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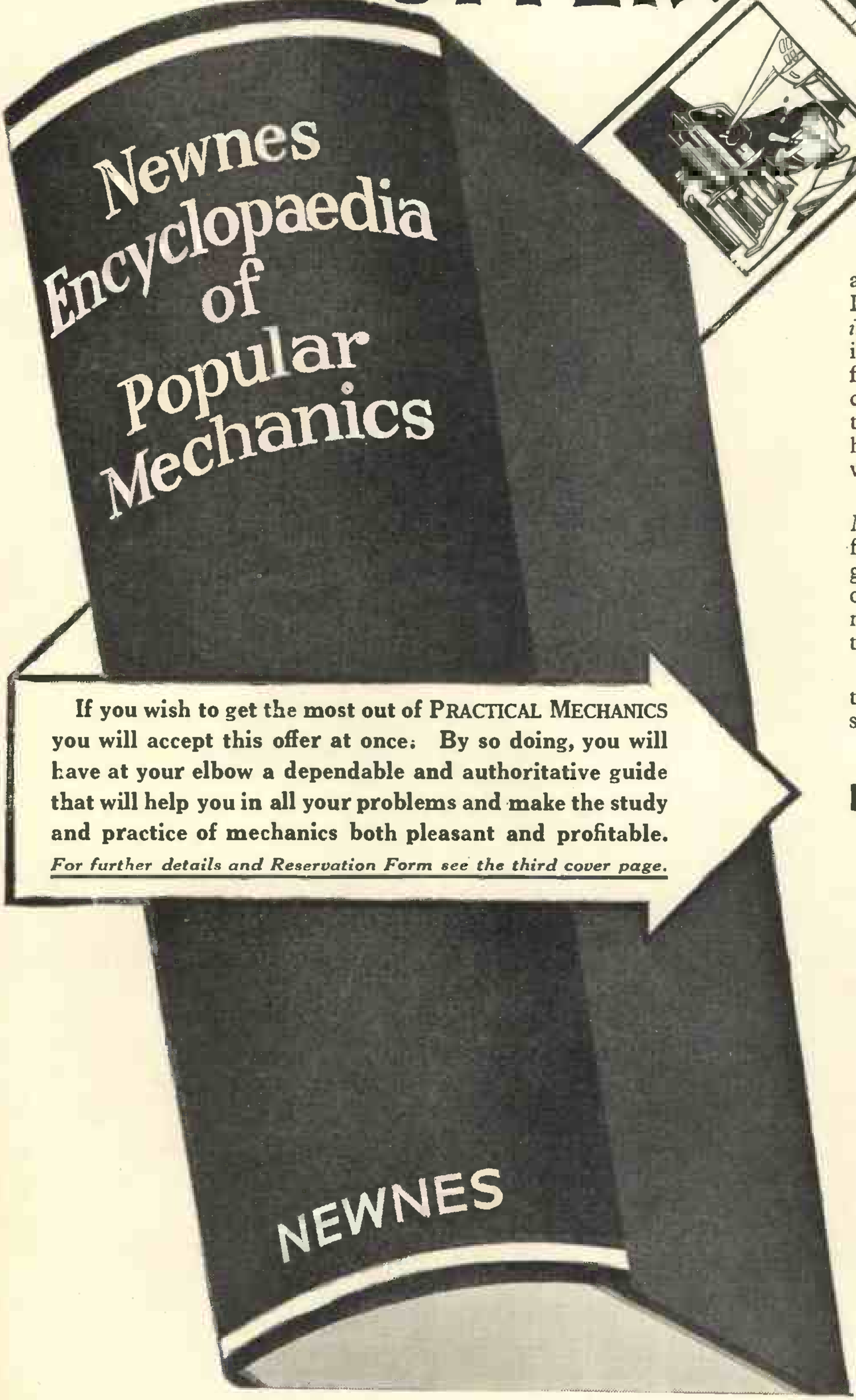

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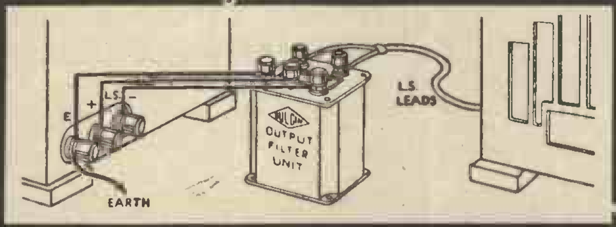

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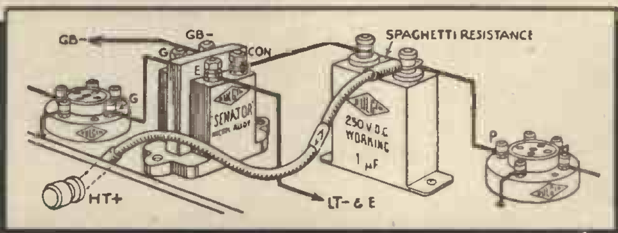

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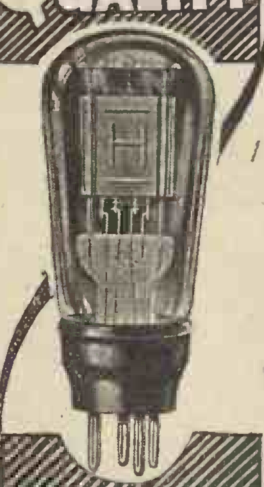

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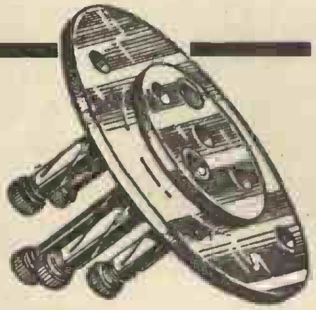

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Practical Mechanics

VOL. I. No. 2
NOVEMBER
1933

Edited by F.J.CAMM

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Notes, News and Views

Great Success of Newnes' Practical Mechanics

IN spite of the fact that over 100,000 copies of No. 1 of NEWNES' PRACTICAL MECHANICS were printed, the issue went out of print within two days of issue. From all over the country came repeat orders, and we were forced by sheer demand to put in hand an immediate and large reprint. That the scheme and policy of the paper, as outlined last month, is approved by our readers is apparent from the cataclysm of letters which has poured into these offices daily.

There is a surprising unanimity about these letters, for in nearly every case the writers express sincere pleasure that at long last a publication has appeared which caters for the modern practical outlook. It would be almost an impossibility to reply to these letters individually, so may I drop the editorial "we" (that delightful plurality of a singular quantity) for once and thank my hundreds of correspondents individually and severally here for their helpful suggestions, appreciation and comments.

The Power Grid Scheme

IT is a coincidence that the publication of No. 1 of NEWNES' PRACTICAL MECHANICS synchronised with the completion of the National Grid Scheme of the Central Electricity Board—one of the gigantic romances of science. The first electric lighting Act was passed fifty-one years ago, and it empowered Electricity Supply Companies to develop electrical power schemes locally, since when the use of electricity has steadily supplanted the use of other forms of power, such as steam, gas and wind. Although electricity is not a prime mover like the steam engine, nevertheless, it assuredly will supersede the older forms of power. Local electricity supply companies originally worked independently and the current they supplied differed considerably in various districts; there was no standard voltage supply and some companies supplied A.C. whilst others supplied D.C. This chaotic state of affairs imposed hardships on users who moved from one district to another, and also presented considerable difficulties to manufacturers of electrical appliances who were forced to stock a range of instruments to cater for this diversity of supply. Quite naturally these difficulties hampered real development and it was not until 1926 that the Electricity (Supply) Act was passed, which resulted in the Power Grid Scheme. The gaunt evidence of the completion of this scheme is now present in the somewhat menacing-looking pylons which are erected all over the country. These pylons carry the overhead cables which are fed from a number of large generating stations and deliver power at 132,000 volts pressure. This power is now to be retailed to district electric supply companies who will deliver at certain standard voltages. It will, of course be entirely A.C. The complete scheme will be in full working operation by the end of 1934 and will result eventually in the considerable cheapening of electrical power.

THE MONTH'S SCIENCE SIFTINGS

A new photographic exposure meter has recently been introduced which registers the correct exposure when directed toward the object; it depends for its action upon an electro-light-sensitive cell arrangement.

The B.B.C. are already experimenting with "120 line" scanning for television. If the experiments prove successful, this system will be used for normal television transmissions, and much greater picture detail will then be possible.

A new bomb-dropping device has lately been perfected by means of which bombs can be dropped vertically. So perfect is the scheme that (dummy) bombs have actually been dropped down the funnels of quickly-moving ships.

One firm has developed an inexpensive watch fitted into a sealed transparent case. Should any defect appear, the watch is replaced free of charge, provided that the seal is unbroken.

Self-changing gears for motor cars (which were described in our October issue under "How it Works") are standard fittings on many of the latest models.

So perfect has the wireless static (electrical interference) suppressor become that one firm of receiver manufacturers has adopted the practice of testing each set before despatch by moving one electrode of a high-frequency generator all over the chassis.

A chemist in the Midlands claims to have invented a special lens which, when fitted to glasses, enables the wearer to see in the dark. The same device can also be fitted to a camera to enable photographs to be taken in their natural colours.

Reserve Your Copy of the "Encyclopædia of Popular Mechanics" NOW!

See pages 2 and 3 of Cover.

Some Brief Facts

SOME nutshell facts concerning the Power Grid Scheme are: It has taken five and a half years to complete; has provided work for nearly a quarter of a million people; has cost £27,000,000; there are 265,000 pylons from 70 ft. to 80 ft. in height; whilst the pylons which carry the cables across rivers are nearly 500 ft. high and are 290 tons in weight. The overhead cables extend for 4,000 miles, of which 200,894 are at 132,000 volts pressure and the balance at 66,000 volts and 33,000 volts in about equal proportions. The materials used apart from the cables, include over 12,000 tons of aluminium and 170,000 tons of steel.

The Next War

If it be true that the next war will be fought in the air it would seem that a few high-speed bomb droppers could rapidly paralyse the whole country. Civil aviation may be considerably restricted in its development by this national network, quite apart from the danger of aeroplanes flying into these cables.

It is significant that in Germany the new houses are being built with underground "caves" into which the tenant can retire and be reasonably immune from aerial attacks. The Power Grid Scheme has, of course, been in operation in Germany for some time.

Our Presentation Volume

IF you have not yet reserved your copy of the "Encyclopædia of Popular Mechanics" you should turn at once to pages 2 and 3 of the covers of this month's issue and comply with the conditions without delay. This intriguing volume should be in the hands of every practical mechanic, for it contains valuable data and information on every branch of the subjects with which this JOURNAL deals.

The Lightometer

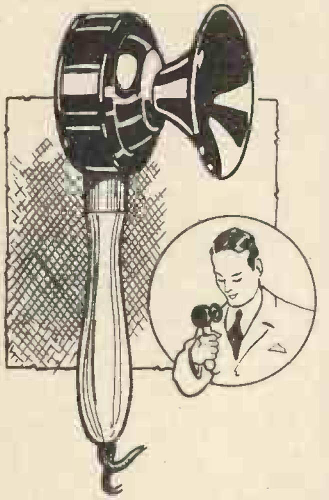
A NEW photo-electric cell of the dry type recently marketed possesses remarkable characteristics. It consists of a very special light-sensitive disc which is contained in a moulded bakelite case 2¼ in. in diameter. This case is fitted with two contact pins which can be plugged into a valve socket. There are no separate anode or collector plates or evacuated space as in the usual form of photo-electric cell. The device transforms light energy into electrical energy without the use of any auxiliary power source. It will readily be found that this device has a number of practical applications.

The LATEST Novelties

The address of the makers of any device described below will be sent on application to the Editor, PRACTICAL MECHANICS, 8-11 Southampton St., Strand, W.C. 2. Quote number at end of paragraph.

An All-purpose Adjustable Microphone

THE microphone illustrated here is a scientifically made instrument suitable for home address, home recording, radio transmitting, house and factory telephone, and many other uses in connection with a radio set. It responds evenly to all sound frequencies, and permits clear speech and music transmission at any power of amplification. The sensitivity can be adjusted to suit the output volume, which enables parasitic noises to be avoided and a silent background to be obtained. It must be used in conjunction with 100 to 1 microphone transformer when used in conjunction with a radio set or amplifier. It costs only 7*s.* 6*d.* [9]



The R.C. all-purpose adjustable microphone, suitable for public address, home recording, transmitting, house telephone and many other uses.

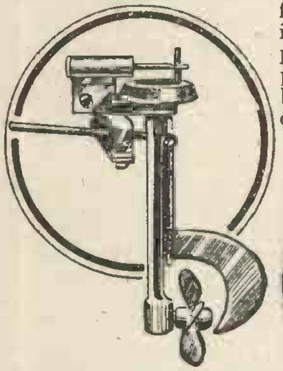
An Electric Immersion Heater

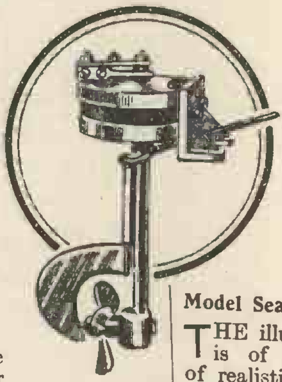
AN efficient and rapid method of electrically heating liquids can now be obtained in a variety of sizes at 6*s.*, 7*s.* 6*d.*, and 10*s.* 6*d.* complete. The 6*s.* size is the 300-watt type, the 7*s.* 6*d.* size 450 watts, and the 10*s.* 6*d.* size 600 watts. Each is supplied with a 5-ft. length of flexible cord and lamp-holder adaptor, but they can be supplied at an extra cost of 1*s.* with a 2-pin wall plug. The heater is placed in the vessel, containing the liquid it is required to heat, and the current is switched on. Half a pint of the liquid will be brought to boiling point in a few minutes. It has obvious uses; for rapidly making tea, coffee, boiling eggs, heating shaving water, soups, etc. [10]

The "Telette" pocket microscope which has a number of uses to the reader.

A Pocket Telescope

A WAISTCOAT pocket telescope, no larger than a fountain-pen, fitted with optical lenses and with a magnification factor of 5, can now be obtained in a case for 10*s* 6*d.* It is a fascinating pocket companion for rambles, picnics, etc. [11]

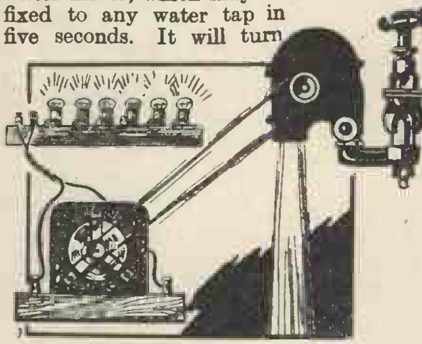




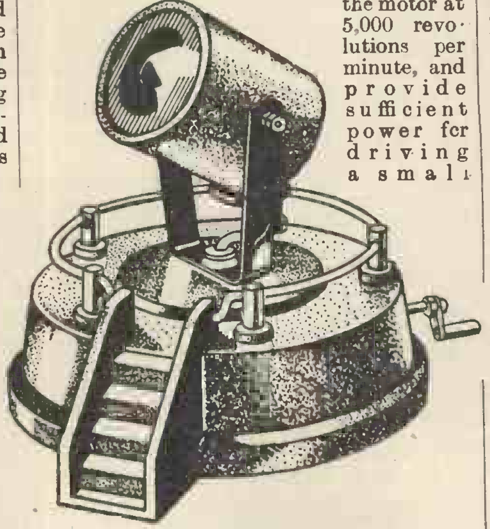
Two types of outboard engines (steam and electric), neat in appearance and efficient in performance.

The New Water Motor

THE sketch shows the Bowman high power water motor, which may be fixed to any water tap in five seconds. It will turn the motor at 5,000 revolutions per minute, and provide sufficient power for driving a small dynamo, and the electricity so generated can be led to any part of the house to light small electric bulbs. [12]



A simple water motor that can be fitted to a tap as shown for driving, models, etc.



A splendid new model searchlight of realistic appearance.

New Power Plants for Model Boats

ILLUSTRATIONS on this page show miniature outboard engines of ¼-in. bore and ⅜-in. stroke, complete with propeller and rudder, bevel drive, etc. Cylinders of the oscillating type are fitted, and the cost is 7*s.* 6*d.*, by post 7*s.* 9*d.*

A remarkable toy that can be made to submerge and ascend like a real diver.

The second illustration shows an electric version which is reversing.

They are intended to be clipped on to the stern of any hub. [13]

Model Searchlight

THE illustration at the foot of column 2 is of a powerful model search-light of realistic appearance, having a heavy cast metal base and a swivelling lamp. The special lens projects a concentrated light of great power at any angle. The battery is concealed in the base. The instrument is 4 in. in diameter and has a 1¾-in. lens. Complete with battery, it costs 5*s.* 6*d.*, by post 6*s.* 3*d.* [14]

Model Railway Signal

AN illustration on this page shows an illuminated signal for model railways. It is 4 in. high and costs 3*s.* 3*d.* exclusive of switch. It is finished in black. [15]

A Model Diver

A REMARKABLE novelty which can be made to submerge and ascend like a real diver is illustrated. It is made of metal, is 7½ in. high, and, complete with control tubes, bulb and battery, costs 8*s.* 6*d.*, by post 9*s.* 3*d.* The diver is complete with hatchet and electrically lit waterproof lamp. [16]

Pictorial Gramophone Records

A NEW line of flexible gramophone records, costing 1*s.* 6*d.* each, have attractive-coloured title pictures on each side. The absence of scratch and the quality of reproduction compares quite favourably with more expensive types. They have the added advantage, of course, that they are unbreakable and flexible and may be played with any type of needle. They are full 10 in. double sided and light in weight. Six titles have already been issued. [17]

A new illuminated model signal for a model railway.

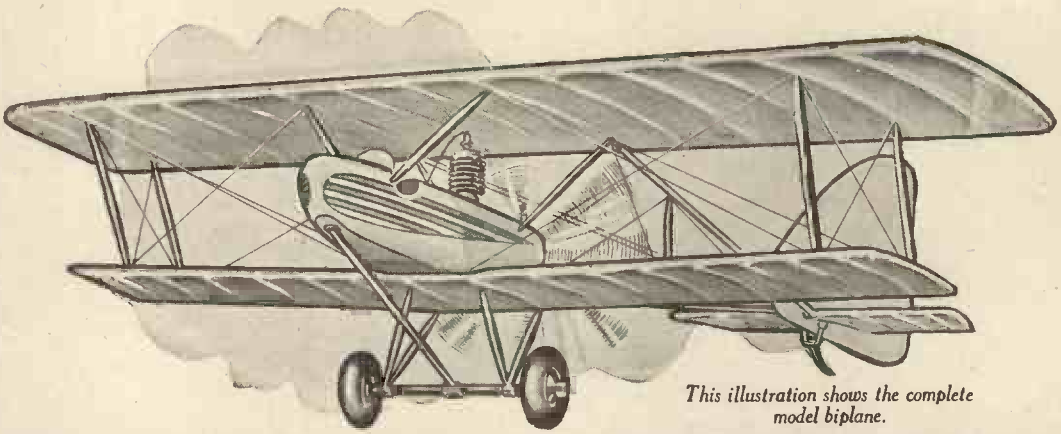
A PETROL-ENGINED MODEL BIPLANE

HOW TO BUILD A SPLENDID POWER-DRIVEN FLYING MODEL—FLIGHTS OF OVER 10 MINUTES MAY BE OBTAINED

By THE MODEL AEROPLANE EXPERT

THIS month we deal with the construction of the O-2P-1 biplane driven by a 15-c.c. engine, both of which were illustrated last month.

The motive power for the model about to be described is designed by the author and is a single-cylinder petrol engine of specially light construction and having a cylinder capacity of 15 c.c. On a test bench this little two-stroke engine has driven a 20-in. propeller at a speed of from 2,500 r.p.m. up to about 3,500. (The address from which a set of castings for this engine can be obtained will be supplied to readers upon application to the editor.)



This illustration shows the complete model biplane.

The accompanying drawing (Fig. 1) gives a plan view of the pusher biplane fitted with a nacelle. This machine resembles the E.F.2B. This it does as regards type, but I have since remembered the Maurice Farman machine of war-time days and find that the resemblance is still closer, particularly as regards the tail unit.

The lifting area required for this model is 7·8 sq. ft.: this is disposed as shown in the plan where the upper wing is given 660 sq. in. on a mean span of 5 ft. 6 in. The lower wing, which is divided into two portions, contains 470 sq. in., the total, therefore, being 1,130 sq. in. The chord is uniformly 10 in.

Fig. 2 shows the wing section proposed for this biplane, which, as previously mentioned, is to be R.A.F.3. The reader will have to set this out as in previous cases for himself, full size, on another piece of paper or cardboard. Here it will be noticed that there is a double set of figures on each of the ordinates. The lower set gives the heights of the ordinates of the underneath camber of the wing, the upper figures the top camber.

Wing Section Ordinates

There are two methods of figuring diagrams of wing sections, one being the decimal system where the chord is divided into ten parts. Here, however, in Fig. 2, I show the percentage method. Both systems arrive at the same result, and indeed are very similar. It is merely a matter of the position of decimal points. In Fig. 3 the chord is considered as divided into 100 parts; the highest ordinate, marked 8·8, is therefore, 8·8 per cent. of the chord.

Fig. 3 shows the form of one of the ribs and two spars in cross-section. These latter are in metal.

Wing Construction

The light-gauge aluminium used for these will be of two different diameters: for the front spars ½-in. outside diameter and for the rear spars ⅜-in. diameter. These tubes, in both the upper and lower wings, will be continuous through the whole width of the span. The lower wing, however, as may be seen from the front elevation (shown on p. 14 of last month's issue), will have a dihedral angle; this angle being 3½ degrees on each side. The two spars, therefore, in this lower wing must be bent at their centres to an angle of 7 degrees. The whole of the ribs to be fitted over the spars will be solid: that is to say, they will have no lattice-work between the upper and lower members. These members will have a width of ½ in. and a thickness of about 3/64 in.; they are made of spruce. In between them there is a solid filling, about ⅛ in. thick, of Balsa wood. There will, of course, be an entering edge spar and a strip at the trailing edge. These should be of spruce, and they will be passed into the ribs at the same time as the tubular main spars; the ribs, of course, being glued at the entering and trailing edges. I think that if all the ribs are made a good push-on fit on the metal spars no other fixing should be necessary. If the reader, however, thinks it advisable, he can drill, after the ribs are in position, a hole through the spruce, upper and lower members, and through the tubes with a No. 60 drill, and pass through the holes thus made a tiny pin which can be bought at a draper's shop, known as a "Lille" pin. The head can be tapped down flush, the point cut off and clenched over on the under-side. After all the ribs are in place, the ends of the tubes are flattened out and notched to receive the end strip of spruce which forms the extreme

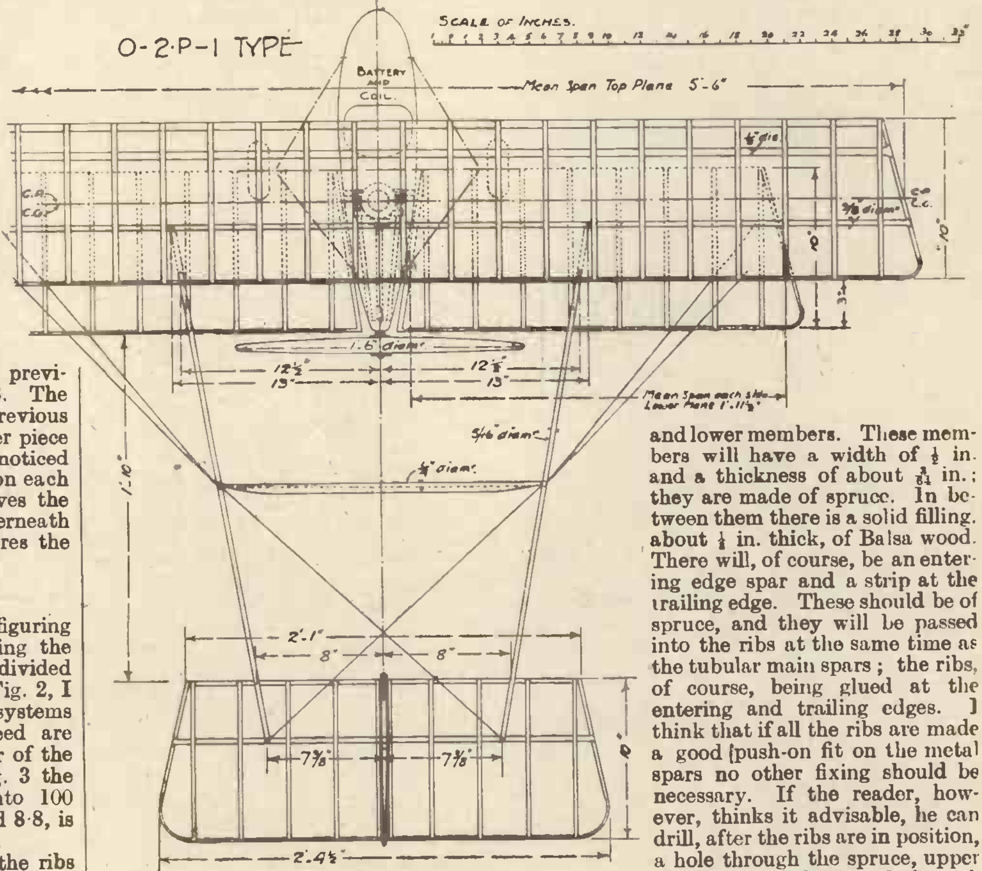


Fig. 1.—Plan of 15-c.c. engined biplane.

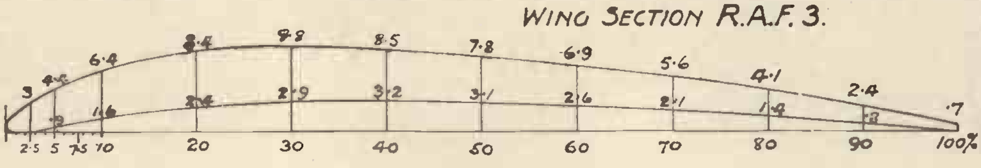
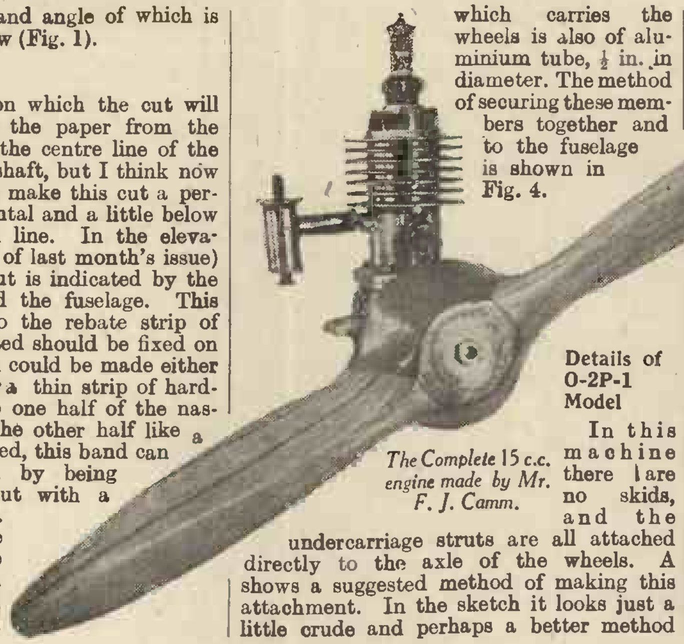


Fig. 2.—Wing section ordinates R.A.F.3 as used for the biplane.

wing tip, the shape and angle of which is shown in the plan view (Fig. 1).

The Nascelle

The parting line, on which the cut will be made to remove the paper from the former, could follow the centre line of the engine and propeller shaft, but I think now it would be better to make this cut a perfectly straight horizontal and a little below the before-mentioned line. In the elevation (shown on p. 13 of last month's issue) the position of the cut is indicated by the band running around the fuselage. This band is additional to the rebate strip of wood which I suggested should be fixed on the inside. The band could be made either from Bristol board or a thin strip of hardwood. It is glued to one half of the nascelle and slips over the other half like a box lid. If nicely fitted, this band can be made ornamental by being painted or picked out with a different colour. There will probably be no necessity to have the whole top portion of the nascelle loose, the middle part can be fixed and only the front, over the space to be occupied by the battery and coil, and the rear part, over the propeller shaft, made detachable. To carry the engine and the propeller shaft bearing a wooden framework will be needed inside of the nascelle. The front end of this frame should be a complete bulkhead, fitting exactly the inside of the paper and glued to it. At the back a similar piece also fits and is glued in to carry the bearing. These two longitudinals, which are shown in Fig. 1, serve as bearers to which the lugs on the engine crank case will be screwed.



The Complete 15 c.c. engine made by Mr. F. J. Camm.

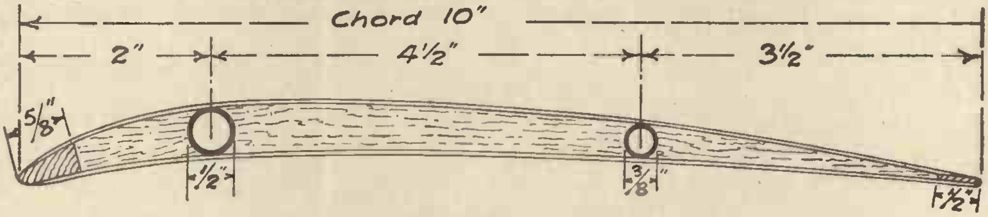


Fig. 3.—Rib construction biplane model.

The Undercarriage

The undercarriage is composed of aluminium tubing of ½-in. diameter. There are six struts, three on each side, and these make angles with the nascelle as shown in the illustrations last month on pp. 13 and 14. The axle which carries the wheels is also of aluminium tube, ½ in. in diameter. The method of securing these members together and to the fuselage is shown in Fig. 4.

Details of O-2P-1 Model

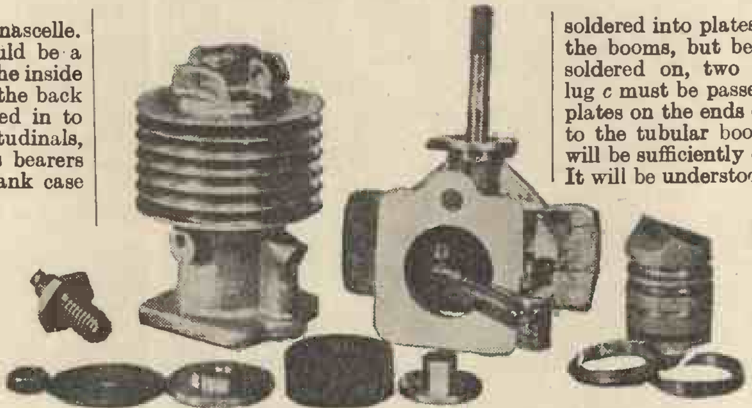
In this machine there are no skids, and the undercarriage struts are all attached directly to the axle of the wheels. A shows a suggested method of making this attachment. In the sketch it looks just a little crude and perhaps a better method would be to use the tubular lugs just referred to. The three tubes required would, however, have to be brazed or silver-soldered to a brass sleeve fitting the axle, and it would be very difficult to get the correct angle for each of the three struts in soldering the tubes to the sleeve. With good workmanship, better workmanship in fact than is indicated in my sketch, the flattening and splitting of the struts, *c, c, c*, could be made to look quite presentable. The split ends are screwed, as shown, to a trefoil lug on the sleeve *a*. This sleeve, with the lugs, should be cast in one piece in aluminium and drilled out to fit the axle *b*, to which it is secured by a split pin.

Tail Trimming

An enlarged sketch is also given showing the arrangement to be fitted to the tail booms for making fine adjustments of the angle of the horizontal plane, and here I have shown it at B. The booms are marked *b, b*; *a* is the front edge of the horizontal tail; *c* is a forked aluminium casting secured to the front spar of the tail, with a screw fitted as shown; *d* is a length of brass rod screwed, about No. 4 B.A., and bent to the radius about which the edge of the plane will move. This brass thread will be soldered into plates which will wrap around the booms, but before both the plates are soldered on, two milled nuts *e* and the lug *c* must be passed over the thread. The plates on the ends of the screw will be bent to the tubular booms. I think the sketch will be sufficiently clear to explain the idea. It will be understood, of course, that two of these adjustable fittings will be required: one on the left-hand pair of booms and the other on the right. The booms themselves can be attached to the mainspar of the horizontal tail plane, both above and below it, by flattening the tubes, forking them and pivoting by means of a rivet or screw on to simple angle plates, after the manner of *Ca* in Fig. 4, except that the plates will be bent to a right angle instead of the angle shown. These plates will come opposite each other above and below the spar, and so can be secured by rivets or pins passing through both of them and through the spar.

Views C (Fig. 4) show the method of attaching interplane struts and tail booms to the wings of the O-2P-1 model. *a* and *b* are pieces of brass tubing silver-soldered

(*Continued on page 95.*)



The various machined parts of a 15 c.c. two-stroke aeroplane engine shown above. Note the miniature sparking plug and the piston rings.

