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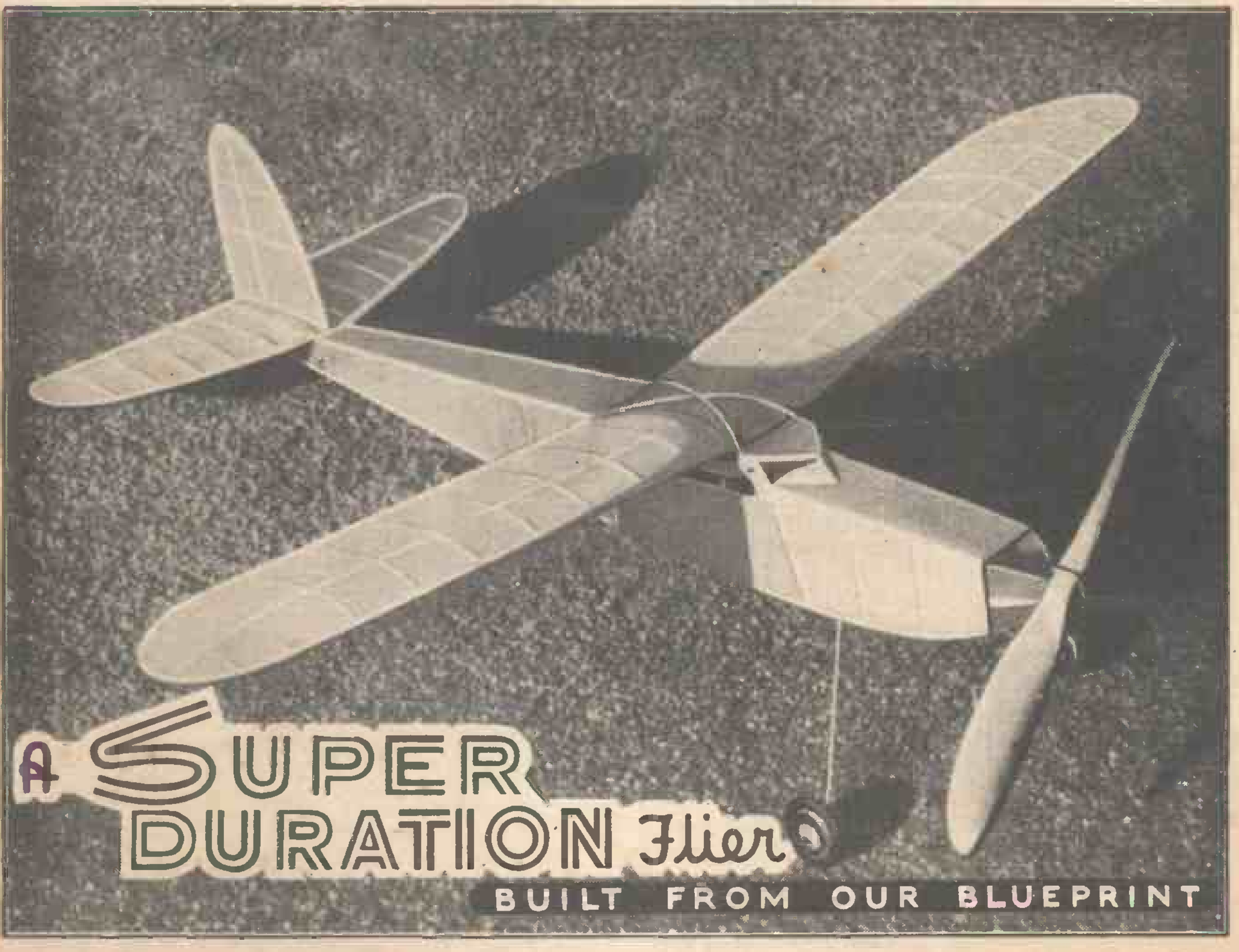
EDITOR : F. J. CAMM

