be fixed. Whereas bolts provide considerable strength, it should not be overlooked that it is often impracticable to ensure easy and accurate fitting to *timber*—to *metal* it is different. Therefore, it is considered that the method shown at the left-hand of Fig. 53 is practical for ensuring that the sides of the units will be level and that one side will not deflect more than the other. The small metal plates should be sunk into small housings.

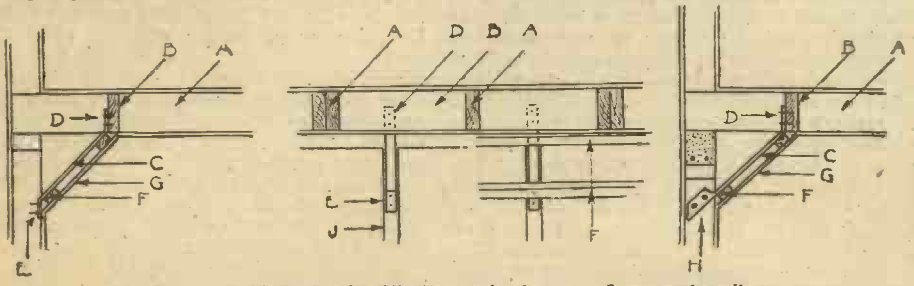


Fig. 52.—Methods of stiffening angles between floors and walls.

A—Joists. B—Bearer to which angle braces are fixed. C—Steel flat angle brace. D—Stout screws. E—End of brace let in sinking in wall member and screwed to same. F—Small timber bearers, screwed to brace, to carry covering G. G—Covering. H—End of brace twisted and screwed to wall member. J—Wall member.

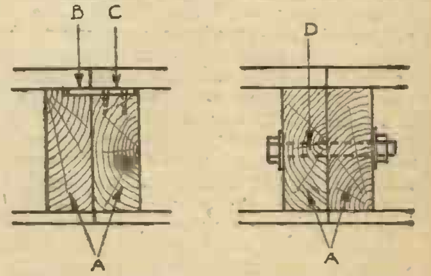


Fig. 53.—Methods of connecting floor units at their sides and ends.

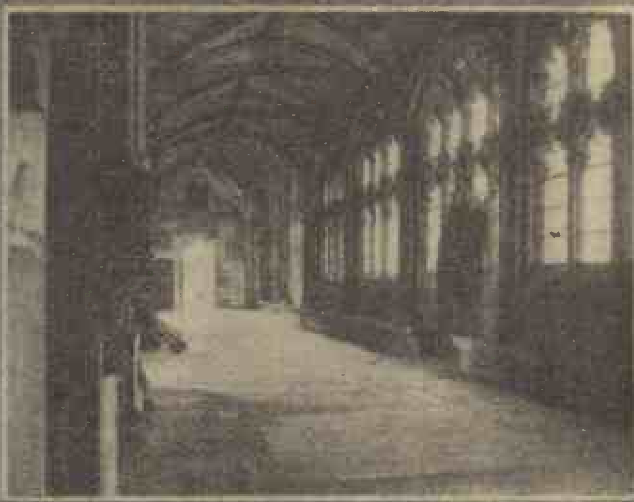
A—Side joists or end binding boards. B—Small steel plate, 2in. wide × ¼in. thick. C—Plate screwed here only and also to adjoining timber member if desired. D—½in. diameter bolt.

Making a Success of Your Photography

Ecclesiastical Interiors

By JOHN J. CURTIS, A.R.P.S.

The pillars of Tintern Abbey. Selo HP3 film. Developed with Azol.



Chester Cloisters. Selo HP3 film. Developed with Azol.

WHEN visiting any one of our many famous and beautiful cathedrals, I have seldom found any amateur photographer using his camera; in fact, it is surprising how few are really interested in interior work of this description, yet it offers so many opportunities for picture making, and even a few results will add a tremendous amount of interest and enjoyment to your collection.

Church architecture had no appeal to me at one time, until I had the opportunity of listening to a lecture by one of our leading pictorialists and seeing some of his results in the form of lantern slides thrown on the screen. His subject was Canterbury Cathedral, and that evening was full of thrills for me and for his audience, judging by the applause. From that time I have used the camera whenever opportunity served, and I hope that many of my readers will immediately turn their attention to this feature of their hobby, and get the same amount of enjoyment out of it as I have experienced for many years.

Historical Features

Think for a moment of the many objects which present themselves in a cathedral or a large parish church. There are the architectural features, such as nave, chancel, roof, transepts, chapter house, cloisters, etc. The historical features, such as tombs, memorial chapels, pulpits, fonts, brasses, etc., and in some there are items of general interest, such as stocks, misereres, carvings, screens and monuments. Most of these places are store-houses of objects full of some sort of interest to everybody, and especially to camerists, who can by a very little effort bring away records that can give pleasure to hundreds of others.

How is it best to start this work? If you are living in a cathedral city, or intend to visit one, you should write to the dean of the cathedral, asking for permission to photograph; usually there is a small charge of 1s., so enclose a postal order for this amount. Generally you will get a favourable response to your request, with the necessary permit. On entering the cathedral you should first seek out the verger, show him the permit and have a chat with him. He can, if he has the time, be very helpful in telling you where the best results are to be obtained, also some facts about certain objects, give you dates, and other information which you will find very useful. I have discovered vergers who are quite keen amateur photographers themselves, and as such very willing to give some practical advice on the subject of exposure. When you leave the verger, get your notebook out and make a record of those dates, facts and other details which he gave you.

You will find it is of help to next take a walk round the building, noting which objects or which parts appeal to you most and offer a pictorial effect; you will not be wasting time by doing this, in fact, my feeling is that you save time, and are not so likely to miss a really good subject. In any case it is a mistake to spend only a few minutes in such a place and expect to get "prize" results.

You will, of course, take a tripod with you, for it is safe to assume that all exposures will be time ones; if you have not got a tripod you must make use of the back of a chair or a shelf or even a tomb on which to rest your camera, and you had better tell the verger that you might have to do this. He may be able to help you with a light stool or short pair of steps.

The time of day is important, especially if you are out for striking effects, such as sunlight across the transepts, nave or choir. I have found the most useful time is between 11 o'clock and 3 o'clock, but whenever a special exposure is wanted, and the lighting is important, then appeal once again to the verger, or study the position of the windows, judging at what hour the sun will be shining through them.

Correct Exposure

I come now to the most difficult of the problems attending all interior work, the estimating of correct exposure; difficult because of the many factors to be considered, such as lighting, general decoration either light or dark, nearness of subject, speed of film, and also lens stop. I have overexposed with two minutes at F11 and underexposed with 20 minutes, using F8, in another building—a very dark one indeed.

During the last few months I have made some very successful negatives with a three minutes' exposure on Selo H.P.3 films and only altering my stops to suit the lighting, varying these from F3.5 to F16, and most of these have been nave, north or south aisles or the choir and chancel studies. If I have arrived to find other persons walking about the building, then I invariably use a small stop—even F22 or 32, and give a long exposure; by this means you can ignore the people moving about, but, at the same time, you must keep your eye on any individual who is likely to walk into your line of fire, and should he or she stop, then you must shut your lens and reopen when that person has moved away. Obviously this must be done without causing any movement in the position of the camera. Should anyone approach directly in front of your camera slowly, then again you must "cease fire" until the lens vision is uninterrupted.

Ecclesiastical architecture is not exclusive to cathedrals; there are hundreds of parish and village churches in this country with beautiful interiors, some with Norman or Early English, others with a mixture of Norman and Perpendicular and so on, and it would be difficult to find any church which has not got something of historic value. I would therefore urge all my readers to have a good look round their own neighbourhoods and to visit each of the churches. You will find scores of interesting objects for your camera, and which, if collected, as a nucleus for a lantern lecture, together with all the local traditions and yarns, will give not only you, but the public, many hours of entertainment.

I think I am correct in saying that for this class of work it is good to have a "stand" camera, with plenty of extension and rising and falling front, etc., but nevertheless, the folding type with falling front is quite capable of doing excellent work. I have seen some charming prints that have resulted from cheap box-form cameras, so do not be deterred if you have not got an expensive piece of apparatus. A focussing screen, obviously, is useful, and, failing this, you must be sure of your view-finder and distance scale, especially when taking such objects as brasses, and figures on tombs.

Divers Jobs

A Brief Account of the Work Done by Naval Deep Sea Divers

By MARCUS R. CHEADLE, Mech., R.N.

Sapper divers in Tunis, members of a Port Construction Company, help to clear harbour obstructions, and demolish dock installations to facilitate the salvage of shipping. The illustration shows a final adjustment to a helmet before a diver descends.

THIS title, if taken in its broadest sense, is a little ambiguous; however, it is intended to mean the jobs done by deep-sea divers. Again we have a possible cause of misunderstanding in the word deep, which in this case does not carry its true meaning as the diver may only be working in, say, six feet of water, but it does distinguish him from a swimmer.

I propose to touch very briefly on the work of divers dressed in an enclosed suit, and breathing either:

(a) Compressed air in the familiar rubber suit type of dress.

(b) A mixture of oxygen and helium in a rubber suit.

(c) Air at atmospheric pressure in the articulated metal dress.

Before discussing the work done by these divers, I think it will interest many readers if I say a few words about each of these classes of diving in turn, as many people have at some time or another seen a diver at work, but few have had the opportunity of discovering much about the conditions under which he has to work. The scope of this article will only allow the fringe of the subject to be touched, and to those who would care to know more about it I can recommend the book published by Messrs. Siebe Gorman and Co., of Davis Road, Tolworth, Surrey, entitled "Deep Diving and Submarine Operations" (price 10s. 6d. net).

Now, taking each of the above sections in turn:

Rubber Diving Suits

Section (a) covers the greatest amount of diving work undertaken both by naval and civilian divers. Using manual pumps and standard equipment a depth of 30 fathoms may be reached, and work done there with safety. Up to a depth of 50 fathoms may be attained using equipment fitted for carbon dioxide absorption and the Davis Submersible Decompression Chamber. For this deeper work a mechanical compressor is used, as too many manual pumps would be necessary for the maintenance of the diver's air supply, particularly while he is descending. A few details of the standard equipment may not be out of place here. Leading to the helmet will be seen a length of rubber hose called the air pipe. Often, on occasions where divers have appeared in moving pictures, one diver is seen to be twisting the air pipe of another and stopping his supply of air. All I can say is that those divers must be gifted with exceptionally strong wrists as the air pipe is made up of one layer of rubber, three layers of canvas, two sheets of rubber with spring steel wire embedded, two layers of canvas and finally one layer of rubber! The fact that a diver needs an air pipe for breathing is obvious, but that is not the main reason for an air supply. This statement sounds rather drastic, but the point of it will be seen as we proceed. The main trouble to be overcome in diving is the fact that with each 33ft. of depth to which the diver descends, the pressure on his body is increased by 15lb. per sq. in. This means a total increase of about 13 tons on the surface of the body. Thus, were a diver to descend to 33ft. from the surface, the pressure on his body would be doubled, and had no steps been taken to correct this, he would be compressed into half the volume that he occupied on the surface. This, of course, would not be a happy state of affairs either for the diver or his insurance company. The main use of the air pipe now can be seen. In the helmet is an outlet valve which is spring-loaded to retain a pressure of not less than half a pound more than that of the surrounding water. The valve is adjustable to retain more than this pressure to give buoyancy, but cannot be opened to give less. There is also an inlet valve where the air pipe joins the helmet which is made non-return by a light spring so that should the air pipe be severed, the diver has the air already in his suit to last him until he can reach the surface, which he can do by slipping his weights.

Air Control

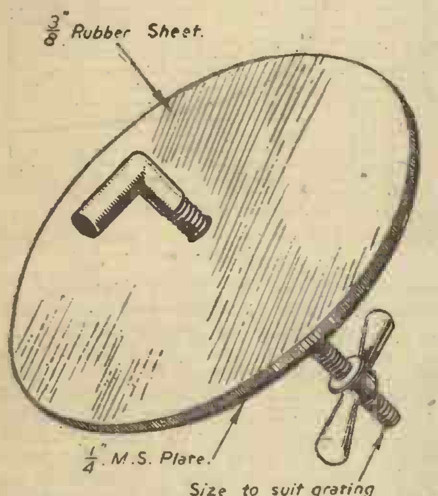
The diver has no control over the air which enters his suit except by asking his attendant for more or less, but he can control the air leaving his suit, and thus make himself light or heavy as he wishes. It will thus be seen that the diver is always breathing air at a pressure just above that of the water in which he is working, whatever his depth. This air immediately it is inhaled transmits its pressure to the whole of the blood stream and enables the body to withstand the pressure of the surrounding water. Many people ask me how it feels to be under pressure. The fact is that the pressure cannot be felt at all, and the only discomfort is the difficulty of making the limbs move through a denser medium than that to which they are accustomed. This applies to the hands, which are exposed, as well as to the parts of the body actually in the suit. It is this fact of the compressed air reaching all parts of the body which is responsible for the ailment known as "Bends." This ailment is also met by compressed air workers in tunnels, etc., and is due to the fact that the nitrogen in the air (of which it comprises about 79 per cent.) dissolves in the blood when under pressure; and when the pressure is quickly reduced, it is released in the form of bubbles which continue to expand as the pressure reduces and tend to coagulate with each other usually in a joint such as the knee or elbow where they interfere with the circulation, and cause intense pain and in serious cases paralysis. A diver under pressure was likened to a bottle of soda water by Professor Leroy de Mericourt. Just as a bottle of soda water is apparently clear and free from dissolved gas while under pressure; but when the pressure is released appears as a mass of bubbles, so does the diver's blood. "Bends," therefore, will not affect a diver while he is under pressure, but when he ascends to the surface quickly. This danger is counteracted by the diver surfacing in gradual stages from deep water so that the bubbles have time to disperse. The blood can accommodate twice its natural content of nitrogen without discomfort, so that a diver who descends not deeper than 33ft. may stay there indefinitely and may ascend direct. Below this depth the times and stages of decompression depend on the depth reached and the time spent there. A series of tables have been compiled by Messrs. Siebe Gorman, giving details of "stops" and times for various depths and durations of dives, and in the Navy, at any rate, these are strictly adhered to. To counteract the buoyancy of the air contained in his suit, a diver wears boots weighing about 20lb. each, a 40lb. weight back and front, together with his helmet and corselet (on to which the helmet is attached) which weigh 45lb.

Oxygen and Helium Apparatus (b)

In very deep work (over 500ft.) experiments have been carried out with a diver breathing a mixture of these two gases. As helium is inert as far as the body is concerned and is almost insoluble in the blood, times for decompression can be greatly reduced. The value of this will be seen when it is realised that for a stay of one hour at 300ft. the time needed for ascent is over four hours. All this time is wasted as far as productive work is concerned.

Articulated Diving Dress (c)

Several types of articulated diving dresses have been the subject of experiment during the past few years, the great advantage being that the occupant of the dress is able to breathe air at the pressure of the atmosphere



A rubber-covered plate, with hook-bolt used for sealing large gratings in a ship's hull.

and can therefore stay in very deep water for unlimited time and can ascend to the surface as fast as the dress can be hoisted without ill effects. However, the amount of work that can be done in this type of dress is very limited as the construction has to be such as will withstand a great external pressure with no internal air pressure to balance this, and the amount of movement controllable by the diver is very small. The dress has to be lowered and raised by derrick and the main use to which the dress is used is to act as a guide for the placing of grabs, or explosive charges in salvage work. The two main types of articulated dresses in use are the "Neufeldt and Kuhnke" and the "Peress," which differ mainly in the types of articulation employed. Needless to say, the diver's hands are *not* in contact with the water in the armoured dresses, but the arm ends in a type of claw which can be opened or closed by the diver. Air is not usually pumped down to these dresses, but a form of self-contained breathing apparatus installed. The weight of either type is in the neighbourhood of 800lb.

A question that I am often asked is "How do they pull you up?" The answer to this is that a "compression diver" is never pulled up unless he is unconscious or seriously injured, but by closing his outlet valve he can inflate his suit until he has positive buoyancy and leaves the bottom. As he ascends the air in his suit will expand as the pressure decreases, and he allows sufficient to escape so that the speed of his ascent is fully under his control, and he can stop immediately on receiving a signal that he has reached a "stop" or stage for decompression.

The Work Done by Divers

By far the greater part of work done by naval divers is done on the bottom of the ship in which they are serving, or some other vessel which does not attain to the importance of carrying its own divers. The other types of diving such as salvage work and constructional work has been dealt with at length in fiction and even the daily press, but little has been said about the work which occupies most of a diver's time, and which can be classified into five rough sections.

Propellers

Most operations on propellers consist of removing wire or rope which has become entangled with the blades, and is also usually found to be around the shaft and jammed between the stern gland and the propeller boss. The method of clearing this mess is not always simple, as it is amazing how solid a wire and, for that matter, even a rope can become after the shaft has revolved a few times. In a lucky case an end can be found and by hauling on this and turning the shaft by hand it can be unravelled. Often, however, it is necessary to cut the wire or rope away by hammer and chisel, hacksaw or, in the case of some steel wires, by the use of oxy-hydrogen cutting flame. Sometimes small repairs can be carried out to propeller or rudder to save the expense of docking, damage having been caused by going aground or striking some submerged object.

Inlets and Discharges

Every ship possesses a number of inlets and discharges where the sea water is admitted and discharged after being used for cooling purposes, fire-fighting pressure system, sanitary purposes, etc. In water with much vegetable content the gratings of these become choked with weeds, etc., and require to be cleaned periodically. Sometimes it is necessary to refit the valve at the inboard end of an inlet or discharge pipe, and the outboard end can be plugged by the diver so that this work may be carried out. Small round pipes can be sealed by a wooden plug, and for large gratings rubber-covered plates secured by hook-bolts are used. After the work on the inboard end is completed, the plug or plate may be removed by the diver. The external pressure of the water will always tend to tighten the joint, so that it is comparatively easy to obtain a watertight joint.

Other Underwater Fittings

Various other fittings under the waterline, such as speed and distance recording logs, submarine detecting gear, paravane gear, etc., require a periodical inspection and occasional removal for repair. This is carried out by divers where docking is not expedient.

Repair Work

Since the war has been in progress there has arisen a new class of work which is the temporary repair of damage caused by near misses or hits by flying fragments of bombs. Where rivets have been sprung or plates are buckled a temporary repair may be made with wooden plugs and wedges, bolted patches, etc., which have many times served to keep a ship afloat until it could reach dock.

Cleaning of Ship Bottoms

After a prolonged period of steaming the condition of the ship's bottom may be such that the maximum speed available is reduced, and the fuel consumption for lower speeds is increased. Normally the work of cleaning this is done in a dry or floating dock, but it can be carried out by divers if it is not convenient to dock, using wire scrubbers and scrapers. A practised diver can cover from seven to 12 square yards per hour.

The Bottom Line

In all these operations the diver reaches his work by descending on a bottom line, which is a chain or rope passing from the upper deck under the keel of the ship and up to the opposite side. Most underwater fittings are marked for position by a brass plate on the upper deck so that the bottom line can be rigged to enable him to descend straight to the job without difficulty. Where work is likely to be prolonged, a stage is sometimes rigged, consisting of an iron ladder or grating suspended from above so that the diver may sit or stand on it to enable him to have more freedom of movement.

At all times, whether working on a bottom line, stage, or on the bottom of the sea, the diver can adjust his buoyancy by the use of his outlet valve, and thus control his comfort and weight. Two instances of the use of this valve are that when a diver is working in a strong tide, he can make himself heavy to lessen the effort required to move against the tide; and when he is working in mud he can lighten himself to prevent sinking in.

Divers of a Sapper Port Construction Company at work on a grounded French vessel at La Goulette, Port of Tunis. In the foreground is seen the "Painter" from which the divers operate.

The Design of Air Compressors

Factors Which Affect Efficiency

TO design an air compressor it is first of all essential to know (a) the quantity of air required per minute and (b) the delivery pressure. The quantity may be stated in lbs. per minute or alternatively in cubic feet of free air per minute; either will

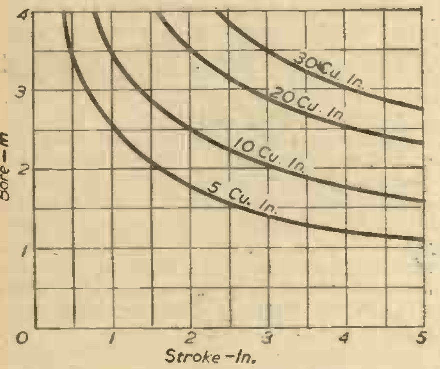


Fig. 1.—Graph illustrating piston displacement.

do because they can easily be converted one to the other by remembering that 13 cu. ft. of free air weighs 1lb.

It is not proposed to describe in detail the mechanical aspect of the design because it is assumed that in most cases the compressor will be made from an old petrol engine suitably modified, and the details will differ in every case. The following general remarks will, however, apply to most cases.

The Inlet Valve

Either the inlet or the exhaust valve of the engine can be used as an inlet valve to the air compressor by removing the timing gear and replacing the valve spring with a very much weaker one, so that the valve can be sucked open when the piston performs its outward stroke; excessive valve lift should be prevented by placing a tubular distance piece on the valve stem inside the spring. The strength of the valve spring and the maximum valve lift are best determined by trial after the compressor is finished but a good starting point would be about 1lb. pressure on the spring and a lift of 3/32in. to the valve. The other valve can be left just as it is and it will remain inoperative while serving to close the valve port. It cannot be used as a delivery valve because it opens the wrong way.

The Delivery Valve

It is therefore necessary to make a delivery valve complete with seating to screw into the sparking plug hole. This may consist of any kind of spring loaded non-return valve; a ball valve should be quite suitable, in fact an old sparking plug of suitable type could probably be adapted. Keep the valve as large as reasonably possible. The engine flywheel should be retained.

A point of great importance is to reduce the compression space as much as possible, the ideal being to leave no clearance at all. This, of course, will not be possible but much can be done by fixing an aluminium block inside the cylinder head or any alternative device depending upon circumstances. This point is referred to again later and a graph is given so that the reader can determine the extent to which the delivery will be reduced on this account, and so make the cylinder larger or increase the r.p.m. to make up for the loss.

The use of the accompanying graphs will provide a useful approximation within their range and will eliminate calculations. The method of using them can best be explained by taking an example.

Calculations

Let us assume that a disused motor cycle engine of 2½in. bore and 3in. stroke is available. It is required to know the speed at which it must be driven, and the horse-power required, to compress 3 cu. ft. of free air per minute to a pressure of 50lb. per sq. in.

From Fig. 1 find the bore on the left-hand vertical scale and the stroke on the horizontal scale; follow the lines across the graph and they will be found to meet midway between the 10 cu. in. and 20 cu. in. curves, thus indicating that the displacement volume is 15 cu. in. Now take 15 cu. in. on the vertical scale of Fig. 2, follow the line to the right till it meets the curve, and thence vertically downward until 120 r.p.m. is read off on the bottom scale. The compressor must therefore be driven at 120 r.p.m. for each cu. ft. of free air to be compressed per minute, so for 3 cu. ft. it will require to turn at 360 r.p.m.

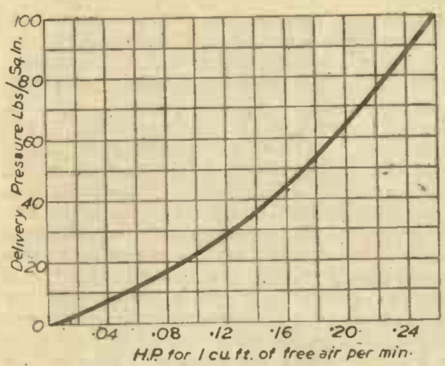


Fig. 3.—Curve indicating horse power required.

To find the horse power needed turn to Fig. 3. Running a horizontal line from 50lb. per sq. in. to meet the curve and then vertically downward it will be seen that for each cu. ft. of free air dealt with, .17 horse power is required; so we shall require three times this power, and a ½ h.p. motor will therefore be necessary. This allows a reasonable margin for mechanical losses.

The Pulley Size

The next item to be determined is the size of the pulleys on the motor and compressor. The speed at which the motor runs will usually be found marked on a small plate with the maker's name and other information.