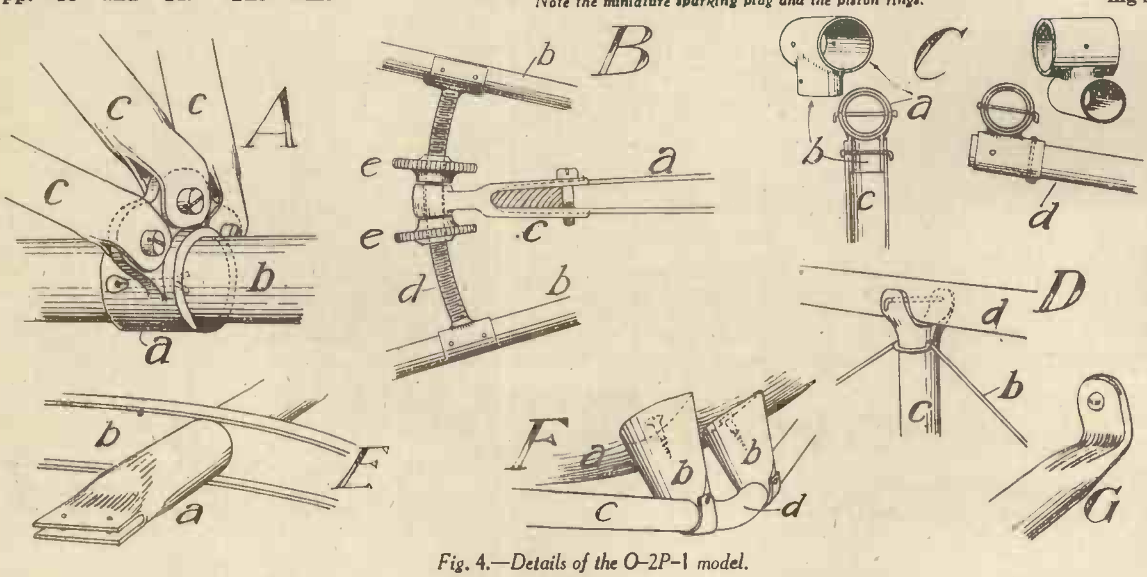
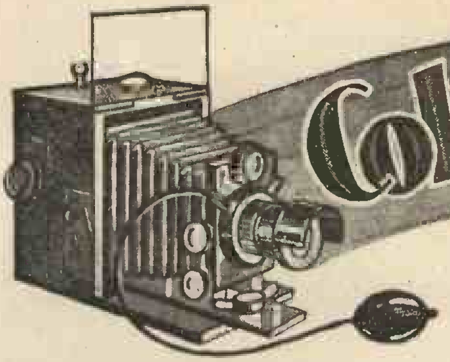


Fig. 4.—Details of the O-2P-1 model.



Colour Photography Simply Explained

SOME PLAIN WORDS ON A COMPLICATED SUBJECT

By S. J. GARRATT

EVER since the earliest days of photography the production of photographic prints in natural colours has been the aim of many experimenters, but no solution of the problem has been achieved that brings colour photography within the scope of the ordinary amateur, though there is no reason why the really expert amateur should not produce passable results.

Certain processes—of which perhaps the "Autochrome" is the most generally known, and others similar in principle—will produce wonderfully good results for viewing by transmitted light or by projection from a magic lantern. The plates, etc., for these processes are easily procured and can be used in an ordinary camera by any amateur capable of developing his own negatives, but they do not produce prints on paper. Each exposure produces one transparency on glass, and no satisfactory method is available for producing an unlimited number of prints as in ordinary photography.

The Autochrome Screen

Although the pictures are made by one exposure only, they are based on the three-colour principle, the actual colours being carried in some kind of screen. The autochrome screen consists of multitudes of transparent dyed starch grains, spread in a single layer under the sensitised film. Red parts of the picture, for instance, are obtained by blocking out all the coloured grains except the red ones. It is a very interesting process, but unfortunately space will not permit of a full description.

Most readers will know that ordinary white light is composed of a mixture of lights of many different colours, and that these colours can be sorted out, so to speak, by passing a narrow beam of light through a glass prism, to form a spectrum in the manner shown by Fig. 1. The colours, of course, do not change in steps, but merge almost imperceptibly into the neighbouring colour.

Practically speaking, all colour photography (there is, however, the proverbial "exception that proves the rule," though it is more of a laboratory experiment than a practical process), is based on the fact that all the colours of the visible spectrum, and also others that do not appear in the spectrum, may be closely imitated by mixing three colours only, namely violet, green and red. Now some readers with a knowledge of three-colour printing might have expected to read that the three colours should be yellow, red and blue, but bear in mind that we are talking about mixing *light*, which is quite different to mixing *pigments*, such as paint or printers' ink; for instance, the more lights we mix together the lighter becomes the resulting mixture, but in mixing pigmentary colours the result becomes darker than the pure pigments.

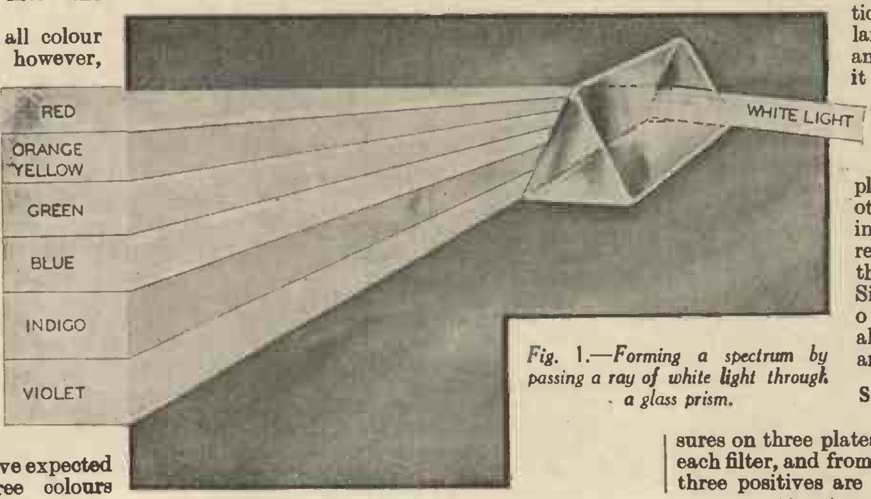


Fig. 1.—Forming a spectrum by passing a ray of white light through a glass prism.

Imitating the Spectrum

In explanation of how the spectrum may be imitated by three colours, imagine a screen in a darkened room exactly as used for a lantern lecture but provided with three separate lanterns. One lantern must have a red glass in front of its lens, the second a green glass, and the third a violet one.

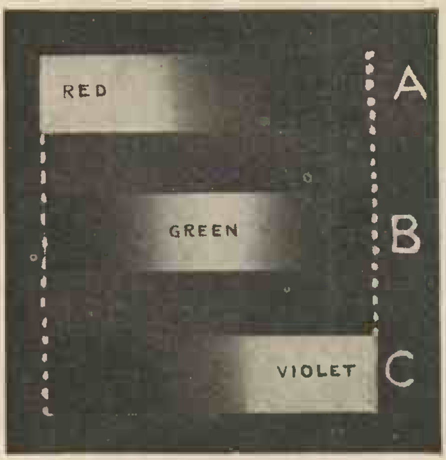


Fig. 2.—Showing how three colours build up a reproduction of the complete spectrum.

The first lantern is provided with a slide which throws a graded patch of light, like Fig. 2A, at the left-hand end of our spectrum-to-be, and this patch of light will of course be red owing to the glass in front of the lens. The second lantern throws a green patch of light graded off from the middle, as shown by Fig. 2B, while the third lantern throws another graded patch like 2C, of violet colour. Now, if we move the lanterns so that the three patches are superimposed in their correct relative positions, we shall obtain a good representation of the spectrum; in fact, if the colours are suitably chosen and the patches are correctly graded off, it would not be possible to detect any difference from a true spectrum with the unaided eye.

If then the graded patches are prepared by photographing a spectrum we have an example of real colour photography. We are only considering the spectrum here for convenience of explanation, bu we may of course substitute a coloured object for the spectrum with an equally satisfactory result.

Sensitive Plates

To produce the three negatives for the three different colours requires plates that are sensitive to light of all colours. An ordinary plate is not sensitive to red light at all, so obviously the red end of the spectrum would not show. Specially prepared plates termed "panchromatic" must therefore be used, and because these plates are sensitive to light of all colours, the usual red dark-room light cannot be used, so the plates must therefore be loaded and developed in total darkness.

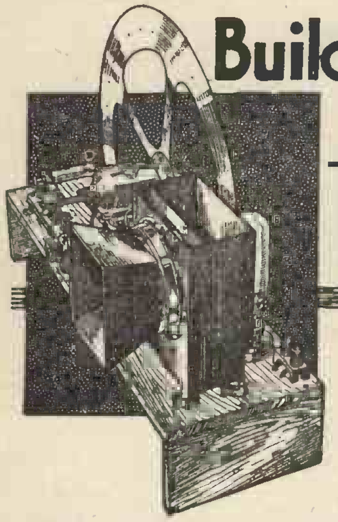
Now there is another "snag" to be overcome, for if the spectrum is photographed straight on to a panchromatic plate the negative will show a rectangular patch over the whole spectrum with little or no distinction between the different colours. Carefully prepared coloured glasses called "light filters" are therefore placed in front of the lens. The colours of these filters are the same as already mentioned for the projection lanterns, *i.e.*, red, green and violet. The red filter, it should be noted, not only allows the red light from the real spectrum to act on the panchromatic plate, but it also passes other colours, orange, for instance, that require red to imitate them in the synthetic spectrum. Similar remarks with obvious modifications also apply to the green and violet filters.

Separate Exposures

Three separate exposures on three plates are made, one through each filter, and from the resulting negatives, three positives are made. The latter, on

(*Continued on page* 62.)

The first article on Construction appeared last month.



Building the "Practical Mechanics" TELE-DISCOVISOR

THE SYNCHRONISING GEAR

By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc.(Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

I HOPE readers found the instructions given last month sufficiently lucid to enable them to make a start on construction, for in the interim period I have been carrying out a large number of very interesting experiments, and I want to deal with these refinements to the "Tele-Discovisor" in this article. It will be recalled that the photographic illustrations shown in the last instalment were not those of the finished model, and they should be compared with those which appear this month, as these show the completed model which I want potential constructors to duplicate.

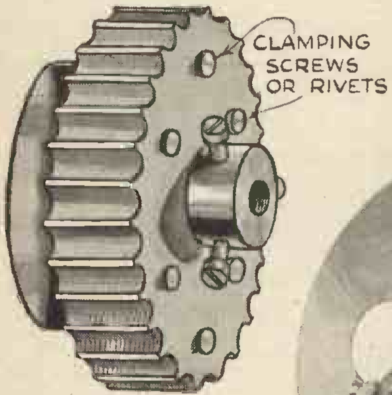


Fig. 1.—Showing the completed flanged cogged wheel.

A Cogged Wheel

Television's fascination lies in the number of experiments which can be undertaken personally, and my prime subject for this month is synchronising. This is really a very intricate side of television to understand theoretically, so I think it will be better first of all to make up the parts required and then learn all about their exact function later.

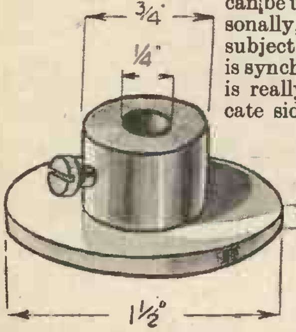
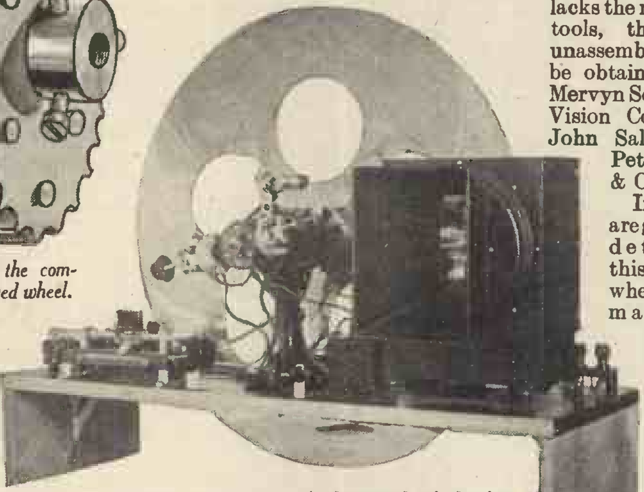


Fig. 2.—The steel boss flanged on one side which is used to construct the cogged wheel.

Up to the present, the best method known for synchronising the television receiving apparatus with the transmitter makes use of the Baird cogged-wheel system. Its essentials are a thirty-toothed cogged wheel mounted direct on the motor shaft. This rotates between the poles of a pair of electro magnets, through which pass the incoming synchronising pulses.

First of all, then, our cogged wheel. I am furnishing dimensioned drawings and a full description of the gear, so that the amateur can duplicate the scheme exactly, but if he is at all doubtful of his skill or lacks the necessary tools, the parts unassembled may be obtained from Mervyn Sound and Vision Co., Ltd., John Salter, and Peto Scott & Co., Ltd.

In Fig. 1 are given the details of this special wheel. It is made up from a mild steel boss flanged on one side, as shown in Fig. 2, and having a ¼-in. hole so that it may be slipped on the motor shaft of that diameter. A grub screw is also included to hold it firmly in position on the shaft. Slipped on to this we have eighteen circular laminations of No. 22 S.W.G. (·028 in. thick) sheet iron, the diameter of the laminations being 2¼ in., with a centre hole of ¾ in.



A photograph of the front of the televisor showing the correct motor in position.

Before placing on the last blank, it must be marked out as in Fig. 3. A circle of 2 in. diameter should be scribed concentric to the outer periphery of the blank, and this must be divided into thirty equal parts by drawing radii to subtend an angle of 12 degrees at the centre, using an accurate protractor for the work. Now make a centre punch mark at each point where a radius intersects the 2-in. diameter circle circumference.

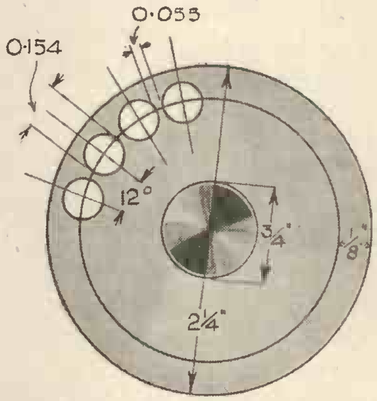
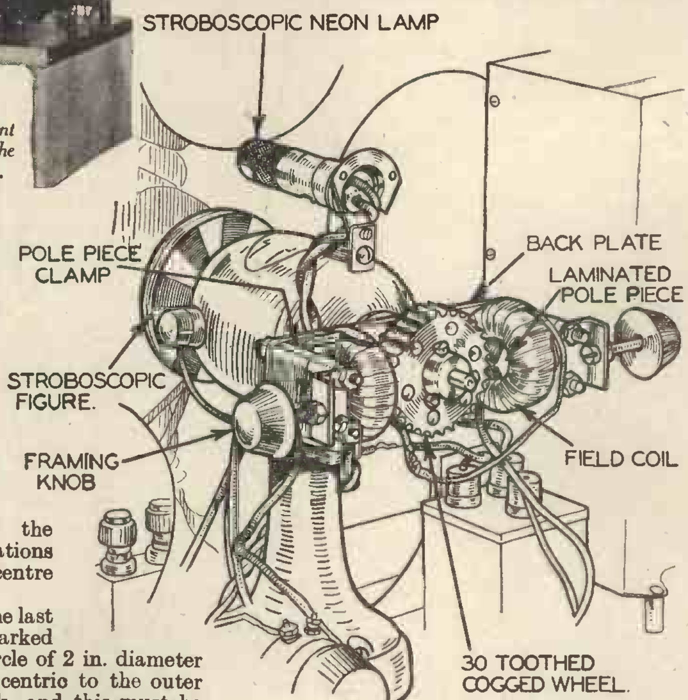


Fig. 3.—How to mark out the wheel ready for drilling.

Making the Teeth

These circular blanks are then clamped together by drilling holes, as shown in Fig. 1, and gripping them tight against the boss flange (the flange, of course, being drilled through identically as the laminations) by rivets or screws and nuts, which-



A pictorial sketch of the synchronising mechanism.

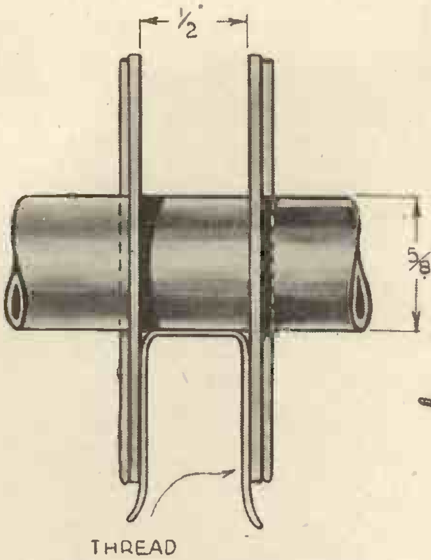


Fig. 5.—The former for the field coils.

ever the constructor prefers. This will give a wheel approximately ½ in. in thickness.

To form the teeth, drill thirty holes with a No. 23 twist drill right through all the laminations, one at each centre punch mark on the outer blank previously marked off for this purpose. Each hole will be ·154 in. in diameter, and on a 2-in. circle this gives a narrow tooth or facet strip nearly ·055 in. wide.

While carrying out these drilling operations, keep the wheel well lubricated (soapy water is very satisfactory), and then with a piercing saw cut right through these holes, keeping the blade just outside the 2-in. circle. Finish off the cogged wheel by trimming up the tooth edges with a smooth file, it being necessary for each tooth edge to be exactly on the 2-in. circle. This wheel has to run dead true on the motor shaft between pole faces, when the disc is revolving at its normal speed of 750 revolutions per minute, so that the greatest care must be taken to ensure that the final job is accurately turned out and finished to the dimensions given.

Field Magnet Details

The next part of the work to be tackled is the field magnet framework and pole pieces. This will be seen very clearly in the photographs and line illustration, but full details will be found in the "exploded" diagram, Fig. 4. The object of this device is to produce a concentrated magnetic flux in the air gap between the pole tip or face and the cogged wheel.

The main support is provided by a rectangular mild steel or wrought-iron cross piece cut to the dimensions shown. The centre hole, of ⅝-in. diameter, is to enable it to fit over the brass boss of the motor. Two pairs of side pieces, also made from mild steel or wrought iron, have to be made up to the sizes shown, the rectangular cut-out on the two centre metal faces being to accommodate the pole piece.

Each pair of ends is held to the main back plate by through bolts and nuts in the manner indicated. Be careful that each pair is identical in size, otherwise the pole piece alignment will not be true.

As far as the pole pieces themselves are concerned, to give the greatest efficiency, I am specifying individual laminations—eighteen of the same 22 S.W.G. sheet iron, similar to that employed for the cogged wheel.

The shape of each individual lamination will be seen in the diagram, Fig. 4, the tapering towards the pole facet edge being for the purpose of reducing the magnetic leakage flux to a minimum. The laminations are held together by two rivets, while the rectangular end is gripped between the two end plates. This is shown clearly in the illustrations.

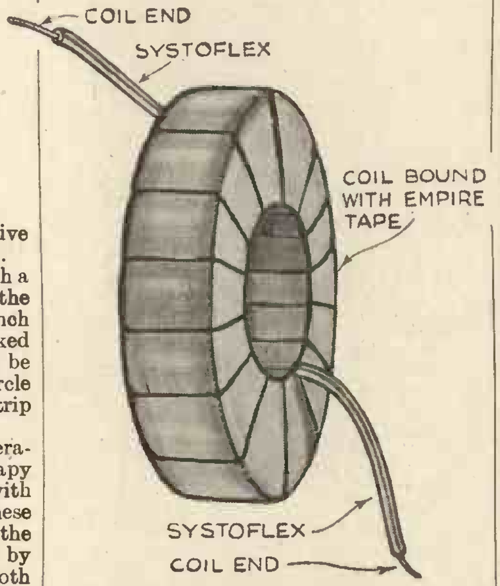


Fig. 6.—The finished coil bound with Empire tape.

Image Framing

For the purpose of "framing the image," that is raising or lowering it so that it is centrally disposed in the mask of the lens assembly, the whole field magnet system must be capable of being moved round the brass boss of the motor. To do this conveniently I have made up two right-angled aluminium brackets. These can be slipped under washers and held by the through bolts when the nuts are tightened. Then add a 1¼-in. 2B.A. screw, as shown, finally putting a knob on each end of the screw as a finger grip for circular movement.

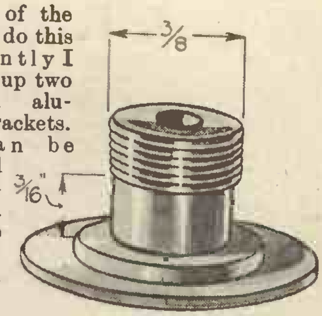


Fig. 7.—How the collar is reduced and threaded.

Carefully assemble all the parts when completed individually, and then proceed to wind the pair of field coils. These can be done most conveniently on formers, but must then be removed from the former and bound with Empire tape. First of all, obtain a piece of rod of ⅝-in. external diameter and slip on two side cheeks, or large washers, on this so that they are separated by a distance of ½ in., as shown in Fig. 5. As the cheeks must be removable when the coil is completed, hold them in place by two "pins" passed right through the rod, as indicated.

On this temporary former, wind a coil having 3,500 turns of 37 S.W.G. enamelled wire, but before making the first turn, lay three or four pieces of thread in the groove, so that when the coil is completed it can be tied firmly before taping. Also be very careful how you bring out the end of the first turn of wire. This should be passed through a hole in one cheek, and a short length left outside the former. When the coil is wound, tie up the threads tightly, slip out the distance pins holding the side cheeks, and slide the coil off the former. Place a length of systoflex over the coil ends, and then bind the coil round tightly with Empire tape, so that it resembles somewhat the sketch, Fig. 6.

Repeat this for the second coil, and when both are finished slip them over the pole pieces so that they are wedged tightly in place against the field magnet side pieces. Our magnetic field system is now complete and to accommodate it on the motor, and yet be magnetically insulated from it, it is necessary to remove the three screws holding the boss to the motor carcase, and reduce the ½-in. diameter collar to ⅜ in., as shown in Fig. 7. Also thread this collar (leaving a clear distance of 3/16 in. at the flange end) so as to take two thin ⅜-in. lock nuts (twenty-six threads to the inch). The collar will now just fit into the ⅜-in. hole of the magnet system cross piece, so replace the boss on the motor carcase, and hold the cross bar in place on this by screwing home the two locking nuts. Do not jam the nuts home too tight, just allow easy movement of the magnet system. Place the cogged wheel on the motor shaft and tighten up the grub

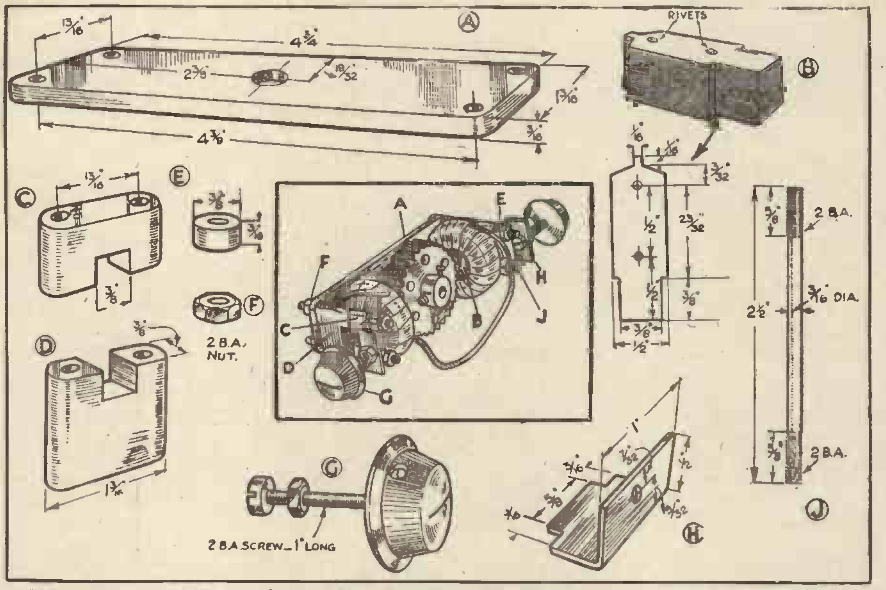


Fig. 4.—Constructional details of the various parts of the synchronising apparatus and (inset) the complete apparatus.

Fig. 9.—The ring indicator neon lamp.

screw when the wheel is opposite the pole pieces.

Wiring

The pole pieces may now require slight alignment, as an air gap of not more than ·006 in. has to be present between the teeth of the wheel and each pole facet. It is as well to note that the average safety razor blade can be employed as a useful thickness gauge for this purpose.

As signals must be fed to the field coils, it is now necessary to wire these up. Join the inner wire of the left-hand coil to the outer wire of the right-hand coil. This will join them in series so that each coil produces an opposite polarity at the respective pole tips when a direct current is passed through the combination. Now join a length of twin flex to the two remaining coil ends, thread the flex through a hole in the baseboard, leaving sufficient slack for a 180-degree movement of the synchronising mechanism, and cleating the wire under the baseboard, bring it out to a pair of Belling Lee Type B terminals, complete with terminal mount screwed to the centre of the baseboard at the back. These can be marked input — and input +, similar to the neon lamp, but to avoid confusion mark the synchronising terminals 2 and the neon lamp terminals 1.

Readers will also note from the accompanying illustrations that I have mounted a Belling Lee " earth " terminal on a small right-anged bracket at the front of the baseboard. To this should be connected the earth wire of the interference filter unit.

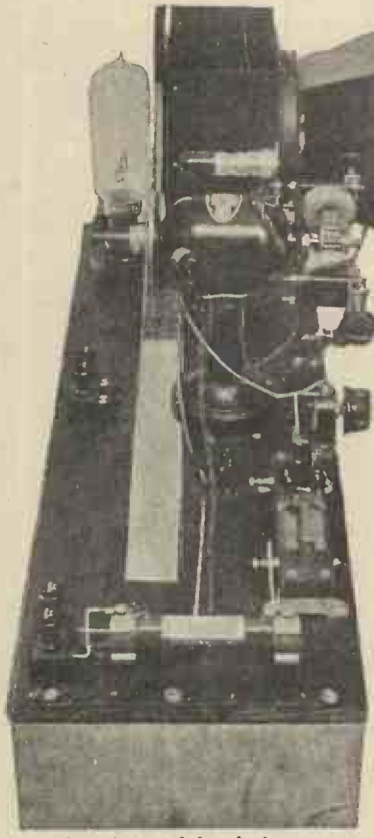
Stroboscopic Speed Guide

It is often extremely difficult for the beginner to judge when the disc is rotating at its correct speed of 750 revolutions per minute, but for those cases where the motor is driven from *A.C. mains* I have built up a simple but very effective speed indicator device.

When a neon lamp is connected to 50-cycle A.C. mains it lights up 100 times per second, so that if we have a regular geometric figure revolving at such a speed that identical sections appear at the same spot of observation each time the lamp lights up, it will produce an optical illusion by showing the geometric pattern apparently stationary. But our disc is to revolve at 750 revolutions per minute, that is 12½ times per second, so if we have a circle divided into eight black and white sectors of equal size it will take just $\frac{1}{100}$th of a second for a black sector to move from position 1 to position 2, see Fig. 8. If this sector is not illuminated during the course of this movement, then as far as the eye is concerned no apparent movement takes place, for it sees the pattern in the same position each time. By letting our neon lamp, which lights 100 times per second, illuminate the pattern, therefore, we shall have no apparent movement of the black sectors taking place when the disc is revolving at 750 r.p.m.

The first task then is to remove the disc from the motor shaft and mark out the eight black sectors by drawing radii subtending an angle of 22½ degrees at the centre—see Fig. 8. Use black stove enamel for painting the sectors.

As only a small light is required, I chose the diminutive G.E.C. ring indicator neon lamp, complete with batten holder, for this purpose. This must be blacked over the glass, except for a small section at the end, see Fig. 9. To mount the batten holder I removed the screw at the top (front) of motor carcase, and then fixed the back of the batten holder to a small piece of aluminium, holding the aluminium vertical by passing the motor screw through a hole drilled in the aluminium support. The lamp now lies horizontally, and the small unblackened section at the top must be made to face downwards.



An end view of the tele-discovisor.

Two wires from the lamp holder then pass round the motor support and along the baseboard to the mains terminals on the left (facing Tele-Discovisor front). Cleat this pair of wires to the baseboard.

Now, when the mains are switched on and the disc begins to gain speed, the black sectors of the pattern illuminated by the neon lamp will appear to be revolving rapidly in a clockwise direction. As the disc approaches its synchronous speed this black sector movement appears to slow down, and at 750 revolutions per minute the sectors seem steady.

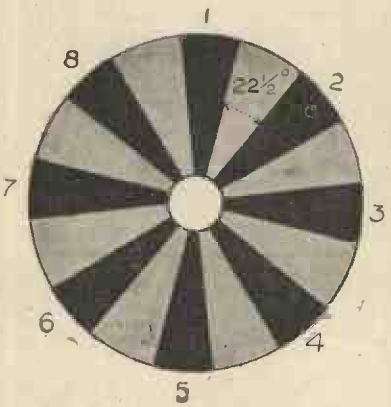


Fig. 8.—Details of the stroboscopic speed guide.

COLOUR PHOTOGRAPHY

(*Continued from page 59.*)

being projected from three lanterns, build up the coloured reproduction of the spectrum as described earlier in this article. If light from all three lanterns falls upon the same spot the mixed light should appear white, while red and green will give yellow, red and violet gives a pink which does not appear in the spectrum, and green and violet results in a bright clean blue.

Let us next consider a coloured print on a sheet of white paper, and we shall find that it presents quite a different problem. In the method of projecting the coloured light by means of lanterns, we started with a dark screen (nominally a white screen, but it is obviously a dark screen in a darkened room) and *added* light of various colours to build up the coloured image ; but in the case of a print on white paper, the paper already reflects the maximum amount of light that can appear in the picture, and we can only form an image by *subtracting* light from that which proceeds from the surface of the paper.

Now suppose we wish to reproduce the spectrum again, and let us consider first the negative through the red filter. The places where red light reaches the sensitive plate will become dense when the negative is developed, and a print from this negative would appear like Fig. 2A. Now, the parts which are white in Fig. 2A must reflect the red light of the white paper, but the other end of Fig. 2A (*i.e.*, the right) must not reflect red light, though it must still reflect green and violet light. To achieve this, Fig. 2A must be printed in a colour almost turquoise blue, by any suitable process, say a carbon print. Following the same line of reasoning for the other two negatives, we find that the negative through the green filter must be printed in a deep pink, while the violet filter negative has to be printed in yellow. The negatives are thus printed in colours complementary to those used in the filters. If we examine any example of three-colour printing, the cover of PRACTICAL MECHANICS, for example, we shall find that these are the colours actually made use of. Full-strength yellow and full-strength deep pink gives a bright red, pink and blue gives violet, while yellow and blue, of course, shows a green, and all three colours together make black. Intermediate colours are, of course, made by varying the strength of colour in each print. It is interesting to compare these results with the mixtures of coloured light referred to earlier.

A Complicated Business

To make a colour print, then, is rather a complicated business. First the three negatives must be made, and from these, three prints must be prepared in the proper colour by any suitable process. The carbon process is perhaps the best for use by amateurs, and carbon tissue specially prepared for colour prints can be obtained. The three-colour process is full of pitfalls—each print must be just right in strength so that one colour does not predominate, and all three must be accurately superimposed in correct register. Considerable judgment must be used in developing out the carbon prints to obtain good results ; for instance, the pink will have to be developed out of the greens and blues as much as ever possible, otherwise these colours are likely to appear too brown. These sort of things have to be learned by experience. The successful results obtained by letterpress colour printing are largely due to the facility with which retouching of the separate colour blocks can be done.

Lathe Work for Amateurs

2. TURNING BETWEEN CENTRES

By F. J. CAMM

LAST month I explained the various parts of the lathe and its associated terms. Before practical work can be done in the lathe it is necessary, firstly, to have some means of driving it, secondly, a series of devices for holding the work in the lathe, and, thirdly, a series of tools of various shapes and cutting angles for operation of work of varying form and material. The amateur has the choice of two forms of drive — power and treadle. I can say at once that whilst the treadle is satisfactory up to a point, it is quite impossible to work with the same celerity as with a power drive, nor is it possible to work so accurately or to exercise adequate control over the tools.

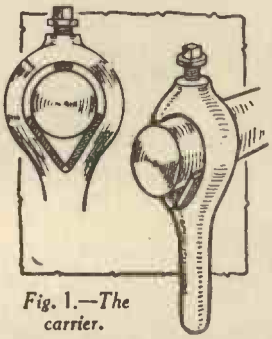


Fig. 1.—The carrier.

Holding Devices

Under this head I include split chucks or collets, which are coned to fit the coned recess in the lathe spindle and are intended to grip round work. The split collet is made to grip the work by means of a draw spindle which passes through the lathe mandrel. Such collets are available in all sizes to suit standard round stock, and if the amateur is likely to do much turning from rod he is advised to purchase a set of them, varying in sizes from ⅛-in. diameter hole up to about ½-in. diameter hole.

Fig. 2.—Bent work cannot be turned satisfactorily.

Other chucks are the self-centering and three-jaw, the four-jaw independent chuck, the face plate, the angle plate, the bell chuck and the carrier and catchpin. There are many other special forms of chuck, with which we will deal later on in this series of articles. In the meantime, I propose to deal with simple turning between centres so as not to confuse the reader with a multiplicity of technical details.

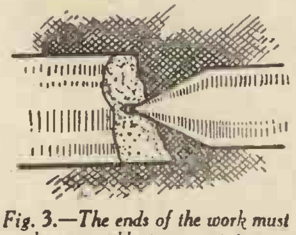


Fig. 3.—The ends of the work must be reasonably true—not irregular as shown here.

Turning Between Centres

For turning between centres it is necessary to have a carrier which will grip the work in the manner shown in Fig. 1. The tail of this carrier contacts with a catchpin attached to a small circular plate, which screws on to the lathe mandrel and is usually supplied with it.

Before round work can be turned it is necessary first of all to make sure that the rod is reasonably straight. Otherwise it will be impossible to turn a true cylinder. Fig. 2 indicates the effect of endeavouring to turn a rod which is bent. It is also necessary to make sure that the ends of the rod are true. It may be necessary to take a preliminary facing cut by chucking the rod in a split collet or three-jaw chuck. If the end of the rod is left irregular, as shown in Fig. 3, the work will tend to revolve unevenly and the centre hole will rapidly wear, causing the tool to dig in and the work to chatter.

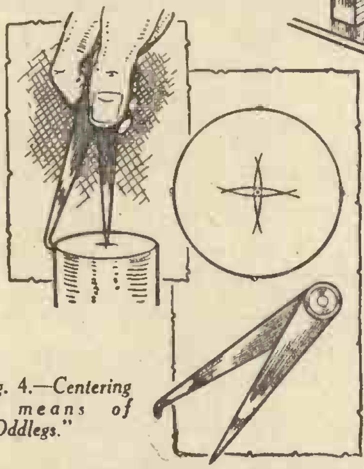


Fig. 4.—Centering by means of "Oddlegs."