APRIL 1952



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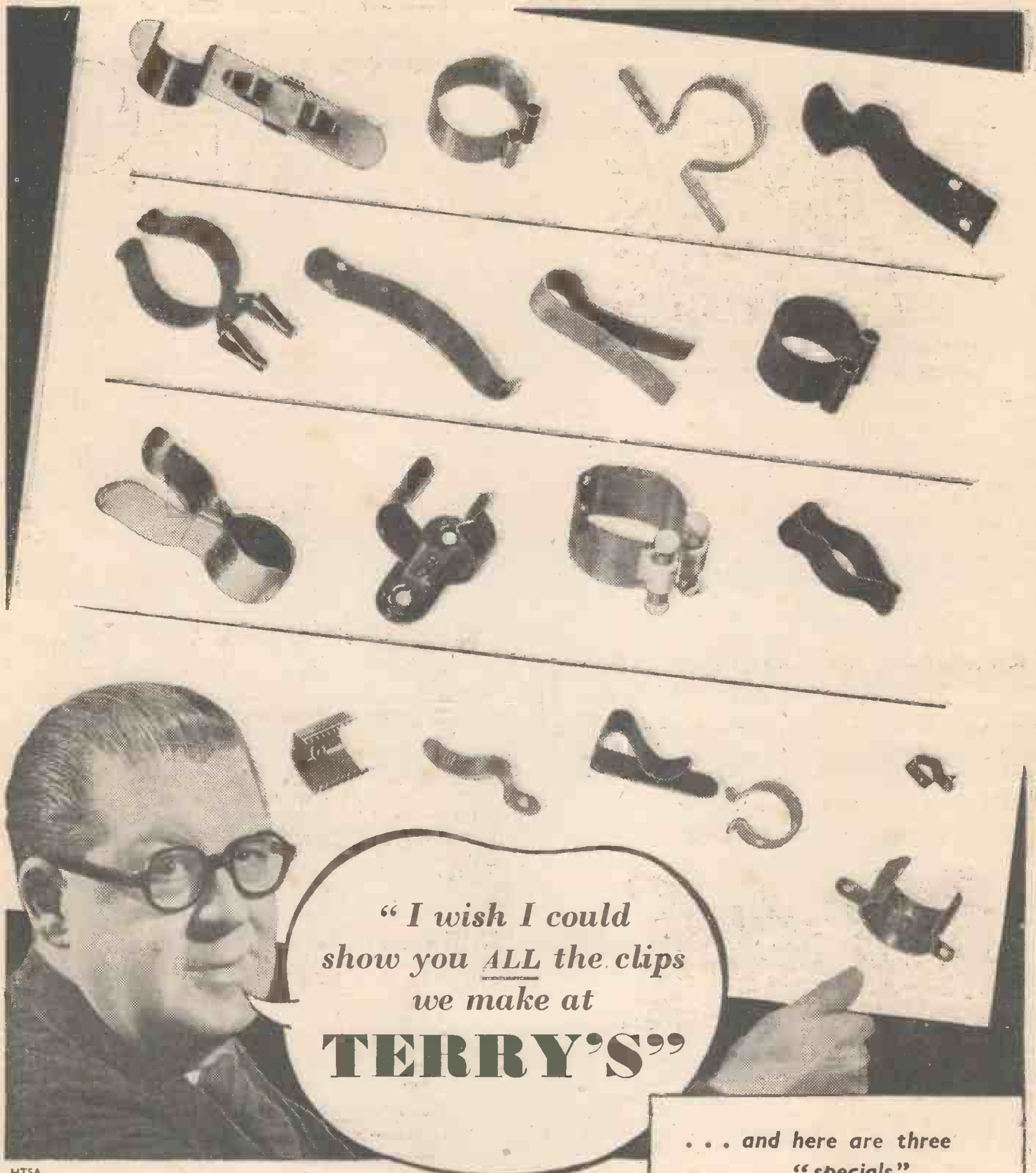