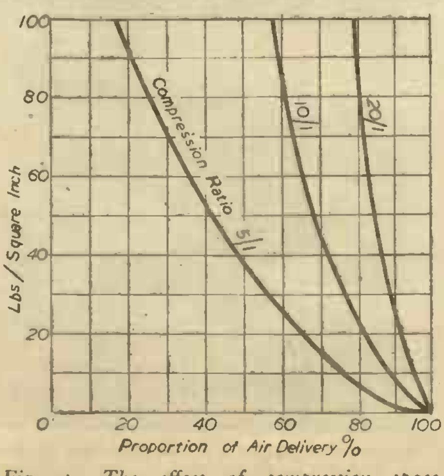


Fig. 4.—The effect of compression space.

Say the speed is 1,800 r.p.m., then the drive ratio is 1,800 ÷ 360 which equals 5 to 1. Then if the motor pulley is 2in. diameter the compressor pulley must be five times this or 10in. diameter. If a chain drive is used the compressor sprocket must have five times as

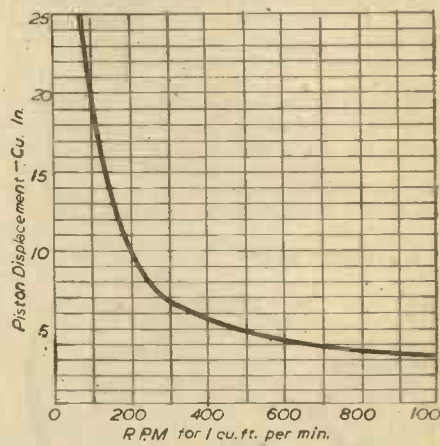


Fig. 2.—R.P.M. required for each cubic foot per minute.

many teeth as the motor sprocket. All other cases can be worked out in a similar manner by taking the appropriate figures.

Fig. 4 shows the serious loss in performance in a compressor unless the compression space at the inner end of the stroke is kept very small. With 50lbs. delivery pressure and 5 to 1 compression ratio the compressor only delivers 40 per cent. of its possible output. If the compression space is reduced by one half the output will improve to nearly 70 per cent. and further improvement is readily obtainable, but if the clearance volume cannot be reduced, the compressor must be larger or driven faster to make up for the loss.

MORSE INSTRUCTOR

ONE of the most important inventions of the nineteenth century was the Morse code, which system of dots and dashes is greatly used in the present war.

There has been submitted to the British Patent Office an application to patent apparatus for teaching the Morse code by a very simple method.

In a preferred embodiment of the invention a number of rectangular cards are employed, each of which has on one side the sign indicating a letter or numeral according to the code. A score, groove or indentation lengthwise of the card and adjacent to its lower edge, indicates the correct positioning of the card to agree with the prescribed reading of the code. On the other side of the card there is a representation of the usual character of the same letter or numeral.

In practice, the word it is desired to code is selected. For example, we will assume that the word selected is "Morse." Without referring to the letter indicated in ordinary type upon the back of each card, the student selects the cards which, in his opinion, bear the necessary code signs to form the word "Morse." He then assembles them in the necessary order.

The correctness of the cards selected may be checked by reference to a card or sheet upon which the Morse signs and the letters they signify are printed. Or the cards may simply be turned over to expose the letters on the back.

A Pendulum Harmonograph

Constructional Details of a Novel and Interesting Apparatus

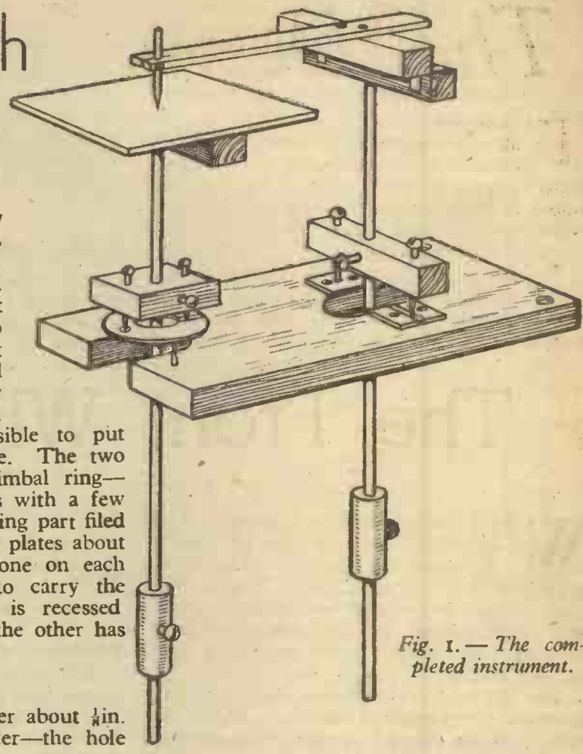
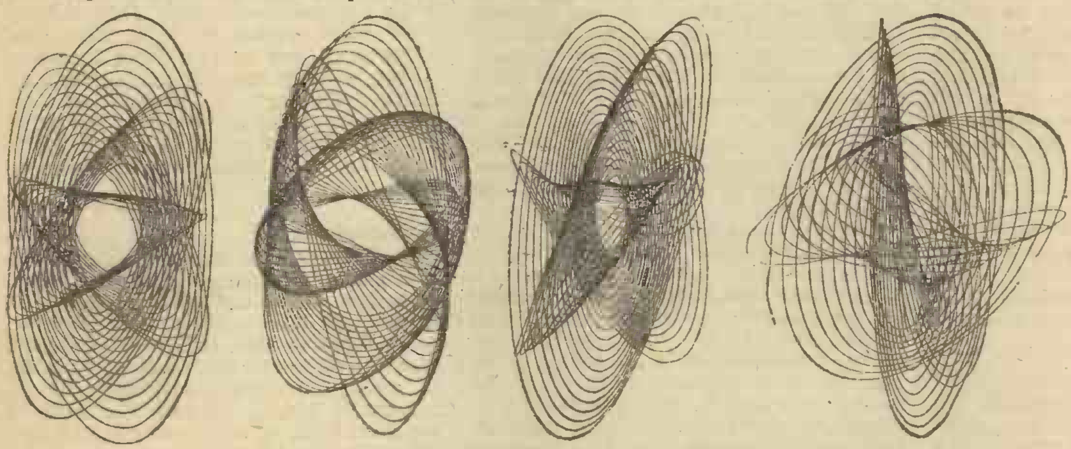


Fig. 1.—The completed instrument.

THE harmonograph described below combines the motions of two pendulums to produce complicated curves of great beauty and regularity, and the automatic repetition of these curves makes marvellous patterns. The number of different patterns that can be produced is incalculable, in fact, it is in practice impossible to get two alike. The apparatus is quite simple to make and it is most fascinating to watch a pattern such as those illustrated herewith growing quite quickly before one's eyes; the illustrations each took about one minute to produce, and though it seems almost incredible at first sight, each of them is made by one continuous line.

The Designs

The complete instrument is shown in Fig. 1. The pendulum carrying the small table at its top is mounted on gimbal bearings which allow it to move in any direction, so that it is able to swing in circles, ellipses, or straight lines. The second pendulum operates a pencil or stylus on the end of a hinged arm, and moves to and fro in a straight line only, just like a clock pendulum.



These designs were made with a pendulum harmonograph.

Commence construction by making the base board as shown in Fig. 2. It is intended that this should be screwed on to a firm table or bench, but be sure that there is no "ricketiness" about the support or the results obtained will probably show wobbly, irregular lines. Screw clamps can be used if it is not permissible to put screws into the bench or table. The two points are supports for the gimbal ring—they are ordinary wood screws with a few threads filed off and the remaining part filed to a nice point. Two small iron plates about $\frac{1}{8}$in. thick are screwed down one on each side of the elongated hole, to carry the pencil pendulum; one plate is recessed with the point of a drill, and the other has a V-groove filed across it.

The Gimbal Ring

This is simply an iron washer about $\frac{1}{8}$in. thick and 2in. to $2\frac{1}{2}$in. diameter—the hole should be about $1\frac{1}{4}$in. to $1\frac{1}{2}$in. diameter; you will probably have to file the hole out if you use a standard washer. Make a recess with the point of a drill and diametrically opposite to the recess file a V-groove. Then turn the ring over, and do the same on the other side, but be sure to make the groove and recess on one side at right angles to those on the other (see Fig. 3). Do not try to make a knife-edge bearing for the gimbal; the arrangement described is much simpler and better—unless the knife-edge bearing is made with great accuracy.

The Pendulum

This part is made of wood, except the weight, which is simply a length of very stout lead pipe weighing

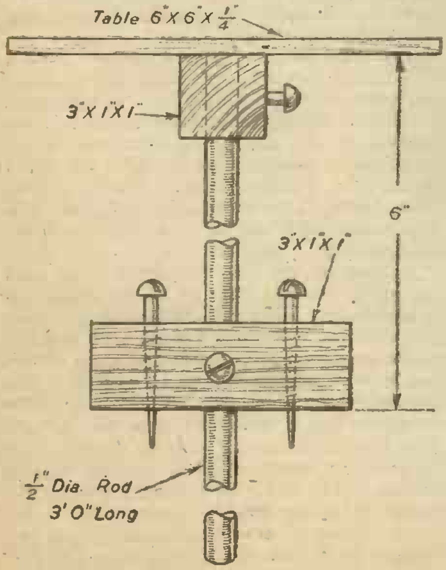


Fig. 4.—The weighted pendulum.

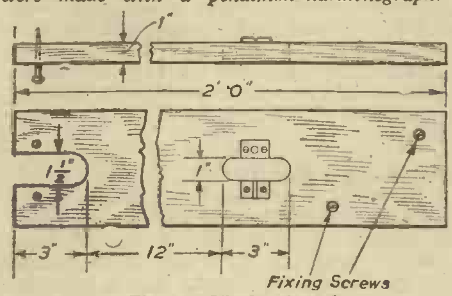


Fig. 2.—The baseboard.

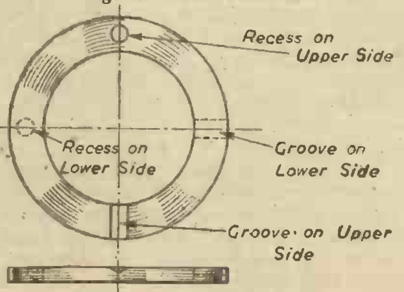


Fig. 3.—The gimbal ring.

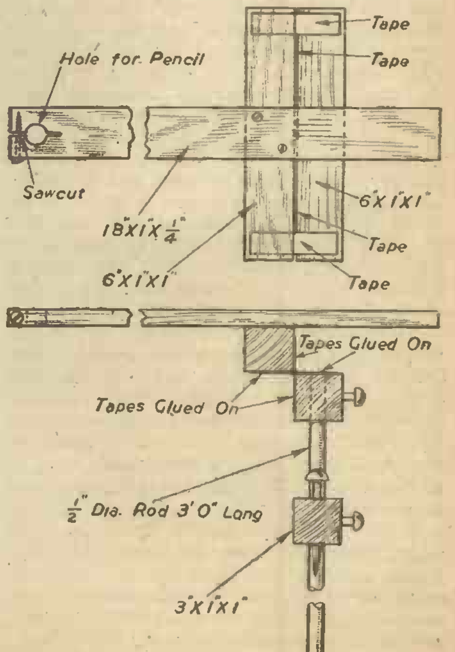


Fig. 5.—The pencil pendulum.

about 1½lb., fixed with a single wood screw (see Fig. 4). If you find it more convenient to use any other form of weight make sure that it is rigidly attached to the pendulum rod; if it can wobble about it will probably spoil the results.

The pencil pendulum is shown in Fig. 5. The arm for the pencil may be attached by a couple of small brass hinges if you prefer it, but the paper or tape hinges shown will probably give better results as they are almost frictionless and free from rattle.

The apparatus can now be assembled for trial. Put the pencil pendulum weight about halfway up the rod, and the other weight at the bottom for a start, and try any other positions you like after. You can make a few trials with pencil and paper first, using a fine pointed pencil; adjust the pressure on the pencil by arranging a small weight on the arm—putting it on one side of the fulcrum will, of course, increase the pressure and on the other side will reduce it. Set the pendulums swinging, drop the pencil on to the paper gently and watch results.

Smoked Glass for the Designs

Although pencil and paper are suggested for a trial, far better results can be obtained by using glass smoked in the flame of a candle, the line being scratched with the point of a needle. The needle should be pushed eye-end first into a piece of wood equal in size to a pencil, allowing only about ⅛in. of point to protrude. The illustrations to this article were produced in this manner, and photographic prints were then made from the smoked glass diagram, which was used like a negative in an enlarger. Although the illustrations are thickened up somewhat in reproduction, they are still much finer than can be obtained with a pencil. The needle, too, causes much less friction than a pencil, for the slightest pressure is sufficient for the needle, while that on the pencil is considerable, and this causes the pendulums to die down quicker.

The Front Wheel of Your Cycle

By "PEREGRINE"

WHAT makes a bicycle balance? This pertinent question is briefly answered by saying: "The gyroscopic effect of the front wheel," but a little more explanation is necessary for satisfaction, and consideration of the behaviour of a rotating wheel throws some interesting light on the matter.

Try this experiment when next you have occasion to remove a wheel. Hold the spindle in the vertical position with one end resting on the floor and then spin the wheel vigorously. It remains upright like a top, a rather unwieldy one, it is true, but one which shows great stability. Whilst the wheel is rotating, press horizontally on the upper end of the spindle. You experience a curious resistance, and the spindle does not move directly away, but tilts over to one side. If the wheel is turning clockwise when viewed from above, the spindle rocks over to the right. If the direction of rotation is counterclockwise, the movement of the spindle is to the left. In each case, if you press the spindle away from you, the upper end moves in the same direction (right or left) as the far side of the wheel.

An Experiment

Now, holding the wheel vertically by resting each end of the spindle in a coiled forefinger, spin it as rapidly as possible with the long fingers of the right hand. You now find that you may release the right-hand end of the spindle altogether, and the other will rest on the forefinger of the left hand, no grip being required. You notice, however, that the spindle, although remaining horizontal, is slowly pivoting about its left-hand end, and the near side of the wheel is moving towards your left arm. When it touches, the friction quickly stops rotation, and the wheel falls. If you move in unison with the wheel so as to avoid any contact, you find that the wheel will remain perched on your finger for some time, but that it turns more quickly towards you as the spin dies down, and eventually wriggles from your hand.

This remarkable behaviour is merely another aspect of what has already been noticed. As the spindle end rests on your finger, the wheel's weight would normally cause it to tilt downwards and so to fall off. When the wheel is rotating, however, the effect is to "tilt" it horizontally, that is, to cause it to turn about the supported end of the spindle.

If you hold the spindle firmly by both wing nuts, and with the wheel spinning rapidly, attempt to tilt it in any direction, you are conscious of an extraordinary resistance, and what is apparently a perverse intelligence determined to defy your efforts. If you analyse the wheel's movements, you find that in every case it replies to any attempt to twist it about one axis by turning about an axis at right angles to the first. This is called the "gyroscopic effect" and it is what makes bicycle-riding possible.

Steering Into the Fall

Your first instruction when being taught to ride was to steer in the direction in which you are about to fall. Suppose you incline to the left. You turn the front wheel to the left, the steering column forming a nearly vertical axis. The wheel responds by turning about a fore-and-aft axis, and so straightens up the machine. The gyroscopic effect arises only when the front wheel is revolving, and consequently you cannot balance a bicycle which is stationary on the road. (The freakish performances of skilled equilibrists are in a different category, and are not discussed here.)

The gyroscopic effect is reduced as the speed of rotation falls; as a result, progress at very low speed is apt to be erratic because comparatively large movements of the handlebar are required to produce the necessary righting effects. In determining the balancing power of the front wheel, the weight of the wheel is just as important as its speed; the heavier the wheel, the more effective it is in balancing. Conversely, the same influence on balance is produced by less handlebar movement with a heavy wheel than with a light one, and on first using sprint wheels after riding relatively heavy "steels," the difference in this respect is very noticeable. Until you become accustomed to the changed conditions, the bicycle usually feels rather skittish.

Balancing Effect

Balancing is thus rendered possible by the rotation of the front wheel, and the faster it spins the more powerful is the balancing effect. Notice that it is not the movement of the bicycle as a whole that is effective, nor can the back wheel offer any assistance. A stationary bicycle may be balanced when ridden on a home trainer, but only if the front wheel rotates. The two drums which support the wheels are connected, not to "make it harder" but merely to keep the front wheel turning, and thus to make balancing possible.

It may be said that a cyclist maintains his balance by subconsciously correcting all disturbing influences through the gyroscopic effect of the front wheel. If he tends to fall to one side he turns his wheel to that side. But that is not quite true, or at least it is not all the story. The wheel itself tries to reply to the tilting effect of falling by turning in the same direction, as may be confirmed by considering the observed gyroscopic effect when it is used as a spinning top. It would be nearer the truth to say that the rider merely allows the wheel to straighten him up by turning to one side when he threatens to fall, and resets his course when balance has been restored. The art of balancing a bicycle is so quickly acquired by a novice that one need not be ungracious to ascribe much of the credit to the machine itself, and this is borne out by the ease with which it is usually possible to ride a bicycle "hands off." Then, steering is obviously effected by slight movements of the body and not by direct handlebar control, and the same is true in ordinary riding. Contrary to appearances, the machine is steered by body movement, and the handlebar effort is required only to emphasise the front wheel's effect on balancing.

Gyroscopic Effect

To show that the balancing of a bicycle is a use of gyroscopic effect, is a partial explanation which still leaves something to be desired. The mathematician might be well satisfied to leave it at that. He could draw two or three lines, speak of "moment of inertia," "angular momentum" and so on, and be able to calculate the result of any disturbance of the bicycle's equilibrium. He might even be able to predict gyroscopic effect without ever having seen a bicycle or a spinning top, but his methods would be meaningless to the average reader who may desire to be told in words what exactly does happen when a rotating wheel is tilted. To meet that desire, let us consider what bicycle balancing demands.

You must be able to give yourself a push in the direction of safety when the machine threatens to fall. How can you do that without touching some fixed object? One method is demonstrated when you throw away some weighty article (for example, a speedman's feeding bottle) whilst riding. You throw it away on the left, and you experience a push to the right, usually evidenced by a slight swerve.

So long as you carry the bottle along with you, it is moving parallel to the road, but in throwing it aside, you change the direction of its motion. When it has left your hand to reach the grass, its path, viewed from above, lies at an angle to the road, since it is still approximately abreast of you when it comes to earth, but is some feet away on the left. You have deviated its path to the left, and in doing so you have given yourself a push to the right. This illustrates a mechanical principle which may be summarised thus: "Alter the path of a moving body, and you experience a push in the opposite direction to the deviation."

Masters of Mechanics—90

The Remarkable Count Rumford

Theorist, Mechanic, Inventor and Scientific Adventurer

AS a physicist, a mechanic and inventor, a military commander, a politician and a social reformer, the versatile Count dominated his circle in Europe for many years. His vital personality found its way into the learned journals of his day and, also, into the comic cartoons of the period. It was a personality which smacked strongly of the romantic, one which deeply impressed itself upon the scientific circles of the time.

To detail, even briefly, the various happenings of Count Rumford's meteoric career would be impossible without composing at least a small book about him. All we can do here is to give the reader an outline picture of this most remarkable and by no means entirely faultless man who flitted so prominently about the European stage in the days during which the great Napoleon Buonaparte was attaining the zenith of his power.

Plain Ben Thompson

Count Rumford came into this world as plain Benjamin Thompson. He was born at Woburn, Mass., U.S.A., on March 26th, 1753, his family being of British origin. The Thompson family at Woburn was a very lowly one. Nevertheless, young Benjamin was given the best education possible, and in his early teens he started life as an assistant to a "dry goods" merchant. Such an occupation not being to his liking, he attended lectures in medicine at Harvard, and later he became a junior schoolmaster at a village named Rumford (which village subsequently changed its name to "Concord"). Here, before he had reached the age of twenty, he married the local squire's widow, a lady who was considerably older than himself. The lady was possessed of money, together with a considerable farm estate. Thompson at once gave up his schoolmastering and settled down to farming and to the administration of the estate.

It was during this early part of his career that Benjamin Thompson, the future Count Rumford, undertook his first scientific or, rather, quasi-scientific investigations. He endeavoured to improve the qualities of gunpowder, and like many an illusioned individual had done before him, he expended long hours in endeavouring to discover the secret of perpetual motion.

Whether it was due to the gunpowder or to the perpetual motion is a moot point, but the fact remains that very quickly Thompson quarrelled with his wife. Their relations were not of the happiest. And when Thompson was imprisoned during the American War of Independence for his avowed sympathies with the English Government, a separation took place, and Thompson crossed over to England, never to see his wife again, although it is said that, twenty-two years afterwards, he received a visit from the infant daughter which he left behind in America.

It was towards the end of the year 1775 that Benjamin Thompson reached London. He had acted as a major in an American militia regiment before his trial and imprisonment for "foreign sympathies." Apparently his adherence to the English cause had so greatly impressed the British Commander, General Howe, that the latter entrusted him with certain dispatches for London.

Under-Secretary of State

Arrived in London, Thompson presented his credentials, together with the dispatches, and he was given a clerkship in the Colonial Office in view of his detailed knowledge of the then American colonies. Within a few years he became Under-Secretary of State in the Colonial Ministry in London. He then entered upon his first serious experiments, which again concerned the subject of gunpowder, and, more particularly, its use in the British Navy.

In 1779 Thompson was admitted a Fellow of the Royal Society and, in the same year, he was given the rank of colonel in the British Army, in view of the study of military tactics which he had made over a number of years.

Four years later, Thompson, ever of a restless, roaming disposition, travelled the Continent, visiting Munich and Vienna. At Munich the Duke of Bavaria, who was evidently a shrewd judge of character and ability, offered Thompson congenial and well-paid employment in his service. The offer was virtually accepted by Thompson, who returned to England, and more or less demanded his release from his British Government posts. His demands were granted, and, as a sort of parting gift, George III of England (who was, of course, of thorough German descent) sent Thompson off to Bavaria with the honour of knighthood!

Thompson's career at Munich was, scientifically, perhaps the most creative part of his lifetime. He not only carried out experiments which made his name famous, but he seems, also, to have gained for himself the position of a beneficent dictator, for he administered public affairs in Bavaria, made social laws, carried various social reforms into practice, and played generally the rôle of a wise and patriotic statesman.

Privy Councillor

Not only did he become a privy councillor of State in Bavaria, but, acquiring rapidly a fluent command of both German and French, he was advanced to the rank of general. Ultimately he found himself at the head of the Bavarian War Office!

Thompson dabbled intensively in military matters. He carried out all sorts of public works, reorganised industries, planned social reforms, revolutionised the army conditions in Bavaria and elsewhere, and was successful in very greatly ameliorating a source of unemployment which, for years, had swept southern Germany and other parts of the Continent.

The Pope recognised much of Thompson's social work and, as a reward, created him a Count of the Holy Roman Empire, a papal honour which persists to this day. Thompson took the name of "Count Rumford" by way of association with the American village (later turned "Concord") which saw the opening of his life's career. It was a title which he prized highly, and which he used exclusively ever afterwards.

Sir Benjamin Thompson—Count Rumford.

Right in the middle of his programme of military and social reforms Count Rumford found time to study philosophy, science, and economics. His was a mind which readily attained a grasp of fundamentals. Had he confined his energies to one or two subjects, the Count would undoubtedly have made discoveries of the first order. But science, to him, was more of an intellectual amusement than anything else. Probably it afforded him a much-needed relief from politics.

Had Count Rumford lived at the present time he would undoubtedly have had control of one of our planning Ministries. He produced a plan for every field of activity into which he entered. Most of his plans were good ones; only a few were the reverse.

It was during his work at Munich on the boring of cannon that Count Rumford carried out his experiments on heat, which proved of such great significance in our understanding of heat principles.

"Caloric"

Heat, in Rumford's days, was philosophically considered to be an actual substance, a form of matter which was given off by a body when it burned. It was called "caloric," a name which persisted long after Rumford's time.

One of Count Rumford's early experiments at Munich (and also in London) was to prove that a substance weighs exactly the same when it is hot as it does when it is cold. Hence, concluded the Count, there can be no passage or departure of a material substance from a body merely on account of its having given off heat. Such an assertion, however, left the "caloric" upholders quite undaunted, for they at once retaliated by declaring that the mysterious heat substance which they called "caloric" was entirely a weightless material! This argument, also, they brought forward when Count Rumford showed that water neither gains nor loses weight when it changes into ice, or vice versa.