Centering the Work

There are many methods of finding the centre of a rod or bar. Some of them are illustrated in Figs. 4, 5, 6 and 7. In the first method illustrated a pair of oddlegs, or jennies, are used. They are opened out rather greater than the radius of the bar to be centred and an arc is struck from four points of the rod, as shown. It will be obvious that the centre of the rod will be in the centre of the various points of intersection. Another method is by means of a bell centre punch, as shown in Fig. 5, whilst Fig. 6 shows a centre square also used for the purpose. In Fig. 7 the bar is rested on two vee-blocks, themselves supported on a flat surface plate, and a scribing block is used in the manner shown. Having located the centre, the next operation is to cut a cone hole with clearance at the bottom so that the lathe centre fits nicely. The clearance enables the point to clear the work and also provides a small reservoir for oil. In Fig. 8 you see one of the special centre drills sold for this purpose held in a chuck whilst the back centre is used to force the work on to it. In Fig. 9 a drill chuck is fixed in the tailstock and a centre drill is locked in its jaws.

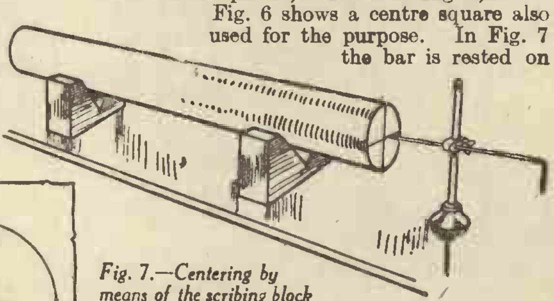


Fig. 7.—Centering by means of the scribing block and vee-blocks.

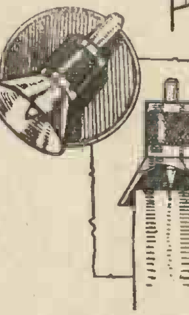


Fig. 5.—The bell centering punch.

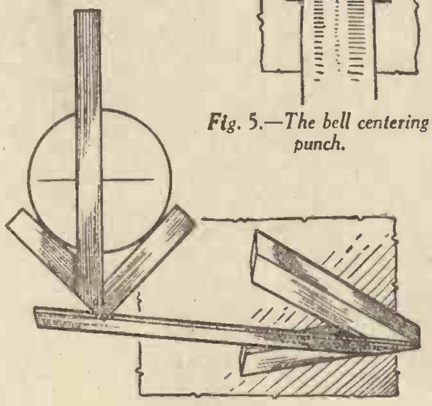


Fig. 6.—The centre square.

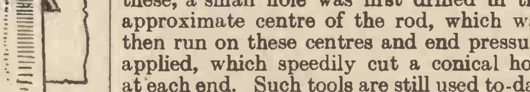


Fig. 8.—Centering from the headstock.

The work to be centred is gripped in another chuck fixed to the lathe spindle, and the tailstock is then fed into the work. Older methods of performing this operation were by means of the square centre and the half centre, illustrated in Fig. 11. In using these, a small hole was first drilled in the approximate centre of the rod, which was then run on these centres and end pressure applied, which speedily cut a conical hole at each end. Such tools are still used to-day for correcting inaccurate centering. When used in this way, a forcing bar, Fig. 10, must be held in the chuck and forced against the rod. Having prepared the work in this way, it is next necessary to mount the edge of the tool in the slide rest to the centre height of the lathe. It is always best to do this before mounting work between centres

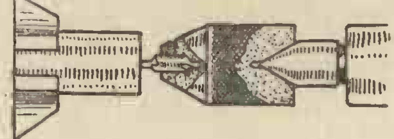


Fig. 9.—Centering from the tailstock.

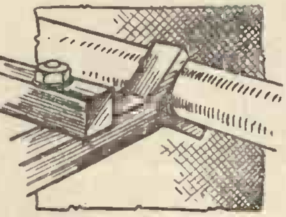


Fig. 10.—The forcing bar.

by running the tool up to one of the conical centres and adjusting its height by means of pieces of packing such as strips of tin, pieces of hacksaw blade, etc. Special toolholders are available (see Fig. 13) which enable the height to be adjusted by means of a thumb-screw, whilst Fig. 12 shows a method of locating the centre height without removing the work from the lathe. Such a method may become necessary if the tool is removed during the turning operation for grinding.

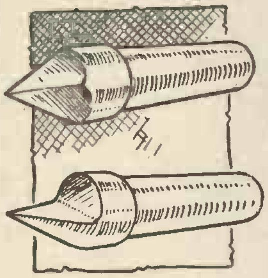


Fig. 11.—Square and half centres.

It is always desirable to check the accuracy of the two centres by running them together, as shown in Fig. 15. Unless the two points exactly coincide it will be impossible to turn parallel. In the method shown in Fig. 12 a square is held against the circumference of the work between centres,

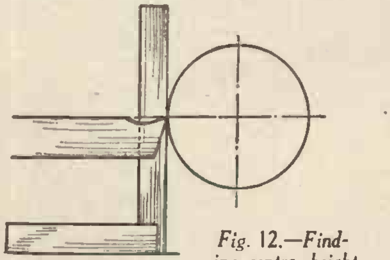


Fig. 12.—Finding centre height by means of a set-square.

the stock of the square resting on the lathe bed or one of the slides of the tool rest. Where the blade of the square contacts with the circumference of the work a scribe line

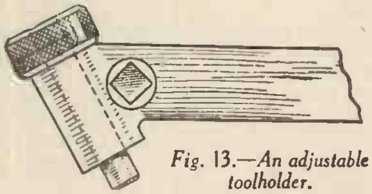


Fig. 13.—An adjustable toolholder.

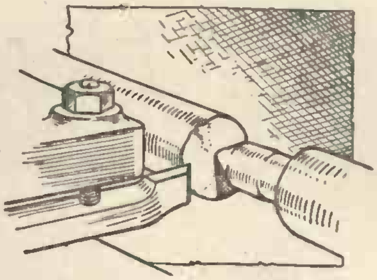


Fig. 14.—Facing the end of the bar.

should be made and the tool adjusted to that point. For reasons which we will explain later it is sometimes desirable to adjust the cutting point of the tool slightly above or below centre height, but we will ignore this point for a moment.

Next month I shall deal with more advanced instruction in lathe work.

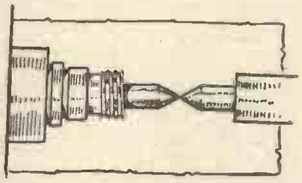


Fig. 15.—Checking the truth of the centres.

The Air-King Three

Some readers who have built the above receiver may have found that the volume control potentiometer appears to be inoperative on the lower waveband. The control performs normally on long waves and enables volume to be reduced to a whisper.

Due to a slight mistake which occurred in the circuit diagram and wiring plan the potentiometer is short-circuited when the wavechange switch knob is pulled out. The error in question is very easily remedied by removing the short wire connecting terminal 2 on the tuned grid coil to the earthing bolt, and in its place taking a wire from the former point to terminal 2 on the aerial coil. The centre terminal on the wavechange switch (marked E) should then be joined to terminal 2 on the tuned grid coil instead of to the ·1 mfd. fixed condenser.

All readers' questions relating to wireless are answered free of charge, but a stamped addressed envelope must be enclosed when a postal reply is desired.

Home Broadcasting

On page 15 of last month's issue a wiring diagram was given showing the connections for a change-over switch for radio or gramophone purposes. Unfortunately the connections to one contact and the arm were shown the wrong way round. The lead from the grid terminal of the valveholder should be joined to the arm (centre point) of the switch, whilst the wire which is shown joined to the arm (from the grid leak and condenser) should be joined to the vacant contact. In other words, the two right-hand connections to the switch should be reversed.

Two Interesting Experiments

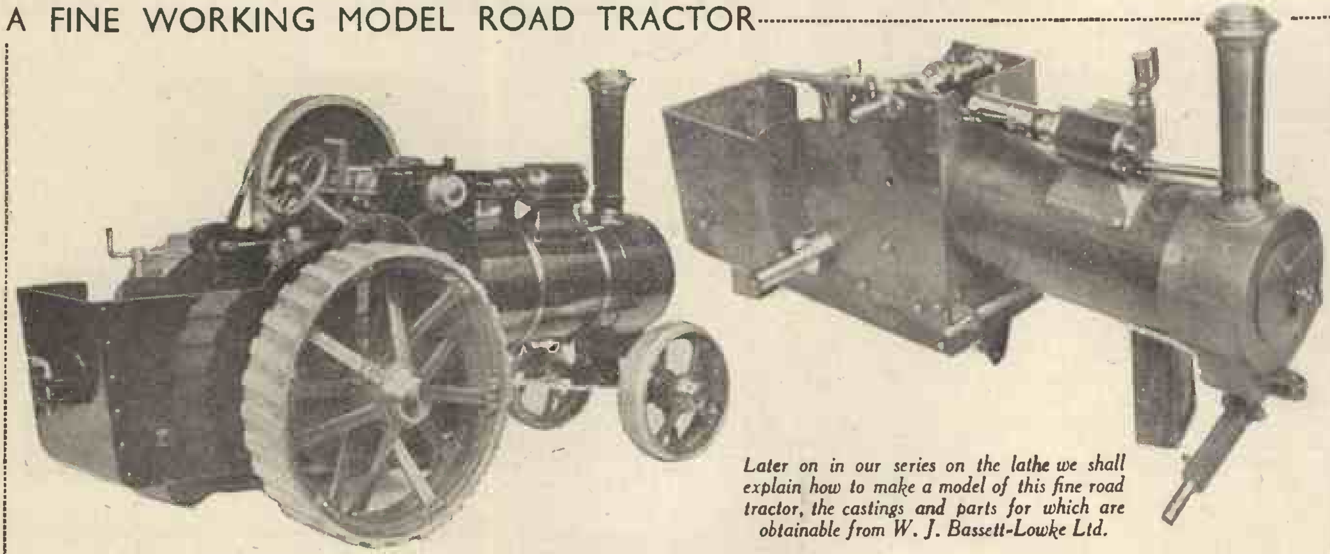
This experiment is far more effective if performed with the "lab." in darkness. Holding a 6-in. length of magnesium ribbon with a pair of pliers, ignite its free end in the Bunsen flame, and lower the burning metal in a jar of gas. The magnesium burns with a most intense and blinding white flame, which lights up the room like brilliant sunshine.

Do not look directly at the light, unless through smoked glass, otherwise the optic nerve will become temporarily "fogged." Performed out of doors on a large scale at night, the neighbourhood can be well illuminated for some distance around.

A Colour Change

Procure a small quantity of Pyro Soda developer solution. Pour this into a jar of gas and shake well. The clear, water-like solution becomes almost black.

A FINE WORKING MODEL ROAD TRACTOR



Later on in our series on the lathe we shall explain how to make a model of this fine road tractor, the castings and parts for which are obtainable from W. J. Bassett-Lowke Ltd.

COPPER-PLATING AT HOME

Most people who newly take up wireless as a hobby find before long that they cannot fully enjoy this fascinating science unless they possess a knowledge of elementary electricity. Therefore this article has been written, not with a view to increasing the wireless fan's knowledge of *radio* only, but his knowledge of electricity and its behaviour and calculations.

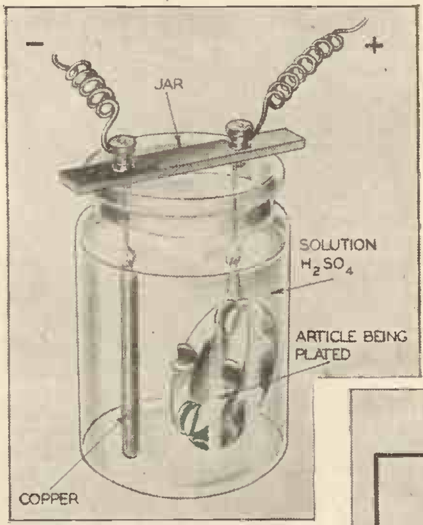


Fig. 1.—This shows the simple arrangement of the plating bath, and the situation of the copper electrode and article to be plated.

A GREAT deal of fun can be obtained by copper-plating one's own metal articles. To do this, the following apparatus is necessary: electric lamps of suitable voltage (see below); holders for lamps: a 2-lb. jam jar; some copper rods or blocks; and a concentrated solution of copper sulphate. The latter is obtained by adding crystals of copper sulphate (obtainable from the chemists) to water until no more will dissolve.

This solution is placed in the jam jar (see Fig. 1). To one side immerse, or part immerse, the copper rod: to the other the article to be plated—if necessary keeping them apart with pieces of wood. The lamps, etc., are wired up as shown in Fig. 2. Great care must be taken to get the polarity right; the best way to do this is to plug into the mains anyway, and the electrode, as the copper block and article are termed, which bubbles most is the negative. This, by the way, only works on D.C.; for A.C. a rectifier, a chemical one will do, must be connected as shown in Fig. 3. This diagram explains itself.

The Plating Process

As soon as the current starts flowing, the following action takes place :—

The copper sulphate, known chemically as CuSO4, under the action of the electricity, splits up into copper, Cu, which is deposited on the article being plated, and a sulphate ion (SO4). Ion is the term for a charged molecule exhibiting polarity. This ion, being negative, cannot, and does not, exist alone, and is consequently neutralised by an ion of opposite polarity (positive). To do this the water is broken into two parts: one of H, hydrogen, and the other O, oxygen. This hydrogen combines with the sulphate ion, forming sulphuric acid. The oxygen comes off as a gas from the positive electrode.

The sulphuric acid attacks the copper rods, forming copper sulphate and hydrogen :—

Cu	+ H2SO4	= CuSO4	+ H2
copper	sulphuric acid	copper sulphate	hydrogen

Thus to all intents and purposes the electric current flowing through the solution has liberated two gases, but from the *water* in the solution, and taken the copper from the rods and deposited it on the article being plated.

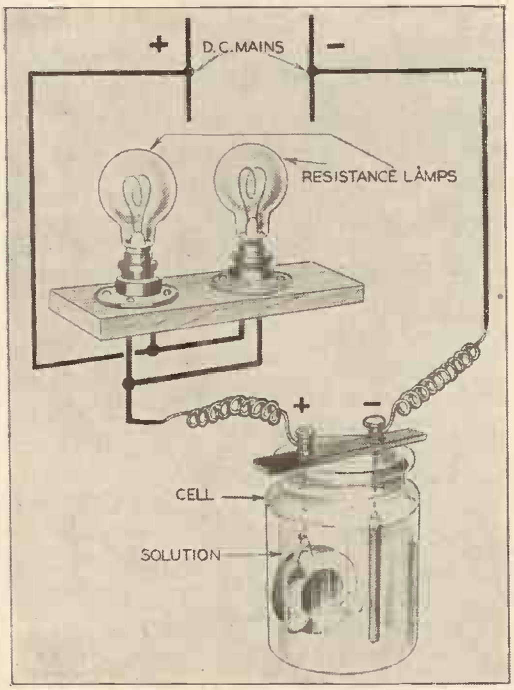


Fig. 2.—Here you see all the connections necessary when using D.C. mains for operating the "plant."

The Rate of Deposit

This is governed by the current flowing; the higher the current, the quicker the deposit, and *vice versâ*. This is true within limits.

Calculating the current flowing is simple: About 1 ampere is required. Assume the electrolytic cell has a resistance of 50 ohms: mains voltage 200. Then the resistance required for 1 ampere is 200 × 1 = 200 (Ohm's Law) R = EC. ohms. But 50 ohms are already to be had in the cell, so only 150 ohms are required externally. But the energy expended (work done) in a circuit in watts is proportional to the current squared times the resistance, *i.e.*, $W = I^2R$. Therefore, in the case in question, the work done is $(1)^2 \times 150 = 150$ watts. Therefore, the external resistance can be lamps which when placed in series total nearly 150 watts, *i.e.*, a 100-watt and a 40- or 60-watt.

Owing to the cell having a resistance, in this case assumed to be 50 ohms, considerable energy takes place at this point of the circuit, to be exact $50 \times (1)^2 = 50$ watts. For this reason, it may be advisable to stand the cell in a bath of cold water, or in a strong draught.

For the amateur who does not like working things out from the fundamental, the following formula may be of interest. Watts expended in resistance circuit = either current squared × resistance *or* voltage *dropped* across this circuit × current flowing :

External resistance = (Mains voltage × current flowing) — resistance of cell.

On A.C. mains, the current should not exceed ½ ampere.

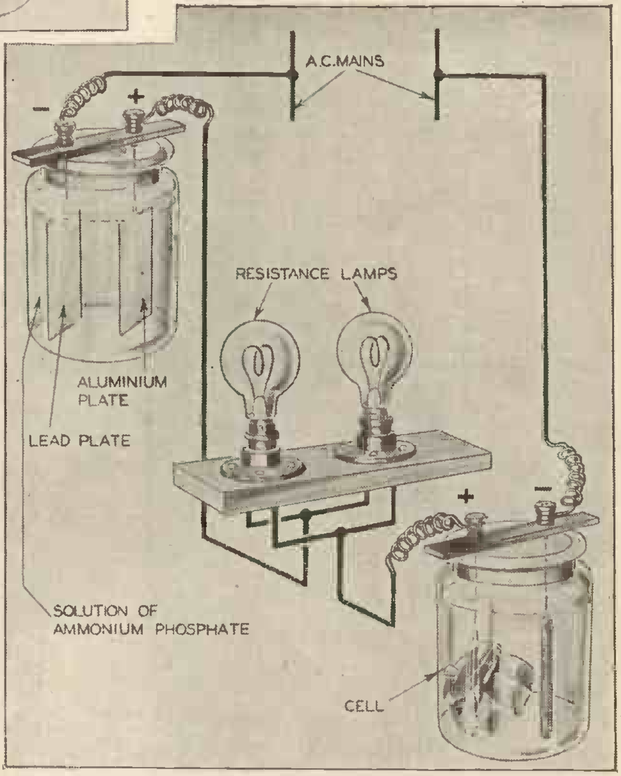


Fig. 3.—This is the circuit arrangement when A.C. mains are used; it will be seen that the chemical rectifier is employed to change the current from alternating to direct.

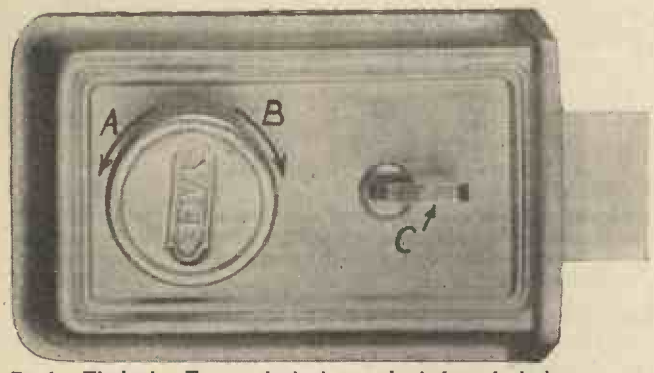


Fig. 1.—The latch. Turning the knob towards A draws back the bolt. Turning the knob towards B prevents opening with a key (see Fig. 3). Pressing down the catch lever C holds the latch open.

HOW A YALE LOCK WORKS

By DAVID CHARLES

The Yale lock is representative of many makes of lock of its now familiar type. Although the tumbler principle was actually employed by the ancient Egyptians (who seem to have established the beginnings of so many modern mechanics), it was an American, Yale by name, who perfected and marketed the device in comparatively recent years.

THE tumbler lock is now applied to many other purposes than the familiar "night-latch," but the latter will serve to exemplify the application of the principle. The outside of the latch, shown in Fig. 1, presents little novelty to the eye, but its severe simplicity conceals some equally simple ingenuity, of convenience to the user. Figs. 2 and 3 show the inside of the latch, which is an entirely independent mechanical unit from the tumbler lock. Fig. 2 shows how turning the knob of the latch (always inside the house or room) draws back the bolt. If, however, the knob is given a sharp quarter-turn inwards (towards B, Fig. 1), the effect will be to fix the bolt as in Fig. 3, and no one can get in from outside, even if in possession of the right key. The bolt is fixed until released by turning the knob in the reverse direction again. The catch lever C is for the purpose of holding the drawn bolt in, when it is not required to have the lock in operation at all, as during the day. So much for the latch.

A still simpler latch is that of the car lock, the whole mechanism of which is contained within the small dimensions of the door handle, Figs. 4 and 5. It is, of course, the tumbler lock which is the fascination, and although one may well wonder how it has been successfully inserted into such a small compass as is shown here, it is best illustrated on the larger scale of the five-pin night-latch lock, which is a quite small enough piece of mechanics to photograph properly.

What the Key Turns

In Fig. 6 is seen what happens when the key is turned. The small cylinder in the lower part of the casting, into the grooves of which the key has been slid, turns with the key. This casting is, of course, hidden from view inside the substance of the door. Linked to the tail end of the cylinder is a flat bar, which also turns with it and, in turning, revolves a cam on a plate which is screwed on the other side of the door. This flat bar and cam are quite clearly shown in this photograph (Fig. 6), which illustrates the whole "transmission," as it were, from key to latch, right through the one hole in the door (of $1\frac{1}{2}$ in. diameter) which has to be bored.

The small cam, which is turned by the bar, engages with the same pin, inside the latch, which is operated by the knob. The two long screws, in Fig. 6, seen alongside the straight bar, are for the sole purpose of securing the tumbler lock in the door. Since they are put through the latch-plate seen here, and are therefore entirely within the thickness of the door, it is not possible after fixing them to get at them excepting from inside the door and after removing the case of the latch.

Fig. 4.—A tumbler lock in car door handle.

It will be noticed that the straight bar has grooves across it, and the long screws parallel with it are also grooved in a couple of places. The purpose of these grooves is to make it easy to cut the bar and the screws, according to the thickness of any particular door, when fitting the lock. At the same time, they prevent any burr, which may interfere with ease in screwing up, or with smooth turning of the cam, as the case may be.

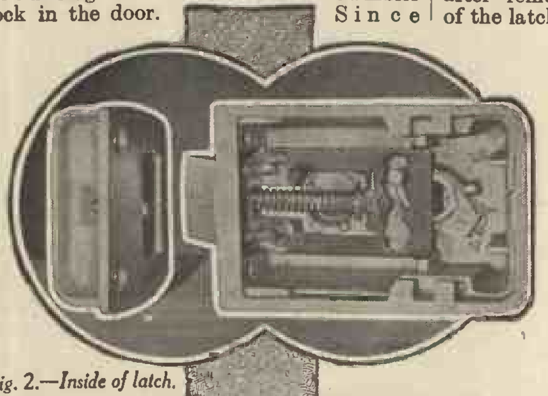


Fig. 2.—Inside of latch.

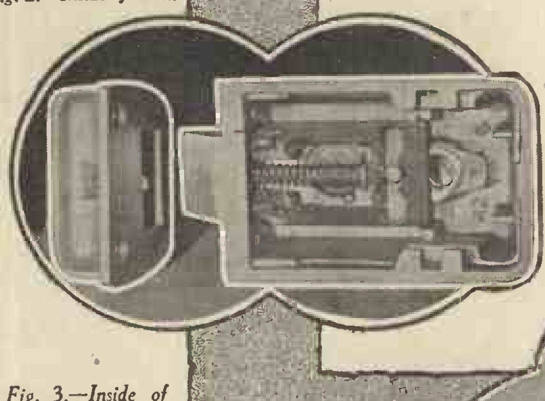


Fig. 3.—Inside of latch, showing how inward turn of knob prevents unlocking.

How the Lock is Fixed

As a clear diagram is always given with instructions for fitting any good lock, it should be sufficient to explain that as soon as a hole (of the stated diameter and in the right place) has been bored through

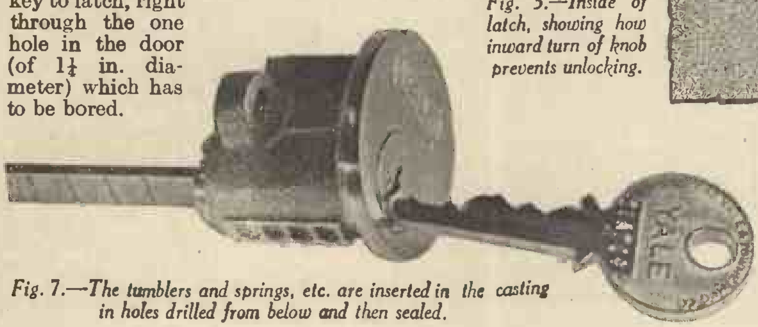


Fig. 7.—The tumblers and springs, etc. are inserted in the casting in holes drilled from below and then sealed.

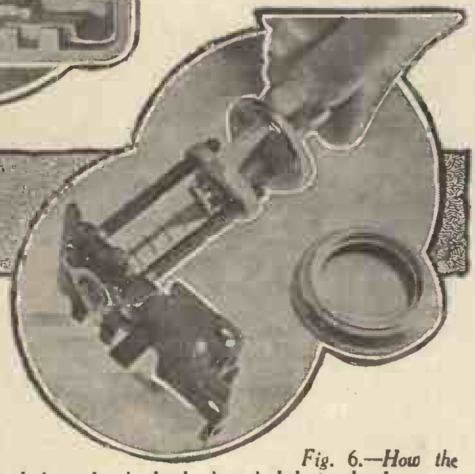


Fig. 6.—How the tumbler lock works the latch through hole in the door.

Fig. 5.—Showing the bolt-action of the car lock (partly withdrawn from socket).

the door, and the bar and the long screws cut, if necessary, to the right length to reach through that hole, the backplate of the latch is screwed to the inside of the door. The cylinder block with its actuating bar is put through the hole from the outside, and is tightened up to the backplate by means of the long connecting screws. Then the latch case is slid on to its backplate, on to which it holds by slotted lugs, and is there secured by a couple of screws. Thus, on the inside, either non-disturbance, or convenient egress, are equally provided. From the outside, ingress only with the right key, and then only if the occupant is willing!

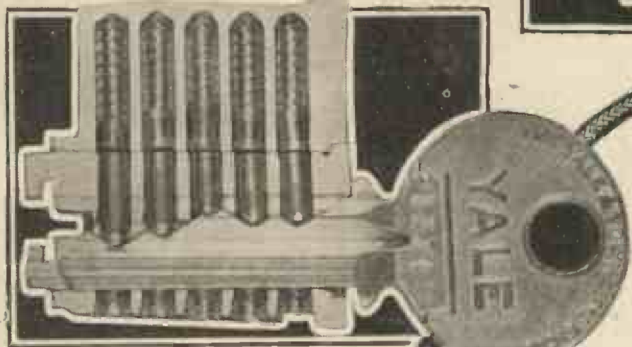


Fig. 9.—Insertion of the right key raises all the tumblers level with the circumference of the cylinder——

The Fascinating Pin-tumbler

The tumbler lock is a casting, yet it contains quite a pretty mechanical device in the form of a five-pin tumbler mechanism, which permits or prevents the cylinder to revolve in it. On reference to Fig. 7, which shows the underneath of the small casting seen uppermost in Fig. 6, a row of five sealed holes are clearly observable, just below the cylinder. These holes go right up into the casting, very nearly to the top, and what these holes contain is far more clearly realised when the casting is cut into section form, Fig. 8. Here in each hole there is a spring, serving to push downwards a small "driver," which in turn presses on a "tumbler" with a rounded point.

About these tumblers and drivers there are several things to note. The first is that they pass downward into holes in the cylinder, but not right through. In the cylinder there are five appropriate holes only in its top half-section. In its lower half-section there is a key slot running through its full length. This slot is not a plain flat slot, but has two ribs, which give it a zig-zag section. The purpose of these ribs is two-fold. The first purpose is to make the key slide easily but with precision. The second purpose of the lower rib is to form a ridge on which the rounded points of the tumblers will rest. Examination of the photograph, made from a section of an actual lock, will explain these points, and what follows.

Each tumbler is of a different length, and the lengths of the drivers vary accordingly. This fact causes the drivers, when at rest, to lie across the junctions of the holes as they run through casting and cylinder respectively. Thus the latter cannot turn.

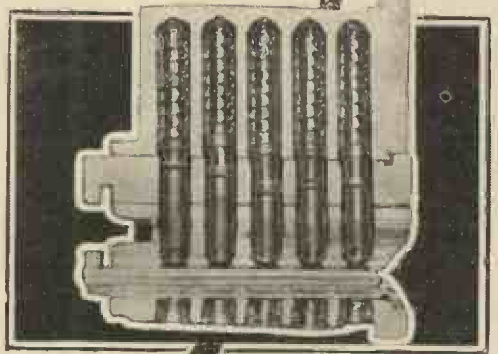


Fig. 8.—A section of the tumbler lock, showing how the drivers prevent turning the cylinder.

What the Right Key Does

When the right key, and *only* the right key, is inserted, the tumblers ride into its various dips, when their top ends lie perfectly flush with the circumference of the cylinder, as shown in the next sectional photograph, Fig. 9. When, quite clearly, the cylinder will revolve in the casting, carrying with it the tumblers, but leaving in the casting the drivers and their springs. This is seen actually happening in Fig. 10, which shows also that the dimension of each tumbler plus its own section of key produces the exact diameter of the revolving cylinder.

More Alternatives than a Crossword

It is by varying the lengths of the five tumblers, and by varying also the order of those lengths, that a practically inexhaustible number of combinations is produced. Fig. 11, which shows just five actual examples of these possible combinations in this type of lock, gives some idea of the variety that is obtainable by this system. If only one of the five pins, or one of the corresponding depressions in the key, is the slightest fraction out of register, obviously the cylinder is locked in the casting and cannot turn to operate the latch. Not the least interesting point about this device is the neatness with which it is contained in such a small compass, and the impossibility of tampering with it without taking the whole thing to pieces. Even to do this is very far from being a simple matter, as anyone who tries will discover for himself, if he doesn't mind the risk of ruining the lock on which he experiments!

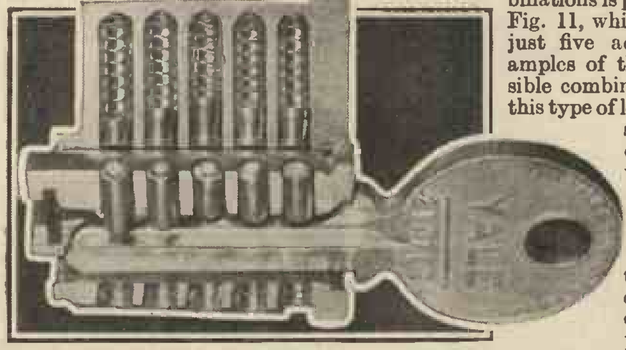


Fig. 10.——consequently the latter will then turn with the key.

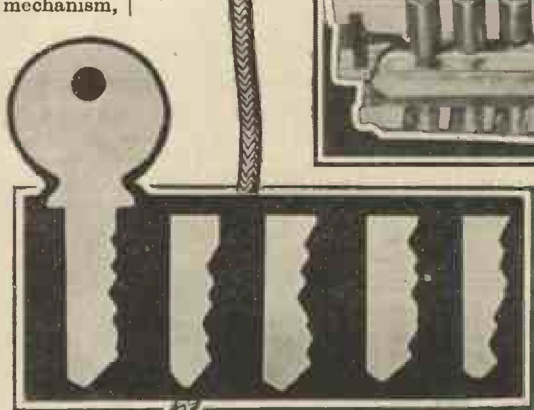


Fig. 11.—A few of the many thousand possible combinations of the five-tumbler principle key.

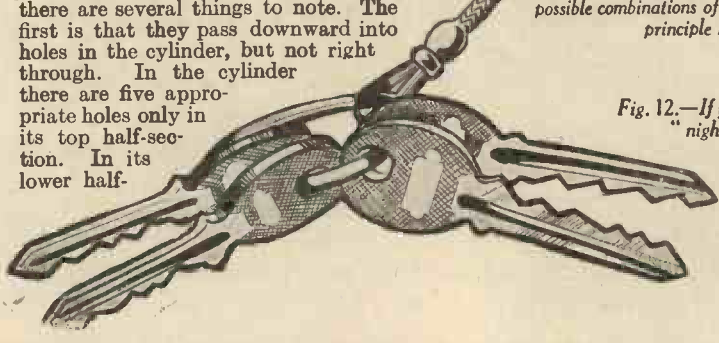


Fig. 12.—If you have a number of "night-latch" keys on your bunch, have the most important one on an extra link or two. On dark, wet nights you pick the right one first time then!

A Yale Key Hint

Anyone who carries several keys of this type on his bunch has experienced difficulty in finding the right one on reaching home on a dark, wet night. By the insertion of a couple of links of strong chain, or a couple of small split rings, between this key and the bunch, it is made to hang slightly lower. It is then found at a glance, or even at a touch.

ALL RADIO QUESTIONS ANSWERED FREE.

The PRACTICAL MECHANICS Wireless Experimenter

Every Question must be accompanied by the Coupon on page 100.

THE "ARGOSY" CLASS B THREE

An Efficient, Cheap-to-build Receiver which has Selectivity and Power in Plenty

BY OUR RADIO EXPERT

IT is no exaggeration to say that the receiver here described is the least expensive instrument using an iron-cored tuning coil and Class B amplification that has ever been offered to the home constructor. Unlike the "Air-King," it is not designed to have an enormous range, but is rather intended to give an ample volume of undistorted output from the nearer stations. Although costing so little in both initial and running expenses, it will easily give sufficient loud speaker output to fill the largest room. Quality of reproduction is remarkably good and natural, so that both bass and treble are brought out in proper proportions. Whether your taste lies in the direction of dance music, symphony concerts or talks the "Argosy" will fill the bill.

Variable Selectivity

In order to provide an ample degree of selectivity to enable the local station to be entirely eliminated, even at very short range, an iron-cored tuning coil of the very latest type is employed. Not only is this of the most selective type, but it is provided with alternative tappings so that the exact degree of selectivity required can be obtained under practically any circumstances.

Of course, there is provision for connecting a gramophone pick-up, and gramophone records can be reproduced with the same volume and perfect tone as the wireless programme. A switch is provided on the front of the set so that the pick-up can be brought into circuit in an instant and without the need for making any connections.

Simplicity of Construction

The set is designed on particularly simple lines, so that it can be made up in a few hours, either by the beginner or the experienced constructor. To assist in keeping the design "clean" and simple, all unnecessary "extras" have been rigorously avoided, whilst a combined tuning and reaction condenser has been employed for the express purpose of simplifying the constructional work and giving a neat and symmetrical appearance to the complete receiver.