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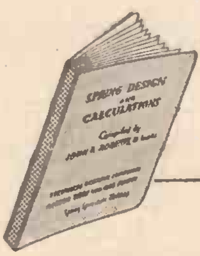

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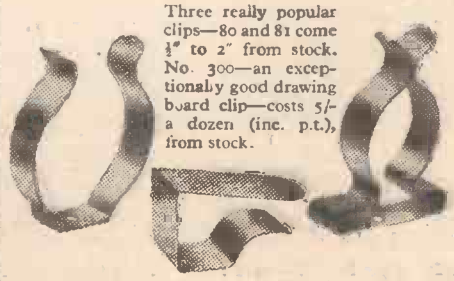

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APRIL, 1952
VOL. XIX
No. 220

PRACTICAL MECHANICS

EDITOR
F. J. CAMM

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

FAIR COMMENT By The Editor

Great National Free-for-all Competition

£200 IN PRIZES!

WE have, in the past, run many successful competitions in which we have invited readers to submit ideas for improvements in existing devices. Typical examples were our competitions for improved lathes, fountain pens and mechanical pencils. Those competitions were highly successful.

Now we invite our readers to enter our latest competition, details for which appear on this page. Readers will see that it is in four sections with prizes of £25, £15 and £10 in each section. The competition is only open to regular readers of this journal, but there is *no entrance fee*. Entries must be accompanied by the coupon on page 56.

There are hundreds of things about the home which are in need of improvement, even in the most modern and up-to-date household. A great deal of the housewife's work, for example, can be drudgery. Perhaps you can suggest a device for making such work less irksome. A simple washing machine which will fit into the sink; an ash and cinder disposer; a hand-operated clothes washing machine; new uses for the vacuum cleaner—dozens of ideas will occur to you. Spend a little time working them out and putting them on to paper. It is not necessary to make working models.

Flat owners, particularly, will welcome suggestions for small labour-saving devices which they can accommodate in their necessarily restricted space, such as a fan-operated clothes dryer and airer, a small refrigerator or a tap-operated food cooler, an automatic fly catcher, a carpet sponger, an upholstery cleaner, a mechanical pot scourer—there is plenty of scope for the ingenious reader.

Entrants must obey the rules which are set out in the adjacent column.

Here are the four sections:—

1. Kitchen appliances (cooking, washing).
2. Cleaning items.
3. Leisure aids.
4. General household fitments.

OUR FREE BLUEPRINT

THE model aeroplane of the high-wing cabin type which is the subject of the free gift blueprint included in this issue is one which has been tested over a considerable period. It is a highly satisfactory long-duration flyer and a competition winner. It is simple to build and the materials are not costly. Full constructional details are given overleaf.

LEONARDO DA VINCI

LEONARDO DA VINCI, who was born just over 500 years ago, was probably the most versatile man in history. He was greater than Newton, Einstein, Faraday, Marconi, Edison or any other of the great names in the world of science. Most of these achieved fame in specialised fields only, but Da Vinci attained distinction in the realms of science, art, music and sculpture. He was a military engineer and Court painter to Caesare Borgia. The 500th anniversary of his birth was recently celebrated at the Royal Academy of Arts, where two rooms were devoted to an exhibition of his original drawings from the collection at Windsor Castle, the British Museum, and the Ashmolean at Oxford. There were working models of his inventions, constructed with great accuracy by the experts at the Science Museum, Kensington, using his original plans, which were also exhibited. He painted the famous Mona Lisa, and although about 20 of his paintings exist it is known that several thousands of drawings in ink, pencil and chalk were made by him. He had a passion for accuracy and this inevitably led him to the study of science.—F. J. C.