In the munition sheds at Munich Count Rumford performed pioneer experiments on heat. He noted that, during the boring of cannon, a blunt tool generated an undue amount of heat. He further observed that this heat was created continuously so long as the boring continued. By surrounding a portion of the cannon barrel with a wooden box containing cold water he was able to bring the water to its boiling-point and to maintain it in a boiling condition merely by the friction of the boring tool.

All the motive power he employed for this purpose comprised a couple of strong horses which were tethered to a wheel-train revolving the borer.

Nature of Heat

After many such experiments, Count Rumford, in his Munich munition factory, comes to grips with the philosophical problem of the nature of heat. "What is heat?" he asks. "It cannot be a material substance, for it apparently comes from nowhere."

And then, the first glimmer of the truth dawns upon him.

"It appears difficult, if not quite impossible, for me," he writes, "to imagine heat to be anything else than that which in this experiment [i.e., of cannon boring] was supplied continuously to the piece of metal, namely—*motion*."

Here, Count Rumford, in virtue of his flash of genius, comes bang up against the truth. Heat *is* motion, motion of the inherent particles of the heated substance. If you heat a body you merely increase the mass motion of its particles; if you cool it, you take away from that motion.

Had the Count not been so busy with other interests, he might have successfully carried his thesis concerning the nature of heat against all the opposition with which it became faced. As it happened, however, the stupid "caloric" theory lingered some forty years after Rumford's death, until James Prescott Joule, of Manchester, gave it the final death-blow with his comprehensive generalisations relating to the nature of energy and, in particular, heat energy.

The "Smoke Doctor"

In 1795, Count Rumford returned to London. He seems at this time to have become infected with a plan for revolutionising the fuel consumption of Britain. He invented a new type of domestic fireplace which achieved considerable vogue on account of its anti-smoking qualities. It gained for Rumford the name of the "smoke doctor," and it was followed by numerous other patented fireplace and chimney constructions, all of which aimed at the same object.

Other inventions due to Count Rumford at this period comprised various systems of steam heating (he seems to have been a veritable pioneer of central heating), cooking stoves, non-smoking chimneys, ventilation and air conduits and hot-water baths. The versatile Count even carried his mechanical interests and abilities to the construction of broad-wheeled "silent" carriages, and to the devising of several types of portable lamps.

But, as we have already mentioned, Count Rumford's interests were far too diverse and widespread for him to concentrate intently upon any one of them, or upon even a single group of them. Many of his inventions, particularly his patent fireplaces, brought him much financial gain, even if they did not greatly advance his scientific reputation.

The Royal Institution

This country, however, has one great debt of memory which it owes to Count Rumford. It is in respect of his initiation of Britain's "Royal Institution," that world-famous edifice of science in London which is so inseparably connected with the illustrious names of Davy, Faraday, and (in our own days) of Bragg. Although Count Rumford was not the sole founder of the Royal Institution, it was his idea, and it was he who took the major part in its formation. Indisputably, the Royal Institution in London is Count Rumford's surviving and lasting monument.

It was in January, 1796, that the Count first mooted the idea which ultimately blossomed forth into the now famed Royal Institution. His original idea (following the lines of his social reform schemes) was to bring into existence a central organisation for providing food for the poor and for "introducing and bringing forward into general use new inventions and improvements, particularly such as relate to the management of heat and the saving of fuel, and to various other contrivances by which domestic comfort and economy may be promoted."

Here we see the Count in one of his social planning rôles. His scheme also included "the formation of a grand repository of all kinds of useful mechanical inventions." In a word, the new Institution was to function as a sort of cross between a philanthropic society and a dispenser of applied science.

At a later date, Rumford modified his proposals, concentrating more on the scientific aspect of his projected institution and leaving the social side of his project to other societies. In 1798, the proposal which the Count put forward was for "the forming by subscription in the Metropolis of the British Empire a public institution for diffusing knowledge and facilitating the general introduction of useful mechanical inventions and improvements, and for teaching, by courses of scientific lectures and experiments, the application of science to the common purposes of life."

Rumford's views prevailed. His projected institution came into actual being, and, in 1799, it received a Royal Charter from George III.

After the turn of the new century, Rumford's attention turned to other objects. He seems to have lost interest in his Royal Institution. Nevertheless, he unconsciously rendered a service of the highest order to science when, in 1801, he selected the future Sir Humphry Davy as the first Director of Laboratories of the Royal Institution.

Madame Lavoisier

In 1804, Count Rumford left England to reside permanently in France. His American wife was now dead, and he had formed an attachment with another widow, on this occasion the widow of the great French chemist, Lavoisier, who had been guillotined by the French revolutionists in 1794.

In 1805, Count Rumford married Madame Lavoisier, but, once again, the marriage was not a successful one. No doubt Madame Lavoisier had many justifiable grievances, for her husband certainly had many eccentric habits, one of the most persistent of which was his practice of walking about the streets of Paris clothed entirely in white, in order to test and confirm some theory of his concerning the transmission and radiation of heat. Perhaps, too, Madame Lavoisier had her own strange temperament. At any rate, after three of four years, the two parties separated, and the Count lived on at his villa at Auteuil, near Paris, until his eventual death on August 21st, 1814.

Much of the wealth which Count Rumford amassed as a result of his many-sided activities was left by him to scientific institutions, including the Royal Society, in London, and the American Academy of Arts and Sciences. He left a fund for the purpose of founding a professorship of physical science in the American University of Harvard, the institution where he had first unsuccessfully attempted to study medicine.

It is not easy to assess the merits of Count Rumford's career. He was without doubt a scientist who plunged into deep theoretical considerations, yet, at the same time, he made not a few essays in the art of mechanical invention. As a "planner" he had his uses. Perhaps, indeed, in the future age of planning which seems to be promised us, he may be hailed as a pioneering spirit!

At all events, Sir Benjamin Thompson, or Count Rumford, as he preferred to call himself, was a scientific man who left his mark upon the scientific world of his day. The present-day Royal Institution, in London, is his tangible monument, and had the worthy Count done nothing in his lifetime other than found this deservedly famed home of scientific discovery, his name would have well merited perpetual remembrance in the romantic record of scientific and inventive endeavour.

Books Received

Fitting, Small Tool Making, Lathe Work and Screw-cutting. By A. E. Leeson, B.Sc., and Peter Sampson. Published by Sir Isaac Pitman and Sons. 88 pages. Price 3s. 6d. net.

THIS handbook presents in pictorial form the outlines of a fitter's work. Each drawing is accompanied by a few explanatory words. The plan adopted is to show on the left-hand page the essential hand and machine tool operations, and on the facing page the application of these operations in making a series of useful fitter's tools. To make the book more comprehensive many secondary operations are concluded. Throughout the book careful attention has been paid to the basic principles of tool design and preparation, the utilisation of tables, and the principles and use of various gauges and machine tools.

Locomotives of the Cambrian, Barry, and Rhymney Railways. Locomotives of the Smaller Welsh Railways, and of the Midland and South Western Junction Railway. By M. C. V. Allchin. Published by the author at Fareham, Hants. Price 1s. 6d. each, net.

THESE two booklets are the first and second in the new series of Locomotive Registers and replace earlier editions of several years ago. The subject matter has been revised and corrected, and the information given is arranged in numerical order of the running numbers, and covers all locomotives in service immediately prior to the amalgamation. Works numbers are included, and details include wheel-types, building dates and subsequent grouping numbers.

Basic Calculations for R.A.F. Ground Duties. By A. E. Druett, B.Sc. Published by Sir Isaac Pitman and Sons, Ltd. 80 pages. Price 3s. 6d. net.

THIS handbook has been written primarily for airmen engaged in the Radio and Electrical Trades of the Royal Air Force. Cadets of the Air Training Corps who are training for any of the ground duties will find that the syllabus in Calculations for the Proficiency Examination is adequately covered. The examples at the end of each chapter which have been prepared are specially applicable to the trades concerned. Solutions to examples given in the text are included at the end of the book.

Electric Motors and Dynamos—1

Notes on Running and Selection

By H. SANDERS

WITH standard machines, the manufacturers normally send connection diagrams, and the instructions given on these for connecting up should be carefully followed. If feasible, the motor should be run light without any load for from 15–30 minutes. This is not absolutely essential, as all motors have usually had a test run at the makers' works before despatch. Most motors, with the exception of some of the smallest fraction h.p. types, have the terminal box cast integrally with the motor frame, and are screwed for conduit entry. If the motor is mounted on slide rails or on a movable base, it will be found advantageous to use a short length of flexible tubing at the motor end. The same method should be used when connecting up to the slip rings on an external slip ring machine.

Rotation

To alter the direction of rotation on induction motors and D.C. machines, the procedure shown on the accompanying diagram should be followed. On D.C. compound wound machines or D.C. motors with a wide speed variation, it may be found necessary to alter the position of the brush rocker in addition to altering the connections.

Some two- and three-phase machines, such as small squirrel cage motors, and all slip ring machines are fitted with either three or four terminals only. In such instances it is only necessary to reverse one pair of leads to alter the direction of rotation.

Machines of protected type should not be used under extreme conditions of dust, dirt, sand, abrasives, moisture, chemicals, or injurious and explosive fumes. There is a correct type of motor for each application, and in doubtful instances the maker should be consulted.

When motors leave the makers' works, the bearings are usually well packed with grease, and so long as they are not operating in a hot atmosphere, these bearings should not need attention for two or three years. At the end of that period it is advisable to remove the outside cap and re-pack with grease. Faults due to over-lubrication are far greater than those due to under-lubrication. In no circumstances must oil or grease containing graphite be employed.

Bush Bearings

Before starting up the motor, the oil wells should be filled through the filler with good quality machine oil, care being taken to ensure that surplus oil is kept well away from the interior of the motor. The bearings should be periodically inspected, and necessary oil added through the oil filler. On machines fitted with oil ring bearings, the oil ring should be in the correct position on the shaft, which point should be checked before the cover is replaced. When machines are started, those fitted with plain bearings, and run for the first time, should be run for half an hour on no load before the load is applied.

With slip ring type motors, two- or three-phase, it is advisable to see that dust, grit, etc., are not allowed to come into contact with the slip rings or brush gear. With internal slip ring machines, the fan fitted to the rotor shaft keeps the inside of the machine comparatively clean, but if the conditions are bad, an external slip ring machine with enclosed slip rings should be employed. The brush gear should be examined from time to time for brush wear and spring tension, and where brush lifting gear is fitted, an occasional smear of grease on the operating rods is recommended. Trouble may be experienced with brush gear if the machine is subjected to excessive vibration. If a belt drive is used, care should be taken to see that the joint or fastener (if any) does not cause the motor to vibrate badly when passing over the pulley. Single phase motors of this type need the same attention.

Squirrel Cage Motors

Squirrel cage motors of two- or three-phase type are so trustworthy that no special instructions are necessary. The single phase are wound either suitable for use with a resistance starter, centrifugal switch, or other types of two-position switch.

With a centrifugal switch, the only external starter necessary is an ordinary double-pole switch. It will be observed when starting up that a flash occurs at the centrifugal switch as the starting winding circuit is broken. This is not detrimental under ordinary conditions, but should the duty call for frequent starting or frequent heavy overloads, causing the switch to operate frequently, this type of motor should not be used.

When starting up, the machine may crawl round accompanied by continuous flashing at the centrifugal switch. This is usually a sign that the starting load is too heavy for this type of motor. A further cause of poor starting is low supply voltage. This may be due to the motor's being at the end of a feeder, or to the cables, switches, etc., used in wiring up not being strong enough to carry the starting current. It should be noted that the starting current of this type of motor may reach the figure of eight times the full load current momentarily. Fuses, etc., must, therefore, be of sufficient strength to meet these conditions.

Repulsion Start Induction Motors

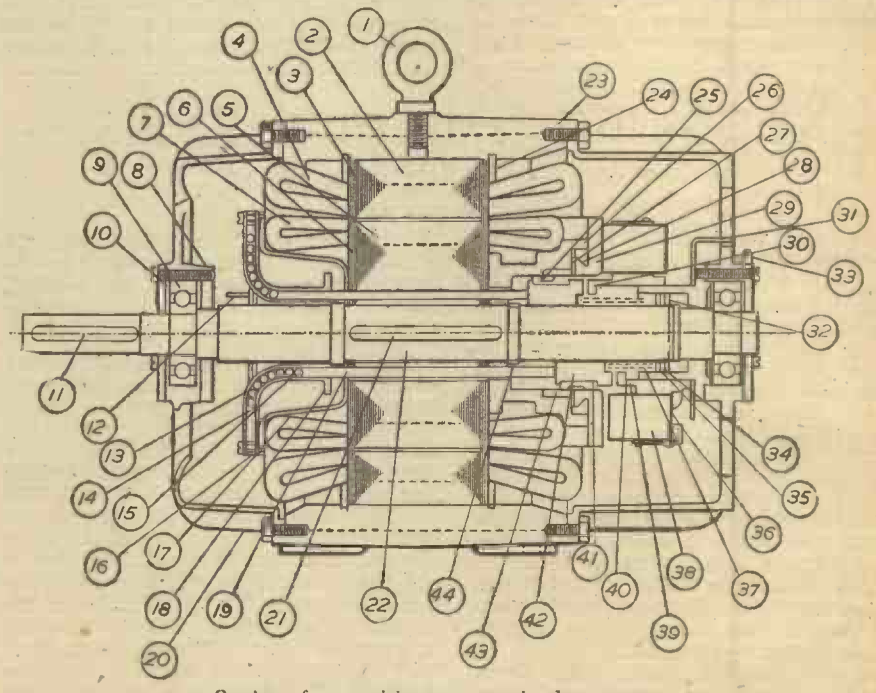
If the machine rotates in the wrong direction for requirements, the screws that clamp the rocker should be slackened off one turn only, and the rocker moved until the pointer on the rocker comes exactly opposite to the other mark on the end cover. In some instances it may be necessary to move the vent covers to see these marks.

The brushes should touch the commutator for a few seconds only, during the starting period. If the governor does not act, the machine is probably overloaded. The governor gear should on no account be operated by hand. It is designed to operate by centrifugal force, and is adjusted accordingly.

Dual voltage machines are wound for the two voltages given on the nameplate.

Direct Current Machines

In starting, the user should make sure that there is an even pressure on all brushes. This should be at the rate of 2lb. per sq. in. of brush contact area. The starting switch should be right across to the left-hand stop



Section of a repulsion-start single-phase motor.

1. Eye Bolt	12. Fan Blade	23. Shell	34. Seating
2. Stator Plates	13. Tube	24. Clamp Ring	35. Washer
3. Stator End Plates	14. Governor	25. Short Lace	36. Brush Spring
4. Stator Windings	15. Balls	26. Comm. Hub	37. Spring
5. Armature Plates	16. Packing Piece	27. Comm. Nut	38. Brush
6. Armature End Plates	17. Cup Winding	28. Insul. Washer	39. Rocker
7. Armature Windings	18. Tube Holder	29. Comm. Bar	40. Spring Holder
8. Cap	19. Pressure Rods	30. Rocker	41. Short Lace
9. Bearing	20. End Cover	31. Pointer	42. Sleeve
10. Thrust Washer	21. Feather Key	32. Spring Key	43. Short Ring
11. Feather Key	22. Shaft (35/40 tons tensile)	33. Nipple	44. Spring Key

The main switch should be closed and the starter operated slowly. Rapid operation of the starter will cause serious damage to the motor.

The machine should be speeded up on open circuit, and the field resistance then gradually switched out, the voltmeter being observed. When the correct voltage is obtained, the main switch may be closed and the machine fully loaded. The field circuit should never be broken while the machine is running. A shunt regulator is essential.

It is important that the commutator should be kept free from grit and dirt. It should be examined twice a week while the machine is running, and should be practically sparkless under all conditions. If sparking does occur, it should immediately be cured or serious trouble will soon arise. The brushes must be perfectly free in the holders and, if removed, must be replaced in exactly the same position.

The insulating washers on the brush spindles, terminals and windings should be kept free from dirt. The safest way to do this is to use a pair of blow bellows and a clean rag.

Fitting New Brushes

In fitting new brushes, care should be taken to ensure that the new brush is perfectly free in the brush holder, and that the flex does not foul the lever. A strip of glass paper larger than the brush should be drawn backwards and forwards underneath the brush. The paper should be kept flat to follow the contour of the commutator. When the brushes are worn down to less than ⅜in. in length, they should be at once replaced.

Unless otherwise specified, machines are set with the brushes on the neutral point, and will commutate running in either direction from no load to full load without any alteration to the rocker. If rotation is specified, either by the maker or by the purchaser, the machine is not reversible without rocker adjustment.

Many motors are capable of having the speed increased by shunt regulation, the amount permissible being usually given on request. If shunt regulators are used to any extent, it may be necessary to adjust the rockers slightly to prevent hunting.

Fractional H.P. Motors

If it is desired to reverse the rotation of the D.C. machines of fractional h.p. type, the covers over the brush holders should be removed, the lead from the right-hand brush holder removed, and interchanged with the left-hand one. This does not apply to all machines. With those wound for 2,800 r.p.m. the ordinary diagram for shunt wound machines holds good. For machines not fitted with leads the connection diagram should be studied.

Split phase induction motors may be either fitted with leads or without leads. In the former case, the maker should be consulted as to the correct leads to be connected together to give the rotational direction required. For machines without leads, the connection diagram should be studied.

Types of Motors for Various Applications

The following notes apply to motors for ordinary industrial applications, and do not attempt to deal with special drives.

D.C. motors are usually of one of three types: (a) shunt wound; (b) series wound; (c) compound wound.

(a) Shunt wound motors are widely used and have fairly constant speed against varying load. The starting torque is good, being in every case equivalent to full load torque. This, however, depends on the value of the resistances incorporated in the starter. Except in the smallest sizes, e.g., up to ½ h.p., they should not be switched directly on to the line without a starter. The rated speed may be increased by inserting a suitable shunt regulator in the field circuit, but there is no increase in h.p. if the speed is increased in this manner. If a shunt regulator is used, the motor should never be started up with a weak field, i.e., with the regulator set for maximum speed.

(b) Series wound motors are particularly suitable for heavy starting loads, and where the apparatus is required to get up to speed quickly from rest, such as lifts, cranes, haulage gear, etc. As the speed at which these motors run is entirely dependent upon the load applied, they should not be left unattended should there be any likelihood of load variation, as if the load should fall, the speed would rise to a dangerous degree, possibly up to a point where the armature might burst owing to centrifugal force.

(c) Compound wound motors combine the characteristics of both shunt and series wound machines. The series winding gives good starting torque, while the shunt winding gives comparatively constant speed. The amount of compounding can usually be varied to suit the particular applications for which the motor is intended. They are specially suitable for driving equipment where there are large fluctuations in load conditions, such as printing machines, planers, etc.

Small compound wound machines may generally be wound suitable for direct starting without the use of a resistance starter.

Dynamos

Dynamos for direct lighting without batteries should be compound wound, as this type is better able to maintain constant voltage under varying load conditions, thus minimising the danger of burnt-out lamp filaments. For battery charging and for lighting, when a battery is also used, a shunt wound machine is used having a voltage range by shunt regulation sufficient to charge the whole of the battery at its correct charging rate irrespective of the condition. The following table gives the sizes in most general use.

Battery No. of cells	*Dynamo Voltage Range*
12	25/37
24	50/75
36	75/105
50	100/140
100	200/280

The author expresses his acknowledgments to Messrs. Higgs Motors, Ltd., Witton, for the information on which this article is based.

(*To be continued*)

Repairing Alarm Clocks

The Fork : Testing Escapement

(*Continued from page* 31, *October issue.*)

The outer wheel resembles a cylinder with a set of 'scape wheel teeth on the inside of the rim, the two sets of teeth are in the same plane and the single pin pallet oscillates between them, but as there is very little free movement of the pin no click or tick occurs, the whole action being much more continuous and smoother than in the usual type of alarm clock. Here again repairs will not differ very largely in principle from the usual practice, the pin pallet may require replacing, but it is more particularly important to make sure that the renewal is exactly the same gauge as the original since it has to work on both sides. Damage to the 'scape wheel can hardly be repaired satisfactorily and, in general, it will be necessary to obtain a new wheel, otherwise there is little further that is likely to arise in the way of repairs.

Before leaving this subject it may be as well to point out that a number of alarm clocks have been ruined completely owing to the impulse surfaces of the 'scape wheel having been filed or scraped to make them smoother, this must never be done since, it will now be understood, to do so reduces the pressure which the 'scape wheel exerts on the pallets so that the power transmitted to the balance wheel is very much reduced and merely increasing the depth to which the pallets enter the 'scape wheel will not properly remedy the trouble, nothing can be done except purchase a new 'scape wheel, which is often impossible.

The Fork

Turning now to the other end of the lever we see that besides the actual fork itself there is a further complication which consists of either two auxiliary arms, rather like horns, situated one on each side of the actual fork which, therefore, appears to have four arms, or else underneath it is mounted a small pin projecting forward towards the balance wheel staff, this is called the safety pin and its purpose is the same as that of the two safety arms which provide the alternative to it, that is to say, they are intended to prevent the fork from moving across to the other side of the balance staff while the ruby pin is travelling round to the back. The ruby pin is mounted either on part of the balance wheel, not necessarily on the centre line of a spoke, or else on a separate collet known as a roller and the safety pin, if one is fitted, then works with a second roller below the first. The second roller has a notch cut in it immediately underneath the ruby pin and the length of the safety pin must be such that it rubs against the roller when the notch, and therefore the ruby pin, is turned to one side so that the lever is prevented from crossing to the other side of the staff. When the ruby pin and the notch return, the end of the safety pin can cross to the other side but the length must not be great enough to touch the balance staff at the bottom of the notch. This arrangement is, however, more expensive and fails if the safety pin happens to become loose, so that it is more usual to find the other type where the same security is provided merely by one or other of the exterior arms coming into contact with the balance staff if the lever receives a blow while the roller is out of the fork, this will occur if the clock is knocked or moved suddenly or overwound, and it is possible that the lever may be struck so hard on the wrong side by the ruby pin coming right round that it may literally bounce across to the other side of the staff in spite of the safety device

Testing Escapement

The balance and lever having been correctly assembled the escapement may now be tested to see whether it functions correctly. It is better not to wind the main spring yet, but to press very gently on the third wheel (not the fourth as pressure there is bound to be too strong) making sure that the wheel is being turned in the right direction, that is, in the same direction as the 'scape wheel (which can be ascertained from the direction of its impulse surfaces) and the great wheel, all of which turn clockwise when viewed from the direction of back plate. (*To be continued.*)

Timber Yard Practice

Selection, Seasoning and Preservation Hygiene

TIMBER may be classified into two categories, namely, hard and softwoods.

Hardwoods

These are obtained from broad leaved trees, e.g., oak, ash, beech, elm, mahogany, teak, ebony, lignum vitæ, etc. They are stronger and heavier than softwood, but some are actually softer; they contain very little resin.

Softwoods

Obtained from cone bearing, needle-shaped leaved trees, e.g., pines, and spruce, woods such as these are termed "deals," being cheap and easily worked, some species contain resin.

All timber may be bought ready for use, but in the case of home-grown timber this is not always done. It is easy to distinguish home-grown from imported timber at a glance. All home-grown timber is planked out of logs without being squared up, ash always being cut up with the bark on; oak is nearly always stripped, as the bark is used for tanning leather. The foreign timber is always squared up, and is imported ready sawn into planks of various thicknesses. One reason for this "squaring-up" is that in transporting the wood from its source of origin it occupies valuable space, and a glance at a log of planks (English timber) will convince anyone that it would be very wasteful to occupy shipping space with such irregular planks (especially to-day). Therefore it is more economical to cut away irregularities and send woods which will pack closely.

If timber is bought as being dry, it is well to deal with firms of repute. When facilities are at hand for storing, then it may be bought as convenient. It should always be stored for drying in suitable sheds until it is required for use, careful records being kept of the dates when it was laid down.

Timber is felled when the sap is at its lowest ebb, and this is in the winter when it is practically dormant. The sap rises and flows back in part at the fall of the year, making during this process a fresh ring of growth. This growth can be observed from a cross section of a felled tree trunk, where it will be noted (a) heartwood (darker colour) is surrounded by (b) sapwood (light colour).

(a) only used, is dead sapwood.

(b) not used, due to being weak and unreliable, as stated above the sap or food each year deposits a surrounding layer of heartwood; spring deposits porous; summer deposits dense.