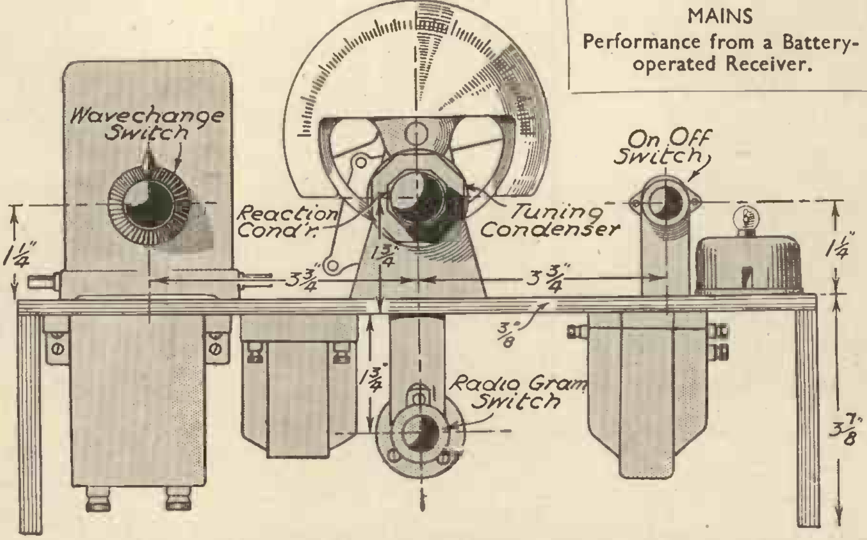
Incidentally, the simplified layout has the effect of increasing the overall efficiency by allowing short and direct connecting wires to be employed. Another direct result of the simplification is that the whole set can be accommodated in a particularly small compass, the chassis measuring, in fact, only 12 × 7 × 3⅞ in. deep. The chassis is of the latest metallised wood type, and thus serves as a useful screen besides having the advantage that many of the "earth" leads can be connected directly to it by means of short screws.

A three-quarter front view of the "Argosy."

Handsome Transportable Cabinet

So that the efficiency of the set should not be "let down" by the poor appearance that many of the present-day cabinets have, a rather unusual and handsome consolette cabinet was specially designed for the "Argosy" and duplicates of it can be obtained by any reader from advertisers, at a distinctly moderate price. This cabinet holds not only the receiver, but also the loud speaker and all batteries so that the finished job is entirely self-contained and transportable from room to room.

MAINS Performance from a Battery-operated Receiver.



This dimensioned drawing shows the positions of the holes required in the front of the cabinet.

Excellent Performance and Selectivity

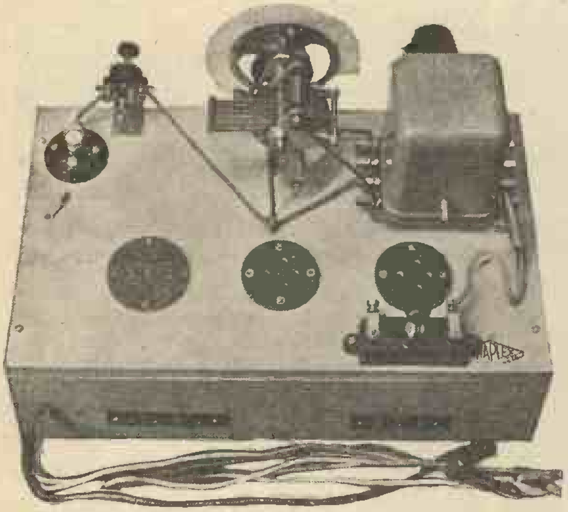
As stated above, the "Argosy" is not intended to give

List of Parts for the "Argosy" Class B Three

- One Peto-Scott "Metaplex" Chassis, 12 × 7 × 3⅞ in.
- One B.R.G. Combined ·0005 mfd. Tuning and ·0005 mfd. Reaction Condenser, type 68.
- Two B.R.G. Component Brackets, type No. 22.
- One Wearite "Nucleon" Coil, type J.D.A.
- One Bulgin Junior On-Off Switch.
- One Bulgin Push-Pull Radiogram Switch.
- One Bulgin Baseboard Fuseholder, with 100 ma. Fuse Bulb.
- One Bulgin Grid Bias Battery Clip, type No. 3.
- One Bulgin Crocodile Clip.
- Two Clix 4-pin Air-Sprung Valve Holders.
- One Clix 7-pin Valve Holder.
- Two Clix Terminal Socket Strips; one with sockets marked "A.1," "A.2," "E.," the other marked "L.S." and "P.U."
- One T.C.C. ·0003 mfd. Fixed Condenser, type 34.
- One T.C.C. 2 mfd. Fixed Condenser, type 50.
- One "Goltone" Screened H.F. Choke.
- One "Goltone" ·0003 mfd. Pre-set Condenser.
- One Dubilier 3 megohm Grid Leak with Wire Ends.
- One Dubilier 25,000-ohm Metallised Resistance.
- One Lissen "Torex" L.F. Transformer.
- One Lissen "Hypernik" Class B Transformer.
- One Coil Bulgin "Quickwyre" Connecting Wire.
- Five Clix Wander Plugs, marked "H.T.+," "H.T.–," "G.B.+," "G.B.–1" and "G.B.–2."
- Three Clix Spade Terminals, marked "L.T.+," "L.T.–" and "L.S.+."
- Six Clix Long Wander Plugs, marked "L.S.+," "L.S.–," "Aerial," "Earth" and two marked "Pick-up."
- Length Flex, short length "Goltone" Screening Braid, Screws, etc.

Approximate Price of above £3 5s. 0d.

- One Peto-Scott "Argosy" Cabinet.
- One Peto-Scott Class B Speaker Unit.
- Three Hivac Valves, types D.210, L.210 and B.220.
- One "Lion" 120-volt High Tension Battery.
- One "Lion" 9-volt Grid Bias Battery.
- One Lissen L.N. 2009 2-volt Accumulator.



This illustration shows the " clean " design of the " Argosy."

reception over extraordinarily long distances, but in tests made on an indoor aerial about twelve miles west of " Brookman's Park " no less than twenty-five stations have been received at comfortable loud speaker strength. It should be mentioned that a certain amount of skill is called for in receiving so many programmes, but anyone who has never before handled a receiver can be perfectly sure of bringing in no less than half a dozen stations at " programme " strength. On the same aerial it was quite possible to eliminate the local stations entirely by turning the tuning dial through eight degrees, when the aerial was connected to the least selective coil tapping. By transferring it to the most selective tapping either transmitter could completely be cut out in no more than three degrees, and even when using this tapping there was more than enough volume for comfortable listening in a large room.

By using the centre tapping (for medium selectivity) a number of foreign stations such as Fécamp, Rome, Muhlacker, Radio Paris and Huizen could be received with perfect ease and without the necessity for delicate operation of the controls.

Economical in Initial and Running Costs

Low price is indeed a great feature of the " Argosy," and although it was not entirely designed " down to a price," the question of cost was kept well in mind when working out the circuit arrangement. Thus, even though the cost of parts is unusually low, there has been no sacrifice of quality in regard to either materials or performance. The full kit of parts for the receiver itself can be bought for £3 5*s.* 0*d.*, whilst when the valves, batteries, speaker and cabinet are also taken into consideration the cost is approximately £8 12*s.* 6*d.*; those who try to make themselves believe that it is cheaper to buy a ready-made set than to build one will find these figures sufficient to defeat their arguments.

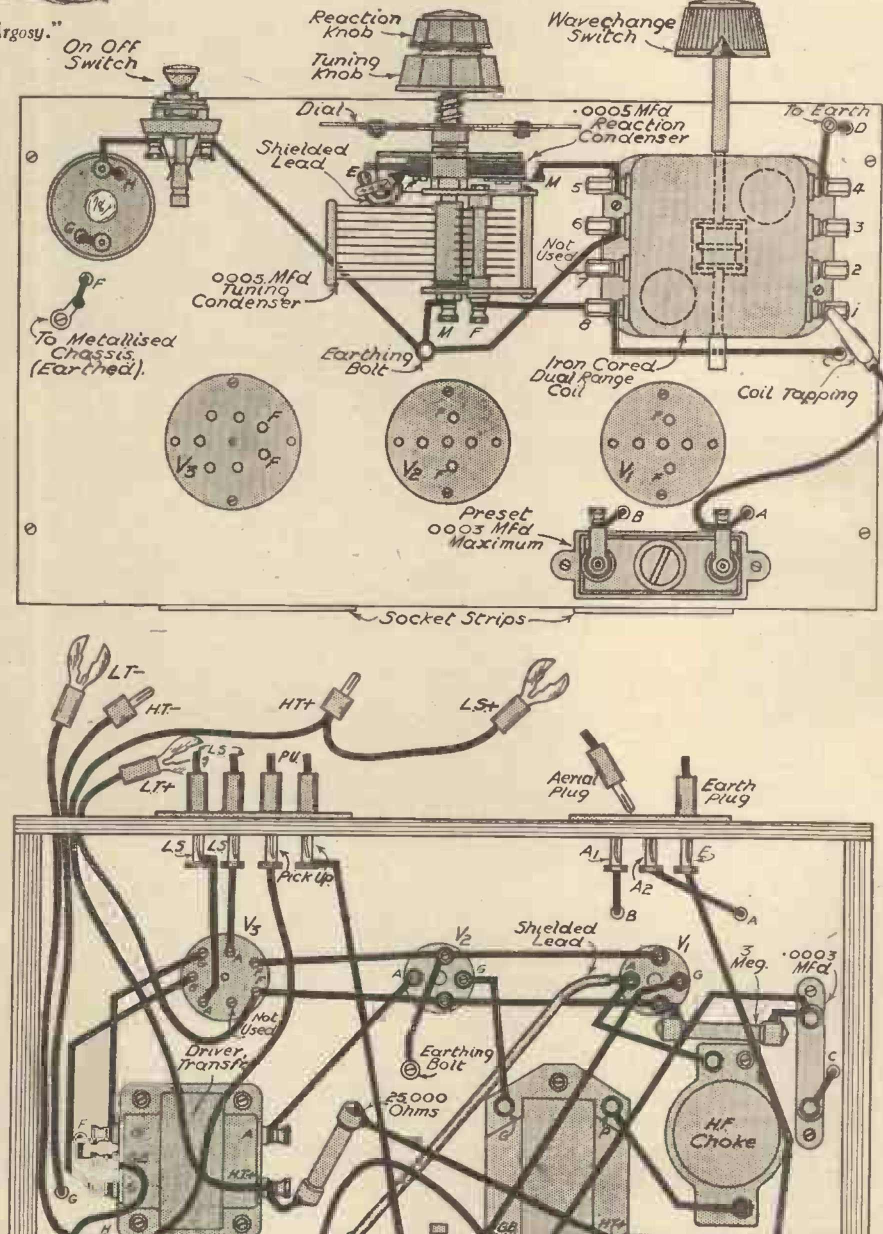
By making a careful selection of valves it has been possible to bring down the high tension current consumption to an average value of no more than 8 to 9 milliamps. Additionally it should be mentioned that the H.T. consumption is proportional to the volume of reproduction. Stated in different language, it can be said that the high tension battery specified will have a useful life of upwards of four months. Thus, despite the fact that the set gives as much volume as the average three-valve mains receiver, it costs considerably less to make and only very slightly more to run.

The " Argosy " is Guaranteed

And now with regard to the actual making of the set. It can be seen from the photographs and drawings reproduced that the work involved is neither tedious nor difficult. Obviously the first thing is to obtain all the necessary components and accessories, of which a complete list is given elsewhere. I would like to stress the importance of using the exact parts named; " similar " ones might or might not give satisfactory results. In any case it is almost certain that alternative parts would differ in size from those listed, and that would make it necessary to modify the layout. That in turn would be practically sure to impair the performance. If you use the parts recommended you will have the satisfaction of knowing that you are building, not only a good, but a GUARANTEED receiver. We give the guarantee that your receiver will perform as well as our original one. If yours does not give the results claimed, you are invited to write to us for FREE ADVICE; all we ask is that you enclose a stamped envelope for a reply. We take a real and personal interest in all our sets and are proud of the performances they give. Consequently we should be more than sorry to learn that any reader was not obtaining the satisfactory results that he should.

Mounting the Components

When you receive the components you will find that the chassis is already drilled to receive the valve holders and terminal socket strips; the first thing is to mount



The baseboard and sub-baseboard wiring diagram.

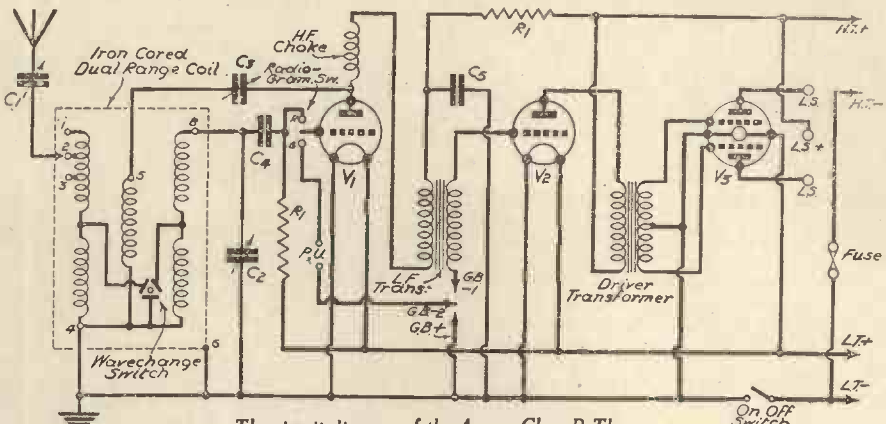
these parts by means of ½-in. screws. Next turn the chassis upside down and mount the transformers, component bracket, grid bias battery clip, fixed condensers and H.F. choke. Before attaching the rest of the parts on to the top of the chassis it is a very good plan to connect as many wires as possible whilst the set can be laid down without any fear of damaging anything. The wire specified for connecting is insulated and is particularly easy to deal with, since to bare the ends it is not necessary to scrape away the insulation but only to push it back with the fingers.

To avoid the possibility of confusion it is advisable to follow some definite sequence in wiring, and you will find it best to commence by joining together the filament terminals on the valve holders. These are not fitted with the more usual kind of nuts, but instead they have holes running through the legs. The bare end of wire is slipped into these, after which the short screw at the end is tightened down. You will notice that the grid leak is not attached to the chassis, but is simply held in place by its own connecting wires. Very nearly the same thing applies to the 25,000-ohm decoupling resistance, but as the wire on one end of this is not long enough to reach across to the 2 mfd. condenser, it is lengthened by soldering a piece of ordinary connecting wire to it.

Note especially the connections to the radiogram switch; the terminal attached to the longest spring contact is joined to the ·0003 mfd. grid condenser, that attached to the shortest spring goes to the pick-up terminal socket, whilst the third terminal (in contact with the medium length spring) is joined to the grid terminal on the detector valve holder.

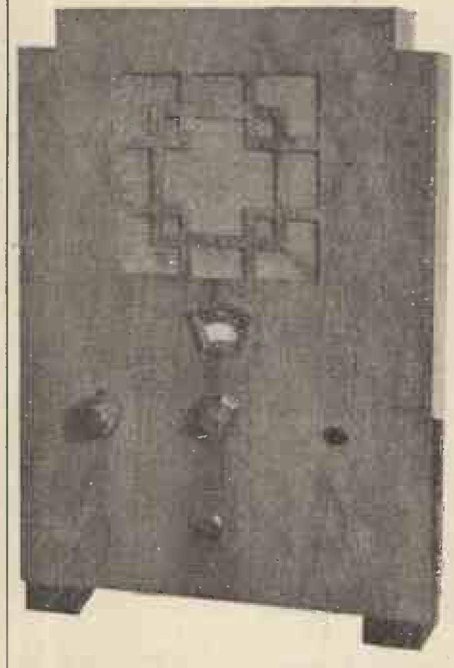
You will see from the drawings that one wire on the under side of the chassis is connected to a bolt which goes through the baseboard and so makes contact with the upper metallised surface.

When as much wiring as possible has been done underneath, the chassis can be turned over and the remainder of the components fixed in their proper positions. Start by mounting the combination variable condenser in the centre of the front edge, taking care that the end of the coil spring on the spindle projects ½ in. beyond the edge of the baseboard. The coil should next be screwed down, after which the second small metal component bracket can be placed in position; it should be fixed at the same distance from the right-hand end as the wave-change switch knob on the coil is from the left-hand one. Lastly, mount the fuse-holder and then complete the wiring. Most of the wires can be traced quite easily, but it might not be perfectly clear at first that



The circuit diagram of the Argosy Class B Three.

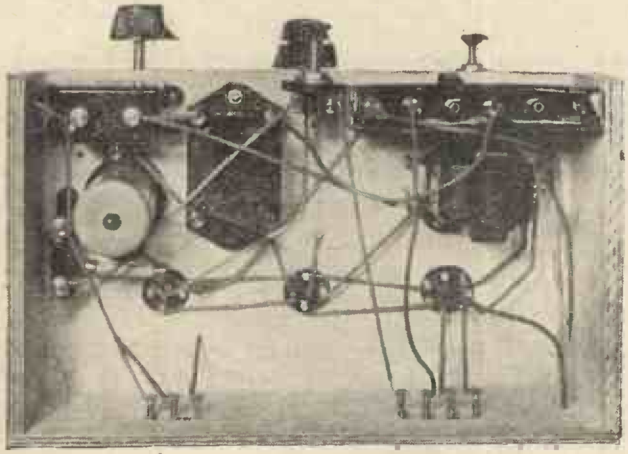
some of them pass from one side of the baseboard to the other through small holes which must be made with a drill. So that these wires can readily be identified the



The finished Argosy in its handsome Peto-Scott cabinet.

holes are lettered on the drawings. Two wires which at first seem rather unusual are those connected to the fuseholder; they pass through holes which are in the holder when bought, and also through corresponding holes that have to be made through the baseboard.

Another point that might not be quite clear is that one wire is brought through a hole just behind the fuse, attached to a soldering tag and connected to the chassis by means of a short wood screw. To prevent any possibility of unwanted reaction effects, the lead from the anode terminal of the detector valve holder to the reaction condenser is screened by means of a length of metal braiding. It is important to take especial care that the ends of the braid do not touch the bared connecting wire, since if they did the H.T. battery would be short-circuited and the fuse would "blow."



An underneath view of the Argosy Class B Three.

That completes the construction of the set, so the next little job is to fit it into the cabinet. You can easily mark out the positions of the holes for the control knobs by making reference to the sketch on page 69, and all except that for the dial escutcheon can be made with a brace and bit. The remaining hole can be made by means of a pad saw.

The set is now ready to be tried out, so you should connect the aerial and earth leads to the two corresponding wander plugs and push these into sockets "A.2" and "E." respectively. Next attach two short lengths of flex to the outer terminals on the loud speaker and provide these with plugs to fit into the two "L.S." sockets (it does not matter which way round they are connected). The lead with "L.S. +" spade terminal, and joined to the "H.T.+" wander plug, should be connected to the centre terminal on the speaker. Now connect up the batteries, inserting the "H.T. −" and "H.T. +" wander plugs into the negative and 120-volt sockets respectively. It will be obvious to which terminals on the accumulator the "L.T." plugs should be connected. It is assumed that the grid bias battery had previously been fitted into the clip and the "G.B. +," "G.B.—1" and "G.B.—2" plugs inserted into the "+," "4½" and "1½" sockets respectively.

First of all attach the crocodile clip on to terminal 1 of the coil and switch on the set by pulling out the right-hand knob. Turn the wave-change switch to the right or left, according to whether medium or long wave reception is required, and then rotate the tuning condenser by means of the larger knob. Once a station has been found it can be made louder or weaker by rotating the smaller (reaction) knob clockwise or anti-clockwise. Be careful, however, that you do not turn it too far in a clockwise direction or else the set will oscillate.

When the crocodile clip is on terminal "1" the set is in its most sensitive, but least selective, condition. Consequently, increased selectivity can be obtained by transferring the clip to terminal "2" or "3." Another way of sharpening tuning, however, is to change over the aerial lead-in from terminal "A.2" to "A.1" and to vary the value of the pre-set condenser.

When it is wished to use a gramophone pick-up, all that is required is to connect it to the appropriate terminals by means of the wander plugs and pull out the knob of the (lower) radiogram switch.

Do not forget that the "Argosy" is a PRACTICAL MECHANICS *Guaranteed* set, and in case of any difficulty at all, you will find us ready to assist you.

Movie Making for the Beginner

CINE FAULTS AND REMEDIES

By PERCY W. HARRIS, F.A.C.I.
Editor of "Home Movies and Home Talkies"

THE beginner in movie-making often asks questions about the film itself. Generally he buys a camera, just asks for a film, loads it up, exposes it according to the book of words, takes it back, has it developed and then, showing it on the screen says : " Well, I won't say it is perfect —but at least it is far better than I had hoped." Sometimes, too, his family immediately decide he has missed his vocation and should be at Elstree. The next film, however, is not so good, although he imagines he does everything as before. Let us try and find out why this is.

Second films are rarely as good as first. Quite apart from the question of film stock, almost invariably when a man starts out to use a cine camera he is inordinately careful with his first roll. He reads the booklet through and through, and makes sure that everything is right. He even double checks everything before starting and follows the book of words so carefully that he is practically insured against failure. When he gets the finished result he is so pleased with it, and the whole business seems so easy, that the next time he isn't anything like so careful and the result suffers accordingly.

Faults to Avoid

I have recently been examining a friend's second film, so as to advise him on its faults. There were thirty feet of it, for it was one of the little 9½-mm. bobbins, and as I pulled the film through the magnifier which I use I let it drop into the waste-paper basket. By the time the whole 30 ft. (or more accurately 25 ft.) had been pulled out it looked in an inextricable tangle. I noticed my friend's eyes glancing uncomfortably at what appeared to him a hopeless muddle. His face fell, for he could not understand how on earth it could be re-wound without the projector, but I soon removed his fears by showing him a quick way to do it.

It happened I had in my bag a bunch of letters fastened together with a wire paper clip. I pulled this off the letters and bent it to form a winding handle. If you examine one of these 30-ft. bobbins you will find there is a central rotating portion which is open on one side and fitted with a slot on the other. The U-shaped portion of the fastener can be pushed through the open end and will fit into the slot at the other. The remaining portion of the fastener now acts as a handle and in a moment the whole film is neatly re-wound into its casing.

Another simple way which many people do not think of is to use the small blade of the average pocket knife, which will fit in that slot just as easily, and it is a comparatively simple matter to spin the pocket knife and wind back the film. It is not quite so easy as the paper fastener idea, however.

Now this film had about a dozen separate and distinct faults, and by no means all of them could be blamed on to the film. Some of them definitely could, as I will explain later, but let us talk about the mistakes in order. Taking the magnifier, I started with the beginning of the film. First of all there was a small portion of the beginning of the film badly blurred. This was due to the fact that just as my friend started the camera he shook it badly. It is a good plan to practise holding and running the camera without any film in it. Plant yourself firmly in front of the subject with your legs slightly apart as if bracing yourself against a wind, but hold the camera in such a way that you do not shake it when you press the release.

By the way, when you are examining a cine film with a magnifier, or in fact in any way other than by running it through a projector, remember that what appears to you to be a bad fault or a fuzziness in one, or perhaps two single pictures may not be noticeable at all on the screen. Remember, too, that the film goes through the projector at the rate of roughly 5 inches a second or two-and-a-half seconds to the foot. As each single picture appears on the screen for roughly $\frac{1}{32}$ of a second only (don't forget the screen is black for half of the time) cutting out a single faulty picture and joining up the film again will not make any appreciable difference to the action. But a bad scratch or a blank frame will show as an irritating flash on the screen.

The first foot or two of the film seemed very good. It was taken out in the garden with good light and the stop used gave a suitable exposure, but in the next shot there were about four separate and distinct faults. Half of the picture was covered with a dark grey fuzzy-edged blur which completely obliterated everything else and ruined the shot. I feel certain that he had his finger over half the lens during the whole of the particular shot. When I explained this he remarked that the scene looked all right through the view-finder and that if it looked all right it should come out all right.

He had overlooked the fact that this would only be the case if we looked through the actual lens which takes the picture. The view-finder lens is generally an inch or two above or to the side of the taking lens, and it is easy to cover the whole of the taking lens with your finger and still not obscure the view-finder. You have no idea how common a fault it is to cover up or partially cover up the lens with the hand.

Finger in Front of Lens

So much for fault number one. Now the second fault was that not only did he hold his finger in front of the lens

(*Continued on page* 78.)

Fig. 1 (Top).—A scene in a cellar taken by Rhos Amateur Film Productions.
Fig. 2 (Left).—The London Amateur Film Club at work on an interior set.
Fig. 3 (Right). — Administering restoratives in the Southend Film Society's production "Congo Nights."

PRACTICAL LIGHT RAY CONTROL

By MAJOR RAYMOND PHILLIPS, O.M.E.

Further Practical Examples of Mechanisms Operated by this New System of Invisible Control

Continuing the Description of the Uses of the Interlocking Relay

THE control switch would be fitted with a contact drum electro-magnetically operated, and so arranged that the drum would revolve in "step by step" stages. A local battery would provide current for the windings of the electro-magnet of the selector, and the supply of current would be controlled by the relay contacts of the relay forming part of the light-control apparatus. It will be apparent that each time the selenium cell is affected by a beam of light projected on it, the relay contacts would close the circuit connected with the electro-magnet of the "selector," and thus cause the contact drum to revolve one stage. The relay fitted in light-control apparatus is provided with terminals, so arranged that its contacts are "normally" open or closed. Such an arrangement is very convenient, as a light ray can be used to open or close circuits.

Other Arrangements

The ingenuity of most amateurs is such that there would be no difficulty in arranging the contacts of the "selector" drum to open or close other circuits connected with a battery and the electric motor, also rudder control of a model boat. It will be understood that a fairly large model boat would be necessary.

Opening Doors

The author has frequently been asked during his lecture tours if it is possible for an amateur to construct apparatus suitable for opening the doors of a private garage by means of light projected from the headlights of a motor car. There is nothing difficult about such an application of light control, because most of the apparatus required can be purchased "ready made" at such reasonable rates that it is really not worth the time and trouble which would be involved with "home-made" apparatus, and the construction of a really reliable selenium cell involves much technical skill.

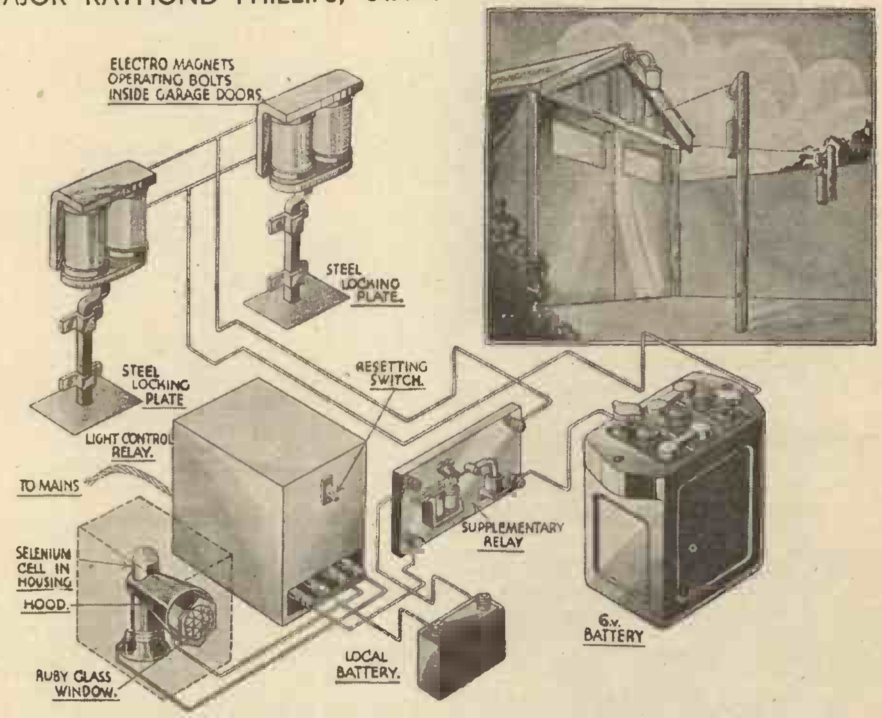


Fig. 7.—The assembly of the light ray apparatus for controlling a garage door.

In the author's opinion the simplest method to adopt (where alternating electric current is available) is to install "all mains" control apparatus with a circuit similar to that shown in Fig. 2. A supplementary relay, as shown in Fig. 4, will also be required. This can easily be made by almost any amateur (as already explained) and is necessary for controlling the circuit conveying current to the windings of powerful electro-magnets which are arranged to release bolts or catches securing the garage doors. As the doors fitted to most private garages are not cumbersome, the author is of the opinion that the simplest method of providing means to open the doors when the securing bolts or catches are released is to attach a length of light flexible steel wire to each door, and pass each wire over pulleys attached to each side of the garage. A block of lead of sufficient weight to open the doors (when these are released) should be secured to the top of each wire. The whole arrangement is shown in Fig. 7.

The light ray control apparatus can be placed in any convenient position. The selenium cell should be "housed" to prevent it being affected by "stray" light rays. It should be placed in such a position that the light rays from the headlamps of an incoming motor car will be projected on the cell. When that happens the relay in the light-control apparatus will close the circuit connected with the electro-magnet of the supplementary relay. The latter will then close a circuit connected with the electro-magnets which release the catches or bolts securing the garage doors, which will then be opened by the weight of the lead blocks attached to the flexible steel wire drawing the latter over the pulleys. A further supplementary relay can (if desired) be arranged to "switch on" current to electric lamps.

The Electro Magnets

The electro-magnets for releasing the catches or bolts should be of massive construction, as a fair amount of power is required for the purpose. It is sometimes possible to purchase suitable electro-magnets "ready made," and they will generally be found wound for an E.M.F. of 4 to 6 volts. It is therefore possible to connect them in circuit with a supplementary relay. and a 6-volt motor-car accumulator. The average motorist generally has a spare accumulator in his garage. It is not practicable to connect the windings of electro-magnets with an electric light main unless they are specially wound for the purpose, and even then it is advisable to have a "lamp resistance" in "series" with the circuit, so that should an accidental "short circuit" take place a main fuse is

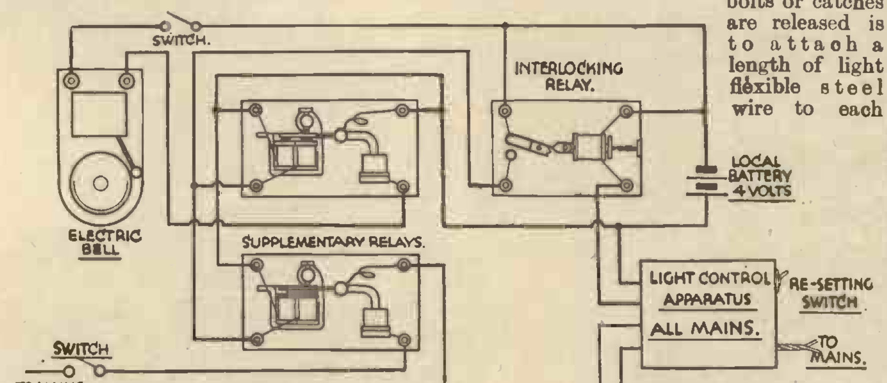


Fig. 8.—The circuit of the apparatus for controlling the arrangement when the car passes through the light ray.

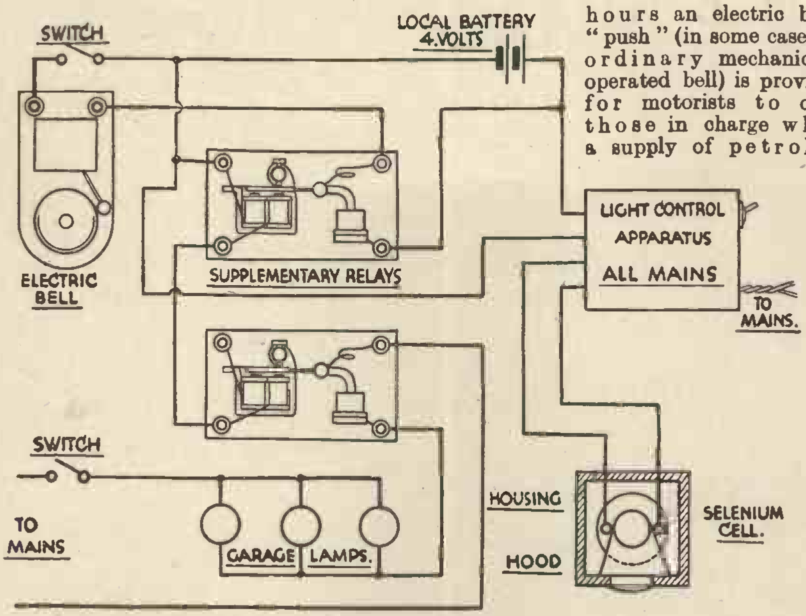


Fig. 9.—This circuit will enable the apparatus to be controlled by the headlights of the car.

not affected. An electro-magnet with soft iron cores 3 inches long by ½ inch diameter and wound with No. 20 gauge enamelled copper instrument wire will be found to exert a powerful pull when current is applied at an E.M.F. of 6 volts.

The catches or bolts for garage doors (as shown in Fig. 7) should each be fitted with a soft iron armature and arranged to slide freely in "guides," also to engage (not too deeply) with a metal plate suitably fitted to the floor of the garage. The catches or bolts should at the lower end be tapered on one side so that they will slide over the metal plates when the garage doors are closed in the ordinary way. When securing the electro-magnets to the garage doors, care should be taken to ascertain that the magnet cores are as near to the armatures as practicable, as the pulling power of a magnet decreases enormously in proportion to the distance of its cores from an armature. If, therefore, the distance is of any magnitude, it would be necessary to use solenoids for the purpose described. Solenoids are a form of electro-magnet with a movable core and are more costly to construct than an ordinary electro-magnet.

Method of Release

It will be understood that the method of release described in this article is not intended for use with heavy doors such as are fitted to commercial garages. Although the same light-control apparatus could be used, more complicated mechanism would be involved, and to automatically open some heavy doors it would be necessary to provide electric motor-driven mechanism.

It will further be understood that those who decide to experiment with light control of the doors of their private garage will use their own discretion as to the position in which the various components are installed, always remembering that a selenium cell must be placed in such a position that it will receive the light rays projected from the headlamps of an incoming motor car. The illustration shown in Fig. 7 is merely a general arrangement of circuits and components.