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RULES

1. All entries must be original and the unaided work of the competitor. They must not be copies or infringements of existing apparatus.
2. Each entry must consist of drawings and a written description explaining the device. Drawings need not be to scale, although scale drawings are preferred. They may be made in pencil or in ink. Models as well as drawings may be submitted if desired. The coupon on page 56 must be enclosed.
3. We reserve the right to publish any of the entries but competitors will be advised beforehand in case they wish to apply for a patent.
4. Each entry must clearly indicate the size, shape, conception and operation of the idea and describe the materials to be used in the making. The availability of such materials, cheapness of manufacture and total cost will be taken into consideration by the judges who will be presided over by the Editor of this journal.
5. Stamps to cover the return of the drawings and/or models must be enclosed with each entry.
6. All entries must be submitted not later than June 1st, 1952, when judging will commence. The result will appear in our August issue.
7. Entries should be addressed to The Editor, PRACTICAL MECHANICS, Tower House, Southampton Street, Strand, W.C.2, and envelopes or packages should be marked "Competition" in the top left-hand corner.

OUR FREE BLUEPRINT!

Building the Cabin High-wing Monoplane

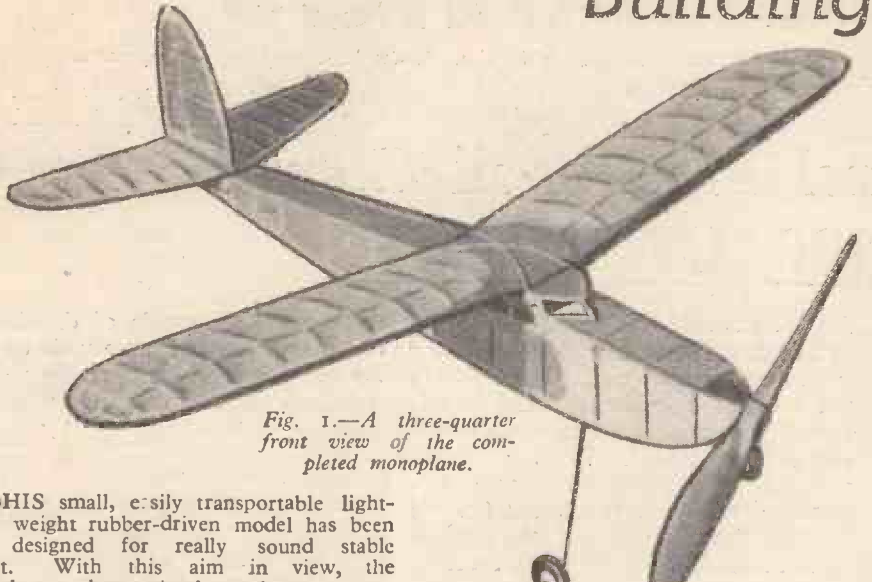


Fig. 1.—A three-quarter front view of the completed monoplane.

THIS small, easily transportable light-weight rubber-driven model has been designed for really sound stable flight. With this aim in view, the model was kept simple and on proven lines, with a reasonable sized propeller, and a deep fuselage forward to give good spiral stability. The model is simple to fly, possesses great spiral stability when reasonably well trimmed according to the flying directions, and has a beautiful glide. Although it is a duration model, places where exceptional stresses occur, such as the nose and where the undercarriage is located, are adequately reinforced by sheet covering and plastic wood. A great deal of interesting and instructive general-purpose flying can be had with this model.

The blueprint shows stage-by-stage construction, and these instructions are augmented by this article. As a result, even a beginner should have little difficulty in making a successful model. Newcomers to aero modelling should pay particular attention to accuracy of the fuselage outline, which will automatically give the correct angles of incidence to wing and tail. Care should also be taken over the paper-covering methods described, and to ensure that there are no warps in wing surfaces or twists in the fuselage. No model will fly with twisted or warped surfaces.

Let us now run through the constructional details, commenting on these stage by stage, with some notes on test flights at the end.

The Fuselage

A building board is advisable, but any flat surface, such as the top of a wooden box or a table will do if a board is not available. The advantages of a board are that no one will disturb the building operations in order to demand the table for other purposes. A half-finished operation can be left to set the cement, until the constructor can find an opportunity to do the next job on the model. Any thick wooden plank *with no twists* is suitable as a building board.