When timber is felled at this time of the year the wood is strong and elastic, and should have a moisture content of 12 per cent., as stipulated by the B.S.I. Std. 373-1929. This moisture content is determined by weighing a certain amount of a given sample; drying in an oven until it ceases to lose weight and then weighing again. Its calculated moisture percentage is as follows:

$$\frac{\textit{Original Weight} - \textit{Dry Weight}}{\text{M} - \text{C} - \% = \text{D} - \text{W} -} \times 100.$$

Having got the timber cut into planks, the next matter to consider is the methods and periods of seasoning.

Natural Seasoning

The general principle for this method is as follows:

The timber when cut from the log is stacked in the open air or drying shed (subsequent paragraph) with narrow strips of wood, called battens, placed between the lengths of timber to allow the air to circulate round all the surfaces. These methods of seasoning require from three to ten years, according to the size and condition of the timber, to reduce the moisture.

The best shed for the purpose of drying (seasoning) is one built with solid walls east and west, a honeycomb wall on the south, and the north side open, but with well overhanging eaves.

The honeycomb wall is built with holes the size of the end of a brick left between each brick. Such a shed will exclude all rain and sun, but will be free to all winds. The floor may be prepared or clear of the ground, so that the air can freely circulate under the bottom planks. Too much stress cannot be laid on the matter of free air anywhere. If stagnation is present then there is early decay, either damp or dry rot, and such rot is infectious and soon spreads to more favourably situated timber.

A point of importance is to see that the packing or battens are square and true to ensure a flat plank when seasoned. The stowage of wood is not dependent on the use of a honeycomb walled building, but it will be found a definite advantage over other type constructions. Care should be taken to ensure full efficiency as to not allowing the encouragement of ingrowing weeds or vegetable growth.

Sheds with one side open should have overhanging eaves on that side, as the absence of direct sunshine and rain is as important as free air circulation. Oak need not of necessity be assembled under cover provided that it will not be subjected to wetness or having the sun playing directly on it. A covering of any scrap material will prevent deterioration, providing free air circulation is allowed for. The timber should not lie in a forest of weeds or long grass, as moisture is conveyed from these plants.

TIMBER SELECTION CHART.

Name.	Source of Supply.	Uses.	General Remarks.
		HARDWOODS.	
Ash	Great Britain	File handles and hammer shafts	Brown-white colour, yet easily worked, close grained, smooth to touch.
Beech	Great Britain, America and Europe	As above	As above.
Birch	Great Britain	As above	Similar to beech, but darker in colour, and not so easily marked.
Ebony	Ceylon	Tool handles, high-class joinery and furniture	Black in colour, with streaks of green, weighs 67lb. per cubic foot, therefore sinking in water.
Elm	Great Britain	Piles (under water) and similar work exposed to wet and damp conditions	Brown in colour, tinged with purple, weighs 41lb. per cubic foot, tough and coarse grain.
Lignum Vitæ	West Indies	Rulers, pulley blocks and sheaves, under-water bearings, tool handles	Very similar to ebony, but more brown in colour, containing natural oils.
Mahogany	Honduras or Cuba	High-class joinery, cabinet making and coach building	Sometimes brown, yellow or red in colour, shiny, close and hard in grain.
Oak	Grown in many parts of the world and existing in many varieties	Internal joinery, ship building, cabinet work, etc.	English oak is generally silver grained, weighs approximately 48lb. per cubic foot, warps and shrinks, contains tannic acid which quickly corrodes ironwork.
Plywood	Various	Panelling and pattern making (where unobserved), e.g., draw bottoms	Thick boards 1/16in. glued together, grain of each sheet at right angles to next giving greater strength and stiffness than solid boards.
Sycamore	North of England	Domestic woodware, pattern making	White or yellow in colour, close grained and reliable.
Teak	Southern India and Burma	Carriage doors and shipbuilding	Brown and tinged with yellow in colour, straight grained, fireproof and insect proof.
Walnut	West Indies	Good class internal joinery and furniture	Characteristics of mahogany, purplish brown colour, close grained.
		SOFTWOODS.	
American Whitewood or Canary wood	America	Partitions and framework, panelling	"Canary" yellow (hence its name), fine even grain free from knots, liable to warp.
Firs and Spruce "deals"	Norway, Riga, Russia, Sweden	Floor boards, joists, rafters, roofing, pattern making, common joinery	Either white or yellow in colour, cheap and easily worked, resinous.
Kauri Pine	New Zealand	Internal joinery	Light brown colour, easy to work, free from knots.
Pitchpine	North America	Floor boards and partitions	Light reddish brown in colour, rather hard and resinous.
Red Deal	Europe	Windows, outside work, roofs	Red in colour, heavy and resinous.

When laying timber up for drying, having the necessary space, between the planks (about 2ft. apart) are laid true battens, pieces of waste wood of equal thickness. A procedure after cutting planks is to strap the ends of the wood with a piece of hoop iron. This is to prevent the planks from splitting on drying. Splits small in nature will occur no matter what precautions are taken, yet this procedure is a means of reducing such injuries. This splitting tendency is due to the natural movement of the wood drying, the outer part of the plank shrinking more than the centre.

After hardwoods are planked they should lie under the best conditions. If the period from felling the tree to its final stacking is neglected, a minimum of one year per inch is necessary, for its age estimation. Where the history of the timber is not known its condition can be approximately judged by appearance.

Water Seasoning

In water seasoning the timber is immersed in a running stream for a definite period, the large or butt ends pointing up stream. The water washes out a large proportion of the sap, and the water is then dried out by either natural or artificial seasoning (below).

Artificial Seasoning

Artificial drying, although considerably resorted to, impoverishes and invites decay. The planks are stacked in a kiln and hot air, humified by a steam jet, passes through; this dry air dries the outside too quickly and causes splitting and other detrimental faults.

Second Seasoning

When timber is used for high-class furniture, joinery and panelling, etc., it is often subjected to a second seasoning, either when the timber is finally sawn to size (but is in the rough), or when it has been loosely assembled together. This second seasoning is advisable, because when timber, even if seasoned, is cut, a fresh surface is exposed and there will be a certain amount of shrinkage.

Preservation Methods and Timber Defects

Stowage timber yard hygiene, such as dipping or painting the timber with hot creosote, causing the air in the wood cells to expand and flow out, the creosote on cooling creates a vacuum in the cells which suck in the creosote.

A second method of creosoting is to immerse the timber in a tank containing the liquid, and forcing this oil under pressure into the pores of the timber. In this latter method, and the best, the timber is placed in an air-tight container. The air is then pumped out of the cylinder, this operation also draws air out of the wood. Creosote oil is then pumped into the container and thus in the wood.

Tarring is often adopted for outside work where the appearance is of little account. An additional and final method is charring, being an efficient and economical practice, often used for preserving the ends of post and similar work, which have to be embedded in the ground.

Defects

The most common defects in woods are knots; these occur more frequently in hardwoods, existing in two forms. Firstly, live knots; these can be observed at the junction of a live branch with the trunk. Secondly, dead knots; due to dead branches, dark in colour and liable to fall out of converted timber.

Cup shakes are circular cracks between the annual rings. Heart or star shakes are cracks radiating from the centre of the tree, such defects can occur at the circumference and radiate towards the centre.

Ringalls are lumpy swellings of the wood round a dark, discoloured patch, and is caused by the timber growing over a wound made in the tree.

Upsets are acquired by the tree receiving a terrific blow, usually in felling.

Waney edges are due to part of the circular trunk (bark) left on the wood.

Science Notes of the Month

Microfilm Saves Paper

WITH a view to saving paper microphotography is now being extensively used by several large business concerns. One London firm is saving about five tons of paper a year through photographing on miniature films documents which would otherwise have to be copied on paper and occupy much valuable space.

At Unilever House two microphotographic instruments are in constant use, by means of which documents both small and large, as well as books, can be photographed on 16mm. and 35mm. films which occupy only 1 per cent. of the space of their paper originals. When seen through a projector these films are magnified to the original size of the documents.

67-ton Flying Boat

THE world's largest flying boat, the Martin Mars, recently completed a 32 hours' endurance flight, covering approximately the distance from Baltimore, U.S., to Berlin. The aircraft will be used as a United States Navy transport. The take-off weight for the endurance flight was 141,000lbs. (more than 67 tons) without carrying her full capacity.

New Fighter Engine

IT was revealed at Detroit recently that a new type Rolls-Royce aero engine, with a two-speed, two-stage supercharger, devised by British and Packard engineers, has been in volume production for some months. The new engine, which raises the ceiling for fighter 'planes by about two miles, develops nearly 1,500 horse power, and is being used in the new North American P.51 Mustang fighter.

Magnetically Guided Torpedo

THE Germans are reported to be using a new kind of torpedo which is magnetically guided, and explodes when a microphone with which it is fitted picks up the sound made by the victim ship's propeller. Fired at the ship from astern, the torpedo is said to overtake the vessel and explode near the propeller, damaging or destroying it so that the ship is disabled and an easy mark for a point-blank torpedo.

Synthetic Rubber Plant

IT was announced recently that the first unit of a 90,000-ton synthetic rubber plant, first of the big Government-owned plants comprising the bulk of the synthetic rubber programme, has been placed in operation by United States Rubber Company at Institute, West Virginia.

The Institute plant, which is the world's largest synthetic rubber plant under operation by one company, produces buna S, the type of synthetic rubber chosen for the major part of the U.S. Government's synthetic rubber programme. The butadiene gas, chief ingredient of buna S, is made from alcohol at an adjacent plant.

Army's New 'Plane

DETAILS were recently released of a remarkable British 'plane which can land and take off in a very small space, and climbs "like a lift." The 'plane, the Taylorcraft Auster 3, is a low-wing monoplane built in Leicestershire and works exclusively with the Army. It has been described as the eyes of the artillery, and it can land almost anywhere on roads, or in small fields.

The Auster has a top speed of 125 miles an hour, and is unarmed.

One of the American-designed amphibious craft known as a "duck" entering the water at Reggio harbour to reload with supplies from waiting ships.

Inventions of Interest

By "Dynamo"

Rifle With Periscope

AMONG recently accepted applications for a patent in this country is one relating to the rifle.

The object of the inventor has been to provide an arrangement enabling a marksman to aim and fire in comfort in any posture, i.e., standing, kneeling or lying flat.

The device is simple and can readily be incorporated in, or fitted on to, a service rifle or other gun. It has the usual sighting arrangement and the weapon can be sighted and fired in the orthodox manner, while the marksman remains under cover.

This improved rifle is furnished with a periscopic sighting device having one mirror reflecting the line of sight on to a second mirror fixed below and to one side of the line of sight.

There is an auxiliary butt for shouldering the gun when the periscope is being used. In this case, upon the marksman having the auxiliary butt at his shoulder, the second mirror mentioned reflects the line of sight upwardly and rearwardly towards his eye.

Submarine Lifeboat

AN improved submarine lifeboat has hove in sight. The function of this emergency device is to expedite the safe exit of crews from submerged vessels.

The invention furnishes the submarine with a cylindrical compartment which normally is sealed by a removable cover There is an escape chamber which comprises a base portion and, extending upwards, a conical upper portion.

Both the compartment and escape chamber have ports by which the crew can obtain access to the escape chamber. And there are hatches to seal the ports.

Attached to the base portion is a cable and there is a barrel on which the cable is wound. By this means the escape chamber can be drawn into the compartment. The construction is such that, when an emergency arises, the crew pass through the ports to the escape chamber. The ports are then sealed and the cover is removed. Next, the escape chamber is ejected or permitted to float to the surface. There, whatever the weather conditions, it floats apex upward.

The floating chamber can be pulled back into the compartment for further use.

"*Moving Pictures*"

THE germ of the "movies" was contained in a gyrating toy which amused the youngsters of the Victorian era. This somewhat resembled a cake-tin with a very high wall. In the wall were slits through which one inspected a series of pictures round the interior. When the toy revolved, the figures represented in the pictures appeared to move. The idea was that of the film and it embodied the principle of a Walt Disney cartoon.

To the same family belongs a new device which produces moving-picture effects. This is a book having a series of pictures representing phases of motion printed adjacent the edges of a group of successive leaves and extending the whole or only part of the way down the pages.

By bending the book and allowing the sheets to be successively exposed, the sequence of representations presents to the eye the appearance of a motion picture.

Cream Substitute

THE British Patent Office has accepted an application relating to a cream substitute, which, it is stated, is not subject to souring or putrefying changes common to natural cream or to artificial creams made from constituents of cream, and from eggs, egg albumen or egg yolks.

The information on this page is specially supplied to "Practical Mechanics" by Messrs. Hughes & Young, Patent Agents, of 7, Stone Buildings, Lincoln's Inn, London, W.C.2, who will be pleased to send free to readers mentioning this paper a copy of their handbook, "How to Patent an Invention."

If desired, a preparation of a suitable substance rich in vitamins (e.g., vitamins A and D) may be included in the product.

It is affirmed that this cream substitute can be whipped to an aerated mass like natural cream with an increase in volume up to about 150 per cent.

In the whipped state the substitute is capable of being piped and in other ways dealt with as whipped cream can be treated.

Trivet Attachment

FOR some years it has been the custom to build fireplaces of brick or tiles. In such fireplaces there is at the edging an absence of metal work. Because of this lack of metal it is a problem how to provide a trivet, or like support, for cooking utensils, dishes or a kettle.

The aim of a device for which a patent in this country has been applied is to remedy this deficiency. The idea is a member composed of metal and of more or less block form built into the brickwork of the fire cavity. This provides an attachment for a trivet.

For Unskilled Tailors

THE inventor in question has devised a method which he contends makes for the manufacture of standard pattern garments in a manner ensuring exact measurements in the finished article.

This, he declares, may be carried out by semi-skilled workpeople and even by unskilled labour with only a few days' training.

According to his method, several parts of the garment are cut from what is known as a "lay," on which a pattern for the cutter has been marked. Each of the several identical pieces from each cutting are subsequently provided with lines along which the stitching is to be done. By this means the desired result is achieved by the machinist following the lines on the parts where the stitching is to be effected.

In the case of parts of garments which, in addition to having hemmed or joined edges, have attached elements such as pockets, the attachments will be indicated by further lines in correct register with the first-named lines.

Standard Suits

THE mass-production of clothes should be exceedingly useful in these days of innumerable uniforms.

The new American semi-submarine, made of concrete, and designed as a troop and cargo carrier. The illustration shows a 124ft. model of the new type of concrete vessel. It is 7ft. diameter at the widest part, and is powered by two V-8 motors. If trial runs are successful, full size 10,000-ton ships will be constructed.

A perfect fit in the past has sometimes been obtained only by more than one trying-on, and a considerable amount of linear draughtsmanship with white chalk.

An inventor has been devoting his attention to the making of standard clothing. He points out that in clothing factories where garments are made in large quantities to standard patterns and style, for example, in the manufacture of uniforms, hitherto the methods employed have been such that the ultimate fit of the garment and its conformity to the particular pattern primarily depended on the art of the cutter and the skill of the machinist.

First, it has been customary accurately and carefully to cut the several pieces of the garment from a pattern outlined on the length of cloth. Afterwards the turning in of hems, etc., has been entrusted to the machinists. Unless the latter have been experts, the inventor referred to above affirms, the amount turned in by different machinists has varied. Even those turned in by the identical machinist on different parts of the suit may have varied.

The Story of Chemical Discovery

The Chemistry of Electricity

Chemistry's Influence on the Development of Electrical Science

IT is a rather curious fact that the modern dry battery had its earliest origin in a dish of soup which was being prepared for the ailing wife of an Italian professor.

Luigi Galvani (1737-98) was Professor of Anatomy in the University of Bologna. The story has it that on one occasion his wife was ill, and that a number of edible frogs were one morning being skinned to make a nourishing broth for Madame Galvani. This delicate culinary operation was being conducted by a servant in the laboratory of the professor who was, at the time, engaged in the manipulation and adjustment of a frictional electrical machine. Every time a spark was drawn from the machine the frogs' legs were observed to twitch. Galvani immediately jumped to the conclusion that the twitchings were due to a species of electricity which was inherent in the muscles and nerves of the frogs, and this opinion he still further confirmed in his mind when he found that he could produce the twitchings at will simply by touching the nerve of a frog's leg with a strip of zinc and the muscle of the leg with a copper strip, the metal strips being in contact at the opposite ends.

Galvani wrote a book descriptive of his experiments. He held the notion that the muscle spasms and twitchings were entirely due to a species of electricity inherent in the animal, which force or energy he termed "Animal Electricity." As a result of Galvani's experiments, the term "Galvanism" came into being to signify an electric force produced by non-frictional methods.

Galvani pinned his faith in his "animal electricity" theory to the end of his days. Had he been more acute and less conservative in reasoning he might have invented the electric battery. As it was, however, this device came into being as a result of the work of a fellow-countryman of Galvani's, a professor of physics in the University of Pavia, named Alessandro Volta, who reasoned that the electrical influence in Galvani's experiments came not from the nerves or muscles of the frogs themselves, but from the contact of two dissimilar metals acting in conjunction with the moisture of the flesh.

Volta's Pile

In the year 1800, Volta gave the first electric battery to the world. It was named "Volta's Pile," and it opened up a new era in electrical science, since it provided the only known means of obtaining a flow of electricity or, in other words, an electric current.

Volta's Pile consisted of a number of discs of zinc and copper, each separated by a pad of cloth moistened with acidulated water. The zinc and copper discs were arranged in the pile alternately, a copper disc being at one end of the pile and a zinc disc at the other. When these dissimilar discs were joined together by means of a wire, a steady current was found to flow through the wire.

From the "Pile" it was but a simple and an obvious step for Volta to devise the "voltaic cell" or the "galvanic" cell, as it was sometimes erroneously called. All he required was a zinc and a copper plate, immersed in a vessel containing dilute sulphuric acid. When the two plates were joined together externally by means of a wire, a current flowed through the circuit so formed.

Alessandro Volta, inventor of the first electric battery—the Voltaic pile.

Alessandro Volta was a physicist more than a chemist, and he does not appear to have grasped the precise chemical significance of his discovery. That was left to others. Naturally enough, at this time, the scientific world was agog with excitement over the new mode of obtaining electricity by chemical means. Scientists, especially in England, settled down to investigate the chemical aspects of the new discovery. It was quickly discovered that when any two dissimilar metals are immersed in a liquid which acts on the one metal more than it does on the other, an electric current will be set up in an external circuit connecting the two plates.

A replica of Volta's famous "pile."

From these simple beginnings came, as the years went by, a flood of new batteries, each having its own particular electrodes and its own chemical solutions for the generation of the current. These batteries produced approximately the same voltage per cell, but their amperages varied somewhat in view of the fact that the internal resistance of some cells was greater than others.

Chemical investigators vied with one another in their multiplication of different types of chemical batteries. They did this because the electric battery became in great and ever-increasing demand as an important implement of chemical and scientific research, for it then represented the only practicable means of obtaining a continuous electric current.

It was not, however, until a considerably later date that the full meaning of the voltaic cell was thoroughly understood, since a thorough grasp of its principles awaited the further development of chemical and electrical theory.

The Primary Cell

The action of the electrical battery or "primary cell," as it is nowadays called, is mainly a chemical one, and is not difficult to comprehend. Consider, for example, the simple cell invented by Volta in 1800. It comprised a zinc and a copper rod immersed in dilute sulphuric acid. Now, zinc is readily attacked by sulphuric acid with the formation of zinc sulphate and the liberation of hydrogen gas, thus:

$$\underset{\text{(Zinc)}}{Zn} + \underset{\text{(Sulphuric acid)}}{H_2SO_4} = \underset{\text{(Zinc Sulphate)}}{ZnSO_4} + \underset{\text{(Hydrogen)}}{H_2}$$

As the zinc dissolves in the sulphuric acid, its atoms lose some of their electrons. Now, an atom without its full complement of electrons becomes a positively-charged body. Consequently, the zinc *ions* (as the dissolved zinc atoms are termed) become positively electrified.

The free electrons from the dissolving zinc pass through the zinc rod and through the external circuit, this flow of electrons comprising the electric current. The positive hydrogen atoms which are formed pass through the dilute sulphuric acid (which constitutes the "electrolyte" of the cell) in the direction of the copper rod. On reaching the latter, they give up their positive charges, each positive charge being neutralised by a negative charge from the stream of electrons returning to the cell from the external circuit via the copper rod. In this way the electron flow is perpetuated.

Viewed in the above light, an electric battery or voltaic cell will be seen merely as a chemical means of generating and liberating a stream of electrons into an external or outwards circuit. Owing, however, to the fact that the liberated hydrogen tends to accumulate around the copper or positive rod of the cell, the internal resistance of the cell increases and its action tends to stop. A cell in this condition is said to be "polarised." In consequence of this fact, the main object of the majority of the primary cells which were introduced after Volta's inception of "chemical electricity" was to prevent or, at least, to inhibit this phenomenon of polarisation. The most successful of such cells achieved a partial success by dint of surrounding their positive electrodes with some chemical substance which absorbed or removed the hydrogen as it was released.

Leclanché

One of the most successful of these "anti-polar" cells was that invented by the Frenchman, Leclanché, in which the positive electrode of carbon is contained in a porous pot, being surrounded therein by a mixture of crushed carbon and manganese dioxide. The porous pot stands in a strong solution of ammonium chloride (sal ammoniac), a zinc rod standing in this solution comprising the negative electrode.

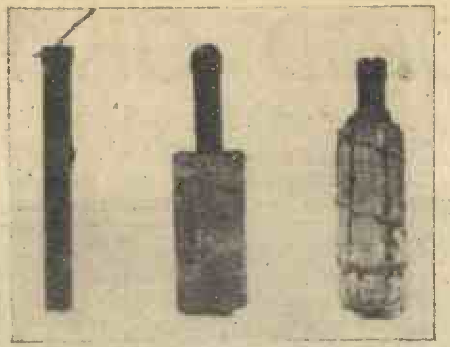
The present-day ubiquitous and deservedly popular "dry battery" is simply a modification of the Leclanché principle. In the dry battery the porous pot is replaced by a canvas bag containing the anti-polarising mixture surrounding the carbon rod, the of ammonium chloride (sal ammoniac), a form of a moist paste contained in a zinc case, which forms the negative electrode of the cell. A "dry cell," therefore, is not dry at all. If it were, it could not possibly function. It is purely and simply a portable variety of the original Leclanché cell, its basic principle as a chemical electron-generator being precisely the same as that of the simple sulphuric acid cell of Alessandro Volta.

Electrolysis

The eighteenth century had hardly dawned when chemical investigators discovered not only that chemical reactions can be made to initiate an electric current, but that the converse of this is also possible, that is to say, that an electric current can set up a chemical reaction. Thus was the nowadays widely-applied phenomenon of "electrolysis" revealed. The first men to hit upon this phenomenon were Sir Anthony Carlisle, a London surgeon, and William Nicholson, who, in 1800, found that if two platinum strips are immersed in water which has been rendered slightly acid with a little sulphuric acid in order to make it conductable, and if the platinum strips are connected to the poles of a voltaic "Pile" or battery, the passage of the current through the water results in the actual chemical decomposition or splitting-up of the latter, hydrogen gas being evolved at the negative electrode and oxygen at the positive. A portion of the water is thus actually resolved into its component elements by the energy of the current:

$$H_2O \xrightarrow{\text{electrolysed}} H_2 + O$$

Four years after the discovery of electrolysis by Nicholson and Carlisle, Professor Brugnatelli, of the University of Pavia, showed that the current from a voltaic pile could, by passage through a chemical solution of gold, be made to deposit metallic gold on coins suspended in the solution. Brugnatelli, by this experiment, obviously becomes the "father" of electro-plating, although he is little recognised as such. It was, indeed, not until years after Brugnatelli's pioneering experiments that the possibilities of electro-plating were first seriously investigated on the theoretical side by the illustrious Michael Faraday, and on the commercial side by others. Faraday deduced certain laws of electrolytic action, chief among which is the fact that the chemical decomposing action of an electric current is always constant for a given quantity of current. In other words, a unit amount of electricity has a definite and a fixed amount of chemical activity. Faraday's laws of electrolysis have been of enormous assistance to the development of chemistry both on the theoretical and on the manufacturing side, since they have made possible the calculation of the amounts of chemical substances which can be liberated from their compounds by the passage of given amounts of electricity.