Other Light Ray Controls

The author (during his lecture tours) has noticed many instances of commercial garages where the proprietor or manager resides either on the premises, or in a house adjacent to the garage, and after closing hours an electric bell "push" (in some cases an ordinary mechanically operated bell) is provided for motorists to call those in charge when a supply of petrol is required. Many proprietors and managers have asked the author if it would be possible to install light-control apparatus so arranged that a motor car passing through a ray of light or light rays from the headlamps of a car would cause the electric lamps fitted in the compartments on the tops of petrol pumps to be illuminated and an electric bell set in action.

An Example

As an alternating current supply of electricity is installed in most garages it is advisable to use "all mains" light-control apparatus. Fig. 8 shows an installation arranged to effect control when a motor car passes through a ray of light from a light projector, and Fig. 9 shows the same apparatus controlled by light rays projected from the headlamps of a motor car. The "all mains" light control circuit, as shown in Fig. 2, can be used for both installations, but it will be noted on referring to Fig. 8 that an interlocking relay (as shown in Fig. 6) is used for controlling two supplementary relays. The latter are necessary for both systems, as it will be noted there are two separate circuits to be controlled. One is a battery circuit connected with an electric bell, and the other circuit is "all mains" connected with the electric lamps on the petrol pumps.

The author's interlocking relay shown in Fig. 6 will be found a useful piece of apparatus where it is desired to definitely or permanently open or close a circuit with each light-ray impulse. It will be apparent on referring to Fig. 8 that where a motor car passes through an "entrance" and "exit" it could be arranged for the car to "switch on" all circuits on entering, and "switch off" when leaving. It will be observed from the arrangement shown in Fig. 9 that a selenium cell would have to be "housed" and placed in a position where it would be affected by the light rays projected from the headlights of an incoming motor car. With this installation it would not be necessary to place the author's interlocking relay in circuit with a supplementary relay, as the latter would be connected direct with the relay forming part of the "all mains" light-control apparatus, which is provided with a switch so arranged that when it is in one position, and the apparatus functions, the latter will continue to do so until the switch is re-set. This means that once a light ray affected the selenium cell the electric lamps on the petrol pumps of a garage would be illuminated, and the electric bell would continue to function until those in charge of the garage re-set the switch.

Headlamp Rays

The light rays projected from the headlamps of a motor car are usually very powerful, as means are provided to make the beam as intense as possible by reflecting the light rays with a parabolic reflector so that they are projected with equal intensity within a certain angle. The extent to which the beam of light spreads or widens out depends upon the design of the reflector. The projected light rays will affect an exposed selenium cell at fairly long range, making the "housing" of a cell imperative in order to keep stray light away from it. A piece of ruby glass placed in front of the cell "window" also improves matters, as shown in Fig. 9.

The author has constructed selenium cells which are only affected by white or deep-ruby light rays. There is no effect with ultra-violet rays.

Infra-Red Rays

A great deal of so-called "mystery" has been introduced in connection with infra-red rays. The author has seen instances of exaggerated claims. To non-scientific observers there is always an element of mystery when scientific instruments are affected by invisible forces, but in many cases such phenomena appear simple when the cause is explained. The "invisible ray burglar alarm" has created considerable interest, and the author recently conducted a demonstration showing a combined door and burglar alarm controlled by infra-red rays. Most people are familiar with the mechanically-operated bell fitted to a shop door and which is affected by a trigger engaging with a "catch" when the door is opened. The chief objection to such an arrangement is the fact that it will not function if a door is left open, so that in the absence of the

(Continued on page 94.)

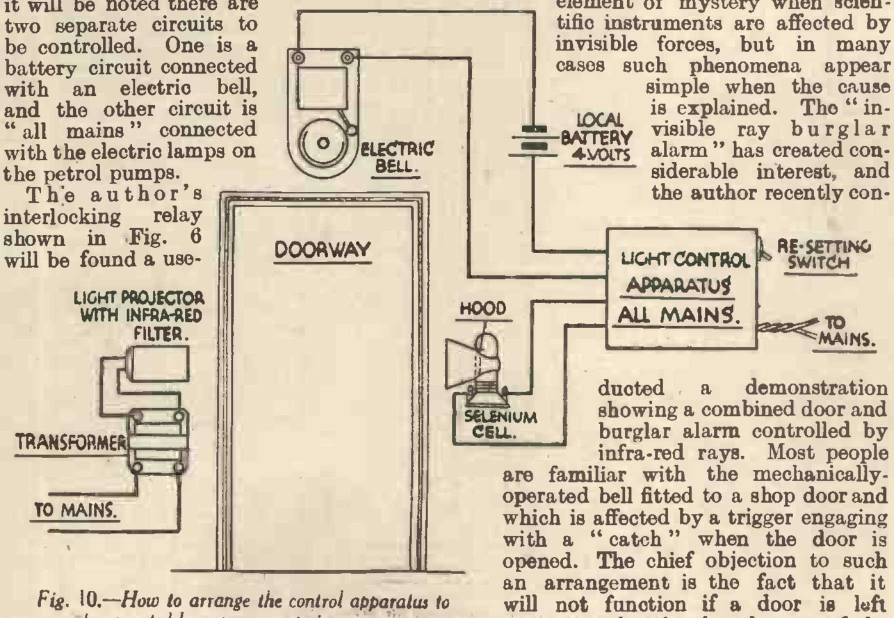


Fig. 10.—How to arrange the control apparatus to be operated by a person entering a room.

Half Hours with the Microscope

In this article some of the simpler forms of life are examined in order to obtain a working knowledge of the microscope. A small pond or stream will yield ample supplies for the purpose.

By W. J. DELANEY

IN the article published last month it was assumed that you had had no previous experience with the microscope, so I therefore gave the names and explained the principal parts of the apparatus. It is now presumed that you have obtained a simple microscope, and have made up the simple net and live-box which was described, and are now ready to make your first microscopic examination. Obtain an ordinary jam jar or similar type of glass vessel, and an ordinary magnifying glass—the more powerful the better, and set off for the nearest pond or stream with your net. On arrival, dip the jar into the water and fill it about one-quarter full, and by so doing you will no doubt take in many forms of life which you may or may not be able afterwards to examine. Now lower the net into the water, hold it stationary for a few seconds, and then make a vigorous sweep up and out of the water. With your magnifying glass examine the tube at the bottom of the net (holding it vertical, of course, so that the collected water may not run away). You are almost certain to be able to see dozens of small specks bobbing about in all directions—*Daphnia*, or, to use the commoner expression, water fleas. Empty the contents of the tube into the jar, and repeat the process once or twice. Now adopt different tactics. Place the net so that the water only enters half of it (Fig. 1), and walk round the pond slowly, scraping the top of the water. Do not withdraw the net until you have covered as much of the surface of the pond as possible, avoiding, of course, large floating weeds, etc. Empty the contents of the tube into the jar, and before going home with your prize take a few sweeps at the very bottom of the pond, being careful to avoid stirring up the mud and so obscuring the contents of the tube.

Manipulating the Microscope

On arriving home, obtain a piece of the tubing which was mentioned in the first article, and placing the forefinger over one end of it lower it into the jar. No water will enter the tube until the finger is removed, and you should wait for a second or so and then remove the finger quickly, and the moment you see the water rise in the tube to the level of the water in the jar replace the finger. The tube may now be withdrawn from the jar and will carry with it the small column of water, together with any life that may have been drawn up by the suction created when the finger was withdrawn. A watch-glass should be stood by ready to receive the contents of the tube, and it should be unnecessary to state that the tube should only be lowered just far enough in the jar to obtain sufficient water to rest on the glass in the form of a large raindrop. Place this on the stage of your microscope, and fit the lowest power you have—say 1 inch. Stand the microscope so that direct daylight may fall on the mirror below the stage, and turn the mirror so that a direct light is reflected upwards through the tube. Instead of looking down the tube to start with, and perhaps straining your eye, it is preferable to lean back slightly and look at the upper lens of the eyepiece. The reflection of the light will be seen as soon as the mirror is in the right position. Now place the eye close to the eyepiece, and adjust the instrument, according to the particular type which you have got, so that the drop of water is brought into focus. Some cheap instruments are adjusted for this preliminary inspection by a simple push fit, whilst others have geared screws. Whatever type of adjustment is fitted, try and get the preliminary rough focus as quickly as possible in order not to get eye-strain at the commencement. You will probably find that very few seconds will produce a feeling of strain when first carrying out microscopic operation, but when once the idea has been grasped you will find that the objective can be put almost into position without looking down the tube. You will get to know the distances from the object for the various powers which you use, and this not only saves time, but also prevents that feeling of being "cross-eyed" which one gets after using one eye for the first time. In this connection it might be pointed out that a small clip fitted with a black disc (Fig. 3) may be obtained from some opticians. It is clipped on the body of the microscope and covers the unused eye, thus saving the strain of endeavouring to

Fig. 1.—Using the net to obtain various forms of life from the surface of a pond.

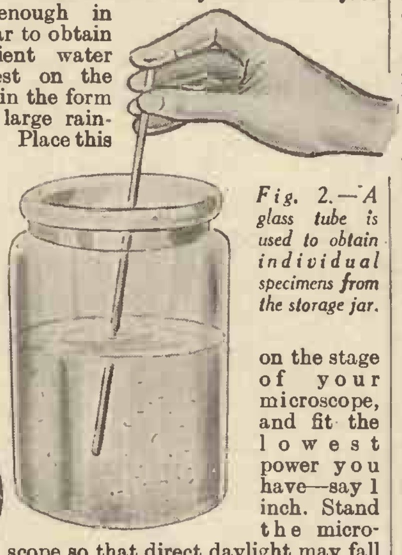


Fig. 2.—A glass tube is used to obtain individual specimens from the storage jar.

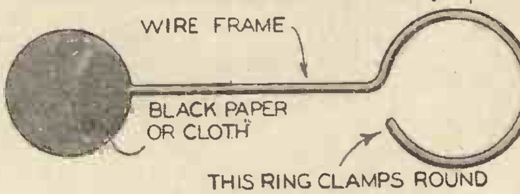


Fig. 3.—To avoid eye-strain a shade made upon the above lines may be used.

Fig. 4.—One of the commonest forms of pond life—Daphnia, or *water flea.*

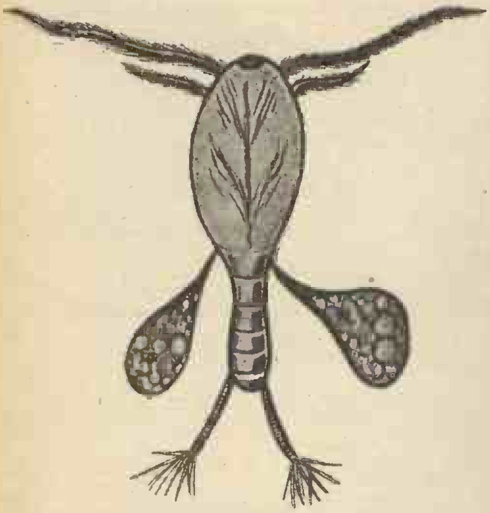


Fig. 5.—Another popular subject obtained from a pond—this is Cyclops, *complete with two bags of eggs.*

keep one eye closed. I do not want you to get the idea that microscopy is hard work, or that eye-strain will result, but if you are over thirty years of age, and have not previously endeavoured to use one eye only, you will undoubtedly find it awkward. Many people cannot, of course, close one eye without holding it with the fingers, but after a short time you will find that it is not difficult. To start with, however, do not spend more than five minutes with the instrument.

Making the Adjustments

As soon as the water is brought into focus you will see specks moving about all over the field, which is the term given to the illuminated area which you can see. Directly these specks are seen, proceed to adjust the focus more carefully, and provided you have used a low power as directed you will no doubt find that the whole of your field is occupied by many small objects swimming round and round in circles, and long thin tubular-looking bodies proceeding slowly across the field. Adjust the mirror now so that the light is gradually reduced, and as the light is removed from the bottom you will find that the objects will stand out in colour against a semi-darkened background, and this should be left whilst you admire the many interesting types of life which are revealed to you for the first time. It is, of course, impossible to say what you will see, but, if the pond was of the ordinary unprotected type, the majority of your catches will be *Daphnia*.

They are small, brownish creatures which appear to travel on their sides, and they proceed along in a series of jerks which is most interesting when viewed for the first time. It will not be difficult to associate the reason for their name—water fleas. There are many types, and the female differs from the male fairly considerably; but one of the most interesting facts, which you will be able to verify when you are using a higher power, is the carrying of their young inside the small shell-like body. If you have turned your mirror to give the correct "dark-ground" illumination, you will see that the creature possesses only one eye, and this is a most beautiful object to examine under high power. Probably it will appear of a pinky colour if the light strikes it at the right angle, and it is of the compound lens type. The illustration (Fig. 4) is drawn from an actual specimen which I was examining as I wrote this article, and it gives some idea of the interior organisation of this small creature.

Cyclops

Another object which is almost as common as *Daphnia* is the *Cyclops*, and one of these is illustrated in Fig. 5. It is also of the one-eyed variety, and the only really interesting feature about it is the egg-bags which are carried on each side of the female. Leave the instrument for half an hour or so, and then return to it to look for other specimens. I would urge this method of using the instrument to commence with, as you will thereby be assured of not contracting any form of eye-strain, and furthermore you will not lose interest so quickly. Amœba is a form of life which will later form a most interesting subject for examination. Its appearance, under the lower power at present being used, will be of a small lump of green jelly, varying in shape as it moves about in the drop of water. It will appear very small, but will sometimes be long and hair-like, and, whilst you are looking at it, it will contract to practically a sphere. If a particularly large specimen comes into view, it may be seen to possess no organs, but to consist of a jelly-like substance. Should a small piece of dead leaf or similar decayed substance come near to it it will be seen to extend part of its "body," and to contract round the leaf until the latter is completely engulfed. If you are lucky enough to be able to keep it in view the whole time you will find that the leaf will gradually disappear as it is dissolved away and so nourishes the amœba. Several evenings may be pleasantly occupied in examining in this way the products of your excursion to the pond, and for certain objects the live-box described in the first article will prove very valuable. If the "trough" has been made just large enough to occupy the field when using the low power you will be able to keep an object in view the whole time, and will not be disappointed to see it suddenly swim out of sight. No attempt should be made to use a high-power yet, and several insects should next be examined in order to still further gain interest in the hobby. Later, we will deal with high-power operation, together with simple dissection, which is both fascinating and instructive.

Fig. 6.—A micro-photograph of the proboscis of the ordinary domestic fly. This will be described in our next issue.

CINE FAULTS AND REMEDIES

(*Continued from page* 74.)

but he did not hold the camera level and that made the picture appear all askew on the screen. It does not matter how much you tilt your camera downwards or upwards—in fact, some of the most effective scenes are obtained by shooting at quite a steep angle down on to the subject—but you must not in any circumstances tilt the camera sideways. In a still camera you can trim the print to get it square again, but remember nothing whatever can be done with a cine film to correct this fault.

Fault number three was that for a part of the scene he had the sun shining straight into the lens (it happened towards the end of the scene, for he panorammed the camera from one side of the lawn to the other). The effect was to fog the film and to obscure detail. Against the light shots are some of the most effective you can take, but it is always necessary to protect the lens from the direct rays of the sun or light source. The cine lens is recessed somewhat in its cell so as to give a hooded effect but if you want to photograph a scene at the angle my friend tried to do you must have additional shielding either by holding something in a position to shade the camera or by using a lens hood.

The final fault was that the scene passed from shade into bright sunlight. The shadow part of the scene was excellently exposed but when we passed into the bright sunlight it was undoubtedly over-exposed. A part with a little girl in a white dress made this clear. There was no detail in the white dress, it formed just a white blob, while the edges were blurred and fuzzy giving a kind of unpleasant halo. That is called "halation" and often comes from over-exposure when the light has penetrated right through the emulsion and has been reflected back again from the celluloid film.

The stop which was right for the shadow side of the picture was much too big for the bright sunlight, and so one should not attempt to panoram from a dark scene into a bright one unless at the same time you can gradually reduce the stop. This *can* be done if you are using a stand, but it is by no means easy to the beginner.

Towards the end of the film a number of scenes were over-exposed. This led me to ask what film he used. I found it was a different film from that in his first picture; one of those new fast panchromatic films which a friend had recommended to him, as he said it was so much better than the ordinary stock.

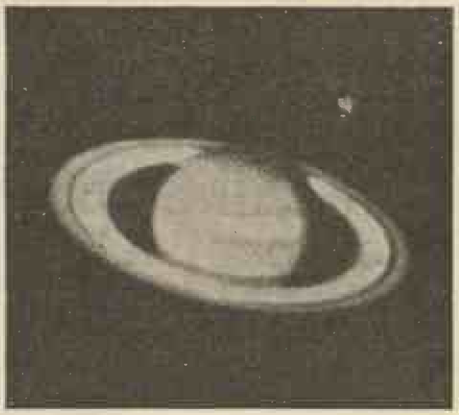
In your book of instructions the stops recommended are usually worked out for the older type of film, which is not so fast. If you are using one of the modern fast films you should give one stop smaller in each case. Thus if it says f.5·6 you should give f.8 or, if the markings of your camera have different figures from these, just take the next smallest marked figure, remembering that when I say "smallest" I am referring to the stop. The actual figure may be larger—thus f.8 while a larger *figure* than f.5·6 is really a smaller stop.

But I must tell you about stops and how they are calculated in the next article.

ABOUT THE PLANET SATURN

By N. DE NULLY

NO other of the sun's satellites exhibits such unique features as the concentric rings encircling the planet Saturn. Large instruments are required to reveal details, but quite good views can be obtained through small telescopes of not less than 3 in. aperture, provided they are fitted with suitable astronomical eyepieces. It so happens that Saturn, though preparing to leave us for a season, is still visible from dusk until about 8.30 p.m. as a dull isolated star low over the south-west horizon. If the side on which the white spot is situated should be turned towards the earth at the time of observation, that strange phenomenon may be seen under favourable atmospheric conditions. The "spot" has, however, elongated into a strip and may ultimately be stretched to a complete band.



The planet Saturn with rings wide open. Observe Cassini's division between the outer rings, and the veiling effect of the "Crape Ring" along the inner edge of the bright ring where it crosses the illuminated disc. Note also the planet's shadow cast upon the rings themselves.

A Giant Among our Companion Worlds

Its equatorial diameter is 75,100 miles—over nine times that of the earth—but the substance of which it is composed averages but one-eighth the density of terrestrial materials. Its consistency might, therefore, be likened to that of a lightly-squeezed snowball. This suggests the probable existence of a small compact core wrapped in thick layers of heated gas. The theory accords with the abnormal flattening at the poles and arrangement of the surface in parallel zones. Such results might be expected from the exertion of a powerful centrifugal force upon a swiftly rotating plastic sphere. The broadest and brightest of the zones girdles the equatorial regions and is distinctly yellow in colour. Those in the northern and southern hemispheres are narrower and greyish in tint, while the polar areas are covered by pale blue hoods. It is on the northern edge of the seemingly tranquil broad equatorial belt that the mysterious white spot has manifested itself. Whether it originated in an uprush from profound depths or from shallower disturbances is unknown.

The Sixth Planet in order from the Sun

Saturn revolves around that luminary at an average distance of 886,000,000 miles in a vast circuit requiring twenty-nine and a half of our years to complete. At its immense remoteness from our common source of heat, Saturn receives but one-ninetieth of the solar warmth that we do, and its surface temperature is estimated to be as low as 150 degrees below zero Centigrade. This is equivalent to the intense cold of 270 degrees of frost on the Fahrenheit scale. The rate of the planet's rotation on its axis is terrific, for, notwithstanding a circumference ten times that of the earth, its combined day and night occupies but ten and a quarter hours. During the progress of their respective revolutions round the sun, Saturn and the earth can approach each other to within 745,000,000 miles or drift 1,000,000,000 miles apart. They are now some 850,000,000 miles asunder and the distance is increasing.

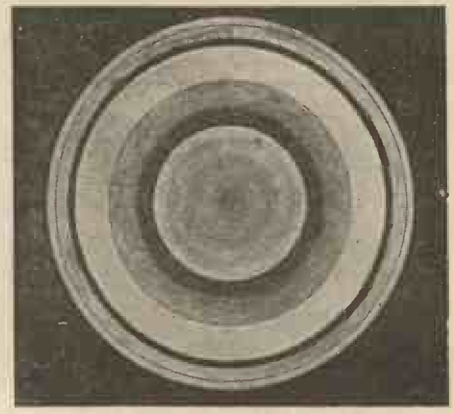
The Rinks round Saturn

The rings are almost circular and flat on both sides. Their oval shape is due to the slant at which we see them. For close on two centuries they were believed to be solid, but in 1857 Professor Clerk Maxwell, of Cambridge, mathematically demonstrated the impossibility of such structures remaining rigid at their relatively close proximity to the huge bulk of the ball. Tidal strain would have long ago broken them up. It is consequently accepted that the rings are in reality vast whirling streams of countless closely-packed particles. Each of these appears to act as an independent satellite and their speeds must be more than 30,000 miles an hour. The overall diameter of the ring system is 171,000 miles, and it consists of three distinct concentric hoops. The outermost ring is 10,000 miles wide. It shows signs of a narrow thinning, first detected by the astronomer Encke and called after him. A fissure of 3,000 miles (known as Cassini's division and quite perceptible in small telescopes) separates the two outer rings; the latter is the brightest and 16,000 miles across. After a gap of 1,000 miles comes the "Crape Ring," which is 11,500 miles in width. The abrupt darkening of this ring is most marked and obviously due to a sparse distribution of the flying fragments. These become increasingly scanty towards the inner edge, where the ring is reduced to little more than a transparent dusky veil. Though large apertures are needed to show the "crape" effect, it can be traced in smaller instruments as a shadowy silhouette against the illuminated disc. A clear space of 7,000 miles intervenes between the "Crape Ring" and the planet.

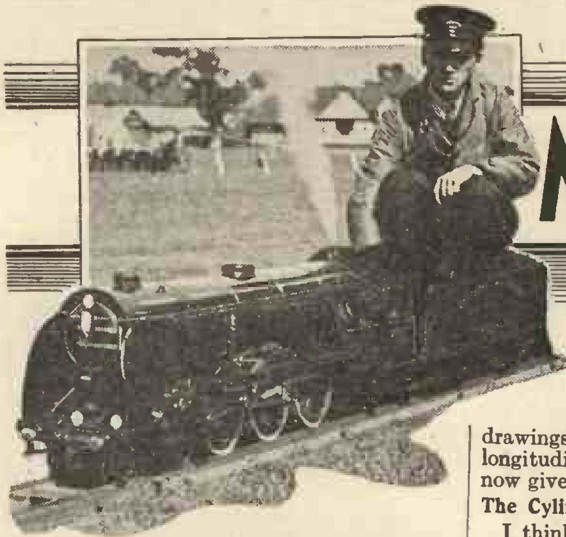
The planet Saturn with rings invisible. The dark stripe beneath the equatorial band is the shadow of the ring system. Note the darkening of the ball owing to loss of reflected light from the edge-on rings.

Above and Below

Owing to the track of Saturn being slightly tilted relative to that of the earth we sometimes see the rings from above and sometimes from below. This causes them to be presented edgewise to us twice in every twenty-nine and a half years, and, being less than 100 miles in thickness, they then become temporarily invisible. Their last disappearance took place in 1921, and it will happen again in 1936. The corresponding phase of maximum opening occurred in 1929 and will be repeated in 1943. The ten satellites of Saturn exceed in number those under the gravitational sway of any other planet, but the existence of the smallest is rather doubtful, as it has been only once seen since its photographic discovery in 1900. Titan, the largest, is half as big again as our moon, and revolves round Saturn in nearly sixteen days at an average distance of 771,000 miles. It can be discerned through any telescope that will show the rings. All the other satellites are beyond the range of amateur equipment.



Plan of Saturn's Ring System (to scale).



MODEL RAILWAYS

FURTHER NOTES ON THE ½-INCH MODEL G.W.R. "CASTLE" CLASS LOCOMOTIVE

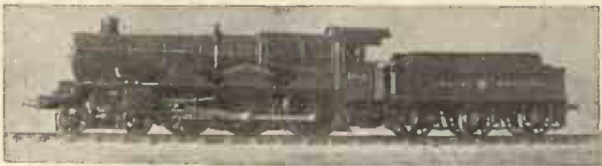
By E. W. TWINING

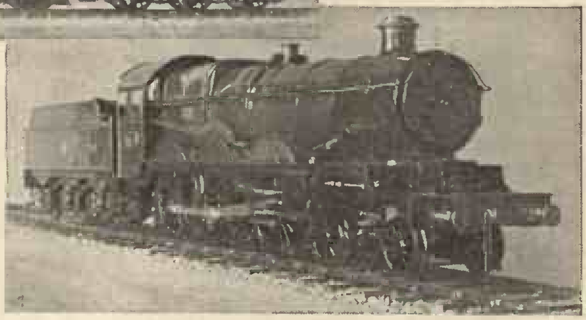
IT is thought to be worth while mentioning that for strict accuracy the gauge of the track on which a ½-in. scale locomotive and rolling stock is to run should be 2⅜ in., for, after all, it is, strictly speaking, the gauge which should settle the scale. As 2½ in. has, however, erroneously, been generally adopted as standard, I have made the model "Launceston Castle" to fit this width of track, but it would not be by any means a difficult matter for any reader who prefers to adhere to scale measurements to reduce the width over the engine frames when he sets out to build. The cylinders and firebox are the chief items which would require to be modified, and as the drawings show, especially the accompanying plan view, Fig. 6, there is enough metal outside of the cylinder walls to allow of the frames being brought in 1/16 in. on each side. Nothing else in the chassis would need to be crowded.

Perhaps the most important of all the drawings is the general arrangement of the longitudinal vertical section and the plans now given in Fig. 6.

The Cylinders

I think that the cylinders of our engine call for a few critical comments, and the arrangement for some explanation. As will be seen from the drawings, I have given them a large diameter. Some model locomotive men advocate keeping the diameter down to about two-thirds the size which it should be by scale and then running with a full throttle. I have never quite been able to see that there is anything to be gained by this. On the other hand, there is much to be lost. For one thing, a considerable amount of condensation takes place in the cylinders when starting up from cold, since the cylinders have to be filled many times before condensation nearly ceases; that is to say, before the mass





Two views of the ½-in. scale G.W.R. "Castle" locomotive.

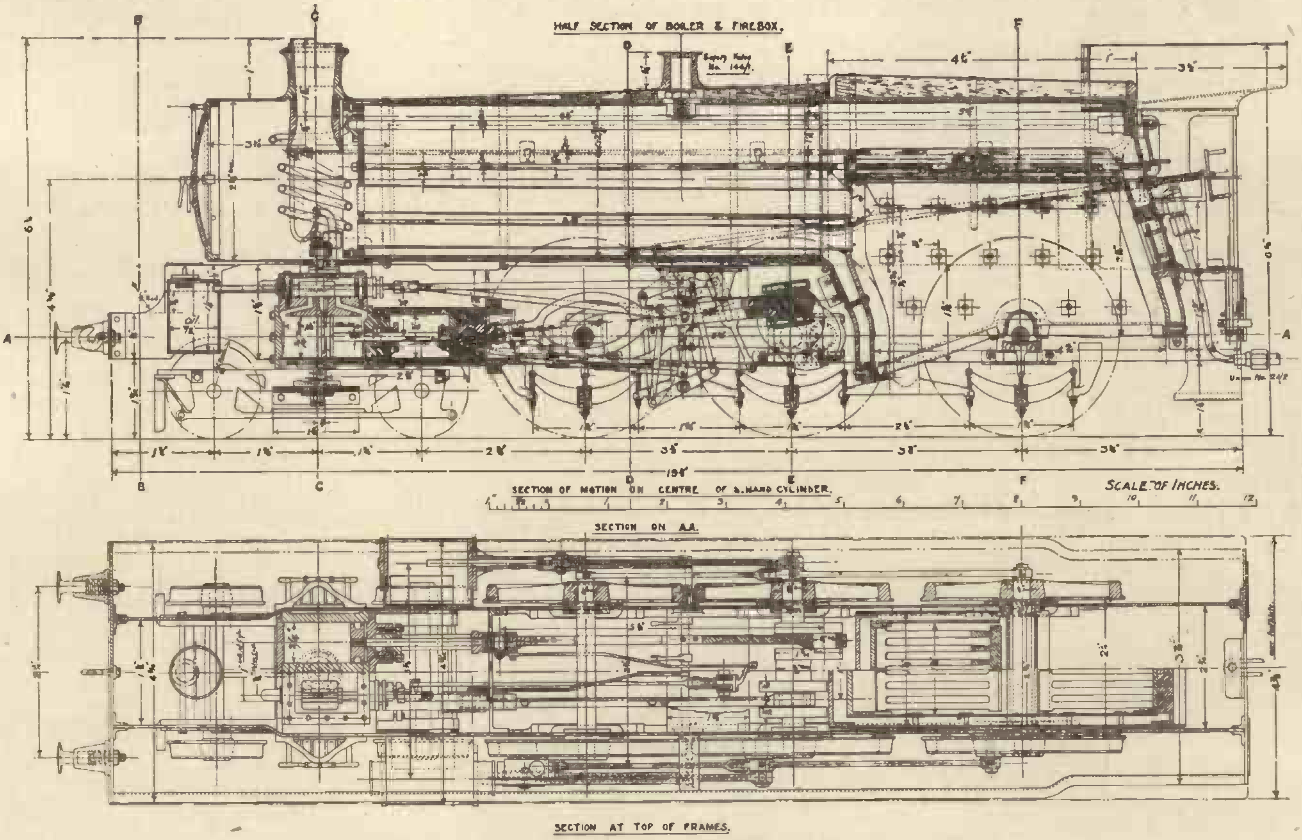


Fig. 6.—General arrangement of the ½-in. scale G.W.R. "Castle" class locomotive.

of metal into which the steam passes becomes heated up. This conversion of steam into water occurs when the greatest tractive effort is required to get away with a train. If, on the other hand, we adopt a big bore, a greater volume of steam enters when the regulator is opened, the cylinders are heated more quickly, and we get a maximum tractive force at the rail just when it is wanted. When the train is under way, we can either link up or throttle down; so I have made the bore of our cylinders ¾ in., which is equivalent to 18 in. in full-size practice.

The Exhaust Pipe

I do not know who originated the type of valve chest which is adopted in the present model, but it was certainly designed over twenty-five years ago, and has been repeated some hundreds of times since, and so has become common practice in model locomotives. The chief feature calling for comment is the fact that the exhaust pipe passes through the chest between the two valves. The cross-section at C, C in Fig. 5 does not indicate the fact that the passage between the two exhaust ports is drilled through from the outside of the cylinder casting; as a matter of fact, it is drilled from the right-hand side in the present model and then plugged with a tightly fitting screw. This connects the two exhaust ports; then, down into this passage, in the centre of the valve face, is a tapped hole into which the exhaust pipe is screwed. Its passage through the steam chest cover must be made steam-tight by counter-sinking in a stuffing box and fitting a gland, the packing around the pipe being asbestos string. It will be noticed in the longitudinal elevation that the cross centre-line of the cylinder is ⅛ in. behind the centre of the chimney. This means that the exhaust pipe must either be bent, or a special blast nozzle must be made. Since the pipe is too short to allow of bending, the latter form of nozzle must be fitted. This is a circular block of brass drilled from underneath, tapped and screwed on to the pipe, whilst the nozzle is formed by a smaller hole drilled from above and meeting the first hole eccentrically, the amount of eccentricity being ⅛ in.

Lubrication

The simplest, and perhaps most reliable, method of lubricating the cylinders of a model is by means of a Roscoe, or displacement, lubricator; for very many years the method used in full-size practice. In the present model this lubricator is placed between the frames in front of the cylinders. It is fitted with a screw cap or filling plug, and its only other outlet—and inlet—is a pipe connecting it to the centre of the front of the valve chest. It is made from a piece of copper tube with ends and pipe silver-soldered in. Strength is necessary, because it will have to withstand the full steam pressure in the chest. The principle on which this lubricator works is that on being filled completely with oil, small quantities of steam pass through the pipe and are condensed in the lubricator. The water thus formed falls to the bottom of the oil, so compelling small quantities of oil to pass through the pipe into the valve chest and through the ports to the cylinders. The cap must be made steam-tight, preferably by a small copper gasket. It will be noticed that I have made no provision for emptying.

The Boiler and Lagging

I mentioned last month that there were two methods of making all the joints in the boiler; namely, soft and hard soldering. There are also two orders in which the firebox and tubes may be inserted. In one case the inner firebox with the flue tubes are built up complete and passed into place before the outer back plate is fixed. This is perhaps the easier method, since we can be sure of making the tubes steam-tight at the firebox tube plate, but it involves the necessity of screwing the back plate in; for it is, of course, impossible to introduce rivets, the screws being put in from the outside. The other is to rivet up the whole of the outer firebox, the inner firebox and foundation ring, lastly passing all the tubes in through the smokebox tube plate.

With regard to the lagging of our boiler, the longitudinal section indicates that two materials are used; that which comes next to the boiler itself is sheet asbestos, which is soaked in water and wrapped around the shell. If necessary, this may be secured by winding from end to end of the barrel with fine tinned iron wire. Outside of this, asbestos strips of wood are fitted, such strips being carved to fit the barrel and firebox, and shaped lengthways to give the requisite taper.

As is well known, the feed water of the Great Western engines is delivered to the boiler through check valves placed on either side of the safety valves. In the model these check valves and their pipes are dummies and the feed water is taken through a check valve on the firebox back. Besides the chute a small firing iron will be required. This will consist of a 5-in. or 6-in. length of ⅛-in. steel rod with a small steel plate riveted at the end. The use of this will facilitate pushing the fuel into the box.

This locomotive is capable of hauling a juvenile passenger, and should form a valuable addition to a garden railway.