The plan has had to be produced with the fuselage and wings "cut in half" for economy of paper reasons. These "half components" should be carefully cut out and joined accurately, being pasted down to a paper packing. Any piece of paper will do, provided the lines of the fuselage are kept accurate, for these lines give the correct trim of the model.

Place the plan on the board and pin over the plan a sheet of grease-proof paper. This will prevent the balsa cement used for glueing joints sticking to the plan. Pins for construction are ordinary domestic pins. Pin the longerons down to the board. Each fuselage side longerons are laid on top of each other as the two fuselage sides are built together. This saves time and makes for accuracy. The pins are placed each side of the longerons in order not to weaken the wood by piercing. Where the uprights come, tiny pieces of grease-proof paper are interposed between the bottom and top longeron. This will prevent the longerons sticking to each other when the uprights are cemented in. Where a longeron has a sharp bend a little soaking in water is advisable before pinning into the lines of the fuselage. This applies to the bottom forward run of the fuselage. (See Fig. 2.)

Now cement in the uprights, with plenty of cement at the joints. It never pays to be sparing at joints with cement. A quick-drying balsa cement should be purchased.

When the cement is dry, separate the two sides of the fuselage carefully with a razor blade, of the one-edge type. This is also used for all cutting of balsa wood. Clean up the joints and then place the two sides upright, having previously cemented in the side windows of very light sheet celluloid. These two sides must be absolutely vertical and at the right distance apart according to the plan, so that the four widest crosspieces can be cemented in. When the cement is quite dry, the nose and tail crosspieces can be cemented in, keeping these sprung in by temporary pins until the cement is dry. Be very careful at this stage not to pull the fuselage out of line or twist it. This is the difficult period. When the cement is dry at nose and tail, the remaining crosspieces, of widths according to the plan, can be cemented in at the correct stations, slightly springing out the longerons. If accuracy and ease of building are sought, as they should be, it always pays to make a simple jig to get the fuselage true. This can be done as shown in Fig. 3.

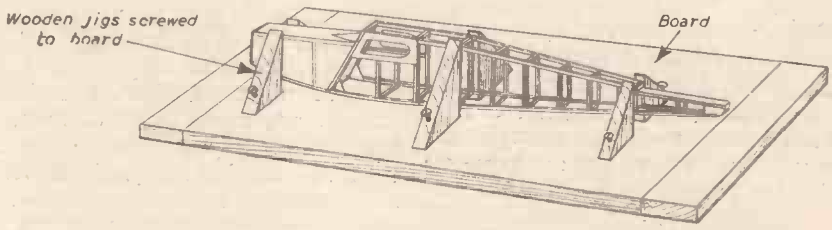


Fig. 3.—Keeping the fuselage true by simple jigs screwed to the building board for keeping the fuselage upright and free from twists as the cement sets.

Remember that a twisted fuselage or a lop-sided fuselage will never permit accurate flying, as wing and tail will be out of line with each other. It is quite possible to build without a jig, if one is reasonably skilled, and is possessed of an accurate eye, but a jig ensures accuracy and is often worth the time spent. Furthermore, if a second fuselage is required at any time, a jig saves trouble.

The Fittings

Fittings such as wing retaining dowels of hardwood and tail hook, the undercarriage, etc., all shown on the blueprint in detail, should now be made and fixed to the fuselage. When these items are fitted they should be reinforced by plastic wood smeared to the sheet balsa covering at these points, which it will be observed are located

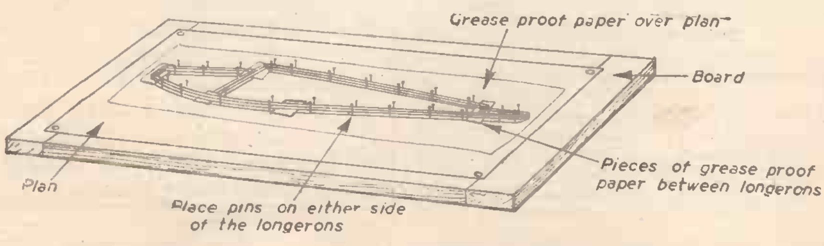


Fig. 2.—Pinning down the fuselage outline to the building board.