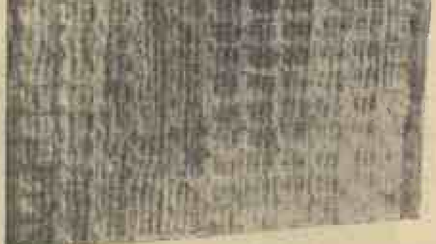


The components of a modern torch lamp cell.

On the practical side, industrial electro-plating came about mainly through the efforts of two men, George Richard Elkington, in Birmingham, and De la Rive, on the Continent. George Elkington, a Birmingham manufacturer, was an amateur chemist, an enthusiastic dabbler (if we may so call him) in many other sciences, and, withal, a rather remarkable and energetic individual. Elkington had associated with him two other enthusiasts in the chemical world, John Wright, a Birmingham surgeon, and Alexander Parkes, the discoverer of celluloid. All three had a share in the introduction of gold, silver and copper plating by electrical means, but it was Elkington himself who commercialised the process and, after seven years of struggle, placed it on a satisfactory and practical basis.

Davy's Discoveries

After Nicholson and Carlisle had demonstrated the fact that water can be resolved into its elements by means of the electric current, Humphry Davy, that renowned chemical investigator in the Royal Institution Laboratories, London, reasoned that the current should operate in an analagous manner on molten caustic potash and soda. Putting his theory into practice, Davy isolated metallic potassium on October 6th, 1807, and metallic sodium a few days later, using the current from a multi-cell battery. A lump of potash (potassium hydroxide) was placed on an insulated platinum disc which was made the negative pole of the battery and a platinum wire connected to the positive pole of the battery was allowed to make contact with the substance. Says Davy:



The lead plate of a modern accumulator, showing the active material packed into the grid-like interstices.

"Under these circumstances a vivid action was observed to take place. The potash began to fuse at both points of its electrification. There was a violent effervescence at the upper surface; at the lower, or negative surface, there was no liberation of elastic fluid; but small globules having a high metallic lustre, and being precisely similar in visible character to quicksilver appeared, some of which burnt with explosion and bright flame as soon as they were formed, and others remained and were merely tarnished and finally covered with a white film which formed on their surface."

The electrolytical isolation of the metals, calcium, barium, and strontium, followed soon afterwards.

Nowadays, of course, not only is sodium manufactured by electrolytical means, but so, also, are aluminium, magnesium, and other metals. The chemical industry employs electrolytical means of producing vast amounts of chlorine gas and of various chemical compounds of high industrial import in view of the fact that modern chemical research has made it possible to obtain very fine control on the purity of electrolytically produced products.

Electrical energy can act in a chemical manner by other ways. If, for instance, oxygen or air is submitted to the action of a high-frequency electric discharge a certain proportion of the oxygen atoms combine together to form a strongly-smelling gas which is called "ozone." Likewise, when nitrogen gas is so treated, it becomes "activated," in which state it is able to undergo chemical reactions which it is not capable of in its normal state.

Enter the Accumulator

The modern accumulator or storage battery is a highly important product of electro-chemical discovery. Essentially, the accumulator is merely a reversible battery. An ordinary "primary" battery is a device which produces electricity by means of chemical action. Once that chemical action has spent itself, the primary cell or battery is useless, since it can produce no more electricity. In the accumulator, however, matters are so arranged that after the active chemicals have expended themselves in the production of electrical energy, they are capable of being reconverted into their original state by passage of electrical energy through them. This process of conversion and reconversion can go on repeatedly, and (in theory) indefinitely, so that a cell which is built on this chemical principle becomes, as it were, capable of *accumulating* electrical energy by passage of the latter into it.

The present-day lead-plate accumulator or "secondary battery" is the outcome of a number of experiments made by a Frenchman, Gaston Planté, who, about 1879, made a battery with sheet lead plates which were kept apart by a piece of cloth soaked in dilute sulphuric acid. The Planté battery was charged by connecting it to a primary cell, whereby lead peroxide was formed on the one plate, and spongy lead on the other plate. When the Planté cell was connected to an external circuit, the peroxide plate became the positive and the spongy lead plate became the negative pole of the cell, and a current flowed between them.

Planté cells were impracticable in view of the fact that the plates were only "formed" with considerable difficulty by passage of current into them. They were improved enormously by another Frenchman, Camille Faure, who, in 1881, added a paste of red lead to the plates which were immersed in dilute sulphuric acid. By this arrangement, large amounts of lead peroxide and of spongy lead could be formed on the respective plates on the passage of the "charging" current into the accumulator.

THE WORLD OF MODELS

A Variety of Interesting Model Pieces Seen Lately by "Motilus"

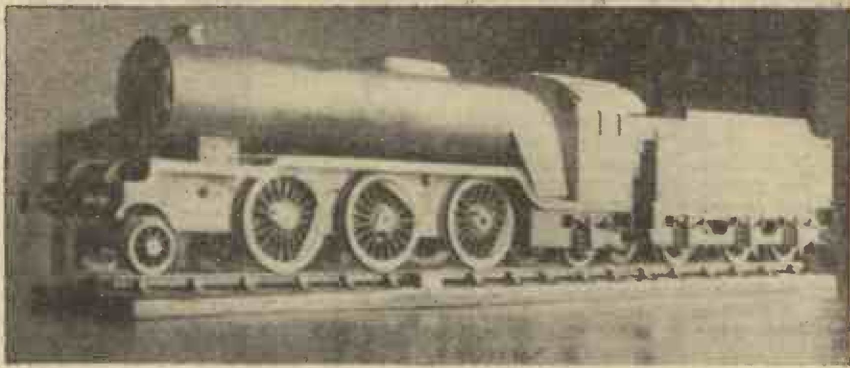
A Model of the "Green Arrow"

VISITING an old friend of mine, who lives at Fairbourne, in Wales, I found in one of the rooms in his home a partly finished half-inch scale model of the 2-6-2 locomotive "Green Arrow," which I learnt was the work of Mr. Stanley Harrison, a keen young model maker, who is now engaged on war work in the north of England.

The model is complete with boiler and Belpaire firebox, full Walschaerts valve gear, and pump in tender, and has been sent to the owner's mother living in Wales, in its partly finished state, so that it may be safe from air raids and kept in good condition until the opportunity occurs to finish it. It has been constructed throughout from drawings by "L. B. S. C." Mr. Harrison is looking forward to completing the model as soon as hostilities cease.

An Old-time Ship

The photography of models was, in peacetime days, a most fascinating pastime for me, and since I have been writing this feature I have come across, and reproduced from time to time in these pages, railway and other pictures where it was difficult to tell the model from the real thing, but here is a different angle on miniature photography. This time the photographer has effectively arranged a black background for an old-time ship, and the resulting photograph is very pleasing.



Model ½ scale 2-6-2 "Green Arrow."

Model warship display.

Interesting Model Work by Boys in the R.A.F.

I am not yet certain whether men in the Services are specially encouraged in the hobby of model-making, or whether there are more model-makers than I have ever imagined, because I am constantly seeing specimens, or photographs of specimens, of model work done by serving men.

There is bound to be a certain amount of leisure time for those on board ship or on R.A.F. stations, and what better hobby could there be to fill this usefully than

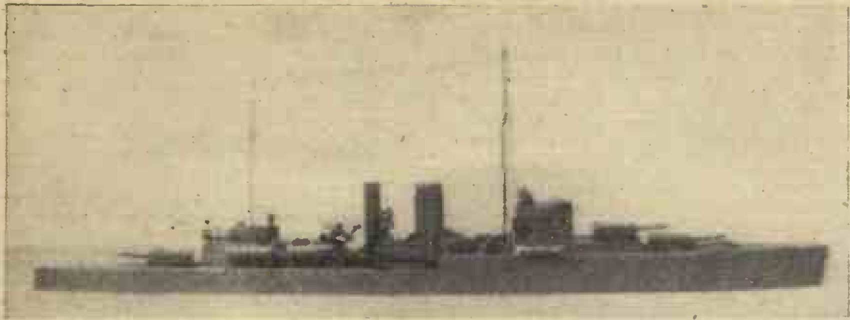
A Novel Type of Model Warship Display

Calling in at Bassett-Lowke's London shop in High Holborn, which, despite the war, often has some quite interesting models on display (though not always for sale!), I came across a very striking method of displaying models of warships.

The manager explained to me that they are constantly asked for the loan of models for war savings weeks, warship weeks and other similar efforts, which, with the non-production of models—except for Government purposes—it was impossible to supply. So they have recently arranged, with the permission of the Admiralty, to prepare a display of specimen 50ft. to 1in. model warships. The ships represented are a British submarine, battleship, cruiser, aircraft carrier and destroyer, and the display piece may be loaned to a responsible official connected with any war savings campaign. The novel idea of circular sidelights gives the case an attractive nautical appearance and also enables the models to be viewed from a different angle from the usual "broadside."

I thought the idea worth bringing to the notice of readers who need a brain-wave for displaying their own handiwork. The case was designed by Mr. Misha Black.

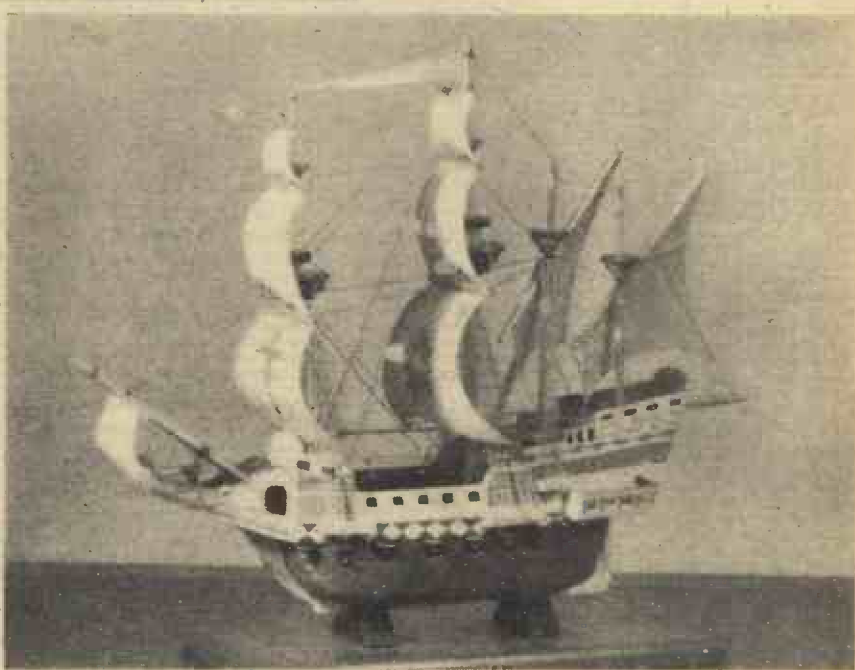
An old-time ship.



Model of H.M.S. "Exeter."

by creating something that will remind them in after days of when they served in the second great World War. I feel model-making offers one good solution to the problem.

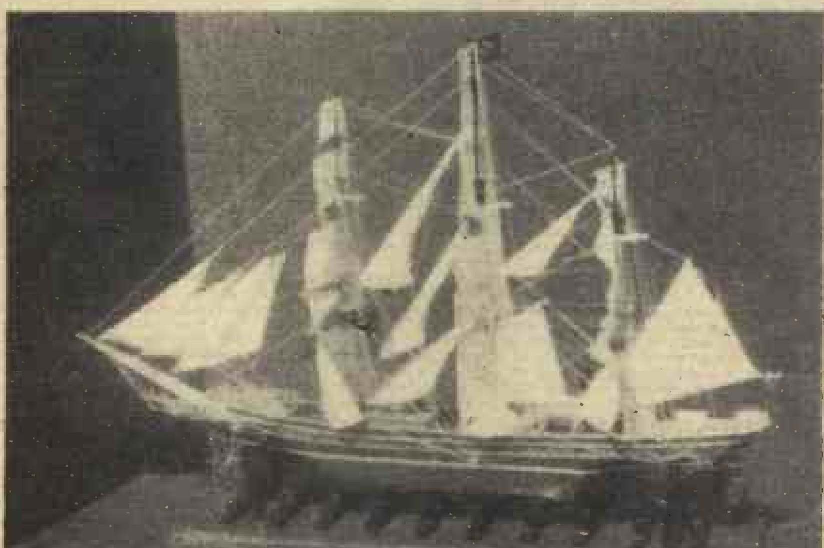
The two pictures shown of H.M.S. *Exeter* and of an Elizabethan galleon are the work of A.C.1 S. Wadsworth, of the R.A.F. The *Exeter* model is approximately 30ins. long, and the plan and necessary wood were purchased from Messrs. Hobbies in the early days of the war. Every detail has been hand-made by Mr. Wadsworth, and a number of details were added to the *Exeter*, for he had happened to visit the real ship before the war. The galleon is 14ins. long by 16ins. high, and these two models—Mr. Wadsworth's first attempts at model-making—so fired his enthusiasm that his next effort—now half-finished—is Sir Richard Grenville's *Revenge*. He is leaving the galleon in more or less natural colours, as it would be when first launched, as more pleasing in appearance than the antique style favoured by most people.



An Elizabethan galleon.

"Cutty Sark"

The model of the *Cutty Sark* is the work of F./Sgt. Stampton, of the R.A.F. He was hoping to start work on the even more ambitious *Juan Sebastian de Elcano*, one of the world's most beautiful training ships, but embarkation leave has intervened. However, he has the full set of drawings, and writes me the cheerful message: "When the Juan is finished I will send you a photo."



Model of the "Cutty Sark."

Best of luck, F./Sgt. Stampton, and I'm sure your comrades in all the fighting Forces echo your words: "Let's hope it won't be too long before we all can settle down again to our hobby."

A well-known expert on the hobby once said: "Model engineers are the salt of the earth," and told the story of a doctor friend of his who had spent 13 years building a model locomotive. A friend said to him: "Do not you think you could have devoted 13 years of your spare time to some better object?" The doctor's reply was: "I have had 13 years of pleasure in building my model, which has given me relief from the anxieties of my professional work, and has enabled me to face my daily duties mentally and physically refreshed. Moreover, I am building a model which will have considerable historic value to future generations as the record of a very famous locomotive."

I think those words would prove more than a match for any similar questioner.

A Display Case for the Tiny Model

Infinitesimal models hold an attraction for everyone, even those who are not usually interested in the hobby. One I came across recently is that of a square-rigged ship only ⅞in. long, inserted in a gold watchcase, complete with a suitably modelled sea and painted sky background. The maker of this exquisite little showpiece is Mr. George Sell, of London, and he tells me the model and scene took approximately 60 hours of work to complete. The ship is constructed in boxwood and rigged with very fine silk cord.

The owner is keenly interested in novelties of this kind, and carries his model ship watchcase round to show his friends.

Here is an idea for experienced workers in miniature to preserve their *pièce de résistance.* It is a better proposition than the ship in a bottle, and can be displayed without the risk of damage through handling.

Model in a watchcase.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on back cover must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the reader. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

Celluloid Solution : Codeine

WOULD you please answer the following three queries ?

(1) I desire to refix a stone in a ring, and require a very strong glue which will stand water. My idea was to make an acetone based glue (such as a very concentrated nail varnish). I mixed equal parts of amyl acetate and acetone, but the celluloid I used would not dissolve. It was scrap celluloid from the undeveloped part of a film negative. Could you suggest why it is that I failed to make the celluloid solution ?

(2) Owing to the difficulty in obtaining ethyl alcohol would it be possible to use methylated spirits in such preparations as liquid shampoo ?

(3) When using methylated spirits is there any method by which the "methylated" smell can be eliminated ?

(4) What exactly is the substance codeine ?—W. E. Savidge (Blackpool).

(1) CELLULOID is perfectly soluble in a mixture of equal parts of acetone and amyl acetate, and the only reason which we can suggest for your failure to get the celluloid film scrap into solution is that you did not remove the gelatine which is coated on to both sides of the film in order to render it non-curling. Wash the film well under hot water to remove the gelatine. Dry it thoroughly, cut it up into shreds, place these in the solvent mixture, allow to stand for 24 hours, and then give the mixture a vigorous shaking.

(2) Methylated spirit *can* be used in certain toilet preparations, but its employment in such respects is very objectionable, since the spirit contains certain materials which give it an undesirable smell. Furthermore, on contact with water, or with preparations containing water, the spirit turns milky, which, in most instances, is another serious disadvantage. A far better and cleaner substitute for pure ethyl alcohol is surgical spirit, which is obtainable from any retail chemist. Another substitute is iso-propyl alcohol, which is *not* dutiable, and can be obtained from large firms of chemists, or direct from chemical manufacturers such as Messrs. A. Boake, Roberts & Co., Ltd., "Ellerslie," Buckhurst Hill, Essex, price about 2s. 6d. per lb.

(3) Methylated spirit can be deodorised and purified, but any such tampering with this liquid is highly illegal. For this reason, we are unable to give you any instructions for the purification of the spirit.

(4) Codeine is the methyl derivative of morphine, having the chemical formula : $OCH_3\ C_{17}H_{17}\ NO\ OH$. It can be made by treating an alkaline solution of morphine with methylating agents. It is a crystalline material, melting at 150 deg. C. It occurs naturally in opium, along with morphine. It is more staple, chemically, than morphine, but, as an alkaloid drug, it is physiologically much less active than morphine.

Hardening Duralumin

WOULD you please advise me respecting the process of hardening and annealing duralumin ? Also, could you supply me with the name and address of any firm from whom I could purchase a drawing of a rotary sleeve-valve engine ?—N. Adams (New Penshaw).

SOLUTION heat treatment in a molten salt bath or electric air furnace is necessary. Heat to about 485 deg. C., and quench. Annealing is carried out for forming or cold working processes at 380 deg. C.

(2) Try Peter Brotherhood, Ltd., Peterborough ; or Coventry Climax Engines, Ltd., Coventry.

Nickel-plating

COULD you kindly help me with a trouble which I am getting with a little nickel-plating vat I have made up as a hobby ? My trouble is that after a job has been in the vat for about half an hour the plating, which up till then appears to be coating excellently, begins to lift and peel away of its own accord.

At this stage the nickel may be peeled off the job quite freely, and shows no adherence to the job worth mentioning.

So far all my work has been on either polished copper or brass. I usually proceed as follows : I take the polished work and scrub it thoroughly with pumice powder and hot water with a brush. Then I boil it in caustic soda solution to remove any traces of grease.

I then wash off thoroughly with running hot water till I think all trace of the caustic should be removed.

The object is then suspended in the bath, taking care to avoid handling with the fingers in the process.

The bath holds a gallon of fluid composed of nickel sulphate and ammonium sulphate. I have an anode of pure nickel on each side of the job, and about 3½in. to 4in. from same.

The current is supplied by a six-volt motor-cycle battery through a resistance ammeter.—James Hector (Dartford).

THE trouble may be due to poor quality base metals. Their composition should be known and controlled, as the structure may influence not only reactions in cleaning and pickling, but also the coating structure. Pores, cracks and inclusions are always harmful.

For nickel plating on brass and copper at low current density the best plating solution is one containing 16oz. per gallon of nickel sulphate, 2 oz. per gallon of ammonium chloride, 2 oz. per gallon of boric acid. For high current density nickel plating use 30–40 oz. per gallon of nickel sulphate, 6 oz. per gallon of nickel chloride, and 4 oz. per gallon of boric acid. For low current density plating use 10–20 amps. For high current density plating use 20–50 amps. The average current density must be maintained within the limits for the respective solutions.

It seems to us that your trouble lies in the solution employed.

Battery-Operated Master Clock

I HAVE built the battery-operated master clock described in "Practical Mechanics," but would like to change the operative medium from the 8-volt battery now in use to a supply from my 230-volt A.C. mains.

A minimum of 8 volts D.C. is essential. Is a trickle charger available that can supply this (current consumption at 8 volts is .08 amps.) ? If not, what type of rectifying unit do you recommend ?—M. Crapper (London, E.C.).

PROVIDED that you wind the magnet coils to a higher resistance it would be quite in order to use the trickle charger. As designed, however, there is a possibility that your particular charger would not deliver sufficient momentary current to impulse the magnets, or, at any rate, would give such a weak pull that you would only get a few swings at each impulse. This is not a serious fault, and, provided that you do not mind the additional impulsing (which only needs slightly more tricky adjustments for regular time-keeping), you could use everything as it now stands. We do not know where you could obtain a trickle charger at the present time.

Bending Glass

I WISH to bend some glass about 6in. square into a slightly convex form. Is it possible to tackle this job at home ; if not, I would still like to know the simplest method of doing this ?—R. Merrilees (Hayes).

WE are decidedly of the opinion that it is not possible to tackle the permanent bending of a square of glass at home, since all such curved glasses are produced either by hot rolling or by moulding (casting).

If, however, you did attempt to tackle the job, you would require some kind of a furnace in which you could heat the glass to bright red heat. It would then have to be laid over a curved iron plate similarly heated and pressed down on to it while in the softened condition until it attained the curvature of the iron plate. Finally, having been given its new curved shape, the hot glass would have to be cooled down *very slowly* over a number of days in order to anneal it and to render it reasonably free from strain-breakage. And even if you succeeded in carrying out these difficult operations satisfactorily, we think that you would find that the surfaces of the glass would have lost their clearness and transparency and that they would require repolishing. If we were in your place, we should feel inclined to write to a firm of glass manufacturers, such as Pilkingtons, of St. Helens, and inquire whether they had any small glass plates of the curvature desired. We feel sure that by adopting this suggestion you would obtain your special glasses at far less cost and with infinitely less trouble than would be the case if you attempted to make them yourself.

Dyeing Feathers

WILL you please inform me of the best way to dye white feathers brilliant colours ?—W. H. Greenland (Wimborne).

FEATHERS are nowadays usually dyed with aniline colours. Previous to dyeing, the feathers should be soaked for several hours in a bath of soapy water, followed by a soaking in a moderately strong solution of washing soda. These two baths remove the natural grease of the feathers, which so strongly resists effective penetration of the feathers by the dye.

After this treatment, the feathers may be dyed by means of any of the well-known "packet" dyes which are on sale in grocers' and other shops. Less water than usual should be used in making up the dye solution, since a fairly strong dye is needed. Sometimes a teaspoonful of sodium sulphate (Glauber's salts) added to the dye bath improves the shade of colour obtained. The same may also be said of a little soap dissolved in the dye liquor.

With some feathers it is advisable to soak them for an hour or two in a 5 per cent. solution of tannic acid, and then to rinse them thoroughly previous to entering them into the dye bath, the tannic acid treatment helping to fix the colour.

The feathers, in all cases, should be entered into the *cold* dye bath, and this should be brought to boiling point slowly and kept at that temperature for about three-quarters of an hour. After this time the feathers are removed from the dye bath, well rinsed and slowly dried in the air.

In many instances it may be desirable actually to bleach the feathers before dyeing them. The following liquor is a good bleach for this purpose, and it has the advantage of not exerting any harmful effect on the feathers :

Hydrogen peroxide, 10 parts.
Ammonium persulphate, 3 parts.
Methylated spirit, 2 parts.
Water, 100 parts.

Immerse the feathers in this liquid for several hours. Then remove them and allow them to dry (without rinsing) and preferably in sunshine.

Curing Rabbit Skins

WITH reference to the curing of rabbit skins, I understand that saltpetre is used for this purpose as well as alum, which is supposed to prevent the fur from falling out. In spite of many attempts, I have so far been unsuccessful in making the skin really pliable. Could you please tell me the correct method and the names of any other substances required ?—S. A. J. Challice (Benfleet).

THE curing of rabbit skins is not really difficult, but it needs a good deal of patience, together with some experience. It is an occupation which is learned by practice rather than by mere written instruction.

The first stage of the process consists in scraping every trace of flesh away from the skin side of the fur. It is best to do this by stretching the fur, skin side outwards, over a curved surface, such as a baluster rail, and by scraping it with a blunt knife. After this flaying process has been completed, the pelt is soaked in a solution made by dissolving 4 parts of common alum and 1 part common salt, these ingredients being dissolved in just as much warm water as will dissolve them properly. This soaking process usually takes from two to three days. It is completed when the skin side of the pelt shows a clear white line when folded back sharply on itself.

Next, make a paste of flour and water and, having rinsed the skin, rub the thin paste all over it. Then wash out the flour paste with plenty of cold water and hang up the skin to dry.

When the skin is about half dry (i.e., just moist), stretch it out on a flat board and rub the skin side over with fine pumice powder. Wash out the powder, and finally hang the skin in a stretched condition to dry.