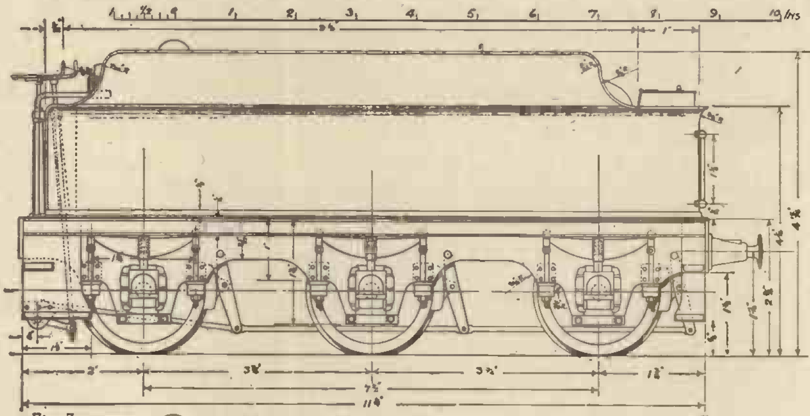


Fig. 7

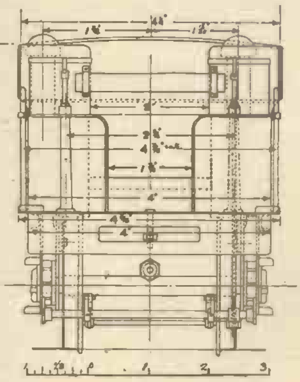
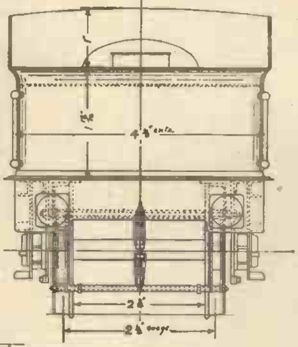


Fig. 10



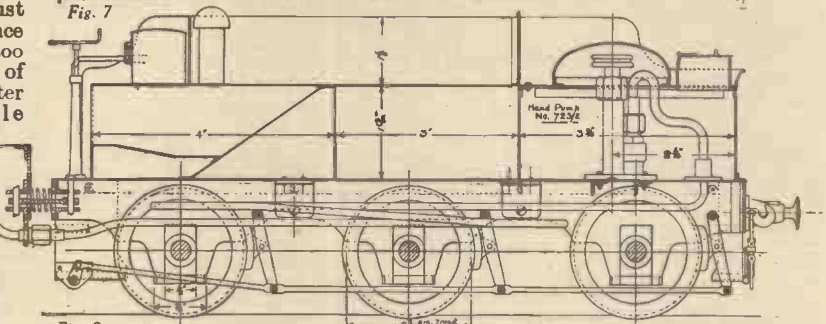


Fig. 8

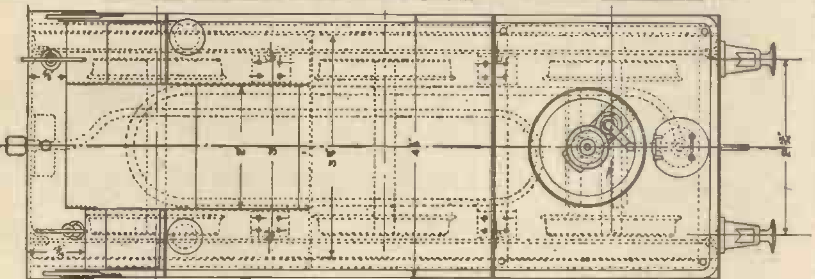


Fig. 9

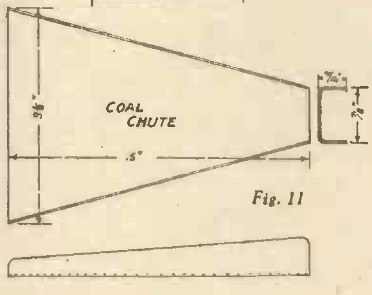


Fig. 11

Figs. 7 to 11.—Further constructional details of the ½-in. scale G.W.R. "Castle" class locomotive.

Fascinating Experiments in CHEMISTRY

Simple and safe experiments which can be carried out at home without expensive apparatus. This article deals with oxygen experiments.

THE atmosphere we breathe is made up of a mixture of oxygen, nitrogen, carbon dioxide (carbonic acid gas), and a small percentage of rare gases, including helium. It is the oxygen alone which is essential for the life of all breathing animals, the nitrogen and rare gases are inert, while the carbon dioxide is the product of our breathing; we inhale oxygen and exhale carbon dioxide. Remarkable as it appears, in spite of the rate at which oxygen is taken from the air by our lungs and replaced with the deadly carbon dioxide the percentage of the life-giving gas remains the same. This is due, briefly, to the breathing action of green plants in sunlight, who find carbon dioxide as necessary to their existence as we find oxygen. The story of this wonderful provision of nature, this photo-synthesis, as it is known, which keeps a constant supply of oxygen in our atmosphere, is worthy of study and experiment by any scientific minded individual.

Oxygen

The process of breathing is one of combustion, or burning; we take into our lungs air, the oxygen in it combines with the food carbon in our bodies, and we breathe out carbon dioxide. If the amount of oxygen in the air were greater, the combustion would be accelerated and our lives would probably be correspondingly shortened. As an example of this, it might be observed that one of the earliest experiments was the introduction of living mice into an atmosphere of pure oxygen, when an immediate increase of vitality and quickened movement were manifest. The story of the discovery of the gas, the early experiments performed with it, and the curious theories held at that time regarding it, form entertaining reading.

And now, having learned quite a lot about the "whys and wherefores," let us prepare it in our home-made laboratory.

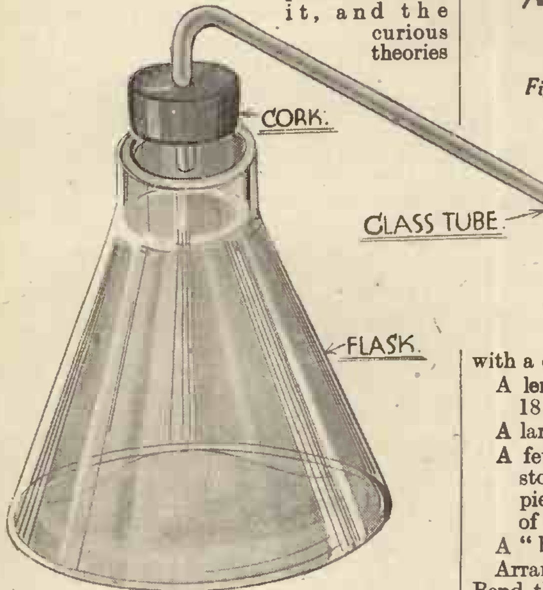


Fig. 3.—A cork is bored to accommodate the tube as shown.

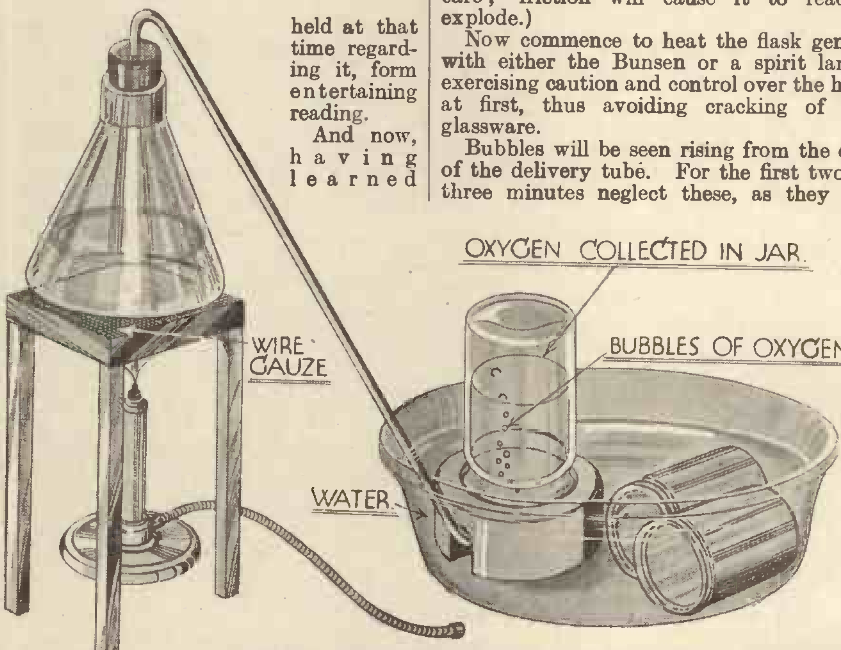


Fig. 1.—The arrangement of the apparatus for making the oxygen.

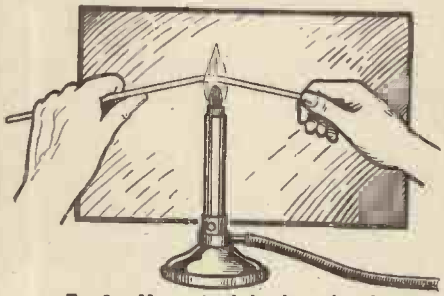


Fig. 2.—How to bend the glass tubing by heat.

Preparation

Apparatus required:—

A small glass flask with a cork to fit.

A length of narrow glass tubing (about 18 in.).

A large bowl.

A few jam jars with as many pieces of stout paper of such a size that each piece will comfortably cover the mouth of the jar.

A "beehive" shelf.

Arrange the apparatus as shown in Fig. 1. Bend the glass tubing as shown in Fig. 2, and, using the cork borer, make a hole through the cork just large enough to accommodate the tube (see Fig. 3). Make sure the joint is airtight. Make a "beehive" shelf out of an old tin box, as shown in Fig. 4 and place this in the bowl over the delivery end of the glass tube. Place also in the bowl the jam jars and their paper covers. Now pour water into the bowl until the jars (lying on their sides) are submerged and full of water (see Fig. 1),

Obtain ½ oz. of potassium chlorate and ½ oz. of manganese dioxide, mix them gently on a paper, and introduce the mixed powders into the flask. Replace the cork and tube. (Caution: When handling potassium chlorate, treat it with respect and care; friction will cause it to readily explode.)

Now commence to heat the flask gently with either the Bunsen or a spirit lamp, exercising caution and control over the heat at first, thus avoiding cracking of the glassware.

Bubbles will be seen rising from the end of the delivery tube. For the first two or three minutes neglect these, as they are formed merely of hot air driven out of the flask by expansion. When a steady stream of bubbles is seen to be delivered from the tube, take hold of a jam jar, bring it upright, keeping its mouth beneath the surface of the water, and stand it over the hole cut in the top of the beehive shelf. The gas will bubble into the jar, displacing downwards the water which fills it. When the jar is full of oxygen and all the water is driven out, quickly slide a paper cover over the mouth of the jar, and remove it from the bowl, at the same time replacing it by another jar. Continue this until no more gas comes over, collecting as many jars full as possible.

We have now several jars of pure oxygen.

Stopping the "Sinking Feeling"

Remove the cover from a jar of oxygen and take two or three deep breaths of the contents. A feeling of buoyancy and exhilaration will immediately be noticed.

Relighting a Piece of Charring Wood

Obtain a thin splint of wood and hold it in a flame until it takes fire. Now blow it out, and as it is glowing, plunge it into a jar of oxygen. Immediately the stick bursts into a brilliant white flame, reminding one of November the Fifth.

Fig. 4.—Details of the "hive."

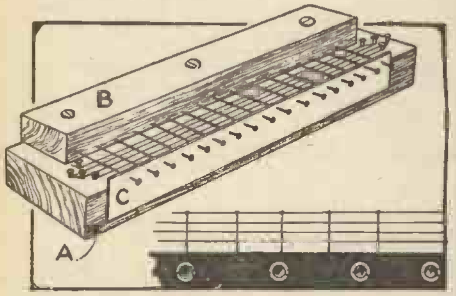
SEND IN — —YOUR HINT

THAT HINT OF YOURS

Every reader of PRACTICAL MECHANICS must have originated some little dodge which would be of interest to other readers. Why not pass it on to us? For every item published on this page we will pay 5s. Address your envelope to "Hint," PRACTICAL MECHANICS, George Newnes Ltd., 8-11 Southampton Street, W.C. Put your name and address on every item. Please note that every hint sent in must be original.

Miniature Railings for Model Boats

RAILINGS for small boats and other models can be made from pins and flower wire if the following method be adopted. Two strips of wood (A and B) are screwed together as shown in the diagram, and small nails driven in so that suitable

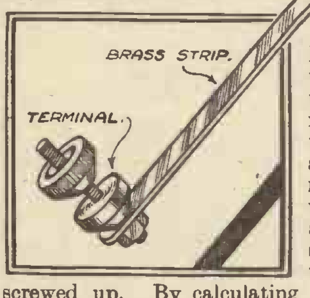


Method of making miniature railings for model boats.

lengths of wire can be strained between them at the required distance apart. C is a strip of cardboard tacked in position, and pins are stuck through this at equal distances so that they lie across the wires at right angles. The points of the pins just penetrate the strip of wood B. This arrangement keeps the wires and pins in position for soldering. Flux is then put on each pin where it crosses the wires and solder applied sparingly. Care should be taken not to let an excess of solder clog the wires. When each pin is securely soldered clean off the flux and cut through each pin just above the first wire with a small file. The railings can then be removed from the support and fitted to the model.

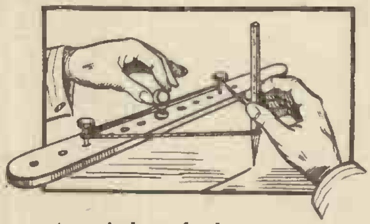
A Useful Mileage Measure for Maps

A USEFUL mileage measure for maps can be made from a strip of brass and a screw-down wireless terminal. Drill a hole in one end of brass strip and fasten it to the top of the terminal by means of a small nut. Now place the milled nut on the stem of the terminal. To use the device rest the milled nut on the map, and as you follow the route the nut will unscrew. When you have reached the destination on the map remove the device and run the nut backwards along a rule or straight line until it is screwed up. By calculating the miles to the inch a fairly accurate reading can be made.



How to Draw an Oval

THE sketch shows a simple device for drawing an oval. The drilled bar can be made from a strip of wood or a Trix girder can be used. Two pins are inserted in the holes and a small knob is fitted in the middle to hold the device down. By placing a pencil in a piece of looped string, as shown, a fairly accurate oval can be drawn.

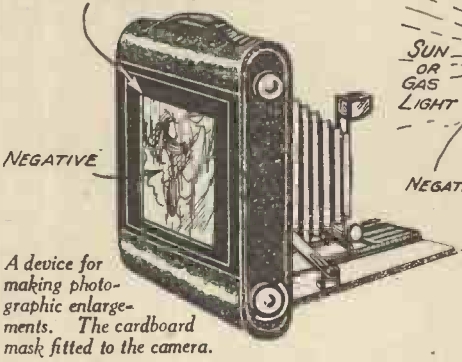


A simple device for drawing ovals.

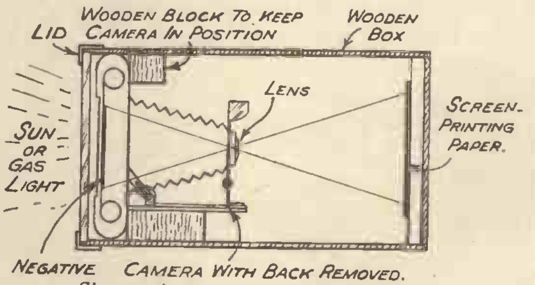
Making Photograph Enlargements

THE sketch shows an arrangement for producing enlargements of photographs by simply using a folding camera and a box.

No measurements are given as the sizes of cameras vary a great deal, but an idea is given of a simple method for those who are prepared to experiment and improve upon the apparatus themselves. It consists of three things—a box with a glass top, a folding camera, and a screen for the printing paper. The construction can be followed by the sketches which are self explanatory.



A device for making photographic enlargements. The cardboard mask fitted to the camera.



Showing the arrangement inside the camera.

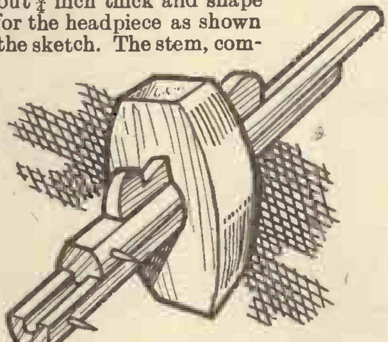
Wedging a Hammer-head

THOSE readers who do a lot of carpentry have no doubt experienced the annoyance caused by a loose hammer-head. By driving a screw into the head of the hammer, as shown in the sketch, this difficulty can be overcome.

Wedging a hammer-head.

A Double Marking Gauge

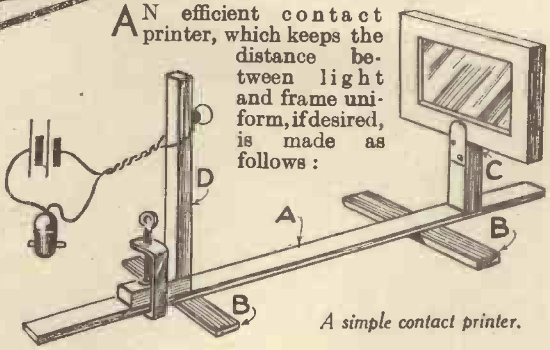
THOSE readers who are interested in woodwork and carpentry will find this tool well worth making. Obtain a piece of wood about ¾ inch thick and shape it for the headpiece as shown in the sketch. The stem, composed of two pieces, is then cut, one having a groove cut in it and the other a tongue. A wedge is next cut to hold the stem firmly in the head. A pin is then inserted into each half of the stem and the gauge is ready for use.



A double marking gauge.

A Photographic Contact Printer

AN efficient contact printer, which keeps the distance between light and frame uniform, if desired, is made as follows:



A simple contact printer.

A piece of wood 14 × 1 × ¼ inch (A) has two other pieces 4½ × 1½ inches (BB) fixed to it at about 4 inches from each end. At one end screw an upright (C) 6 × 1 × 1 inch.

A wooden L-shaped block (D) has an electric bulb, arranged in the circuit as shown, fixed to it. If D is clamped on A its position will be easily adjustable.

The printing frame is held by clamping its wooden edge to C.

MAKING A MICRO-POLARISCOPE

By CHARLES EARLE

The instrument described in last month's issue is quite efficient in showing the beautiful colour effects of polarised light, but is, as stated, a polariser only. To get the full effect of this wonderful light, and to perform more advanced experiments, it is necessary to have an instrument utilising two prisms and, where very small objects are being examined, some form of magnifier or microscope attached.

WE propose, this month, to give details of a Micro-Polariscope, and much care has been expended in making this apparatus not only efficient and easy to construct but also, where metal or glass parts are essential, of such components as can be got almost anywhere and for the expenditure of a few pence.

An Ingenious Substitute for "Nicol-Prisms"

The greatest stumbling-block in the making of a good type Micro-Polariscope, is the fact that two Nicol Prisms are absolutely essential, for these are expensive items. Fig. 1 shows an ingenious substitute for the "Nicol" which, if care be taken in the construction, is almost as efficient and whose cost is fractional by comparison. Most of the work in the making of this "prism," is of a kind that Amateurs in general, and Craftsmen in particular, are usually proficient in.

The optical part of the job is composed of ¾ in. square microscope cover-glasses, these being of amazingly thin, clear glass, and procurable from any good optician or scientific instrument dealer. They are a standard article, packed in ¼ oz. boxes, and one box contains more than sufficient to make three prisms. Now for the actual construction.

Make a light case (not unlike a matchbox "outer") as shown in Fig. 1 at "A," using 1/16 in. thick wood. When finished, and glue is quite hard, measure along the lower edge of one narrow side, 11/16 in. measuring from the left. Repeat this on the top edge of the same side but measuring from the *right*. If the case is accurately made, a line drawn joining these two points should make an angle of 35½ degrees with the bottom edge and the same at the top. The accuracy of this angle is of the first importance so, before proceeding further, check it with a protractor, and, if necessary, correct. Repeat the measurements on the other narrow side of the case, but, in this case, measure from the *right* on the bottom edge and from the *left* on the top, so as to make the two lines parallel. Join these by two straight lines, one across each of the wider sides of the case, and your markings should appear as shown in Fig. 1A. With a fine saw cut the case into two halves along these lines, taking the greatest possible care to ensure accuracy.

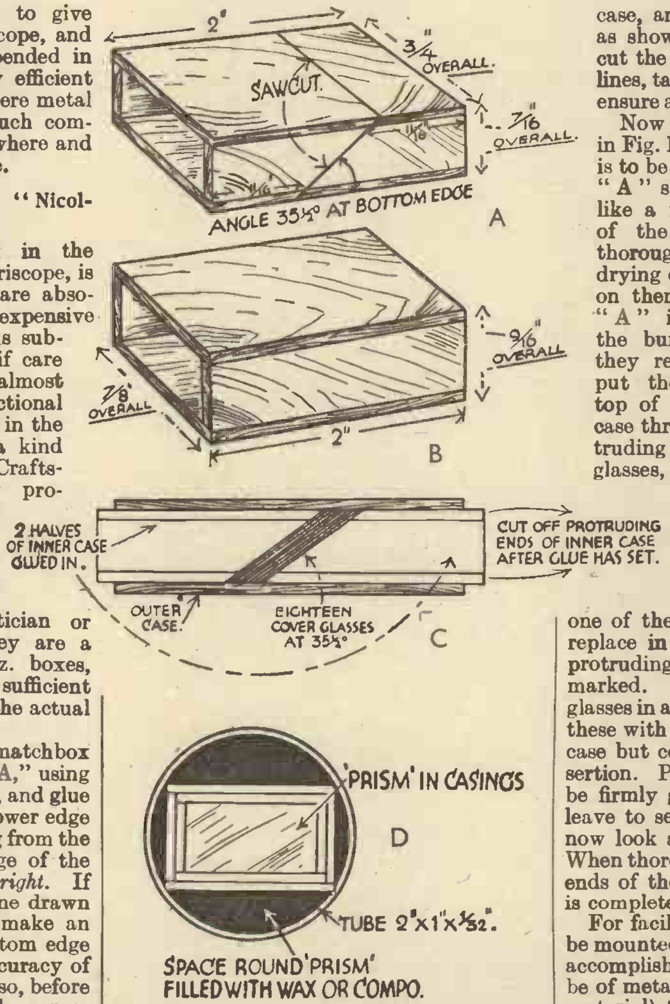


Fig. 1.—Substitute for nicol prism made from microscope slide covers (reading from top to bottom). a: Case cut in two at angle shown. b: Outer case into which two halves of inner case fit snugly. c: Outer case with halves of inner and cover glasses fitted shown in section. d: End view of completed instrument with prism bedded into tube.

Now make up another case as shown in Fig. 1B, but this case, when completed, is to be left intact. The two halves of "A" should fit neatly into "B"; just like a matchbox. Next take eighteen of the cover-glasses and clean them thoroughly with warm water and soda, drying carefully so there are no specks on them. Place one half of the case "A" into the outer "B," and drop the bundle of cover-glasses in so that they rest on the wedge-shaped part; put the other half of "A" in on top of the glasses, and slide the inner case through the outer till the two protruding ends are equal in length (the glasses, gripped between the two halves, causing the protrusion). Draw a line at each end marking the amount that sticks out, and withdraw the whole inner case, being careful not to drop and break the glasses. Next coat one of the half cases with thin glue and replace in the outer, taking care that the protruding end is exactly as previously marked. When glue has dried put the glasses in again, exactly as before, and follow these with the remaining half of the inner case but coating same with glue before insertion. Press well home so that glasses will be firmly gripped between the halves and leave to set hard. The whole thing should now look as shown (in section) at Fig. 1C. When thoroughly dry, cut off the protruding ends of the inner case and your "prism" is complete.

For facility in use, these "prisms" must be mounted in tubes, and this is very easily accomplished, a piece of tubing (which may be of metal, bakelite, celluloid or any other material), 2 in. long, 1 in. outside diameter, and 1/32 in. thick, is required for each "prism." Stand the tube on one end and insert the finished "prism." Fill the space between the wood casing and the inner walls of the tube with wax, plaster-of-paris or battery-sealing compo; so that the whole thing becomes firmly bedded, take great

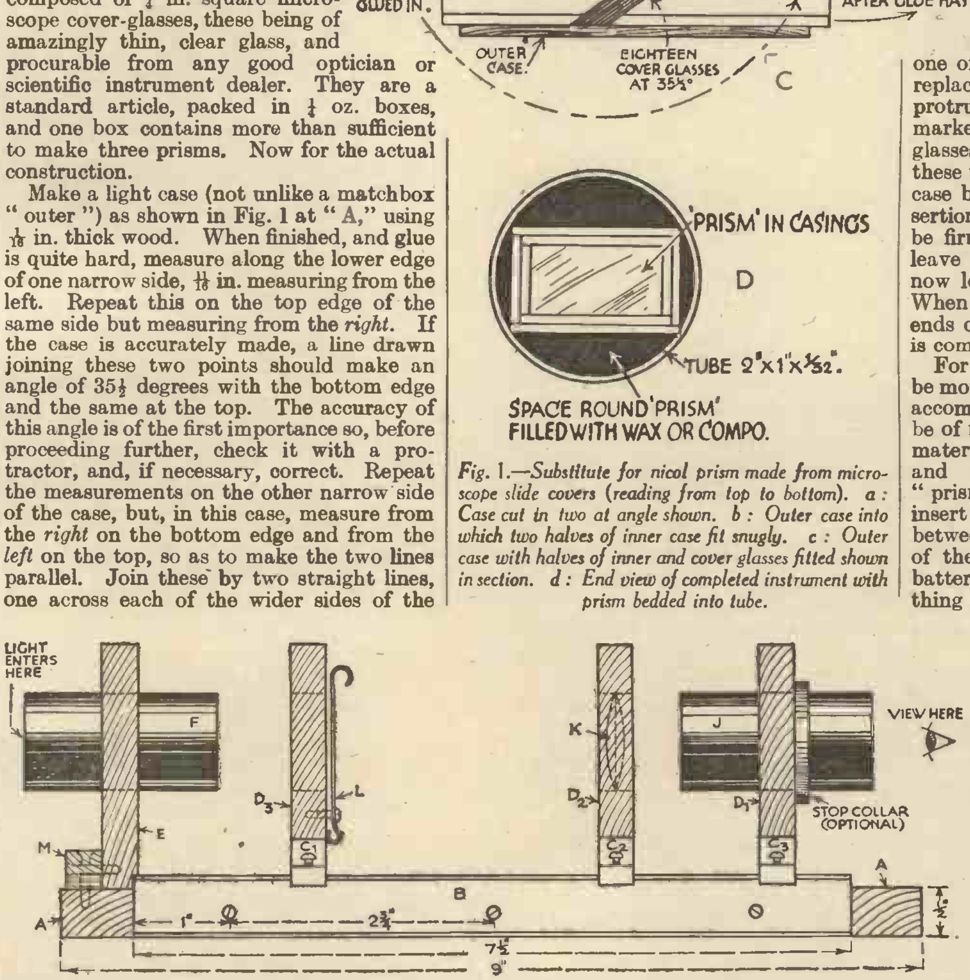


Fig. 2.—Side elevation of micro-polariscope. The materials required are (A) 1 baseboard, 9 × 2¼ in. of ½-in. wood. (B) 2 adjustment rails, each 7½ in. of brass rail. (C) 6 brass rail clamps for locking and adjusting. (D) 3 squares ⅜-in. plywood with 1-in. diameter hole, as shown. (E) 1 rectangle similar to (D), but 2 × 2¼ in., and fixed to M. (F) 1 polariser in mounting tube as described. (J) 1 analyser in tube as described. (K) 1 magnifying lens as described. (L) 2 spring clips to grip specimen slides. (M) 1 strip wood, 2¼ × ⅜ × ⅜ in. to support (E).

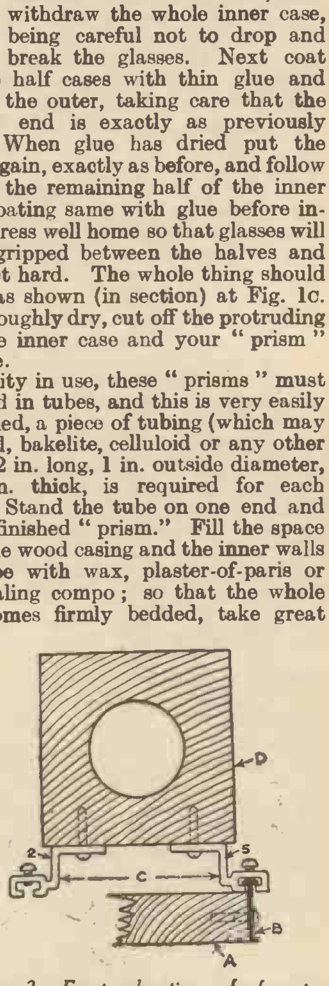
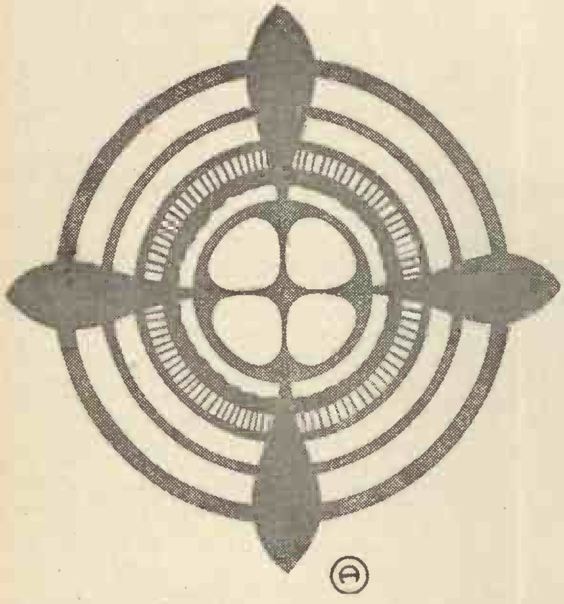


Fig. 3.—Front elevation of focussing mounts. 1-in. holes in D1 for analyser J. D2 for lens K. D3 for specimen under 2 clips L. E for polariser F in "E," hole must be ½ in. above centre to be in line with D1, D2 and D3.



care, however, that no specks of the composition used get on to the surface of the glass. The completed polariser (or analyser) should look exactly like Fig. 1D.

A Convertible and Focussing Micro-Polariscope

The apparatus shown at Fig. 2 is pretty well self-explanatory. The tubes F and J are the tube mounted "prisms" we have just discussed, and are carried in blocks of wood, 2 in. square by ⅜ in. thick in the case of the analyser (J), and 2 × 2½ × ⅜ in. thick in the case of the polariser (F). The other two blocks, pictured between these two, are each 2 × 2 × ⅜ in. thick, and constitute (D3) a block with 1 in. hole through which the light passes from F to the object under examination, which is held in place over this aperture by the two clips (L); and D2, a precisely similar block, but in this case the aperture has an ordinary magnifying lens inserted in the aperture and kept in place by putty, plastic-wood, or clip rings, as may be most convenient.

The blocks D1, D2 and D3, are supported on special brass clamps which slide along the brass rails on each side of the baseboard and may be locked in position by the grub-screws shown. With this arrangement, not only may the instrument be focussed, but, if large objects are to be viewed, the magnifier may be very easily slid off the rails and placed on one side.

A word of explanation regarding these brass clamps and rails. They look quite professional, scientific and expensive, but are, in fact, quite easily procured and amazingly cheap! The rails are merely curtain runner-rail of the section shown, and the clamps are sold as an accessory for same, being actually meant for use as supporting brackets. The rail comes in 15-in. lengths at 3*d*. per length, while the clamps, complete with screw, are 1*d*. apiece. These fittings may be got at any branch of that class of store whose motto is "nothing over sixpence." There are two types of brass rail, and at least a dozen types of bracket, so be sure you get the type illustrated. No alteration is necessary, except to cut the rail into two 7½-in. lengths and drill three holes in each for screws to fix to the baseboard as shown.

The supporting block (E) for the polariser (F), is a fixture, and simply attached to the wood base as shown. It is 2½ in. high, the extra ½ in. being due to the fact that it has no supporting clamps as have the other blocks, and the 1-in. hole must be cut ½ in. *above* centre to bring the polarising "prism" in line with the other fitments and analysing unit. Any fair power lens will do for the magnifier, and should be 1 in. diameter, if a smaller size has to be utilised the aperture in the block concerned will, naturally, be cut to correspond. The polariser remains stationary, but the analyser has to be rotated, therefore it may be found useful to fix a stop-collar round this tube. This is easily done by winding a coil of Passe-Partout tape round it as shown, taking care to see that each layer is firmly gummed to the previous one.

With the foregoing explanation, and the drawings to guide you, it should be quite a simple matter to erect the apparatus, without much trouble, and at little expense.

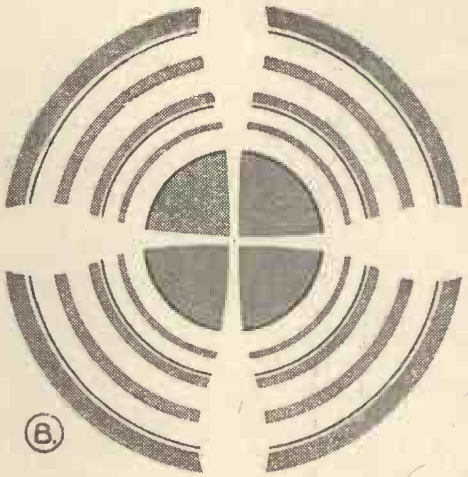


Fig. 4.—Reversal of pattern. (A) Light and dark rings with dark cross and super imposed. (B) Dark and light rings with white cross; from same specimen on rotation of analyser.

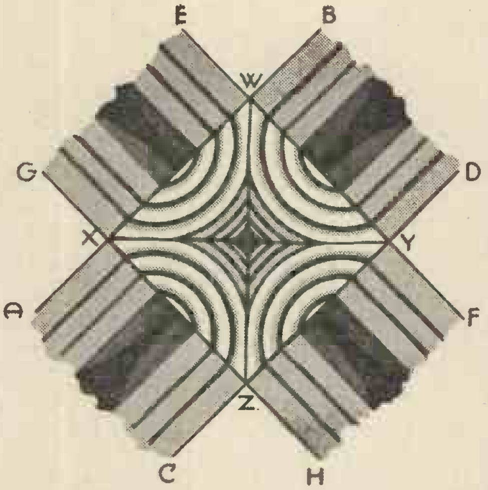


Fig. 5.—Figure obtained by crossing two slips of glass ABCD and EFGH. When viewed between polariser and analyser the straight line design of each slip is seen to change to the pattern WXYZ where slips overlap.

Using the Apparatus

If a splinter of mica, or of gypsum, be placed under observation, a beautiful coloured design is observed when both polariser and analyser are in the same plane (incidentally, the thinner the splinter, the more elaborate the colours). Now rotate the analysing tube (the one you look through), and the colours will slowly fade out, keep on rotating, and the design will return in all its vivid richness, *but the colours are different.* Where red was, green now appears, while blue takes the place of yellow, etc.; in other words, the design has returned in colours which are optically complementary to the original ones.