mostly at nose and tail, with the exception of the wing platform. The plastic wood can be obtained at any model shop or iron-monger, and can be mixed with a little balsa cement. When it dries it "spreads the load" of highly stressed parts. This is an invaluable feature not seen on many models. It certainly adds very little to the weight, but adds tremendously to the strength, reliability, and long flying life of the model. Wing platform and tail platform are cemented on. The nose piece is made from laminated pieces of balsa wood and then carved to shape of the model's nose. The nose is drilled to take a bearing tube, and this drilling must be dead centre. Bearings and little ball races to take the propeller thrust can be bought from model shops. The wire propeller shaft is carefully bent to shape by round-nosed pliers. The free-wheel mechanism makes for long glides and prevents a stopped propeller causing spiral dives on the glide. It is therefore well worth the trouble of making, although for general purpose flying it is possible to fly with a fixed propeller. This, however, is not advisable if the maker can construct a free-wheel gear as shown on the blueprint.

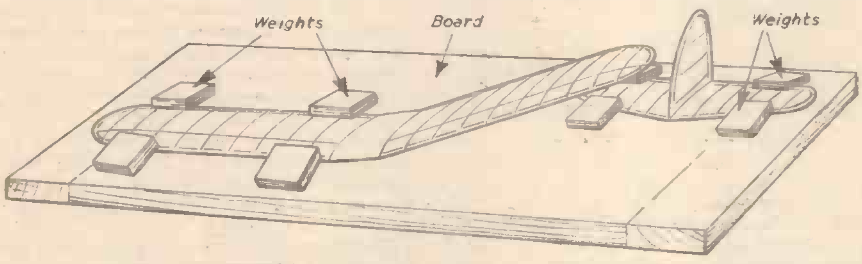


Fig. 4.—Weighting the wing surfaces prevents warping whilst the dope dries. Dope each wing separately, and add weights carefully. Do not apply weights until dope is sufficiently dry to prevent sticking to board.

Propeller

The propeller is a very vital component, for it hands out the power. Propeller carving by a novice is not perhaps as easy as the rest of the model building. A piece of hard balsa should be obtained, if available, and a blank cut out to the outline shown on the plan by tracing on to the blank. The blades must be carved so that the sections as shown are incorporated and at the correct pitch angles. This matter of pitch and diameter of the propeller is always a very big secret of a light model's flying success. It is necessary to balance the propeller as an unbalanced one will cause vibration and wobble which will upset the model. To balance, slowly spin the propeller on a shaft of wire. The blades should come to rest each time at different points. If one blade always stops at the bottom, after rotation, it is too heavy and must be sand-papered down to match the other blade.

Wing Tail and Fin

These flying surfaces are built up on the board, or an absolutely flat surface, over the plan with greaseproof paper interposed, after having cut the ribs to shape with a razor blade, and sanded the outline smooth. The shape of the ribs must be accurately maintained by tracing the outline on to balsa sheet, with a piece of carbon paper interposed between balsa sheet and plan. It is a good plan to make up one master rib for the wing, as this saves the plan. The rib can be made from three-ply and used to trace round. It can be used if another wing is wanted at any time, and should be kept.

The correct dihedral is obtained as shown on the blueprint. This is always important on any well-designed model, as the dihedral for lateral stability is "balanced" in design with the side area shown by the fin. If too big a dihedral is given, this may cause instability on turns. A small dihedral has a similar result, and fails to recover the model in a gust. Blocks under the wing tip ribs will ensure correct dihedral. (See Fig. 4a.)