It will dry stiff and hard, but this hardness can be removed by working the skin patiently between the fingers ; the more the skin is worked, the more rapidly it will become permanently pliable. Sometimes softness can be imparted to the skin more rapidly by rubbing a little neatsfoot oil into it, but this oiling must on no account be overdone or else the skin will become unpleasantly sticky.

After treatment with thin flour paste, some authorities recommend that the skin should be immersed in a dilute solution of tannic acid (2 per cent. solution), or in a liquid made by boiling oak bark in water. This treatment certainly gives an extra tan to the skin, but, in our opinion, it renders the skin unduly hard and difficult to soften afterwards.

Perhaps, however, you might care to make experiments in the curing of rabbit skins with and without tannic acid or oak bark treatment.

Product from Waste Wood

COULD you please oblige with some information on the following: titles of books dealing with products made from wood waste; also, what means are used—acid, etc.—to obtain cellulose from wood? And, finally, has any substitute been manufactured which has the same characteristics as wood, i.e., able to be sawn, glued, nailed, etc.? Has any use been found for lignite, a by-product?—E. Banks (Lowestoft).

(1) SO far as we have been able to trace, there are no books extant upon the subject of waste wood material. It is possible, however, that this subject has been dealt with in one or more specialised papers published in various technical journals, and, if you wish to pursue this subject further, we would advise you to write for any such possible information to the Director, Forest Products Research Laboratory, Princes Risborough.

(2) Pure cellulose is ordinarily obtained from cotton-wool. It is not easy to obtain pure cellulose from wood. However, you may attempt the task by boiling the chopped wood material with a 20 per cent. solution of caustic soda for several hours (and preferably under pressure). At the end of this period, the wood chippings should be reduced to a greyish pulp. The pulp is filtered off, washed thoroughly with water and then stirred into a clear solution of bleaching powder (chloride of lime). After a few hours in this solution (during which time the pulp slowly bleaches) the material is again filtered off, and thoroughly well washed. The resultant product should be a fairly pure white cellulose. Do not choose pine woods or other woods containing a high proportion of resin for this extraction, otherwise the results will be apt to prove anything but satisfactory.

(3) No artificial substitute has been able to replace wood in all its properties. Many attempts have been made to produce "artificial woods," but these all contain sawdust which has been bonded by compression. Some of these products may be cut and sawn, but they have nothing like the mechanical strength of wood.

Lignite, or lignone, is a variety of cellulose which is sometimes termed "lignocellulose." It is produced naturally by the process of wood formation during the growth of the tree. It is not produced during the destructive distillation of wood, and since it is a material of somewhat mysterious composition, no definite economic use has been found for it.

Is it possible that, in making this inquiry you are really referring to *ligroin*, which is a clear liquid, a light petroleum, having a boiling range between 80 and 120 deg. C.?

Toluene Thermostat: Photographic Printing Paper

I SHALL be very grateful if you would give me some information on the following queries.

(1) I have for some time been endeavouring to make a thermostatic regulator for use in a water-bath; I have given most attention to the toluene-mercury type, the expansion of the toluene raising a mercury meniscus in a glass tube, so cutting off the gas supply to the burner. I have not been very successful in this, partly owing to the difficulty of obtaining toluene, but mainly due to the glass-blowing operations. I am now contemplating making a regulator consisting of an open thermometer tube filled with mercury only, using the rise and fall of the meniscus to make and break an electric circuit, so controlling the action of a gas valve. Could you give me the details as to making the regulator (which must not allow a temperature fluctuation of more than 1 deg.) and also the gas valve? If this is not possible, then could you give me details as to how to make a bimetal strip regulator to be used instead?

(2) I have read that a certain printing paper (for photography) is obtainable, which is covered with a layer of gelatine to which has been added potassium dichromate and a coloured pigment. I understand that when the paper is exposed to light, the gelatine is thereby hardened, and the print is then "fixed" in hot water to remove unchanged gelatine. Could you please give me information as to making this paper, and the proportions of substances required?—J. Hopkins (Risca, Mon).

(1) We would advise you to stick to the normal toluene regulator type of thermostat, since this instrument is very simple and extremely efficient and reliable in practice. If you cannot get toluene, you can use ordinary benzene in place of it. Also, you can purchase these toluene regulator tubes from any large firm of chemical apparatus suppliers, such as Messrs. J. W. Towers, Victoria House, Widnes, Lancs, or Messrs. Philip Harris and Co., Ltd., Birmingham.

You can, of course, make a mercury regulator on the lines you suggest simply by inserting two fine platinum wires one above the other into a straight mercury tube, but we fear that this arrangement would not give anything like the sensitivity which you desire.

Bimetal elements are simply made by soldering a strip of brass and a strip of steel together and by winding insulated resistance wire around the composite strip so formed. When a current is sent through the resistance coil so formed, the strip will bend, and, in this manner, it will either make or break a contact.

(2) You can make the photographic printing paper to which you refer simply by dissolving 10 parts (by weight) of gelatine in 90 parts of hot water and then by stirring into this 2 parts of lampblack (or other fine insoluble pigment). The resulting black or coloured solution is brushed on to the surface of good-quality paper and allowed to dry. The "carbon" paper thus prepared is sensitised by immersing it for five minutes in a solution made up by dissolving 3 parts of potassium bichromate in 97 parts of water. This immersion of the paper and its subsequent drying *must* be carried out under artificial light. The paper, when finally dry, is ready for photographic printing on the lines you suggest.

Such paper can be purchased ready-made in the sensitised or unsensitised condition. It is quite cheap, and may be had in a variety of colours. Its working constitutes the basis of the beautiful "carbon" and "carbro" process of photography, which gives absolutely fadeless and permanent prints. We would advise you to write to The Autotype Company, Ltd., Ealing, London, for copies of their literature on the "Carbon" and the "Carbro" processes and to study these carefully before deciding to go further in the matter. It is generally found easier to purchase carbon paper ready-made than to go to the trouble of making it.

Electrical Polishing: Nitrous Oxide

I HAVE heard that in certain types of electro-plating, if various chemicals are added to the electrolyte, the article which it is desired to be plated assumes a coating of polished appearance, and does not require any finishing treatment.

Can you please give me the names, and also the proportions used, of chemicals suitable for use in "polished plating," in the following types of electro-depositation: 1, nickel; 2, chromium; 3, silver, and 4, copper?

I understand that nitrous oxide is the only gas possessing almost identical properties with those of oxygen. Is it possible to obtain a small cylinder of this gas for experimental purposes, or is the sale of this gas restricted owing to its being what is termed a "medical gas?

If it is obtainable for the above purpose, can you give me any idea as to the price of the gas?—K. L. Churley (Cricklewood).

(1) We think that, in your first query, you refer to the process known as "electrical polishing," which is, essentially, an electrolytical process in which the article to be polished is made the anode (positive electrode) of an electrolytical bath, and to which is applied a very carefully-controlled current for a definite period of time.

Electrical polishing is a very new subject, and it is only, as yet, in its experimental stages, although, to a limited extent, commercial success has been made of the method.

It would be impossible for us to describe the various methods of electrical polishing in detail here, and, up to the present, no books have been published on the subject, since the details have been maintained more or less secret. However, for your information, "Chemistry and Industry" published a comprehensive paper on "Electrical Polishing" in its issue dated June 26th, 1943. This, we think, would interest you greatly and give you all the information you require. The above periodical is obtainable, price 1s. 9d. (post extra), from 56, Victoria Street, London, S.W.1.

(2) Small cylinders of nitrous oxide (N_2O) are obtainable from The British Oxygen Co., Ltd., Wembley. The gas itself is quite cheap, costing about 10d. per cubic foot, but even the smallest cylinders, with their necessary regulating valves, are expensive, the complete outfit costing about five guineas. Write to the above-named firm and inquire whether they would be willing to lend you a cylinder (plus regulating valve) on your undertaking to return it within a definite time or to pay a rent charge on it. The smallest cylinder available contains about 20 cubit feet of the gas.

Coloured Chalks

CAN you inform me of the raw materials used, and the manufacturing process involved, in making chalks for blackboard writing purposes? I would also be glad of the names of any books on this subject.—Dr. R. J. Russell (Royston).

THE "chalks" to which you refer consist essentially of a mixture of white clay with a suitable pigment, together with a little soap or stearic acid to act as a bonding agent.

Such "chalks" can be quite simply made by adding a 5 per cent. soap solution in water to powdered pipe-clay, kaolin or similar material containing an admixture of pigment (about 20 per cent. of the latter). The damp mixture is then rolled into cylinders between boards or moulded in some other suitable matter, slow drying of the composition being essential.

As regards pigments, use ultramarine for blue, umber for brown, venetian red for red, chrome yellow for yellow, etc.

So far as we have been able to trace, no books have been published on this subject in England, but it is quite possible that there may exist American works on the subject. We would suggest that you get into touch with either Messrs. W. and G. Foyle, Ltd., Charing Cross Road, London, W.C.2, or Messrs. Wm. Bryce, 54, Lothian Street, Edinburgh, and request to be notified of any American publications treating of this subject.

Making Coal Briquettes: Slow-setting Cement

I SHALL be glad of your help concerning the following two queries:

(1) Some time ago you published a recipe for making briquettes from coal slack, and I cannot find the issue with this particular recipe in. Can you repeat the recipe, please?

(2) I propose making a rock garden, and as rocks are impossible to obtain while the war is on, I suggest making my own rocks by means of old bricks and floating these over with cement (i.e., cement and sand).

Is there anything that I can put in with the cement to prevent it developing cracks after a time, and so spoiling the appearance? I believe that plasterers use horse-hair to strengthen plaster, and recently I have come across concrete paving slabs with straw embedded. Would you suggest a very good mixture, say 2 : 1?

Is there anything that I can put on the blocks when made to take the new appearance off them?—J. P. Clark (Netherfield).

(1) There are many different formulæ for the making of coal briquettes. One method of making briquettes is to mix the coal dust with about 2 per cent. of its weight of a very soft tar or a heavy oil and, afterwards, to compress the mixture in moulds.

Alternatively, the following formulæ can be used, the briquettes as made by this formulæ being slower burning:

Coal dust	10 parts.
Cement	1 part.

The above mixture is made slightly moist with a dilute solution of common salt (about a 5 per cent. solution) and afterwards strongly compressed in moulds.

(2) The best thing you can do to prevent cracks developing in your cement is to incorporate about 20 per cent. of coarse asbestos powder in the cement mix. Write to Messrs. Turner Brothers, Rochdale, for particulars of their various grades of asbestos powder. If you cannot get asbestos now, you will have to rely on some other substitute, but it is important that such a substitute be of a definitely fibrous nature. Hair and straw seem to be rather too coarse for your purpose, but they might suffice if they were finely cut.

A slow-setting cement would, we think, be less liable to develop cracks. Such a cement can be made according to the following formula:—

Magnesium oxide ..	2 parts (by weight).
Alum	2 "
Caustic soda ..	3 "
Common salt ..	1 "
Lime, slaked ..	100 "
Whiting	2 "
Fine sand	125 "
Water	67 "

The alum, salt and caustic soda should be dissolved in the water used for slaking the remainder of the ingredients.

All cements can be coloured by incorporating a small amount of pigment into them. In your case, we should say that if you used a little ochre in your cement mixes, or, alternatively, a little finely-ground ashes, the resulting cement would set with a non-white appearance.

Slow-Speed Dynamo

I HAVE a dynamo which I intend to use as a wind charger. It is a Lucas (12-volt type C45L) out of a 1930 car.

Here are some particulars: armature, 4¼in. long, 2¾in. diameter, 21 part. Commutator (41 part): 1in. long, 2in. diameter, and four field coils.

Can it be made to charge a 12-volt battery at a low speed by rewinding the field coils only, or will the armature have to be rewound also? What gauge of wire would be required if this is possible?—L. Collier (Baltray).

SINCE the voltage generated in the armature, with a field of given strength and at a given speed, is dependent upon the number of armature conductors, it follows that if the field remains unaltered the number of armature conductors must increase as the speed is diminished, in order to preserve the same voltage. If it is assumed, for example, that the cutting-in speed of this dynamo was originally 1,350 r.p.m., and you now wish to rewind it to cut in at 450 r.p.m. with the same battery, it will be necessary to rewind the armature with three times the original number of turns per coil. This, of course, means using a smaller gauge of wire in order to find room in the slots, and supposing the original winding to be No. 18 gauge, the gauge of the new winding would have to be reduced to No. 23 in order to find room for the increased turns, and the charging capacity in amperes would fall to one third the original current. The field coils would not require rewinding.

ELECTRADIX

SUNDRIES. 6in. **Pocket Thermometers,** nickel case Vet type for animals, 90/100 deg., **1/6.** **H.M.V. Resistors,** glass cased, wire ends, ½ watt, .01, .025, .05, 1/- per set of 3, or 2/9 per doz. Screened **Mike Cable,** flexible sheath, single core, **1/2** per yard. **Multiple Connection Strips** of soldering tags, telephone type moulded mounting, in 25 50, 75 or 100 watts, at **2/6, 3/-, 3/6** and **4/-** each. **G.P.O. Plugs,** 2/- each. **G.P.O. Vertical Telegraph Galvos, slightly damaged but in working order, 7/6. Mentor Battery Indicators** thermal type signal light, thermal type 2½in. dial flush panel, 6 volt and 12 volt, **5/-. Small Solenoids** "Gemi" 6 volts 1½ amps., iron plunger, **6/6. Oldhams Miners Lamps, all-metal,** for accumulator or **dry cell, 7/6. 4-way Cords,** long, suit mikes or handcom phones, **2/-. Electric Counters** to 10,000 revs., G.P.O., **5/6. COVERS.** Light Metal ventilated covers for test boards, resistances, chargers, etc., special arch shape to contain 6¼in. x 5in. with terminal cover extension, **3/-,** postage 6d. **CABINETS.** Oak cabinets with hinged lid and front door, 10in. x 10in. x 7½in. overall, **7/6.** Packing 1/- extra.

HEADPHONES, 12/6. Headbands only for 2 earpieces, **2/6.** Govt. cords, **2/6. Crystal** parts, as **advertised. MORSE KEYS.** We have some ex G.P.O. Quad Keys, in blitzed condition, needing overhaul. **12/6.**

RADIOGONIOMETER Direction Finders, **£4 10/-** and **£6 10/-.**

VALVES. American Replacement valves, 6 and 7-pin in Nos. 2A7, 48, 49, 53, 59, 79, etc., **6/6** each, to callers only. No Post. No Cartons.

DIMMERS or RHEOSTATS with "off" 0 to 1 ohm, for regulation on 6 to 12 volts. One hole fixing for panels. Hollow knob has socket for min. bulb, in carton, 2/6. Worth 5/-.
Large 40 amp. ironclad grid Rheos with heavy 10-stud switch to drop 220 volts to 45 volts. Size 33in. x 16in. x 14in., **£5 10/-.** ; 11 volt. ditto, 16in. x 14in. x 16in., **£2 10/-.**

SOLO VARIABLE CONDENSERS for Wave-meters and Single Circuit Tuning, logarithmic blades .0005 mfd., new. Type F., boxed, **4/6.** Special Short Wave, **4/6.**

POWER TRANSFORMERS.
35KVA 220 volts SP50 to 110/110 volts, **£30** ; 7½KVA 100 v. to 6,000 v., **£14** ; 5KVA 220 v. to 5,000 v., and 500 v., **£10** ; 2KVA 200 v. to 4,000 v., **£8 10/-** ; 3KVA 400 v. to 600 v., **£9** ; 2KVA 230 v. to 11,500 v. C.T., **£8 10/-** ; 1½ KVA 100 v. to 6,000 v., **£3** ; 1KVA 240 v. to 17 v. 57 a., 4 taps to 6 v., **£7** ; ¾KVA 230 v. to 6 v. 100 a., **£6 15/-.**

TRANSFORMER PARTS. Stampings Control limits supply. We offer some 100 watt transformers for rewinding. Complete, good class but unknown ratios. Sold for re-making, **22/6.** Larger 250 watt size, **27/6.** Stalloy Sheets, 38in. x 6in., **1/3** each.

CHARGERS. Tungar double circuit 200/240 volts A.C. mains to D.C. 60 volts 10 amps., **£16.** Davenset Garage Charger, complete, as new, A.C. mains to 30 volts 6 amps. D.C., **£14.** Westinghouse Metal A.C. to 8 volts 15 amps., **£22.** Ditto to 8 volts 32 amps. D.C., **£35.**

FOR AMPLIFIERS or INSTRUMENTS. Ex. W.D. mahogany, canvas covered, 9in. x 9in. x 6½in. with double doors. Chassis 4 transformers, 5-tap switch, rheostat, etc. Suitable for Test Set Apparatus, Mike Amplifier, Oscillator, etc. Unused, **45/-.** Empty Cases only **25/-.**

MOTORS AND DYNAMOS. Croydon D.C. shunt dynamos or motors, 100 volts, 1 amp., **28/-.** ¼ h.p. 110 and 220 volts D.C. motors, **£4.** Induction ¼ h.p. 230 volts, 425 revs., 50 cycles A.C., **£4 15/-.** 50 volts 8 amps., 2,000 revs. Dynamo, **£5 10/-.** ⅛ h.p. D.C. Motor, 1,750 revs., ball bearing, 500 volts, with pulley, **£5.** 240 volts 1 h.p. City Electric, 1,000 revs., ball bearing, 2-groove pulley, **£10.** 2 h.p. 220 volts E.D.C., 1,400 revs., **£15.** 3 kw. Dynamo, 110 volts, 27 amps., **£17.** 460 volts, 6 h.p. D.C. Siemens Bros., 1,680 revs., **£25.** 500 volts 6 h.p. Crypto, 2,250 revs., double end shaft, **£27 10/-.** Winter is coming. Windmill builders want a slow-speed 12 volt automatic Dynamo 600 to 1,000 revs., 10 amp. output. All new. Price **£5.**

When sending enquiries, please enclose stamped, addressed envelope. Thank you.

ELECTRADIX RADIOS
214, Queenstown Road, Battersea, London, S.W.8
Telephone: Macaulay 2159

INSTRUCTION IN PLASTICS TECHNOLOGY

A NEW organisation has been formed to supply ambitious people interested in the Plastics Industry with modern instruction in Plastics Theory and Practice.

The new organisation, known as The British Institute of Plastics Technology, is the specialist Plastics Division of The British Institute of Engineering Technology, Ltd., one of the largest home-study technical training organisations in the world.

Specialist Plastics Courses are being prepared and will be available within a reasonable period. Those interested are advised to submit their names and addresses, when full particulars will be forwarded as our tutorial plans mature. Enrolment for the special courses will first be offered to those whose names have been thus recorded, but no obligation whatsoever will be incurred in lodging an application.

BRITISH INSTITUTE OF PLASTICS TECHNOLOGY
4, Shakespeare House,
17-18-19, Stratford Place, London, W.1.

TOK

ROTARY QUICK MAKE & BREAK
For control of all power and inductive Circuits
BRITISH MADE THROUGHOUT
Write for information.
TOK SWITCHES LTD.,
CAMBRIDGE ROW, BURRAGE RD., WOOLWICH, S.E.18.

SWITCHES

You must know MATHS

If you wish to understand any technical subject thoroughly, you must know Mathematics. Our method of Home-Study Tuition is a proved success. Hundreds of our students who imagined they could never master maths have progressed up to the Calculus, and thoroughly enjoyed learning.

RADIO Big developments in Radio and Television have been forecast. There will be splendid opportunities for trained men to secure well-paid employment, or start businesses of their own.

Now is the time to increase your knowledge and efficiency, so that you may ace the future with confidence.

Post coupon for free details of our Modern Home-Study Courses in Mathematics, Radio Reception, Servicing, Transmission, Radio Calculations and Television.

(Post coupon in unsealed envelope—1d. stamp.)

T. & C. RADIO COLLEGE,
2, The Mall, Ealing, W.5.

Please send me free details of your Home-Study Courses in Mathematics and Radio.

Name..

Address..

M.5..

WHY WORRY?

WORRY uses an immense amount of vital force. People who worry not only use up their energy during the day by worrying, but they rob themselves of that greatest of all restoratives, sleep. People who worry can't sleep. They lose their appetite. They often end up by getting really ill. How often have you heard it said, "I am worried to death"?

What do you suppose would happen if a person who was putting himself into mental, moral, and physical bankruptcy by worrying, were to convert all this worry energy into constructive action? In no time at all he would have accomplished so much that he would have nothing to worry about.

Nothing is more discouraging to a worrying person than to have someone say, "Oh, don't worry, it will all come out right"

This is not reassuring at all. The worrying one can't see how it is going to come out all right. But if the men and women who worry could be shown how to overcome the troubles and difficulties that cause worry, they soon would cease wasting their very life-blood in worrying. Instead, they would begin devoting their energies to a constructive effort that would gain them freedom from worry for the rest of their lives.

You say that sounds plausible, but can it be done?

Half fees for serving members of His Majesty's Forces
(Apply for Services Enrolment Form)

It can be done, and is being done, by Pelmanism every day in the year. This is all the more remarkable because to-day the whole world is in an upset condition and people are worrying to an unusual extent. Yet, every mail brings letters to the Pelman Institute from grateful Pelmanists who have ceased to worry.

People to-day are all too prone to complain that they just have to worry. But once they become Pelmanists they cease this negative form of thought.

Remember—Everything you do is preceded by your attitude of mind

The Pelman Course is fully described in a book entitled *"The Science of Success."* The Course is simple and interesting, and takes up very little time; you can enrol on the most convenient terms. The book will be sent you, gratis and post free, on application to:—

Pelman Institute,
(Established over 40 years)
130, Albion House, New Oxford Street, London, W.C.1.

Readers who can call at the Institute will be welcomed. The Director of Instruction will be pleased to have a talk with them, and no fee will be charged for his advice.

PELMAN (OVERSEAS) INSTITUTES: NEW YORK, 271 North Avenue, New Rochelle. MELBOURNE, 396 Flinders Lane. JOHANNESBURG, P.O. Box 4928. DURBAN, Natal Bank Chambers (P.O. Box 1489). DELHI, 10 Alipore Road. CALCUTTA, 102 Clive Street.

THE Cyclist
Editor: F. J. CAMM
VOL. XII NOVEMBER, 1943 No. 261

All letters should be addressed to the Editor, "THE CYCLIST," George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.
Phone: Temple Bar 4363
Telegrams: Newnes, Rand, London

Comments of the Month

Massed Start Racing

By F. J. C.

IN last month's issue we published the text of the announcement made by the Home Office to the effect that the Home Secretary has circularised Chief Officers of Police, calling their attention to the growing practice of holding massed start cycle races on the highway. The official view expressed was that these races are likely to cause obstruction to traffic and to be a source of danger to the public and to the racers, particularly over roads containing hills and bends, and this danger will be considerably increased when more normal road conditions return. A further objection raised by the Home Secretary is that in present conditions there is a considerable waste of police time involved.

This statement, which, the B.L.R.C. states, has been chiefly inspired by those known to be hostile to massed start racing, has been greeted with whoops of delight in certain quarters. The opinion has been expressed that the announcement amounts to a ban on massed start racing, and that we have seen an end of this form of sport. We want, therefore, to assure our readers that the statement means nothing of the sort, and we think that the Home Secretary and the Ministry of War Transport have been ill advised to issue this statement without fuller investigation of the facts. One of the antagonists, in a statement to the Press, welcomed this announcement, and stated that the new body formed to control this form of racing (which to date it has done with singular success, and without accident or incident) consisted of a number of hot-headed youths. It is, indeed, a sign of old age when we criticise youth! It is, in some respects, better for them to be hot-headed youths expressing their natural desire to progress than extinct volcanoes which have expended their eruptive powers. In any case, the question of racing on the roads, whether massed start or time trial, is not a concern of the Cyclists Touring Club, which is not entitled to express an opinion on it. In the latest issue of its journal, it is stated that "*the C.T.C. promotes far more massed cycling than any other club in the world, and hence we are vitally concerned with its good conduct and with the reactions of public opinion towards it. The revival of massed start racing, after an interval of nearly half a century*—(The minds of many associated with cycling seem to reside permanently in that period, and their ideas have not progressed since.—ED.) —*was calculated to arouse public hostility and inspire repressive legislation. . . .*" As far as we have been able to trace, after careful inquiry, there has not been any public hostility, nor, we can assure the C.T.C., will there be any repressive legislation! The only hostility which has been aroused against massed start racing has been fomented by interested parties, and by those associated with interested parties, anxious to have a finger in control when they have no right to do so. We therefore advise the Home Secretary that he can safely ignore the opinions of the Cyclists Touring Club, which, with a membership of less than 30,000, and which on its own admission promotes massed cycling, does not express the opinions of the 9,770,000 cyclists remaining out of the 10,000,000 presumed to be riding bicycles. The combined membership of the National Cyclists Union, the Cyclists Touring, and the Road Time Trials Council, is not more than 80,000, probably far less, for there is a considerable overlapping membership.