Let a long narrow slip of common thin glass (glazier's offcuts) be placed on the specimen stage so that one end is under observation, while the other protrudes to one side. Adjust the instrument till you get the characteristic pattern of coloured rings and a black cross. Now stroke or wipe the length that protrudes to one side with a damp cloth; instantly the colours change and the black cross is replaced by a white one in the manner depicted by Fig. 4. Better still, obtain a square of glass of suitable size to go on the stage, and with a small hole drilled through the centre; into this hole introduce one end of a length (12 to 18 in.) of copper wire. Twist or bend the end of the wire so it will not pull back out of the hole and arrange the glass square on the observation stage with the wire running out to one side where the free end may be heated by a small spirit stove (or candle) as shown in Fig. 6. As the heat is conducted to the glass by the wire, the former warms from the centre outward. The internal structure of the glass is thus subjected to strains and stresses which immediately appear as a complicated and changing pattern of quadrants and crosses.

Thin slips of glass, arranged crosswise, produce designs akin to that shown in Fig. 5.

If the analyser be equipped with a calibrated dial so that its degree of rotation may be recorded, the instrument becomes a polarimeter, similar to those used in sugar laboratories. Sugar has, as previously mentioned, the power of twisting the polarised beam.

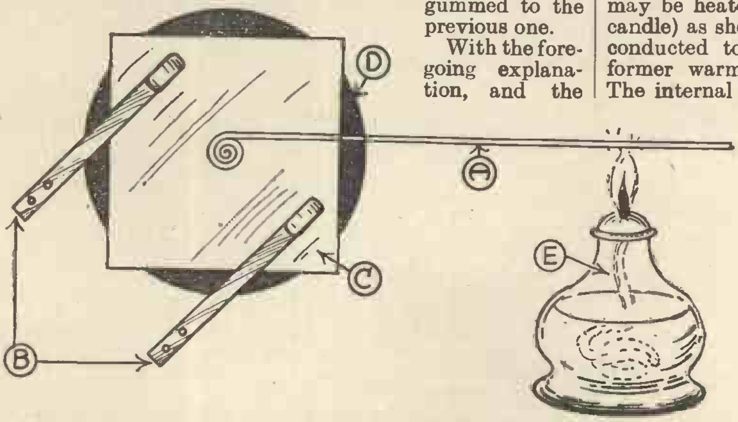


Fig. 6.—Glass plate prepared to view changes in interior molecular stresses as glass is warmed from centre outwards. (A) Copper wire plugged into hole at centre of C. (B) Retaining of clips on stage. (C) Glass plate with small hole in centre. (D) Aperture of stage. (E) Spirit lamp.

ELECTRICAL TRICKS AND ENTERTAINMENTS

Ingenious and amusing tricks performed with simple apparatus so designed that readers may carry them out successfully without unnecessary expense

IN elementary text-books on electricity under the heading of "frictional" or "static" electricity is usually to be found a list of experiments. To the list may be added the experiments forming the subject of this article; for the performance of the experiments, particulars are given of the commonplace apparatus to be used in connection with static electricity.

Two Simple Electroscopes

Obtain a large cork C (Fig. 1) and insert at one end a needle N, the point being uppermost. An index or pointer P is evolved from a strip of note-paper O by folding the paper first along the line AB, and then along EF. Unfold the paper, the point at which the creases intersect is the position of pivoting on the needle, the index presenting the appearance given in Fig. 1.

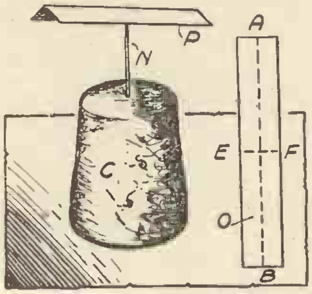


Fig. 1.—A simple electroscope.

If a piece of sealing-wax, ebonite, or even a composition comb be rubbed with flannel, wool, or, better still, a piece of fur, and then be presented to either end of P, attraction of the latter will result.

Thin foil will behave in precisely the same manner.

A modification of the electroscope is presented in Fig. 2. From an inspection of the figure it will be seen that a needle B pushed into the side of the cork has hung from it a folded strip of paper or foil F. Obviously, any other light material, such as pith, feathers, wool, etc., may be suspended from the needle by a silken thread, all of which will be violently attracted by an excited rod.

Fig. 2.—Another type of electroscope.

A glass rod warmed and rubbed with silk will manifest a positive charge, whereas sealing-wax and resinous substances generally, when rubbed with flannel, exhibit negative electrification. It should be remembered, however, there are two kinds of electrification, but not two kinds of electricity. For insulating purposes the cork should be placed on the bottom of an inverted tumbler T.

The "Electric" Aeroplane

This rather fascinating experiment is performed with the apparatus used in the last experiment, the paper or foil being cut in outline to resemble an aeroplane.

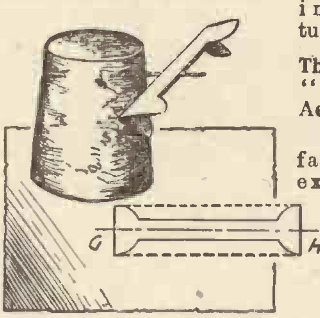


Fig. 3.—An "electric" aeroplane.

Fig. 3 shows how "the aeroplane" is cut out, the material being folded first along GH, and is then cut to the desired outline. After cutting to shape, the "aeroplane" is slightly opened out and the two portions pushed over the needle so that the whole just balances, but at the same time is quite free to spin round on the needle. On bringing an excited rod near the ends of the "aeroplane," the latter is caused to rise or fall, and on the rod being rotated around the needle the "aeroplane" will follow it and perform various antics.

The screening effect of a knitting needle held in the hand and interposed between the "aeroplane" and the excited rod should be verified with the apparatus.

Simply Made Stands

A useful stand for the suspending of pith-balls, etc., may be evolved from a medicine bottle and a length of insulated wire, the completed article is shown in Fig. 4. The bottle should be dried out, and, preferably, given a coat of shellac varnish on the outside. The bottle B is closed by a good fitting cork C, through which is pierced a small hole to take the wire.

A piece of glazite wire is next pushed through the hole in the cork, leaving sufficient projecting to form the bend and loop L from which are suspended the light substances by silken threads.

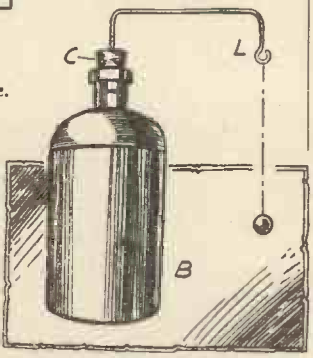


Fig. 4.—A simple stand for suspending pith balls, etc.

An adjustable stand for supporting sparking electrodes, etc., may be cheaply made up by utilising a medium size bottle through the cork of which is pushed a stout rod O (Fig. 5). The rod is either screwed into or soldered to a terminal T. Pushing the rod up or down through the cork will provide for vertical adjustment, whilst the terminal itself provides for horizontal movement of the electrode E. An alternate arrangement is shown in Fig. 6, which is self-explanatory.

How to Make a Small Leyden Jar

A small condenser may be made by glueing on the outside and bottom of the bottle D (Fig. 7) a sheet of tinfoil F to form the outer coating.

To form the inner coating I, a quantity of lead shot is poured into the bottle; connection between the inner coating and the electric machine is by a wire W extending down through the cork into the slot. The upper end of the wire should terminate in a small knob K.

Fig. 5.—An alternative arrangement for making the stand for suspending pith balls.

In the event of a large jar being selected, the mouth will usually allow of the interior being covered with tinfoil up to about three-quarters of the height of the jar. The mouth is closed with a plug of well-varnished wood. To effect electrical connection between inner coating and the external charging knob a piece of chain is hung from the wire so as to rest on the foil-covered bottom of the jar. A thin coating of shellac varnish or good liquid glue will be found suitable for attaching the foil to the jar.

To charge a jar condenser the knob or inner coating is connected to the "prime" conductor of an electrical machine, the outer coating being earthed. Frequently, the jar is held and the "earthing" is then effected through the body of the experimenter.

The inner coating will receive a positive charge, whilst an equal negative charge is simultaneously induced on the inner coating; during the charging process an equal positive charge is repelled to earth.

If the charging be pushed beyond a certain point the mutual attraction of the charges will result in the glass being pierced, accompanied by the neutralisation of the charges.

Experiment to Explain Condenser Action

The reason for "earthing" one coating of the condenser is perhaps demonstrated clearly in the following experiment.

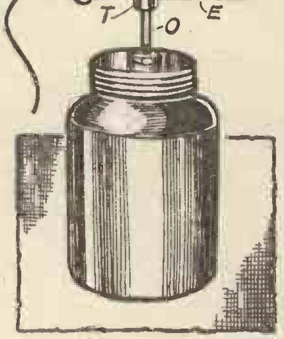


Fig. 6.—A further method of making the stand.

In Fig. 8 an inverted tumbler A has resting on its bottom a brass disc C, and to which is attached a piece of sealing-wax W for handling purposes, also, the disc may at will be con-

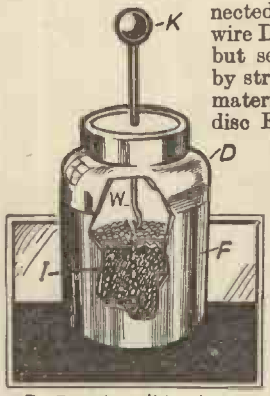


Fig 7.—A small Leyden jar.

nected with an earthed wire D. Reposing on C, but separated from it by strips of insulating material S, is a second disc E, also provided with an insulating handle H.

Suppose now that D is caused to touch C, whilst E is given a positive charge from an electrical machine or an "electrophorus." The next step is to remove the wire D, and by means of the insulating handle H remove the disc E from the influence of C. On now presenting C to the cap of a positively charged electroscope, it will be found that the disc is negatively charged.

If the two discs are next placed in contact, all traces of electrification vanish, and from which the conclusion is drawn that although the charges are apposite in sign, they are equal in quantity.

The Flying Pith-ball

For the performance of this experiment a good Leyden jar is necessary, the charging source being either a large electrophorus or an electrical machine.

The outer coating of the jar rests on a

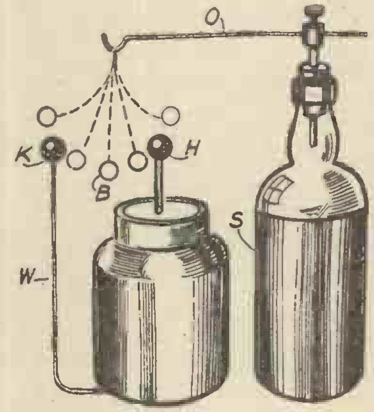


Fig. 9.—The flying pith-ball.

piece of bent wire W (Fig. 9), terminating in a small kob K; a gap of from 1 to 2 in. is arranged between the knobs K and H.

A pith-ball, or other very light body B, is suspended from the wire O of the improvised stand S by a silken thread, the pith-ball being free to play between the knobs K and H.

If the jar is now strongly charged, then, on bringing the ball B into the electrified region of the knobs K and H, the ball will be attracted and repelled in turn by the knobs. During the process the ball will perform various antics.

When performing experiments in frictional electricity, it should be borne in mind that the atmosphere should be dry to obtain the best results.

The "Electric" Shooting Gallery

A very interesting and, at the same time, novel experiment may be performed with the simple apparatus depicted in Fig. 10.

The two wires, B and C, passing through the plug of a large Leyden jar make electrical connection with the inner coating of the jar. The wire C has soldered to it a brass disc R, the wire should extend a few inches above the disc, and terminates in a small knob K. If preferred, balls of silver foil pushed over the ends of the wires may be used instead of brass knobs.

Horizontal wires G pass through the knob K, and from the former are suspended

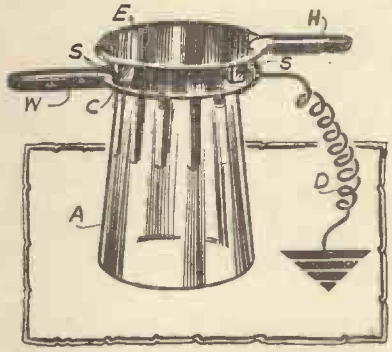


Fig. 8.—An experiment to explain condenser action.

by silken threads pieces of pith P; stuck into the pith-balls are small feathers to represent "birds," and which normally repose on the disc E.

Opposite the knob H, borne by the wire B, may be brought the spherical end of N of a pivoted arm O attached to the stand J; the latter should be connected by a light wire to the outer coating of the jar A.

Before commencing the experiment, N must be removed from the vicinity of H. Then on working an electrical machine L connected to the outer coating, due to the fact that like electrical charges repel each other, the pieces of pith O are repelled and present the appearance of "birds" in flight.

If J be now brought up so as to present N to the knob H, a spark will occur, accompanied by a crackle, simultaneously the "birds" P will drop as if shot.

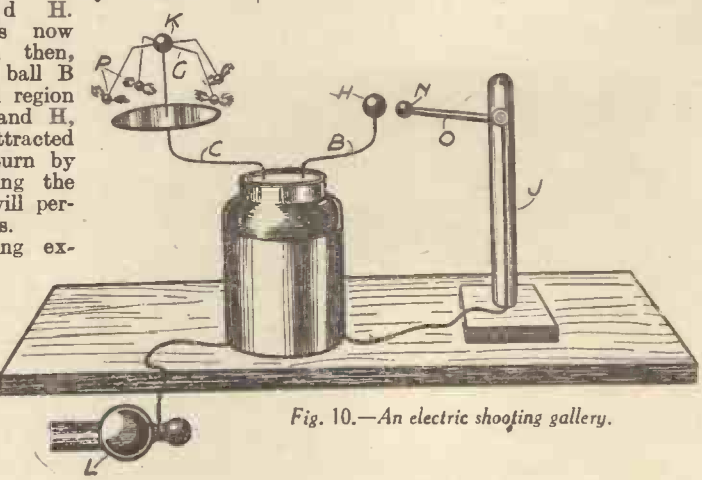
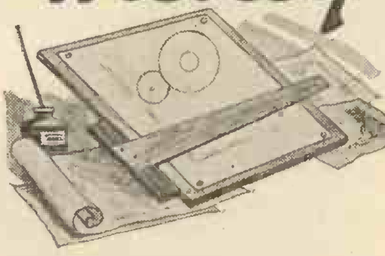


Fig. 10.—An electric shooting gallery.

Money Making IDEAS



Practical Facts, Formulæ and Recipes
By FREDK. JACE
which may be turned to profitable account. Address all correspondence relating thereto to: The Editor, PRACTICAL MECHANICS, Geo. Newnes Ltd., 8–11 Southampton St., Strand, W.C.2.

Razor Paste

ACCORDING to Henley's "Twentieth Century Home and Workshop Formulas," an excellent razor paste can be made by mixing together equal parts of rouge and emery powder pounded with spermaceti ointment.

Metal Polish

ACCORDING to this same volume, an excellent metal polish consists of white petroleum jelly, 9 parts; kieselguhr, 3 parts; paraffin wax, 1 part; refined chalk or whiting, 1 part; and sodium hyposulphite.

Making Tooth Powder

FOR making a good tooth powder, mix together prepared chalk, 1 lb.; finely powdered cuttlefish bone, 10 oz.; powdered orris root, 5 oz.; dragon's blood, 2 oz.; oil of cloves and cassia, each 30 drops. For a liquid dentifrice, take 2 oz. of castile soap and 1 oz. of orris root in powder, and macerate and filter through paper.

Paste for Photographic Prints

THE recipe given below provides a mountant that is extremely adherent. Soak 2 drachms of Nelson's gelatine in cold water for about an hour. Add 2 oz. of slightly warm water to 2 oz. of the finest arrowroot, mix well, and then pour in by degrees, stirring rapidly all the time, 10 oz. of boiling water; a thick jelly will result. Pour the jelly into a large jar, and stand the jar in a saucepan that has been partly filled with water; place the saucepan on a slow fire, and when the jelly is warm, add to it the gelatine, from which all the water must be first strained off. Stir the mass thoroughly until it is well mixed, allow to simmer gently for about fifteen minutes, then remove from the fire and add 20 minims of carbolic acid, 2 oz. of methylated spirit, and 20 minims of ammonia. Well stir the mixture again, and pour into jars, which, when cold, should be carefully covered; this mountant will keep for a considerable time.

Varnish for Maps and Diagrams

THE following is a recipe for a colourless varnish for diagrams and maps. Dissolve by frequent agitation 5 oz. of pale gum crystals in 1 pt. of pure colourman's turpentine. Another recipe is: place 7 oz. of finely-powdered copal in 2 pt. of ether (specific gravity, 0·725); shake at intervals until thoroughly dissolved, and allow to settle; the varnish is then ready for use. It should be kept in a well-stoppered bottle, as the constituents will pass off, leaving a thick, unworkable mass.

Making High Tension Batteries at Home

AN excellent income can be made from high tension battery assembling. A well-known firm retails complete instructions of a process and supplies the various parts. Not only this, but they undertake to purchase from the makers the batteries made under their scheme. The address of this manufacturer was given on the cover of last month's issue.

Japanese Dwarf Trees

THE dwarf trees which share with cherry blossom the floral fame of Japan are a speciality of that country. The tiny trees—some but 6 in. to 18 in. high—are the result of many years of patient training. The Japanese gardeners grow them from seed, in small pots to confine the roots and stunt the growth of the tree, thus retarding growth; the trees are given very little light and water. This appears to be the only method, but the Japanese gardeners are experienced in this cultivation of dwarf trees.

Soap Bubble Liquids

MOST people have seen stage performers producing enormous bubbles and have wondered how it is done. A special soap solution is used made from White Hard soap, 25 parts; glycerine, 10 parts; and water, 1,000 parts, according to Henley's "Book of Formulæ."

Making French Polish

DISSOLVE 6 oz. shellac in 1 pt. of methylated spirit, thin or thicken by adding spirit or shellac respectively. The orange or reddish-brown shellac produces the ordinary brown polish, the white or bleached shellac the white French polish.

Stand Up Portraits

AN excellent income is to be derived from making stand-up portraits from old and new photographs. The portraits are secured to wood by means of the photo-mounting paste already recommended and cut out with a fretsaw, a leg being added at the back to act as a support.

Gouache Painting

THE French term "gouache" is sometimes applied to painting in opaque water-colours. According to the "Dictionnaire de l'Académie Française," the word means a species of painting in which colours are used mixed with gum and water. This class of painting is generally understood to refer to work on a small scale whether decorators' or otherwise, as painting on fans or illuminating, and it is advisable to buy the binding vehicle, gum, ready prepared, as only a very small quantity is needed. For it, the finest gum arabic is dissolved in water. It should be very thin and, to ensure its being clean and clear, it is better to strain it two or three times through a fine cloth. A little white sugar may be added, which will give it greater elasticity.

Indelible Ink

A USEFUL ink for marking linen consists of 86 parts aniline oil, 5 parts of potassium chloride, 44 parts of distilled water, 68 parts of pure hydrochloric acid and 6 parts of copper chloride.

Casting Brass in Iron Moulds

SMALL brass castings may readily be made in iron moulds if due care is taken to allow the air to escape from the mould. Sand is, however, the most common means, since, being porous in nature, it allows all the heated gases generated during pouring to be absorbed. To prevent the castings adhering, the moulds would have to be dressed each time with a mixture composed of melted Russian tallow and a little charcoal. This should be applied sparingly with a brush, a little best flour charcoal being afterwards sifted over from a muslin bag.

Hectograph Ink

HECTOGRAPH ink consists of 5 parts methyl violet dissolved in 5 parts alcohol and 35 parts of water, in which are dissolved 5 parts of gum arabic (parts by weight).

Waterproof Glue

A GOOD waterproof glue may be made by soaking 1 part of glue in 5 parts of water. When the glue is soft melt and add 1 part of bichromate of potash.

Paint Remover

A PAINT remover may be made by mixing 3 lb. of washing soda and a handful of powdered rock ammonia to 1 gallon of slaked limewash.

Etching Copper

FOR etching copper use nitrous acid 1 part, and water 5 parts. Coat the article to be etched with a resist made from white wax, 30 parts; gum mastic, 50 parts; and asphaltum, 15 parts.

Boot Polishing Paste

BROWN: Dissolve 2 oz. of beeswax by heating in 3 oz. of turpentine, and stir in 5 to 10 grains of brown stain. Black: Use the same basis as above; while hot, stir in 2 dr. of best nigrosine, which must be the kind known as "spirit soluble."

Making Lead Toys

With reference to the above idea, which appeared on our "Money Making Ideas" page in the October Issue, we would inform readers that the address of Messrs. Toymoulds, who supply these moulds, is now 7 Jamaica Row, Birmingham.

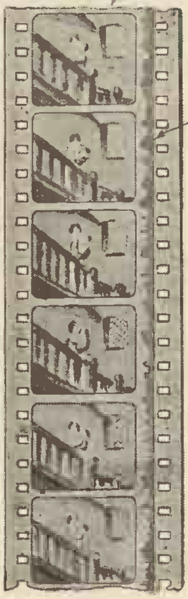


Fig. 1.—*Showing the appearance of a variable area sound-track talkie film.*

MUSIC FROM PENCIL LINES!

A Simple Explanation of Some Recent Developments whereby it is Possible to Produce any Musical Sound by Drawing Pencil Lines on a Piece of Paper

By FRANK PRESTON, F.R.A.

THE talking film has ceased to be the marvel that it was a few years ago, but it has opened up to sound engineers and research workers many new possibilities. These are daily being pursued and are yielding extremely interesting results, not least of which is that it is now quite possible to produce practically any sound, of either a musical instrument or the human voice, by the apparently simple process of making various-shaped pencil marks on a strip of paper.

This seems almost too wonderful to be true, but if one considers for a moment the principle of the "sound-on-film" system of making talking pictures the logic underlying the idea is not really so very involved. You know that with the sound film the picture occupies a comparatively large rectangular portion, whilst the "sound" is accommodated on a narrow strip running down the edge. The "sound-track" appears something like that shown in Fig. 1, and consists of a darkened area, one edge of which is straight and the other wavy. In reproducing the film the picture portion is passed between the lenses and light source of the cinematograph projector, the sound strip being passed before another light source directed on to a light-sensitive cell (or photo-cell). This cell passes a greater or lesser electric current, according to the amount and intensity of light directed on to it. As the cell is connected to a valve amplifier and loud speaker, the varying currents passing through it produce different sounds in the loud speaker. In order to make the sequence of operations more easily followed, the complete scheme is shown diagrammatically in Fig. 2.

Every Sound its own Wave-form

It will be clear that the wavy markings on the film sound track are the "light counterparts" of the sounds previously impressed upon it, and they correspond to the sound waves produced in the recording studio. If one were to examine the wave formations under the microscope, it would be found that every sound had its own particular wave-form; sounds of low pitch would have longer waves, and those higher up the musical scale would be represented by shorter waves. In the same way, "pure" notes, such as those produced by striking a key on the piano, would be represented by waves having symmetrical undulations, whilst more complex sounds and "noises" would appear as unsymmetrical waves. From this the fact emerges that every kind of sound or noise is represented differently, and by studying the wave-forms it is possible to devise a kind of code whereby each wave-form can be imitated and the corresponding sound so produced. Thus, although the method of transforming the light variations into sound is just the same as with the talking film, there is the important difference that instead of the sound being a reproduction of one previously made, it is original.

Recent Developments

The whole question of producing sound in a synthetic manner has been studied most thoroughly and patiently by a German sound engineer, Rudolph Pfenniger. He is now working with the Bavarian Film Company, and is making paper strip records of sounds that have never actually been uttered. This investigator has gone so deeply into the problem that he has been able to prepare a set of stencils covering nearly every sound and musical note. All that he requires to do to prepare a sound strip is to join together the necessary sound "elements" on a long paper tape. To ensure accuracy and ease of manufacture, the strips are made to a very large scale, but they can be photographed and reproduced to any desired size without any loss of detail.

The preparation of a sound strip of but a few seconds' duration is no light task, since it might be anything from 20 yd. upwards in length, but with the more or less mass production methods which Pfenniger and his assistants have evolved, absolute accuracy can be obtained. After further investigation and study of the problem, it is by no means unlikely that lengthy sound records will be produced much more rapidly, but at the present time the process is naturally slow and laborious.

Although the sound strip is made on paper, for reasons of simplicity and economy, it may be made to operate a loud speaker, just as in the case of a celluloid film, by directing the light reflected by it from a suitable light source on to the photo-cell.

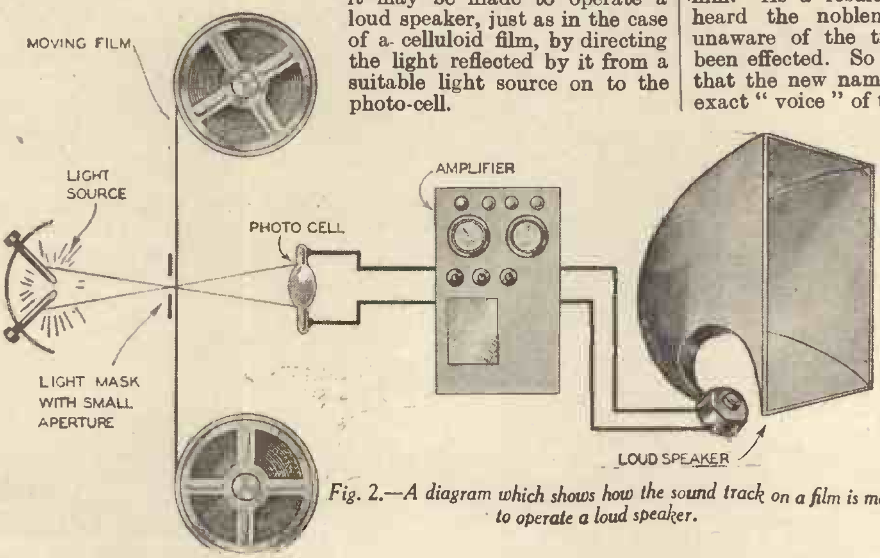


Fig. 2.—*A diagram which shows how the sound track on a film is made to operate a loud speaker.*

Applications of Synthetic Sound

An important aspect of the question of synthetic sound is that perfect articulation, even surpassing that of the B.B.C. announcers, can be obtained with the greatest of ease. In addition to this, it might be possible, if the scheme could be simplified sufficiently, to enable the dumb to "speak" by drawing these complex curves on a strip of paper. But whether or not so ambitious a project will ever be attained, the scheme has many immediate applications, especially in the production of talking films. For instance, any badly spoken words could easily be corrected, or they could be completely altered in the "voice" of the original artiste. Another application would be in the transformation of some of the fearful "Yankie" twang into respectable English, which would not offend the ears of picture-goers in this country.

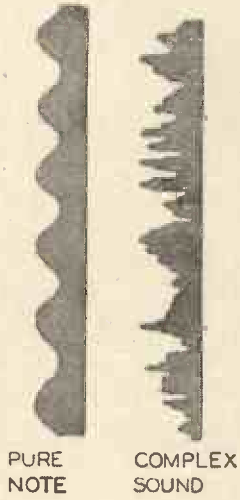


Fig. 3.—*This sketch gives an idea of how the synthetic sounds appear on the sound tape.*

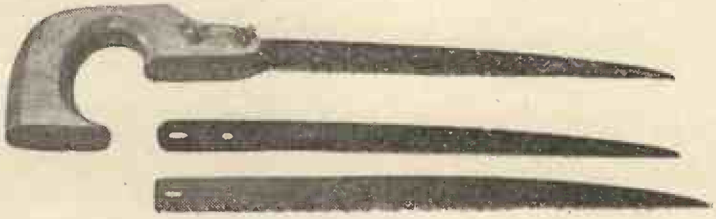
As a concrete example of an interesting use to which the principle of synthetic sound has recently been put, I might describe an incident which occurred in respect to an American talking film which was to be reproduced in this country. At the last moment it was found that the name of an English nobleman was frequently spoken in the dialogue, and for certain reasons this could not be allowed when the film was being shown in Great Britain. Engineers went entirely through the film and painted out the portions of sound track representing the name in question. Another name was then prepared on a paper strip, photographed to the appropriate size, and inserted in the correct positions on the film. As a result, cinema visitors never heard the nobleman's name, and were unaware of the transformation that had been effected. So well was the work done that the new name was "spoken" in the exact "voice" of the original artiste.

There is no doubt that many more applications of the fascinating idea will be made in the future; even if they were not, synthetic sound is especially interesting for its scientific value.

A Review of the Latest Devices for The Amateur Mechanic. *The address of the Makers of the Items mentioned can be had on application to the Editor. Please quote the number at the end of the paragraph.*

The Cobee Saw

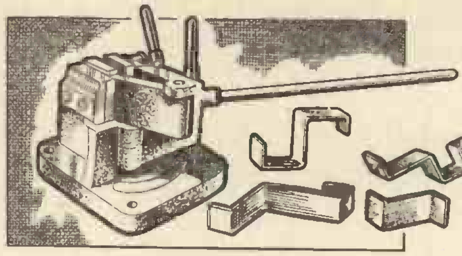
THE handyman repeatedly finds the necessity for using different types of saws according to the kind of work which is being carried out. The well-equipped workshop is fitted with numerous types of saws, but the average man has not the room in which to keep a very large assortment. The Cobee saws illustrated on this page will be found of real service in such cases. As may be seen, interchangeable blades are employed, and these are retained in position in the wooden handle by bolts and wing nuts. These compass saws are entirely British made, and the three blades which are supplied will be found to cover most requirements of all but the very advanced cabinet-maker. The price is 5*s*. 3*d*. [7.]



The Cobee compass saws.

The Miracle Bender

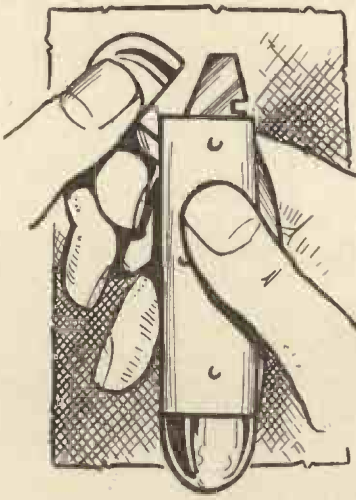
THE tool illustrated is intended for a speedy and accurate bending of cold metal; they are designed for heavy duty as well as light duty, and are manufactured in two useful sizes, operating on sections 2 × ½ in. up to 2½ × 1 in. Rolled or square iron can also be manipulated. [8.]



A cold-metal bender.

Combined Screwdriver and Pocket Knife

A WELL-MADE pocket knife which accommodates also a stout screwdriver in one end has just been marketed, and will be found of extreme use to wireless constructors, motorists, etc. It is made in a variety of designs. [9.]



A handy combined screwdriver and pocket knife.

A Magic Towel

AN ingenious towel which will be found invaluable to home mechanics combines water and soap, and will immediately remove dirt and oil from the hands, even ink stains rapidly vanish. It is sold in a waterproof bag which fits easily into the pocket. It remains permanently moist and it costs 1*s*. 6*d*. It will be found a boon also to motorists. [10.]

A Useful Wireless Test Meter

THE meter shown at the foot of the first column will test voltages from 0 to 8, 0 to 30, 0 to 250, from 0 to 20 milliamps, 0 to 100 milliamps, 0 to 250 milliamps; it will test batteries, resistances up to 4,000 ohms, and it is controlled by an octagonal knob, each face of which corresponds to a dial. It is only necessary to turn the octagonal knob for the test desired. Connect the part or circuit up to the instrument and the reading is taken direct from the window of the instrument. It costs 29*s*. 6*d*. [11.]

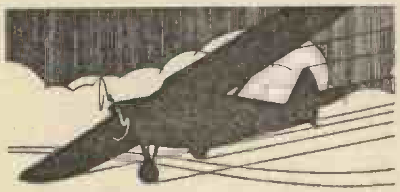
A multi-purpose test meter.

New Hydrometer

KNOWN as the "Guidor," a new high-class float hydrometer of robust make has been marketed. It has a coloured scale and float dive which prevents sticking of the float and gives instantaneous readings. With glass container and glass float it costs 2*s*. 6*d*., with celluloid container and glass float 3*s*., and the unbreakable pattern with celluloid container and machine-made celluloid float 3*s*. 6*d*. [12.]

Tools for All

A NEAT chest of good tools is every handyman's heart's desire. On page 83 will be found an announcement of the new G.T.L. offer—just at the right time for work in the long evenings. A complete brochure will be sent on application to the Guaranteed Tools Ltd., 9/10 Waithman Street, London, E.C.4. [13.]



PRACTICAL LIGHT RAY CONTROL

(*Continued from page* 76.)

owner the shop would be at the mercy of anyone. Other systems of electrical alarms consist of contacts placed under a mat on the floor, or in the space between the door and door frame. The latter systems are reliable in use, but can be a cause of annoyance by a person either standing stationary on the contact mat, or leaving a door open. The general arrangement of the author's experiment is shown in Fig. 10. "All mains" apparatus is used with a circuit similar to that shown in Fig. 2, except that an interlocking or supplementary relay is not required. A light projector fitted with an infra-red filter is placed in any convenient position behind a door, so that the invisible light rays projected from it will affect a "hooded" selenium cell placed at a distance of 3 to 5 feet from the projector. The cell is connected direct to the light-control apparatus.

An Electric Alarm Bell

The latter may, for convenience, be placed in a bedroom, and the electric alarm bell with local battery can be installed in any desired position. When the invisible ray is obstructed the contacts of the relay fitted in the light-control apparatus are closed. As these contacts are connected with the local battery and electric-bell circuit, the bell will function, and give an alarm. When the invisible ray is restored the relay contacts will open, cutting out the bell circuit, and thus causing the bell to cease ringing. If by chance a person stands in the path of the invisible ray for any considerable time the bell will cease ringing after some seconds' interval, due to the fact that the charge on the grid condenser (shown in Fig. 2) will leak through the 5-meg. grid leak. The period of time during which the grid condenser discharges itself is determined by the resistance of the grid leak. It will be observed that in this instance the relay operates in the reverse direction to that described for the author's model train control experiment as shown in Fig. 5. This is possible because the relay of the light-control apparatus is provided with a number of contacts so arranged that such contacts can be "normally" open or closed, when a light ray is projected on the selenium cell.