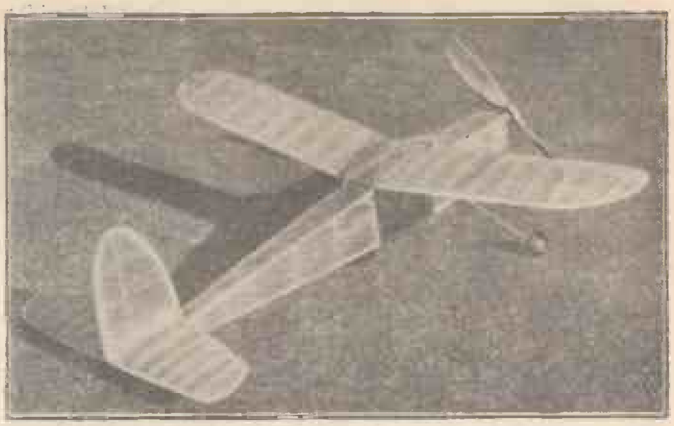


Fig. 5.—Not a wrinkle should be visible on the finished monoplane.

Covering the Flying Surfaces and the Fuselage

Rag tissue paper or Silkspan paper, obtainable from model shops, is used for covering. As mentioned at the beginning of this article, covering is a very important feature, for there should be a good surface free from drag-making wrinkles, and the surfaces must not be warped by the doped covering. So many modellers make a nice air frame and then produce a poor looking completed model because the covering is bad. Covering is really not difficult, but it requires a little practice and knowledge of the correct way to do it.

First cut the paper to the rough outline of the fuselage sides with a reasonable overlap. Now smear the side to be covered with photopaste. Lay on the paper evenly, but do not overwork or stretch. It may look a trifle loose, but provided this is not excessive, it will not matter for we shall get it taut in a moment. The great mistake is to *overstretch* the paper over the framework when dry. Now trim around the edges, allowing approximately ⅛in. overlap. Stick this overlap down around the longerons with photopaste and cover the opposite fuselage side, then the top and the bottom, in that order.

Now, borrow a scent spray, and spray water over the covered structure evenly. When nicely wet allow to dry, but *not in front of a fire*. The paper, if reasonably well put on will now evenly shrink up, and not a wrinkle will be left when dry. When absolutely dry dope the fuselage with two or three coats of good quality model dope. This may appear to temporarily slack off the paper between coats, but as each coat is allowed to dry, the paper will come up taut and gain strength. Doping must be in a warm room free from moisture, but not in front of a fire. It is important to see that the fuselage is kept down true, so that it does not twist as the drying takes place on each occasion.

If by any mischance a twist does develop, or a warp in a wing happens, it is usually possible to twist these carefully out by holding in front of a hot fire, feeling the doped surfaces soften, taken away to cool, and releasing the surface when cool. It should remain where one has anti-twisted it as it cools off.

The nose block requires several coats of dope to harden. If the dope blushes, it has either been applied in a damp atmosphere, or is of a cheap and nasty kind. A good dope by a reputable firm is well worth its selection. Cellon or Titanine are full-size aircraft dope firms of world-wide repute, who also make model dope that gives every satisfaction. The wing should have two or three coats, and the tail and fin only one, after the usual water shrinking. The tail unit is built lighter and may warp in hot weather if too much dope is used. Dope should be "flowed" on with a soft brush, and never "worked" in, like paints. Flow it on thickly without actually running. It dries tacky very quickly and any working back and forth by a brush will ruin the result.

When covering the wing, start with the bottom and then cover the top, by the same methods as used for the fuselage. Smear the outline with photo-paste, including the bottom runs of the ribs to keep the slight undercamber. This is unecessary for the tail, which has a flat bottom to its ribs. Whilst water or dope is drying on the wings, make sure they are weighted gently down to a flat board. This prevents warping as the medium shrinks the covering material. Do one wing at a time, to allow for the dihedral. Do not weight until dope dries sufficiently not to stick to the board. It needs watching. If care is not taken, warped wings and tail will result and flying will be hopeless. One of the secrets of the expert flyers is obtaining unwarped flying surfaces, which enable proper trim to be made.