National Bodies

FOR years the national bodies have promoted a belief that massed start racing is illegal, and over a year ago, in order to lay this bogy once and for all, we communicated with the Government, and elicited that such racing is not illegal, and that provided that the rules of the road are obeyed, and in other respects the law complied with, the police have no power to stop it. Which is the position to-day, and the position which will remain, much as those who have handled this delicate situation with lack of tact would wish it otherwise. In our view, there is far more danger in the massed *finish* of a time trial than there is in a massed start race, where police supervision has been provided. If one is illegal or undesirable, so is the other, for massed start races can be held early in the morning, as are time trials. It would be as sensible to argue that the Boat Race or the Lord Mayor's Show are illegal because they cause the closure of roads and considerable dislocation of traffic for many hours, as well as occupying the time of a considerable number of police.

We would call the attention of the Home Office and the Ministry of War Transport to the fact that massed start races were in pre-war days held over the public roads of France and Italy on a colossal scale, without accident. Such races were front-page news in those countries, where it can by no means be said that the roads are superior to our own. We fail to see why, because a few people are anxious to retain control of cycle sport, and to control it in the manner laid down 50 years ago, when cycles were the fastest vehicles on the road and there was considerable police hostility, massed start racing should not be permitted over here. We preserve an open mind on other aspects of the problem, but we are most anxious to see fair play. We do not believe in letting the tail wag the dog, and 50,000 cyclists are not entitled to speak on behalf of 10,000,000.

The Home Office announcement does not, by any means, close the matter, and a great deal more will be heard about this within the next few weeks. We can, however, assure the Ministry of War Transport and Mr. Herbert Morrison that massed start races will continue.

Police supervision of such races is quite unnecessary, any more than time trials with a field of 100 need police supervision, either at the start or the finish. In a massed start race, the riders by the time they have got into their stride are as well dispersed as those who start in a time trial, and some of the fast finishes in these time trials which we have witnessed can be as dangerous as the comparatively slow start of a massed race. So far as the National Cyclists Union is concerned, they are entitled to excommunicate such of their members as take part in these races. That is not a valid reason, however, for wishing to ban them. Many years ago the National Cyclists Union set its face against all forms of road racing, massed or time trials, but now it seems to be evincing a greater interest in it, and this interest seems to coincide with the cessation of track racing, which alone it exists to control. To fortify its position, it has understandings and working arrangements with the Road Time Trials Council. Adversity does, indeed, make strange bedfellows.

Matters are Proceeding

HOWEVER, as we have stated earlier, matters are proceeding and it may be that when all aspects of the case have been fairly presented to the authorities, a different opinion will prevail. We are not at all satisfied that the Home Secretary and the Ministry of War Transport have been correctly informed on the matter, and in some instances, at least, the clash of personalities has been allowed to permeate and to import into the problem an aspect which should be remote from any sport which claims to be clean.

Room for Bikes and a Pram

THE Minister of Health has good news for cyclists.

The National Committee on Cycling expressed to Mr. Ernest Brown the hope that in the lay-out of new houses there should be included, under cover, space for one or more bicycles and a perambulator.

Mr. Brown has replied that he hopes to see the suggestion incorporated in all future houses with which his Ministry is concerned.

The White Stick Symbol

THE Minister of War Transport, in a recent letter to associations representing the blind, has asked for the co-operation of these bodies in encouraging the use of white sticks and in making their significance more widely known.

He is sure that drivers, for their part, will readily accord to the users of these sticks the additional consideration which makes so much difference to their safety and comfort.

PARAGRAMS

A pretty Thames-side inn.

New Use for T.L.C.
IT has been suggested that after the war tank landing craft should be used as ferries in the British Isles.

Curfew on Cycling
THE Germans in Denmark have placed a curfew on cycling. Cyclists must use their machines only between 8 a.m. and 5 p.m.

Black Market
BLACK market price for bicycles in Dublin is said to be £25 and £30 each.

Reserves Wanted
THE Scottish Amateur C.A. is to be urged by the West of Scotland T.T.A. to invite reserves to its invitation "25" and invitation "50."

Hendry Wins
ALEX. HENDRY, Glasgow Wheelers, has won the 1943 championship of the Scottish Amateur C.A. The championship is over 25, 50 and 100 miles.

Star Returns
JAMES HARVEY, former time trials star of the Ivy C.C., has returned to the game, and is now an active official of his club and the West of Scotland T.T.A.

Liverpool's New Secretary
H. D. PEARSON, 19, Lydford Road, West Derby, Liverpool, 12, is the new hon. secretary of the Liverpool District Council of the R.T.T.C.

Twice Honoured!
SYDNEY THOROGOOD, Herts and Essex Wheelers, has been awarded the D.S.M. for meritorious service while serving with one of H.M.M.L. Prior to the announcement of the decoration the recipient was informed he was the father of a bonny boy.

Watford Wanderers
THE Mayor of Watford started over 70 riders in the open 24-hour ride of 200 miles organised by the Herts District Association of the C.T.C. Although several riders did not finish the course, the finishers included three ladies.

Simpson's Sixth Successive Win
BY winning the open "25" promoted by the South Yorkshire Centre of the N.C.U., Jack Simpson, Barnsley C.C., recorded his sixth consecutive win in road time trials. His time was 1.2.25.

Killed in Action
TWO members of Cambridge Town and County C.C. have recently been killed in action. They are Sergeant Air-Gunner Pat Drane and Andrew Carter, who held similar rank.

Track for Cambridge?
THERE is every likelihood that Cambridge will have a municipal cycle racing track in the near future.

Champion Abroad
BASIL LAURIE, road and path champion of Cambridge Town and County C.C., is now with the Forces.

His Hat Trick
BY winning the Dinnington Trophy for the third time, Eddie Larkin has made it his own property. His wins were in 1934-6-43. The trophy has been "in circulation" for 14 years, and has been held by many famous riders.

Dale Park C.C. to Re-form
THE Dale Park (Croydon) C.C. is being revived. Active before the war, this well-known club lost many members through general mobilisation. No subscriptions will be payable until peacetime standards are reached.

Addiscombe C.C. Loss
LEN. HOBBS, Addiscombe C.C., has been killed during a R.A.F. training flight in South Africa.

Sloper's New Rôle
J. M. SLOPER, joint holder with L. Copping (North Road C.C.) of the 100 and 50 mile tandem-tricycle records, has joined the R.A.F. He has also taken his B.Sc. degree with honours.

Killed in Sicily
FRED GIDDEN, Dulwich Paragon C.C., died of wounds received in Sicily. He had seen service in France, India, Iraq and Persia.

A Veterans' "12"
AT the age of 45, A. E. Metcalf (Barnet C.C.) rode 195 miles to win the Veterans' T.T.A. 12-hour event.

Cycling Pioneer President
SYD CAPENER, Speedwell B.C., has been elected president of the Fellowship of Old Time Cyclists.

The Aquila Club
THE first cycling fixture of the Aquila C.C. will be after the war, as all its members are prisoners of war! The club, whose first run will be to Meriden, is affiliated to the N.C.U.

Ivy Champion in Cairo
ARTHUR HEPBURN, pre-war champion of the Ivy C.C., is now with H.M. Forces in Cairo.

Good News at Last
POSTED missing following the fall of Singapore, J. Baines, Lancaster C.C., is now known to be a prisoner of war.

Famous Track Destroyed?
IT has been stated that the famous Vigorelli track at Milan has been destroyed during R.A.F. raids.

Club Record Broken
AFTER standing since 1938 the De Laune C.C. 30-mile tandem club record has been broken by W. T. Fraser and F. P. Leckie, who clocked 1.7.24.

Poloists in Birmingham
FIXTURES for the winter have been arranged by four polo teams in the Birmingham area. A League has been formed, and prospects for its success are considered excellent.

Bournemouth Arrow's Record
FIFTY-NINE members of the Bournemouth Arrow C.C. are serving with H.M. Forces. Of these three are prisoners of war, while another member, Edgar Tanner, has been posted as "missing, believed killed."

Death of Basil England
BRISTOL club circles have sustained a great loss by the death, at the age of 46, of Basil England. For 11 years he was hon. secretary of N.C.U. (Bristol) Centre until he was elected vice-chairman in 1933.

Hounslow Champion
WITH an average speed of 20.079 m.p.h. at 25, 30, 50 and 100 miles, R. Scholfield becomes Club Handicap Champion of the Hounslow C.C.

Fast at 44
A. ROGERSON (Spen Valley Wheelers) won the Veterans' T.T.A. "25" with a fine ride of 1.8.41. He is 44.

Joyce Dean's New Rôle
JOYCE DEAN, popular and speedy member of the Apollo C.C., is now in the W.A.A.F.

Gosport Service Man's Win
LEN DOMMETT, Gosport Wheelers, clocked second fastest (1.28.11) in a 30-mile event held at the Scottish station where he is in R.A.F. training. At a grass track meeting he was also placed.

Clubman Decorated
JACK SHAW, Hartlepool Grosvenor C.C., has been awarded the Military Medal for gallantry in the Near East.

Friends Meet in South Africa
TWO members of the Stockton Wheelers, W. Laybourne and Harry Topham, both of whom are in the R.A.F., have met by chance in South Africa. They were former joint holders of the T.C.A. Darlington-Wetherby record.

Fine Ride in Devon
V. K. CANN, Mid-Devon Road Club, has beaten club record for Teignmouth to Totnes and back by 52 seconds. He covered the difficult 28 miles in 1.35.0.

At the Roadfarers' Club luncheon. The President, Lord Brabazon of Tara, Mr. P. J. Noel Baker, M.P. (Parliamentary Secretary to the Minister of War Transport), and Col. Charles Jarrott, O.B.E. The Editor of this journal is also seen talking to Mr. C. G. Grey on the right.

Around the Wheelworld

By ICARUS

Noel Baker, M.P., at Roadfarers' Luncheon

THE President of the Roadfarers' Club, Lord Brabazon of Tara, presided at the Roadfarers' Club luncheon at the Waldorf on Thursday, October 7th, when Mr. P. J. Noel Baker, M.P., Parliamentary Secretary to the Minister of War Transport, spoke on the important subject of Road Problems, and Post-war Road Planning.

He said that whilst we must concentrate on winning the war, we must also make time to consider the problems which will face us when the war is won. He was specially pleased to be a guest of the Roadfarers' Club, because he had a very special sympathy for its purpose, and agreement with the methods it intends to follow to get all roadfarers together—pedestrians, cyclists, users of omnibuses, motorists, owners, operators and crews of haulage vehicles. "They are," he said, "not very clear-cut classes," and he liked to think that he had the experience which entitled him to some sympathy with them all. All his life he had a passionate belief in the physical and spiritual efficacy of walking in the country, yet every day, like most other people, he was a pedestrian in London. Like millions of our countrymen, he was an ardent cyclist.

He learned to become a motorist on the roads of Flanders, in the dark days of November, 1914, and drove heavy vehicles, night by night, long enough to know what lorry drivers feel about roads.

We all double many parts, yet, as road users, we tend to fall into classes which bitterly oppose each other. The Roadfarers' Club proposes to bring them together, and, if it may be, to a common point of view, by discussion among all sections and technical investigation of road problems, bringing together those who hold opposite views. The Roadfarers' Club will thus perform a tremendous service in this way alone.

Post-war Period

IN dealing with road problems of the post-war period, he said there will be two new conditions—war always brings great technical advance, so that everything to do with the internal combustion engine will be very different after this war, and there will be great qualitative improvements and changes. There will be higher speeds, and higher performance. There will also be an immense quantitative increase. He prophesied that there will be four times the number of vehicles on the roads in relation to 1939 within the next 20 years.

There must be no more mass unemployment while public work is to be done. He made reference to the very careful investigations of our road problems which have been made by Colonel O'Gorman, who addressed the Roadfarers' Club a few months before. (This address was given *in extenso* in this journal at the time.—ED.)

Speed, he said, is a relative matter. In the 80's and 90's of last century there was a lively agitation about the dangers of the roads. The police brought many prosecutions in the courts against those who had been guilty of furious driving. These "scorchers" were cyclists doing from 15 to 18 miles an hour.

Mr. Noel Baker dealt at great length with various problems, and ended a 40-minute speech, uttered with great sincerity and with great knowledge of the subject, with words of congratulation to the sponsors of this unique club.

Mr. Harold W. Eley thanked Mr. Noel Baker, M.P., on behalf of the Roadfarers' Club. The toast of the Chairman was proposed by C. G. Grey, and Lord Brabazon, in typical Brabazonian vein, reiterated the great interest he was taking in the Roadfarers' Club.

Road Accidents—Safest Year of the War

THE number of deaths resulting from road accidents in the fourth year of war up to August 31st was 6,335. This is not only the lowest total for any war year, it is also the lowest annual total recorded during the last 15 years.

Fatal road accidents during blackout hours in the first year of war numbered 4,504; in the year just concluded, the total was 2,261—a reduction to nearly one half.

While much of the improvement at night may be due to the smaller volume of traffic and to vehicle lighting concessions, there is no doubt that drivers, cyclists, and pedestrians generally are taking more precautions, and even developing perhaps a blackout sense.

Loss of life among children unhappily remained heavy. On the average between four and five more children were killed on the roads every week during the last year than in peacetime.

The major problem is the saving of child pedestrians, especially those under the age of eight.

Another photograph taken at the Roadfarers' Club luncheon at the Waldorf on October 7th.

Wayside Thoughts

by F. J. URRY

Sheepstor, Dartmoor Village.

A Meeting

I WAS stopped on a river bridge a few weeks ago by a grey-haired man who asked my name. "I thought I was right," he said, "and I just want to say to you now, that you are quite correct in saying and writing that cycling is the most varied game in the world if people care to make it so. It is well over 30 years since I rode a bicycle, for the car had spoiled me, and like so many folks I thought cycling was only indulged by people who could not afford motoring. I thought cyclists were "up against" motorists as a result of jealousy. Well, I was wrong, and I thought it a nice thing to tell you because you have so long been an advocate of the pastime. I have no intention of flattering you, unless by flattering the pastime it reflects on you; but I want you to know you are doing good work, and if half the people who read your notes would follow your advice, then they would be happier mortals, healthier, kindlier, and far more interested in life. I first met you at a golf match to which you had ridden on a bicycle, and I laughed to think a man of your years should accept that mode of travel when others offered. I should not laugh now, but applaud, for I have got more enjoyment from cycling than anything undertaken during the last decade or more. I am sixty this year, and I'm quite certain the three score sits more lightly on me because of the services of my bicycle. So go on with the good work of propagation, for in my opinion it is of immense national benefit." That was quite a happy little meeting, for the man was a big manufacturer with an outlook that did not consider expense, and he told me he should never give up cycling as long as he could pedal. Then we compared bicycles and he listened to the various reasons I gave for the value of low gearing, comfortable saddle, positioning, and the cult of lightweight cycling. As I said at the start of these notes, I have experienced many such encounters this summer, but this one recorded was the most enthusiastic of them all.

Joy Without Distance

FOR the first time in 46 years I spent the August holiday at home. The reason was a business one, for with a bicycle the difficulties of travel would not have deterred me from wandering, and I think I have enough friends along the road to give me bed and board. But the business hang-up did not prevent me from enjoying a very delightful day on a country picnic to which six of us rode bicycles—two tandems and two singles—carried all the food we needed, the primus stove with which to cook it, and the plates, etc., to eat it off. It was rather a curious party for the elder tandem couple totalled just over 130 years between them, while the younger one was but half that age. All day we only rode 25 miles, but we were tucked away in a park bordering a rough track, and except for the 'planes overhead saw no other vehicle, not even a farm cart, for seven hours. The point I would make is this: that in these times no other vehicle but the bicycle could have taken us to this remote spot, which we had entirely to ourselves when so many places to where public vehicles ran were crowded out, and the food difficulties were a hungry business. It is just another instance of the variability of cycling in which miles are not the counting factor but are just a part of the enjoyment of a very enjoyable day. I have done this sort of thing scores of times; and hope to live to do it again and again, for it is good and a fine introduction to cycling for the novice.

This Lighting Problem

THE dark days will be with us before these lines are in print, and one hopes all of us who ride will have intelligently read the signs of the times by seeing our illumination is in respectable working order. Personally I confess I do as little night riding as possible, but usually I have half an hour's dark journey five days a week, and because of their convenience use dry batteries. Now that the new regulations on the blackout of head-lamps give us a trifle more light, I find I can creep over the well-known ways without that feeling of insecurity which often accompanied me when the glim of the battery was so shrouded that it was but the ghost of a light. Certainly we are better off in this matter, even though the improvement is little enough to crow about. My experience last winter was mostly concerned with the poor quality of the batteries, and one hopes the many representations made to manufacturers and the M.O.W.T. on this question will have had the desired effect. It is true, I think, that many of us were inclined to be careless in the use of our lamps, and only think about them the self-same moment we wanted to use them: whereas if we did give them a little daylight attention now and then many of our lighting difficulties would disappear. I am told on fairly good authority that the battery shortage will not be so acute this winter, and I hope it is true for, like most utilitarian riders, I frequently suffered a nightmare of regrets from my dealer friends when I needed battery replacements. Finally I was rescued from this worry by a good friend in the wholesale trade who sent me a small monthly supply until spring came marching up the land.

This Pumping Business

WE are abjured to pump our tyres hard and so preserve them for the longest run of miles of which they are capable. It is the advice experienced cyclists have been handing out for years, when the instrument of inflation was a perfect specimen of a pump. Thank goodness I have a few such pumps left to me, in prime working order, and therefore have no difficulty in carrying out the injunction of the tyre manufacturer, and incidentally my own regular habit; but I feel sorry for the many folk who have to undertake the task of inflation with the aid—or handicap—of a wartime pump. No doubt the pump manufacturers cannot help the real decline in quality, but it is rather a paradox in advice to ask us to pump our tyres board-hard with an instrument that often enough refuses to rise to the occasion. I know my pumps are frequently on loan to neighbours, and I have to keep a keen eye on them in order to preserve ownership, particularly the connections. I agree that tyres should be tightly blown, but if I had to undertake the job with some of the pumps sent out on our wartime bicycles I am afraid the definition of "tightly blown" would be in strict relation to the quality of the inflator I possessed wherewith to undertake the job. It seems to me useless to ask people to "do" things and then fail to provide the instrument capable of undertaking the job, and it is about time somebody said so. You can't make bread without yeast, and you can't blow a tyre hard—really properly hard — with a rotten pump. This is the main reason why you still see so many cycle tyres under-inflated.

Labour and Loveliness

SINCE my last visit to Scotland the outline changes of the woodlands are many and wide-spread. It hurts to see the green cloak of the hills torn away, glorious forests reduced to rack and rubble and the scarified slopes where the timber has been hauled aching in the sunshine. The necessities of war are altering the face of the land in many places, and beauty is being sacrificed to the need of timber supplies. It is useless railing against this present devastation, for I am told on the best authority that the country's timber is to-day providing 90 per cent. of our requirements, and the saving in shipping space is enormous, for timber is a bulky commodity. My correspondence with the same authority informs me that the definite intention is to restore our woodlands as soon as possible, and to start on the gigantic task immediately the war is over. This work is necessary in order to preserve the balance of climatic conditions, quite apart from the investment value of new plantations; and that is good news for those of us who have been so often delighted with the great forest sweeps that run in green symmetry over our hillsides. Moreover, it is good to know that much country labour will be employed in this work, and slowly but surely beauty will be restored to the land, and the younger generation will inherit the glory of great trees.

Club Notes

New Birmingham Club

A NEW club has been formed in Birmingham. Known as the 43rd Wheelers it is in entire support of the N.C.U. and the R.T.T.C.

Heavy Hostel Bookings

AUTUMN bookings at Lakeland Youth Hostels were the heaviest on record.

Arthur Stafford Safe

MISSING since February, 1942, Arthur Stafford, Rodney C.C., is now known to be safe and sound in Japanese hands.

Sicilian Casualty

PROMINENT competition rider in Northumberland and Durham, and one of the few riders to beat 1.5.0 in that difficult country, Donald Richardson was killed in Sicily. His fastest "25" was 1.3.17.

Barnesby C.C. News

EDDIE CALLENDER is the latest member of the Barnesby C.C. to join the Forces. Another member of the club, James Colvin, has had some exciting adventures on one of H.M. submarines.

Warwick Castle. Guy's Tower built in the 14th century.

My Point of View

By "WAYFARER"

A street in Painswick, Glos.

record the incident on the tablets of my memory for future use, going elsewhere for my refreshment. The excuse is one which I have not heard for a very considerable time. Perhaps it is demoded—in the presence of far better excuses!

Some Figures . . .

SITTING back in my chair the other evening, I was interested to pass in review some of the figures relating to the two short tours I have been able to carry out within recent months. Each was of nine days' duration (that's what I call a "week" when it comes to cycle-touring!) and the respective distances achieved were 562 and 568 miles. On the first tour I had one idle day: on the second holiday a day devoted to walking and to a family social programme restricted the cyclometer's activities to 30 miles. If, then, we treat No. 1 tour as comprising eight days, we get a daily average distance of 70 miles. The second holiday yields a comparable figure of 63.

Now, I was about to suggest that the weather conditions (barring a really formidable head-wind) do not seem to make much difference to a physically-fit cyclist. (In this connection, it would be interesting to investigate the results of some of our classic road events in "good" and "bad" weather.) But there is more to it than that. It has already been mentioned in these columns that the first of my 1943 tours must rank as "the wettest ever." The second tour very nearly comes in the opposite category, my cape being in use for only about 15 minutes.

Yet, despite the difficulties of wet weather—despite the circumstance that a cape undoubtedly hampers one's movements and increases one's windage—the fact remains that I averaged seven miles more per day during the "bad" weather. At one period of my cycling career I looked upon myself as something of a Jonah, and I had plenty of experience of rainy conditions. But time and again it was apparent that the climatic "amenities" made no difference. I went plodding on, and plodding on, spending the whole (wet) day along the road, and putting "paid" to the account only when bed-time arrived.

Of course, in considering such a matter as this, you cannot ignore the point as to *terrain*, which is a factor of some importance. You would not expect to do in Devon, or in the North Riding of Yorkshire, what could be easily achieved in Cheshire or Cambridgeshire.

. . . And Some More

ON the last Sunday of September I was much struck by the ease with which a relatively long distance can be achieved by a fit cyclist, in a not unreasonable time. Leaving home at 10.30 a.m., I rode 33 miles to the cottage (17 miles distant) which usually provides me with my Sabbath-day lunch, and I spent about 15 minutes with some friends en route. I lingered at that cottage until 3 p.m. (1½ hours) and then adjourned for tea to a house four miles away—though it cost me 20 miles to get there. An hour passed, and then I did another 24 miles to get home, where I "docked" at 8 p.m.

Thus my mileage for the day was 77, achieved in 9½ hours gross, or seven hours net (or a shade less). After a hot bath and supper, I went for a brisk two-mile walk, and then, feeling wonderfully fit, decided to "call it a day." There is no self-glorification about this bare statement of fact. Some such performance recurs at frequent intervals, and I just desire to stress the value of being able to carry out such a cycling programme, which makes for enjoyment—nay, delight—and adds to one's fitness.

Filthy Trick

ONE of the filthiest of tricks in connection with cycle thieving is the appropriation of another man's tyre valve, the enormity of the crime being disproportionate to the size or value of the article stolen. This has happened to me once (once too often), the discovery of the loss being made just as I was on the point of going home to lunch. I did not carry any spares on my business-and-back bicycle, and, as luck would have it, the incident occurred on early closing day. So that I was bunkered. A similar experience has just befallen a colleague of mine. On taking his bicycle out of the rack at the end of the day, he found that the back tyre was flat, the valve parts having been taken, and the result was that he had to find other means of getting home. As I say, this type of pilfering is the dirtiest of tricks, and deplorable in every way.