A Burglar Alarm

The same apparatus can be used as an invisible ray "burglar alarm," so it will be apparent that one's bedroom is a convenient place to install the control apparatus, as previously suggested by the author. The breaking of the invisible ray will cause the electric bell to function continuously until the control apparatus is re-set by means of a switch previously described for the experiment shown in Fig. 9. The switch controls the action of the relay in the light-control apparatus, as when it is closed it "short-circuits" terminals 4 and 5, shown in Fig. 3.

It will be observed from the illustration that when the armature of the relay falls it breaks its own coil and anode circuit to the valve. When the switch is re-set the circuit is again closed and current flows through the relay coil, the core of which becomes magnetised, and holds the armature in position. It is not advisable for amateurs to attempt the construction of such a relay, as these can be purchased "ready made" at very reasonable rates. The author has included this experiment in his demonstrations, which have been witnessed by large audiences, who have on many occasions expressed astonishment at the positive action of the alarm for "continuous" and "short" intervals.

When the author commenced this series of articles he mentioned that "television" is a form of light control. When a person sees an object in the ordinary way it is due to the fact that light rays directed on the object are reflected by it to our eyes. Light rays, to all intents and purposes, travel in straight lines. That accounts for the fact that owing to the curvature of the earth it is only possible to view an object at sea for a limited distance. It really seems there would be no such thing as a horizon if light rays followed the curvature of the earth, as apparently wireless waves do.

Television really means the transmission of an image by means of ether waves so that it is possible to view the image exactly as it is and not a reproduction made up of dots or lines.

The essential difference between wireless and light waves is that of wavelength and frequency. This seems to account for the difference in their behaviour and effect. Almost anything can be done with light waves except to curve them. They can be reflected in any direction, focussed, dispersed, and polarised. The latter means depriving them of their undulations in all except a given plane. Light waves can be refracted (*i.e.*, bent) and split up into their individual component colour waves.

Invisible Light Rays

A beam of light only becomes apparent when there is dust, smoke, or moisture in the air. In a vacuum or perfectly clear atmosphere a beam of light is invisible, and only shows itself by light rays reflected from an object placed in its path.

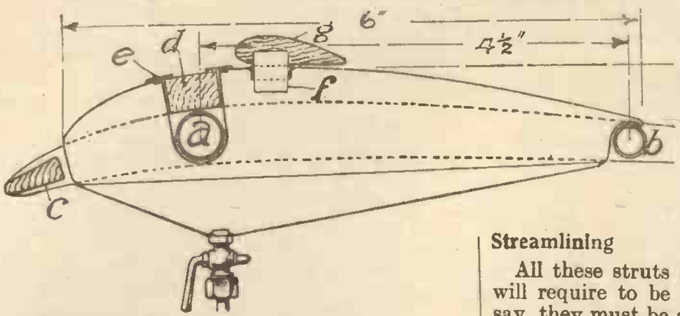
Wireless waves can be reflected, but even then they appear to follow the curvature of the earth, which is not the case with light waves. A method to convert one type of wave into the other has not as yet been discovered, although they are so closely allied. The transmission of light over great distances is, of course, impracticable, for quite apart from the energy involved intervening objects and atmospheric conditions provide an effective barrier. Wireless waves, although not entirely independent of atmospheric conditions, appear to be unhindered by obstacles.

If the problem of converting light waves into wireless waves, and *vice versa*, could be solved, it seems that an extraordinary prospect would be opened up, as it would then appear possible to televise pictures of current events in natural colours in a theatre. Colours are merely dependent upon varying wavelengths of light, and under such conditions there would always be the possibility of witnessing something not listed in the programme, which would be an added attraction. The present "talkie" pictures (a form of light control) are permanent records of scenes and events.

A Form of Light Control

The sound effects are photographed on one side of a film, and take the form of light and dark impressions. Light is projected through the impressions by means of a special electric lamp, which is generally referred to as an "exciter" lamp. As a film is rapidly passed between the lamp and a photo-electric cell the latter emits minute but rapid electrical pulsations which are highly amplified by a special amplifier, and converted into sound waves by means of loud speakers. A photo-electric cell which depends upon photo-emissivity has not been referred to in these articles, because a selenium cell which depends upon photo-conductivity is not only a less costly instrument, but is more suitable for the example described.

A Petrol-Engined Model Biplane (*continued from page* 58)



carriage, also of ⅜-in. tube: the struts between the nascelle and the upper plane, which is known as the centre section, likewise. The lengths of all the tubes must be measured from my drawings by means of the scale attached to them.

together. The piece *a* is a perfect fit over the spar of the wing and *b* must be a fit inside of the strut, or outside if preferred. In any case, they are pinned to their respective tubes. *d* shows one of the tail booms and the double tubular lug which forms the means of attaching the tail to the rear spar of the wings, both upper and lower.

Here the tubular spar E will have to be flattened in order to reduce its vertical thickness and bring it down to the requisite taper and embrace the member of the wooden structure forming the extreme wing tip. The flattened tube *a*, in E, will be notched out as shown and drilled for pinning to the wooden strip. *b* is the end rib of the wing.

The reader will have noticed in the side elevation that the rear spar of the lower wing is some distance away from the rear part of the nascelle and some form of bracket will be required to attach this spar to the nascelle. Such an attachment, or pair of them, is shown at F, where *a* is the under side of the nascelle, *b*, *b* two streamlined struts, preferably of hardwood, *c* the spar and *d* the bend in the centre of the same which gives the dihedral angle.

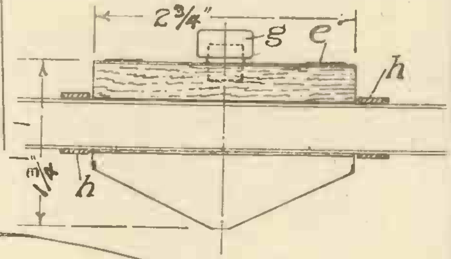
D shows a suggestion for the attachment of the interboom struts to the booms themselves; one of these is marked *d*, the strut *c* and *b* a bracing wire. A simple method of securing this wire, which will be of music quality, will be to pass it twice through a hole drilled in the top of the strut, as shown. For the attachment of the undercarriage struts to the nascelle, the simplest plan will be to flatten the tube and bend it to the requisite angle, as shown at G. A small block of wood is glued on each point to which the struts are attached on the inside of the fuselage and screws passed through the flattened ends of the struts into these blocks.

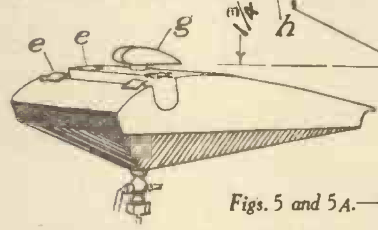
Inter-plane Struts

These will be made exactly like the under-

Streamlining

All these struts and undercarriage tubes will require to be streamlined; that is to say, they must be added to in order to give them that particular form which offers





Figs. 5 and 5A.—Details of the petro tank.

least resistance to passage through air. This streamlining will not be arrived at by altering the shapes of the tubes, but by fixing to the backs, or rear surfaces, of them a strip of Balsa wood, which must be grooved to fit accurately over the tubes. Tail booms are of $\frac{5}{16}$-in. diameter tube; these are left of circular form. They make such a large angle with the vertical that it is quite unnecessary to attempt to streamline them. In fact, beyond a certain angle with the vertical, or, as it is more properly termed, the normal, streamlining becomes positively wasteful because, although head resistance may be slightly reduced, skin friction is increased enormously. Between the tail booms, however, there are some ¼-in. diameter tubular struts, both horizontal and vertical, and these will be faired with Balsa in the same way as the others.

The Tail Unit

I think that the details of construction and sizes of the vertical and horizontal planes, which form the tail unit, will be made quite clear by the plan of the machine (Fig. 1), and it merely needs to be stated that these planes are built entirely of spruce.

(*To be continued.*)

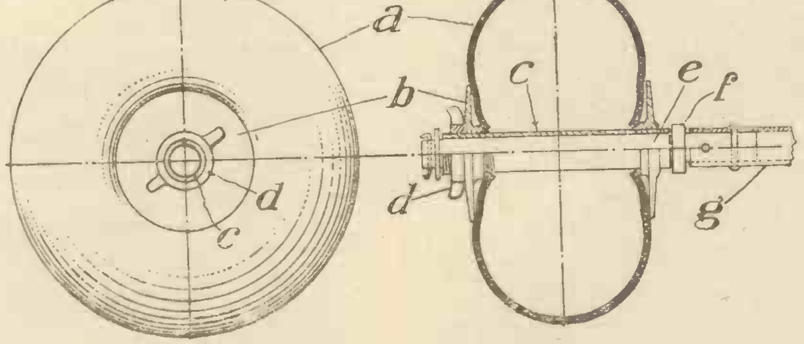
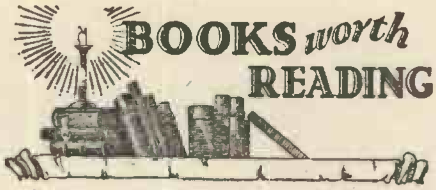


Fig. 6.—Details of the wheels for model



Scale Model Aircraft

By J. H. Stevens. *5s. net. 96 pages, fully illustrated. Published by John Hamilton, Ltd.* This excellently produced volume, with a frontispiece in colour of the Hawker Hart, fills a gap in the literature of model aviation. There are many readers who prefer to make realistic scale models rather than flying models, and this book describes how to make a Hawker Hart, a model aerodrome, and gives drawings of famous aeroplanes such as the Armstrong-Whitworth, the Bristol Bull-dog, the D.H. Dragon, the Bristol Fighter, the S.E.5, the Sopwith Pup, the Sopwith Snipe, the Spad. 5VII, the Albatross DV, the Roland D.11, the Hanoveraner, from which the reader can make models to any particular scale. There is a useful glossary of aircraft terms, and other chapters deal with how to photograph model aeroplanes, how to obtain and use data, and various aspects of scale model construction. The book is well illustrated by excellent line drawings.

The Standard Catalogue of the Postage Stamps of the World

Whitfield King & Co., Ipswich. Price 7s., post free 7s. 6d. 1,040 pages and hundreds of illustrations. This is the thirty-third edition of this handy-sized volume dealing with the postage stamps of the world. It explains the various designations, denominations and stamp values, and forms a reliable guide to the entire field of philately. It is sufficient recommendation for any volume for it to have reached thirty-three editions. This 1934 volume is entirely up-to-date and is quite reliable.

Henley's Twentieth Century Home and Workshop Formulas, Recipes and Processes

809 pages, demy octavo. Published by the Scientific and Commercial Publishing Co., Artillery House, Artillery Row, S.W. 1. This famous volume which has gone through many editions, contains literally thousands of money-making ideas, recipes and formulas. It deals with every subject of interest to the practical mechanic, including workshop and laboratory methods, adhesives, alloys, antiseptics, cements and amalgams, beverages, metals, electro-plating and electro-typing, dyes and disinfectants, dentifrices and cosmetics, enamelling, etching, explosives and fertilisers, lacquers, chromium-plating, paper, perfumes, and plaster-casting, photography, solders, varnishes, watchmakers' formulas, waterproofing, woods—but we have no space to deal with the entire contents which are alphabetically arranged and also carefully indexed. The index as a matter of fact, extends to no less than twenty-three pages, which apart from indicating the comprehensive nature of the book enables the reader quickly to locate information not readily traced by the alphabetical arrangement. The volume is sold on a guarantee of satisfaction or money refunded in full, and we can recommend it as a reliable volume for the practical mechanic. Full details and literature regarding this volume are available from the address given.

What the Clubs are Doing

Club Reports for inclusion in this feature should not exceed 250 words in length, and should be received not later than the 14th of each month for inclusion in the subsequent month's issue.

THE MALDEN SOCIETY OF MODEL AND EXPERIMENTAL ENGINEERS

THE above society possess a large workshop which is well equipped with tools, at New Malden, Surrey.

The subscription is 3s. a month, and club nights are on Tuesday and Friday from 6 to 10, and there are no members under eighteen.

The membership at the present moment is eight. Anyone interested in mechanics or engineering generally are always welcome.

Of course, as membership increases, it will be possible to reduce the subscription. All communications should be addressed to the Secretary, Mr. R. W. Blake, 31 Idmunston Road, Worcester Park, Surrey.

THE LEYTONSTONE AND DISTRICT AERO CLUB

THE above club hold model flying meetings every Sunday at 10.30 a.m. on the Wanstead Flats, Forest Gate, and are always pleased to welcome anyone interested in "Model Aeronautics." Club meetings are also held once a fortnight in the Hanford Memorial Hall, Forest Lane, Forest Gate. The subscriptions are: Seniors (over eighteen years) 3d. per week. Juniors (under eighteen years) 3d. per week for the first four weeks and 1½d. per week after. There is no entrance fee.

STAR AMATEUR FILM PRODUCTIONS (LTD)

THERE is no *reel news* this month, but we have decided on a cyclists' touring section for the purpose of cheap travel to locations, also to make films of famous holiday resorts, which will be entitled "Our Camera Visits ——," which will, of course, be in series, and will portray the special attractions and items of interest in all places visited, but work will not be begun on these films till next spring—Easter at the earliest—then we hope to visit Dover and Folkestone. We have now two guineas in funds, which was a gift, and is to go towards apparatus only not travelling expenses. Communications should be addressed to Mr W. Irons, 78 St. Michael's Road, Northampton.

THE WINDSOR AND MERSEY MODEL AIRCRAFT CLUB

THE club has now been running under the above title for a period of six months. Before this, each club was a separate unit. The Windsor Club, composed of schoolboys, age from twelve to sixteen years, who, before joining the club, had little or no experience of aircraft and airways, and who have progressed under the tuition of the older members.

Since the two clubs amalgamated they have run under the above joint title, the Windsor members being taught the construction of flying models under the guidance of the Mersey members, the actual building being done in the large and well-equipped workroom.

New members in Manchester and district are welcome, and any information required will be forwarded on receipt of an inquiry. All correspondence to be addressed to: "The Blimp," 76a High Lane, Chorlton-cum-Hardy, Manchester. Those interested in non-flying models should correspond with Mr. E. C. Daniels, Windsor Club, and for the flying models with Mr. L Hodson, Mersey Club.

STREATHAM COMMON MODEL RAILWAY CLUB

WE can now offer to all our club members a special "non-stop" programme. Our clubroom is open on every day of the week for use of members and friends. The nights have been allotted to some definite subject, which are moved on one each month, so that on Wednesdays during each month you do not get the same subject.

Mondays and Fridays in November are devoted to Workshop Nights, at which times members are asked to bring up their models and continue them.

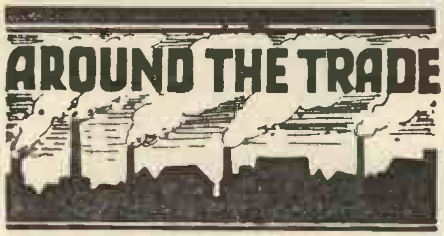
Tuesdays, Wednesdays and Saturdays in November are devoted to the laying of track and the testing of various locomotives.

The Thursday meetings are as follows: November 2nd, General Meeting; November 9th, Lantern Lecture, "Models and Model Making"; November 16th, Lantern Lecture, "Light Railways," by R. Shephard, Esq.; November 23rd, Talks and Demonstrations. We welcome visitors, friends and new members. The Clubroom is situated at 201 Gleneldon Mews, the first turning out of Stanthorpe or Gleneldon Roads. Full particulars from the Secretary, L. J. Ling, Brooke House, Rotherhill Avenue, Streatham, S.W.16.

SEVENOAKS RAILWAY CLUB

THE Club possesses the following facilities: 100 ft of temporary track; immense rolling stock. Meetings every Friday in the St. Nicholas Parish Hall Subscriptions 2s. per annum, payable monthly.

Visits are paid to local feats of engineering. The gas-works, electric light works and the waterworks have been already visited. Further prospectus on application to J. Kemp, 2 Bosville Road, Sevenoaks, Kent.



BRIEF ITEMS AND TOPICAL THOUGHTS CONCERNING MANUFACTURERS AND THEIR PRODUCTS

Books on all Subjects

A LIST of all the books published by Percival Marshall & Co. Ltd., of 66 Farringdon Street, E.C.4, would fill this book, but there is bound to be at least one book which interests you. Write for a full list, or ask for those which specially interest you.

Get a University Degree

MATRICULATION is the first step to a University Degree. Write to the University Correspondence College, 62 Burlington House, Cambridge, for details of Examinations, etc.

Become a Chartered Secretary at Home

EVERY branch of home study is covered in the extensive curriculum of the International Correspondence Schools, Ltd., International Buildings, Kingsway, London, W.C.2. From Accountancy to Aeronautics and from Plumbing to Salesmanship, the courses are most complete.

Strengthen Your Memory

A WELL-TRAINED memory is a valuable, if not essential part of the make-up of the modern thinking man or woman. The Pelman Institute, of Pelman House, Bloomsbury Street, London, W.C.1, needs no introduction, and all who are interested in the training of the mind should write to the Institute for details and a copy of "The Science of Success," post free.

A Course of Health

MAXALDING, of 14 Cursitor Street, London, E.C.4, will show you how to add some inches to your stature and will help you to fill out a weak figure. An Interesting Illustrated Treatise is obtainable free.

Do Your Own Printing

EVERYONE likes to have a visiting card, and there are also many occasions when some small printing would be found very useful. The Adana Printing Machine, which costs 45*s.* from the D. A. Adana Co. (P.M.1), 17 Church Street, Twickenham, will print visiting cards, leaflets, price lists, dance programmes, concert programmes, note headings, and sundry other items. As a spare-time occupation this machine will prove a ready cash producer and turns out work comparable with professionally produced work—and no experience is necessary.

The Householders' Vade-mecum

HOW do you repair a leaky roof? How can you make an Aquarium? Many other similar problems occur every day in our lives, and the answers to them all are contained in the "Amateur Mechanic," a Four-volume work that costs only 2*d.* a day for twelve months. The Waverley Book Co. Ltd., of 96 and 97 Farringdon Street, London, E.C.4, will forward details and a most interesting Free Illustrated Booklet to all who ask for it.

Home Study

"ENGINEERING OPPORTUNITIES" is a 250-page Handbook on Successful Careers, and may be obtained from the British Institute of Engineering Technology of 29–31 Oxford Street, London, W.1. It explains how to obtain those coveted degrees such as A.M.I.Mech.E., A.M.I.E.E., etc. Simple study at home is all that is necessary to anyone of average intelligence, and the book explains everything.

See pages 2 and 3 of Cover.

REPLIES TO QUERIES & ENQUIRIES

If a postal reply is desired, a stamped addressed envelope must be enclosed. Every query and drawing which is sent must bear the name and address of the sender and be accompanied by the coupon appearing on page 100. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes Ltd., 8–11 Southampton Street, Strand, London, W.C.2.

Making Miniature Tangent Wheels

"I have made a number of model aeroplanes from time to time and would like to know if it is possible to fit them with miniature tangent wheels." (M. S., Liverpool.)

It is quite possible to make use of these if you have nimble fingers. You will need a rim and a hub; the latter can be made if you have not access to a lathe by soldering two small washers to act as flanges on to a piece of brass tube. Each flange should be drilled close to its circumference, which should be equally spaced into sixteen divisions. The rim should be drilled to receive thirty-two equally spaced spokes, sixteen coming from one flange and sixteen from the other.

The Origin of the Postage Stamp

"Being an enthusiastic stamp collector, I am rather interested to know if you can tell me the origin of the postage stamp." (A. L., Norwich).

It was in 1829 that a clergyman, Rev. Samuel Rogers, M.A., first conceived a uniform rate for the transmission of letters over the whole kingdom. He published his views in the Press with such effect that a select committee of the House of Commons was appointed to consider the subject. It was to this committee that Rowland Hill, one of the chiefs advocating the postal chain, submitted the idea of the penny postage. James Chalmers actually originated the postage stamp. He was born at Arbroath on February 22nd in 1782. As early as 1834 he invented, produced and exhibited the adhesive stamp for postal services.

Model Aeroplane Fuselage Models

"As a model aeroplane enthusiast, can you let me have the S.M.A.E. formula for that type of model plane?" (J. H., Hammersmith.)

The S.M.A.E. formula for fuselages is as follows: Divide the overall length of the body by ten and square the answer. This will give "the minimum value of maximum cross-sectioned area," whatever that may mean. It seems to us that this formula could be expressed in a far more simple way. Why not say that the largest cross-sectional area must not be smaller than the square of one-tenth of the overall length? We do not advise you to use square section elastic, flat strip $\frac{1}{8} \times \frac{1}{16}$ inch. should be used.

Curvature of Photographic Lens

"How can I attain approximately the curves of a photographic lens?" (D. M., Yarmouth.)

The following rules will give approximately the curves of any lenses. Taking the case of a plano-convex lens, the relation of curvature to focus is illustrated as follows: If a slice, by drawing a straight line, is taken off any circle of any radius, that slice of a circle will give the outline of a plano-convex lens. The focus of such a lens will be approximately on the opposite side of the circle. If, for example, the radius of the circle is 3 in., the diameter will be 6 in.; therefore, the radius of curvature will be 3 in., and the principal focus 6 in. Suppose two circles of 3-in. radius are drawn, intersecting each other, then the lens whose surfaces are indicated by the intersecting lines (called a bi-convex, or double-convex) will have a focus of 3 in., although the curvature of the two surfaces is in each case 3 in. In the case of a crossed lens, or one with surfaces of unequal curvature, the focus is equal to twice the radii of curvature, multiplied by each other, divided by their sum. In the case of a meniscus lens, the focus is equal to twice the product of the radii, divided by their difference. The curves in an existing lens can be found by the use of a spherometer.

Electric Arc Welding

"I would like to know the broad principle of the application of the above system." (L. C., Nuneaton.)

The broad principle of the application of this system is as follows: The current flows from the dynamo to the metal to be welded, from the metal to be welded to a carbon, from this carbon through a resistance regulator for adjusting the amount of current required, and back to the dynamo. When the carbon is placed in contact with the work the current passes. By withdrawing the carbon a short distance, an electric arc is produced, which may be from $\frac{1}{8}$ in. to $1\frac{1}{2}$ in., or even more in length. By withdrawing the carbon altogether from the work, the current is made to cease. The work thus forms one pole of the arc and the carbon the other. The work is almost always the positive pole and the carbon the negative, because the positive pole in an arc is always the hotter. By this single carbon system various kinds of welds are made, either hammered or fused, according to the position of the weld and the nature of the work.

Repairing a Clock Dial

"I have an old clock which I wish to repaint and refigure the dial. I am anxious to know what type of paint is used and the best way of rejuvenating the clock." (T. Y., Belfast.)

To repaint and refigure a clock dial first remove the old paint by scraping. Then give one or two coats of good white paint until the dial is well covered. The figures should be painted in with a specially mixed black, but black enamel as sold in tins will do very well instead of ordinary paint if desired. One way of marking out the figures is as follows: Before scraping off the old paint, mark the 12 o'clock by a scratch on the dial edge. Then lay a sheet of tracing paper over the dial and trace over the figures and the minute marks. Remove the tracing paper, and with a soft lead pencil or crayon retrace the figures on the other side of the paper. If this tracing is laid on the white-painted dial, the pencilled figures on the back can be made to trace their form on the painted surface by pressure, or by tracing over them again with a pencil on the front of the paper.

Making Stereo Metal or Type Metal

"Can you tell me what type of metal is used and how the above process is carried out?" (P. W., Sutton.)

For general stereotyping purposes, as also all kinds of type metal, ingot lead is generally used. Ordinary pure pig lead, which is readily obtained, is also suitable. Type metal usually consists of tin, lead and antimony in varying proportions, the lead being from 70 to 80 per cent., the tin 5 to 10 per cent. and the antimony 15 to 20 per cent. In melting an alloy of these proportions use a good layer of charcoal (flour) to prevent undue oxidation and consequent drossing. If only 10 lb. of dross is made in 14 cwt. of metal, this will do: but this would probably be remedied if a layer of charcoal were used, as any lead oxide formed will be reconverted to metallic lead. Care in regulating the heat will have much to do in keeping down dross, and also in getting cast plates even in all respects.

Zodiac Signs

"I am curious to know what comprises the twelve signs of the Zodiac. Can you let me know?" (F. P., Hatch End.)

The Zodiac is an imaginary band of some of the celestial spheres sufficiently wide to include the apparent movements among the fixed stars of the sun and the five planets which were known to the ancients. The Zodiac was divided into twelve equal parts or "signs," each of which took its name from a characteristic constellation of fixed stars within the division. These signs were the Ram, the Bull, the Twins, the Crab, the Lion, the Virgin, the Scales, the Scorpion, the Archer, the Goat, the Water-carrier and the Fishes. The central line of the Zodiac is called the "Ecliptic," because the moon must be on this line for an eclipse to take place.

Mixing Oil-colour Paint

"I would like to know the recipe for mixing a paint which will stand the stress of all weather." (P. J., Addlestone.)

For painting any surface that has to stand the stress of weather, the paint should be of as good quality as possible. For a good oil paint take, for each pound of colour required, $\frac{1}{2}$ lb. genuine white lead, 1 oz. of patent (paste) driers or a small quantity of terebine, and mix it to the required consistency with a mixture of two parts of raw linseed oil and one part of turpentine. If it is required to dry with a good gloss, replace half the raw oil with boiled oil. If a tint is wanted, work in the requisite quantity of pigment, ground in oil; ochre for cream, venetian red for salmon, middle Brunswick green for pale green, ultramarine for grey, burnt sienna for a reddish buff. For dark-coloured paints, replace the white lead with a similar quantity of pigment ground in oil, and use more boiled oil, or else add a little good oak varnish.

Patent Advice

By A. MILWARD

The services of a professional Patent Expert are available free to every reader. He will advise you on the validity, novelty, and value of any idea you may have. No charge is made for this service, but the Query Coupon appearing in our advertisement pages must be enclosed with every query.

INVENTION

NECESSITY has long since been defined as the mother of invention, and probably every reader of this paper can justly claim to be an inventor in the sense that he has contrived some device at one time or another to meet a momentary want or a necessity. This want or necessity having been met, the means employed to achieve the desired result has been allowed to pass into oblivion. It is more than probable that the invention so evolved, although serving its purpose, was not of sufficient importance, even supposing it to have been actually novel, to warrant the expense in endeavouring to obtain a monopoly for its exclusive use, or, in other words, to form the subject-matter of a patent.

There must, however, be a large number of readers who either have a decided bent for invention, or definitely turn their thoughts in the direction of invention with a view to making money as a result of their ingenuity by taking out patents for their inventions.

Highly Remunerative

Now the number of patents which are commercially successful, apart from inventions by those connected with some particular industry in which they are actively engaged, are comparatively small, yet the return made from a successful patented invention is often highly remunerative; in fact, the patenting of an invention is in the nature of a highly speculative investment.

Patentable inventions may be very broadly divided into two classes; firstly, the production of a new article, a new process or a novel means for utilising either a newly discovered or an old natural law; and secondly, improvements in known processes or machines whereby a better product or a better article is produced or a cheapening of the cost of manufacture is achieved. Needless to say, the majority of patented inventions are included in the latter category, because it is becoming increasingly difficult as knowledge extends to make an invention which may form the subject-matter of a "master patent."

A Wide and Increasing Field

There is, however, still a wide and increasing field for the exercise of inventive skill and ingenuity in bettering existing "manufactures." The term "manufactures" is used in its widest signification to cover not only the machine and process of manufacturing, but also the product of such process or machine. Labour-saving devices, particularly for use in the home, still offer a wide field for invention. Means for the extended use of electrical energy, the better utilisation of the forces of nature, improvements in locomotion, printing and photography, the better utilisation of mineral wealth and waste material of all kind open up an unlimited field for research and invention.

In the newer fields of science television and wireless transmission of sound and power offer a fruitful field for investigation, but in passing it may be remarked that it is a moot point as to how far it is possible to validly patent a wireless telephone circuit, for example.

When an invention has been made—particularly if in a field in which the inventor is not actually engaged—it is politic to make some kind of a search in books and patent specifications dealing with prior inventions of the class to which the particular invention relates to ascertain if the invention is really novel, and so save not only unnecessary expense in endeavouring to patent the invention, but also the inevitable disappointment which results from "castles in the air" suddenly crashing to the ground.

REPLIES TO CORRESPONDENTS

A Patent for a Rising Panel Catch

Sir,—I am sending you specification and drawings of a rising panel catch, the patent of which I have applied for.

Will you please inform me as to validity, novelty and value of this, and any other information which might be of advantage to me, as I am a novice at patent work.

It is presumed that the drawing has been filed with the Provisional Specification, in which case the Application for Patent will probably be accepted in due course, but if only the Specification has been filed it will probably be returned by the Patent Office for a better description. In order to give an opinion as to the validity and novelty of the invention, it would be first necessary to make an extended search amongst prior Patent Specifications and other publications for similar inventions, which is a costly matter. Although the invention is ingenious, it is questionable whether there are not many ways of achieving the same object already in existence, or devices which might be designed to achieve the same object and which would not be covered by the Specification as drafted.

The commercial value of the invention cannot, therefore, be very great. Some difficulty may be experienced in getting a spring of the shape shown to remain effective for any length of time.

Amendment of the Patent Law

Sir,—The author of your article "Patent Advice" in No. 1 of "Practical Mechanics" appears to be ignorant of the fact that the Patent Law was amended in 1932. Your article needs correction in the three following particulars:—

(1) Secret commercial user invalidates a Patent. The old doubt has been settled by specific legislation.

(2) An application and the Patent to be obtained therefor may now be assigned before grant.

(3) Provisional protection is not contingent upon an Application being accepted.

Perhaps you may care to verify the above by reference to the Consolidated Act, if you want confirmation.

(1) Secret commercial user of an invention on a commercial scale in the United Kingdom by a Patentee or others not being a Government Department, or persons authorised by a Government Department, is under the amending Act of 1932 a ground for applying for revocation of a Patent granted on such an invention. It will be seen that a Patent for such an invention may be granted and in some circumstances may be a valid Patent, but in either circumstances it may be revoked after the Patent has been obtained.

(2) It is true that under Section 12 of the amending Act, 1932, that where an Applicant has agreed in writing to assign the Patent when granted, *the Patent may be granted to the assignee* upon proof of the agreement to the satisfaction of the Comptroller.

(3) The period between the date of the Application for a Patent and the date of sealing a Patent on that Application is the term of Provisional Protection, and since a Patent cannot be sealed until after the Application has been accepted it is questionable whether the protection intended to be given by the Act could be claimed by an Applicant whose Application was never accepted

Catalogues and Publications Received

OUR FREE CATALOGUE SERVICE

To save readers trouble, we undertake to send on catalogues of any of our advertisers. Merely state, on a postcard, the number (or numbers) appearing at the end of the paragraphs below and address it to "Catalogue," PRACTICAL MECHANICS, *Geo. Newnes Ltd., 8/11, Southampton Street, Strand, London, W.C.2. Where advertisers make a charge, or require postage, this should be sent with applications for catalogues. No other correspondence whatsoever should be enclosed.*

A Valuable Free Book for Stamp Collectors

MESSRS. Whitfield King & Co., of Ipswich, the well-known firm of stamp dealers, have just issued a new annual price list of stamps and sets in packets which all collectors should have in their possession. It is free, and they offer a collection of 10,000 stamps, all different, for a reasonable sum. Those readers who avail themselves of this generous offer will find it the best and most economical way of starting a collection. A good mixture of assorted used stamps can be bought by weight exactly as imported, without any sorting or picking over whatever. This 127 page booklet is obtainable free to all readers. [7.]

A Handbook on Patents and Trade Marks

THE latest edition of a booklet on Patents and Trade Marks, which is the outcome of forty-seven years' active experience in Patents, Designs and Trade Marks, has just been published by Kings Patent Agency Ltd., 146A Queen Victoria Street, London, E.C.4, and is edited by Benjamin T. King, C.I.M.E. The ever-increasing part played by patents and other forms of protection for ideas makes this book a handy guide for engineers, manufacturers and others engaged in industry and commerce who require knowledge of these subjects. They should avail themselves of the offer of this free handbook. [8.]

Radio Mains Equipment

HEAYBERD mains units have now been on the market so many years that they have proved their superb quality and their reputation is unassailable. By doing away with batteries and fitting a Heayberd mains unit to your receiver, you save literally pounds on the year's running, and you are assured of a constant, ever-available voltage. A catalogue of their various types of mains units, also containing circuit diagrams for installing them in your set, is obtainable free upon application. The book also gives helpful hints which may prove of assistance when dealing with mains radio. [9.]

Television Apparatus

MESSRS. H. E. SANDERS & CO., of 4 Gray's Inn Road, W.C.1, have just issued their price list, covering a large range of television apparatus. A mirror drum kit well within reach financially of the experimenter known as the "Unisphere" also appears in their list. It is for the experimenter's own assembly, is easily adjusted, and is complete with thirty light spot tested mirrors. [10.]

Chemical Apparatus and Chemicals

AN interesting pamphlet has just been issued by Messrs. A. N. Beck & Sons, 60 High Street, Stoke Newington, N.16, comprising a complete list of apparatus and chemicals suitable for beginners in chemistry. They show a wide range of chemicals, obtainable in bottles at 3d. and 6d. per bottle, and also all types of apparatus at moderate prices. Sets of apparatus only or complete with chemicals and text-books are obtainable at prices ranging from 10s. 6d. up to £25. This price list should certainly be in the possession of all readers interested in chemistry, and is obtainable free of charge upon application. [11.]

Booklets for the Handyman

THE well-known firm of the Rawlplug Co. Ltd., Rawlplug House, Cromwell Road, S.W.7, have just issued two fine catalogues which should prove of interest to all mechanics and handymen. Both booklets are well illustrated with a number of half-tone illustrations, covering a complete range of their goods and also a number of photographs of their workshops showing the goods in the process of manufacture. The problem of fixing and its difficulties has been overcome with the Rawlplug. The wood screw revolutionised fixing work, and the Rawlplug is the inevitable development of the wood screw fixing method. They give a complete list of tools, as well as brackets, shelves, mirrors, plastic woods, porcelain liquids, etc. [12.]

Readers' Names and Addresses

WE have received numerous requests from readers for catalogues, but in many cases they have omitted to append their name and address. Those readers who have requested catalogues and have not yet received them should repeat their question, *appending their full name and address.*

CLASSIFIED ADVERTISEMENTS

Private or trade announcements can be inserted in this column at the price of THREEPENCE per word PREPAID.

All communications should be addressed to
THE ADVERTISEMENT MANAGER,
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8/11 SOUTHAMPTON ST., STRAND,
LONDON, W.C.2.

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PRACTICAL MECHANICS, NOVEMBER, 1933.