Fool Questions

MOST of us have been asked an entirely unnecessary question when, having up-ended our bicycle at the roadside and then dismantled a tyre, littering the district with spanners, tyre-levers, and repair outfit, somebody has come along with: "Got a puncher, mate?" The corrosive reply which one is prompted to give to this fool-question would be lost on the type of individual who asks it, and one can only grunt affirmatively, hoping that the inquirer will proceed about his business (if any) before he meets a sticky end. A question in the same class was put to me on a recent Saturday when I had been riding in heavy rain for at least two hours. On reaching the tea-house at which I aimed, I spread my dripping cape over my bicycle, doffed my saturated cap, and went indoors, to be greeted by this fool-question from a lady visitor: "Haven't you got a cape, or anything?" (The silly "or anything" would have caused me to have a pain in the neck, apart from the main inquiry!) A second's consideration would have suggested to the questioner the impossibility of cycling capeless in the rain for more than five minutes without displaying the appearance of a drowned rat—and I'm sure I wasn't doing that! But no! the mentality which divines a "puncher" when festoons of inner tube are littering-up the countryside is akin to that which miraculously imagines that a cyclist who doffs his cape before entering a house must of necessity have been riding unprotected from the weather conditions . . . though his very appearance shatters the belief.

Excuse

AT one time of day it used to be the custom for caterers, who were disinclined to "oblige," to plead that "the kettle isn't boiling," which, of all the excuses for not providing tea, was the feeblest of the feeble. Sometimes the cyclist would counter this silly statement by saying: "Well, it will boil while you're cutting the bread and butter." Personally, however, I am not sure that there is any advantage in coercing an unwilling caterer to get busy, and I would prefer to

Notes of a Highwayman

By LEONARD ELLIS

Straight or Star-shaped?

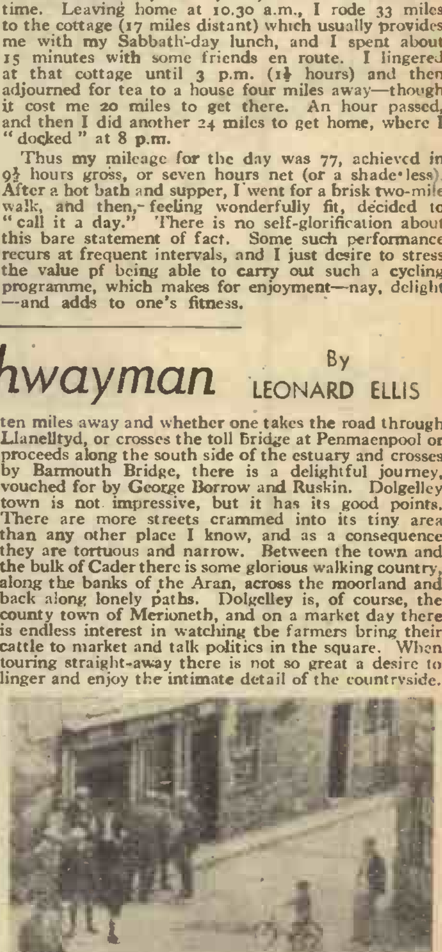
A CYCLE tour may be progressive or from a centre. Each method has much to be said in its favour and each, naturally, has corresponding disadvantages. The youngster, desiring to cover as much ground as possible, will want to jump from place to place and to avoid covering any ground twice. In the piping days of peace, when hotel-keepers were standing in rows along the highway seeking your patronage, one had little fear of failing to obtain a resting-place for the night. In these days when, frankly, accommodation is not so easy to obtain, centre touring has one great advantage. Having once fixed your stopping place you may come and go as you wish. You may travel light for a day, unencumbered by a fortnight's luggage. To the more staid tourist, to those who desire to linger and to those who are not consumed by the "excelsior" flame, centre touring is ideal. You may ride late without fear. One admits at once that at the end of a week or a fortnight one might perhaps get a little tired of the place chosen; then is the time to pack up and seek another centre.

Dolgelley as a Centre

CENTRE touring is particularly attractive to those who have in earlier days done all the main roads with the exuberant speed of impatient youth. They now yearn to see those places over again and to take it quietly, to stop and contemplate and to probe more deeply into the more intimate details of the district. We might, at the risk of being called a heretic, decide to leave the bicycles alone for a day and go walking. Those who have reached a maturer age can do this openly, and honestly admit that there are times when a bicycle can be a positive nuisance. I have in mind a trip to Dolgelley, when I was convinced that it made a grand centre. One of the major attractions at Dolgelley is the magnificent pile of Cader Idris that broods over the town on the south. There are many who aver that Cader is a more imposing mass than Snowdon and there is much in the argument. Its shape is awe-inspiring, and there are no other peaks of importance nearby to rob it of its grandeur. No one would think of trying to take a bicycle up Cader and yet the ascent is well worth the effort, and be it said there are easy ascents and there are really difficult climbs. Cader is only one of the numerous desirable places within easy reach of the town. There is the famous Precipice Walk and the New Precipice Walk nearer Barmouth.

Wealth of Variety

THE Torrent Walk is sheer delight for a mile or so, following the rocky bed of a turbulent little stream. Quite close is the area of Wales that is given over to gold-mining, and, although no Klondyke, gold is still actually worked from some of the mines. Barmouth is ten miles away and whether one takes the road through Llanelltyd, or crosses the toll bridge at Penmaenpool or proceeds along the south side of the estuary and crosses by Barmouth Bridge, there is a delightful journey, vouched for by George Borrow and Ruskin. Dolgelley town is not impressive, but it has its good points. There are more streets crammed into its tiny area than any other place I know, and as a consequence they are tortuous and narrow. Between the town and the bulk of Cader there is some glorious walking country, along the banks of the Aran, across the moorland and back along lonely paths. Dolgelley is, of course, the county town of Merioneth, and on a market day there is endless interest in watching the farmers bring their cattle to market and talk politics in the square. When touring straight-away there is not so great a desire to linger and enjoy the intimate detail of the countryside.



Market day in Dolgelley

KEEP UP THE AIR PRESSURE IN YOUR TYRES, TOO!

Our strength in the air is turning the scales of victory in our favour. But we haven't won yet, and our rubber shortage is still a serious problem. You can help to save the nation's rubber by carefully looking after your tyres. Proper inflation is most important. Keep them pumped up hard and repair punctures immediately.

Pumps are in short supply, too.
Share yours with your pal if he hasn't one.

Treasure Those DUNLOP *Tyres*

3H/311

AWHEEL . . . IN SAFETY

See the beauties of England awheel—but see them in safety. Be sure of safe control, be confident in all weather, fine or wet, by fitting Ferodo All-weather Brake Blocks. Sure-gripping, noiseless and long lasting, they give the cyclist an added margin of safety when the unexpected happens. Be sure to fit

FERODO

ALL-WEATHER BRAKE BLOCKS

REGD. TRADE MARK FERODO

FERODO LIMITED CHAPEL-EN-LE-FRITH.

CYCLORAMA

By H. W. ELEY

The Old Bell Inn, East Molesey, Surrey

Tyre Economy

THE very successful "Tyre Economy" Exhibition, which was held recently at Berkeley Court, London, has been followed by several provincial exhibitions, similar in character, and all aimed at making transport drivers "tyre conscious"—and I learn that good results have been achieved. Exhibitions have been staged in Glasgow, Manchester, Birmingham, and one has recently opened in Bristol. This idea of showing drivers just what can happen to tyres by mis-use, is a good one, and Lord Rothes, the Director of Tyre Control, is to be congratulated upon the scheme.

Kerrys

SO our old friends The East London Rubber Company propose to change the title of the business to "Kerrys." I believe it is only a recommendation as yet, but if the matter goes through, we shall certainly lose a name which has been famous and familiar for a very long time. But I suppose we shall quickly get used to "Kerrys." It is surprising how soon one forgets . . . but in this case, there will be no forgetting the products, for they will be as good and reliable as we have always known them.

The Charm of Kent

THE various counties of England provide never-ending charm and variety. Not the least interesting is Kent—the very cradle of English Christianity—and I have been browsing over a book on the county by that famous son of Kent, Sir Charles Igglesden, who has written volumes about the county he loves and knows so well . . . I doubt whether there is any man living who has more accurate and detailed knowledge of Kent than has Sir Charles! He loves the Weald, he knows the villages of Kent which lie right off the beaten track, and which are rarely if ever seen by the tourist who just sticks to main roads, and never "meanders." I commend any such to read Sir Charles Igglesden, and if they are keen on superstitions, and ancient weird beliefs, then they should make a point of getting his "Those Superstitions," which contains a wealth of information, curious and amusing, about the strange beliefs and customs which still cling in the more remote parts of the county.

Harvest

I RECENTLY travelled by train from London to the Midlands, and although not the month we usually associate with the corn harvest, I was struck, and greatly pleased, to see the amount of corn already cut. How heartening it was to see those sheaves of golden grain! How good an insurance against the wiles and crafts of the enemy! The harvest seemed to be bountiful indeed, and we should be thankful to every farmer who has so nobly responded to the appeals of the Ministry of Agriculture to plough up more land, and to help feed the people. Little use our splendid victories on sea and land, if we had not the food for our tables!

Cycle Advertisements

DESPITE the inevitable shortage of supplies, and the manifold trading difficulties due to the war, it is surprising how full of interest are some of the advertisements issued by firms in the cycle and allied trades. The other day I was much struck by the series of advertisements issued by Messrs. Terrys, of Redditch . . . "Famous Springs." The series features historic springs, and one advertisement shows an illustration of the Roman Bath in the Adelphi, "constantly fed, since the reign of the Emperor Vespasian, by spring water from the nearby Holy Well." And the "copy" goes on to mention that Charles Dickens took "many a header" into the bath, as recorded in "David Copperfield." Now, there is a fine example of how an advertisement can be informative and instructive!

Charles Macintosh

ANYONE connected with the rubber trade was interested recently in the stories in the press about a great pioneer of the rubber industry—Charles Macintosh, who died on the 6th of July, in the year 1843. The centenary of his death was marked by the placing of a wreath on his grave in Scotland. Macintosh, with his almost equally famous colleague Thomas Hancock, really discovered the secrets of vulcanisation, without which there would certainly have been no rubber industry as we know it to-day. Charles Macintosh gave his name to the weather-proof garment which we now all call a "Mac" . . . and this is fame indeed!

With Rod and Line

A MISTY, cool September morning . . . and I was standing beside a lake, rod in hand, waiting for my red-topped float to bob under. The previous evening I have "baited up" and I am hopeful of a good catch. And, after a few hours by this cool placid water, I do go home with a few very nice perch and one or two roach. Boring? Lacking in excitement? Maybe . . . but I have been a lover of a bit of coarse fishing for years, and I still find a wealth of contentment, and not a little thrill, in this ancient pastime. And if you are in search of peace and quietness in these hectic times, I commend a morning with rod and line; good to watch the water, to glance up at those wild duck which sail overhead with long outstretched necks; good to see the antics of the moorhens, and hear the faint rustle of the wind in the willows by the bank. . . .

Holidays at Home

THERE will always be a public for cycle racing . . . and I am reminded of this fact by the success of cycle events at some of the "Holidays at Home" sports which were promoted by so many of our enterprising municipalities. And how keen the club boys are to turn out! Time was when "dismal Jimmies" said that cycle racing was dying!

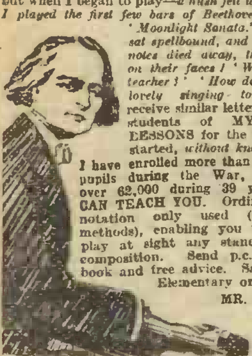
"Bartleet's Bicycle Book"

THE books one finds in hotel lounges are usually of a varied character . . . and many a time, when staying at some small hotel in a country town I have found strange volumes, and dipped into old books dealing with queer subjects. The other day, browsing among the volumes in an old book-case in a typical "lounge," I came across a book which really did arouse my interest in cycles and their evolution . . . and it also brought back many memories. It was none other than that little volume written by Sammy Bartleet—"Bartleet's Bicycle Book." What monumental research "Sammy" undertook in connection with his life's great passion! And with what gusto he would pounce upon some writer to the papers who had gone astray on his dates! Truly "Sammy" was the Historian of Cycling—an individualist to his finger tips, and a great fighter. I treasure my memories of the arguments I had with him, arguments never marred by ill-temper or animosity. [*With this we profoundly disagree. Bartleet made more mistakes than anyone else on matters of cycling history, and his alleged museum contains many falsities.*—ED.]

MATRICULATION
brings Success & Security

Whatever your age, you can now study for the all-important Matriculation Examination at home on "NO PASS—NO FEE" terms. "MATRIC" is the accepted passport to all careers, and opens up opportunities which would otherwise be completely closed to you. Ensure the success and security of you and yours through post-war difficulties by writing for our valuable **"Guide to Matriculation"** immediately—**FREE** and without obligation. **B.T.I. (Dept. 160), 356, Oxford Street, London, W.1.**

"They Laughed at First



but when I began to play—*a hush fell upon the room. I played the first few bars of Beethoven's immortal 'Moonlight Sonata.' My friends sat spellbound, and when the last notes died away, the excitement on their faces! 'Who was your teacher?' 'How do you get that lovely singing tone?'*" I receive similar letters daily from students of MY POSTAL LESSONS for the PIANO who started, *without knowing a note*. I have enrolled more than 12,200 adult pupils during the War, have taught over 62,000 during 39 years, and I CAN TEACH YOU. Ordinary musical notation only used (no freakish methods), enabling you to read and play at sight any standard musical composition. Send p.c. for FREE book and free advice. Say Moderate, Elementary or Beginner.

MR. H. BECKER (Dept. 358), Fleet St., E.C.4.

"Easily the best soldering fluid obtainable." This statement by a regular user of "BAKER'S" expresses the general opinion of motor and engineering trades. Sold in 6d., 1/- and 1/6 tins. *Also in Bulk.*

Baker's Soldering Fluid

SIR WM. BURNETT & CO. (CHEMICALS) LTD. Gt. West Rd., Isleworth, Middx. Hounslow 0476

LARGE DEPT. FOR TECHNICAL BOOKS

FOYLES

★ BOOKSELLERS TO THE WORLD ★

New and secondhand Books on Engineering and all other subjects.

119-125, Charing X Rd., London, W.C.2

Open 9 a.m.-4 p.m., including Saturday

Telephone: Gerrard 5660 (16 lines)

W. & G. Foyle, Ltd.

ELECTRIC ETCHING EQUIPMENT

AS SIMPLE TO USE AS A PEN

Will etch on any metal. Quicker than machine engraving. *From Dealers or direct.* Send for leaflet "E.13."

RUNBAKEN-MANCHESTER-1

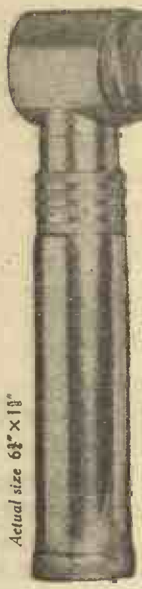
"ARGENTA" SILVER PLATING MATERIALS

For home use, same as supplied to Electroplating Trade. Silver Plate Lighters, Cutlery, etc.; a profitable and instructive pastime, complete set 15/6, plus postage and packing 1/6. Send 2½d. stamp for printed folder to **ARGENTA PRODUCTS, 40, Harrogate Road, London E.9.**

Welltested simplified Diagrams (5) and clear instructions for any Handyman to construct a satisfactory **TOY or MODEL MAKER'S LATHE** from obtainable materials costing approximately 50/-. Parts stocked. Price 3/6.

P. M. BARHAM, "Hilltop," Bradmore Green, Coulsdon, Surrey.

NO MAN CAN KNOW TOO MUCH OF HIS PRODUCT



Actual size 6⅞" × 1⅞"

BRITISH MADE

Full particulars on request.

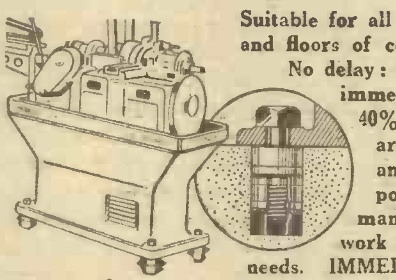
The Ultra Lens is a revealing eye of six actual diametrical—36 area magnifications, which brings out points of strength or weakness. Whether you are engaged in manufacturing, buying or selling, it is an ally of real value. No instrument you can buy will more quickly justify and pay for itself.

For the close scrutiny of every conceivable object, metals, tools, fabrics, fibres, minerals, precious stones, paint, print, manuscripts, biological and botanical specimens, cutting edges, fractured surfaces, raw materials, and innumerable other purposes, the ULTRA LENS is invaluable, and presents in many instances hitherto unsuspected data which can be used to advantage.

The price is **£4-5-0** complete in case with spare bulb, battery, and transparent measuring scale.

The Ultra Lens Company, RICHARD BOCK, 75, Finsbury Court, Finsbury Pavement, London, E.C.2.

BOLT DOWN THAT MACHINE IN HALF THE TIME
with CINCH Bolt Anchors



Suitable for all fixings to walls, ceilings and floors of cement, brick, stone, etc. No delay: full load can be applied immediately. Depth of hole 40% to 60% less than ordinary fixing methods. Cinch anchors give a quick and positive bite that holds permanently. Will not slacken or work loose. Sizes to suit all needs. IMMEDIATE DELIVERY.

Free! SEND FOR DETAILS AND SAMPLE ANCHOR and prove our claims

HOYT METAL CO. OF GT. BRITAIN, Dept. P.M., Deodar Rd., Putney, London, S.W.15

SCALE BUILDINGS	"00"	"0"
PLATELAYERS' HUTS	2/6 5/6	& 6/9
COAL OFFICES	3/6 & 4/-	6/6
WEIGHBRIDGE OFFICE	5/-	—
NEW BUNGALOWS	18/6	—
Postage 4d. extra.		
BUILDING LITHOS	3d.	3d.
STATION NOTICES	6d.	6d.
SHEET USEFUL NAMES ON CARD	9d.	9d.
Postage 4d. extra.		

BOOKS

A.B.C. of G.W.R. LOCOS 1/3, by post 1/5½

BRITISH RAILWAY ROLLING STOCK 4/6, by post 5/-

WANTED — RAILWAY BOOKS AND MAGAZINES.

TYLDESLEY & HOLBROOK, 109, Deansgate, Manchester, 3. Bla. 7312.

BOOKS

TWO USEFUL PUBLICATIONS: "THE ART OF SCALE MODEL AIRCRAFT BUILDING," 4/11 net. ("One of the best books on Modelling." —A.T.C. Gazette, October.) "AROUND THE WORLD WITH PEN & CAMERA," 1/6.—Useful Publications, 37, Aldwych, London, W.C.2.

TOOLS

NEW MACHINERY. *For essential work only.* Electric Motors, Band Saws, Drilling Machines, Pumps, Grinders, Welders, etc.—John P. Steel, Bingley.

MISCELLANEOUS

INVENTORS' Models made by engineer who specialises in all Patent Work, Design, Drawings, and marketing of patents.—BBJY, London, W.C.1.

CHARGE your Accumulators, Car Batteries, or lighting free from wind. Build your own wind charger from a few simple parts. Full instructions for building mast, head, propeller. 2/8½d.—Pearse, Midtaphouse, Liskeard, Cornwall.

GALPINS

ELECTRICAL STORES

"FAIRVIEW," LONDON RD., WROTHAM, KENT.

TERMS CASH with ORDER. No C.O.D.

Regret no Orders can be accepted from Eire or Northern Ireland.

ELECTRIC LIGHT CHECK METERS, well-known makers, first-class condition, electrically guaranteed, for A.C. mains 200/250 volts 50 cy. 1 phase 5 amp. load, 10/- each; 10 amp. load, 12/6, carriage 1/-.

1 K.W. TRANSFORMER, input 100 volts at 100 cycles, single phase, output 10,500 volts, centre tapped to earth. Price £4/10/-, carriage forward.

HEAVY DUTY CABLE, V.I.R., and braided, in first-class condition, size 37/13, lengths 30 to 40 yards. Price by the length, 5/- per yard, carriage forward, or 7/- per yard for short lengths, carriage paid.

ROTARY CONVERTER, D.C. to D.C., input 48 volts; output 2,500 volts at 1 kW., condition as new. Price £10, carriage paid.

½ WATT WIRE END Resistances, new and unused, assorted sizes (our assortment), 5/6 per doz.; post free.

SOLID BRASS LAMPS (wing type), one-hole mounting, fitted double contact small B.C. holder and 12-volt 16 watt bulb, 3/6 each, post free, or 30/- per doz., carriage paid.

TUNGSTEN CONTACTS, 3/16in. dia., a pair mounted on spring blades, also two high quality pure silver contacts 3/16in. dia., also mounted on spring blades fit for heavy duty, new and unused; there is enough base to remove for other work. Price the set of four contacts, 5/-, post free.

AUTO TRANSFORMER. Rating 2,000 watts, tapped 0-110-200-220-240 volts, as new. Price £9, carriage paid.

RESISTANCE MATS, size 8in. by 6in., set of four, 80-80-150 and 690 ohms, to carry ¼ to ½ amp. Price, set of four, 5/-, post free.

LARGE TRANSFORMER, input 230v., 50 cycle. Output 2,000-0-2,000 volts at 200 m/A., and 11 volt L.T. winding. Price £3/15/0, carriage paid.

MOVING COIL Ampmeter, 2½in. dia., panel mounting, reading 0-20 amps., F.S.D. 15 m/A. Price 30/-, post free.

REDUCTION GEAR BOX, right angle drive, ratio 50 to 1, ball bearing, shafts 7/16in. and 5/16in. in new condition. Price 25/-, carriage paid.

MOTOR DRIVEN PUMP, 100v. D.C. motor, "Keith Blackman," ¼ H.P.; ⅜in. inlet and outlet, gear type pump, in perfect working order. Price £5, carriage paid. Ditto 220v. D.C. motor, ½in. inlet and outlet. Price £7/10/0, carriage paid.

MOVING COIL movements, needing slight repair, modern type, famous makers, deflection 10 m.a. Price 15/-, post free.

ROTARY CONVERTOR, D.C. to A.C. Input 22 volts D.C. (twenty-two). Output 100 volts at 140 m/A. 50 cycle, single phase, ball bearing, in first-class condition, no smoothing. Price £5, carriage paid.

MOVING COIL VOLTMETER, 2½in. dia., range 0-10 volts, F.S.D. 5 m/A, panel mounting. Price 32/6, post free.

MILLIAMPMETER, flush mounting, 2¼in. dia., range 0-100 m/A, shunted, moving coil. Price £2, post free.

MOVING COIL AMPMETER, 2¼in. dia., range 0-5 amp., panel mounting, F.S.D. 15 m/A. Price 25/-, post free.

D.C. MOTOR, shunt wound, 110v., ¼ H.P., speed 1,750 r.p.m., ball bearings, laminated fields. Price £2, carriage paid.

ROTARY CONVERTER, D.C. to D.C., input 11 volts, output 1,100 volts, 80 watts, will operate successfully on 6 volts input. Price 50/-.

MASSIVE GUNMETAL WINCH, complete with long handle, for use with ⅜in. wire cable, weight 50 lbs., condition as new. Price £3, carriage paid.

200 AMP. KNIFE SWITCHES, S.P.-D.T., in first-class condition. Price 15/-, each.

DYNAMO, maker C.A.V., output 20 volts, 10 amps., speed 1,500 r.p.m., ball bearing. Price £5.

RECORDING AMPMETER in large iron-clad case, moving coil, 0-3 amp., no pen, clockwork perfect. Price £10, carriage paid.

2 K.W. TRANSFORMER CORE offered for rewinding only, windings not guaranteed. Price 30/-, carriage paid.

"Practical Mechanics" Advice Bureau **COUPON**
This coupon is available until November 30th, 1943, and must be attached to all letters containing queries, together with 3 penny stamps. *A stamped, addressed envelope must also be enclosed.*
Practical Mechanics. November, 1943.

Published about the 30th of each month by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and Printed in England by the Newnes and Pearson Printing Co., Ltd., Exmoor Street, London, W.10. Sole Agents for Australia and New Zealand—Gordon & Gotch, Ltd. Sole agents for South Africa—Central News Agency, Ltd. Subscription Rates (including postage). Inland 10s. 6d. per annum. Abroad, 10s. per annum. Canada, 10s. per annum. Registered at the G.P.O. for transmission by Canadian Magazine Post.