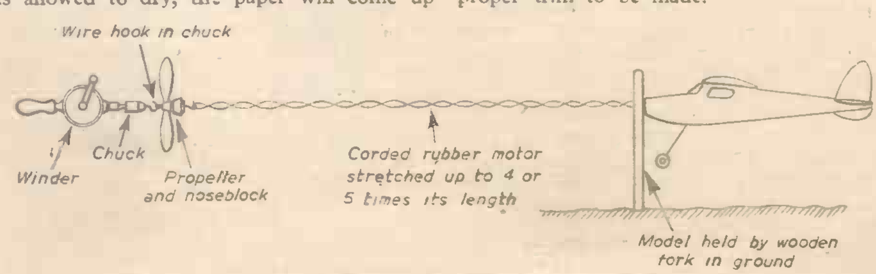


Fig. 7.—Stretch-winding a "corded" motor.

Another view of the finished monoplane on the ground and ready for a flight.

Remember.—Do not stretch that covering too much. Just lay it on *evenly*, and the water spray will do the stretching efficiently. Of course, if you put it on unevenly with vast wrinkles no amount of water shrinking will do the job.

The Rubber Motor

One of the troubles of a rubber-driven model is bunching of the unwound rubber motor, which has to be longer than the fuselage, when the model is on the glide. This may cause a shift of centre of gravity, and the model dives or stalls on the glide. This is best overcome by making up the motor by the "Corded method" as shown in Fig. 6. The cording makes the slack of the motor evenly spaced when unwound. It is a little more difficult for the novice at first, and means that the motor must be "stretch wound," using a "winder," made up from a geared drill brace, with a hook in the chuck. If an uncorded motor is used, it is best to fit one not too long, and to restrict the number of turns put in when wound up, and therefore keep the length of flights short. Even so, this model should get "upstairs" well, and have quite a long glide home when properly trimmed for a good glide. The beginner may feel this is the best method to gain flying experience, and later indulge in the "corded method" with geared winder. In any case, two things are vital, apart from buying only the very best rubber. These are: to fit rubber bicycle valve tubing over the hooks to prevent the wire cutting the rubber strip, and to use a really good rubber lubricant. Dry rubber always gives trouble, and will incur extra expense for replacement. Never overwind rubber motors. Fig. 7 gives details for stretch winding.

Flying the Model

Now comes the important moment. The secret of success in flying is getting *careful gliding trim first, and then controlling the power flight from stalling by alteration to the thrust line.* It is advisable for the newcomer to commence by controlling his model through stable flight trim. The finer shades of trim come with experience.

To this end the glide trim will be dealt with first. It must be quite beyond reproach before we even try a power flight. If it is not obtained and adhered to, the model will stall or dive when the power ends. Glide duration is lost, and the model will probably crash.

First balance the model on the fingers, with rubber in position, and ready to fly. This should be done indoors in still air. The model should balance about the halfway back position from the wing's leading edge to the trailing edge. If not, add a tiny piece of lead to nose or tail. If the model is built properly this will be very small as the design has allowed for the correct balance position. But people build differently, and balsa wood weight is variable, so there may be slight discrepancies.

Now choose a light and steady wind, and if possible take the model out to a soft grass field with longish grass, where the "blow" of possible bad trim glide will be softened until we have got the trim absolutely correct, when the model will glide down to perfect landings.

Launch dead into the wind with fin set

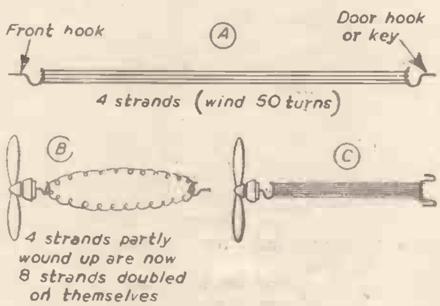


Fig. 6.—Make up the motor as at A; double the 4 strand skein over the propeller hook as at B, so that the motor becomes 8 strands. Allow the motor to go slack as at C.

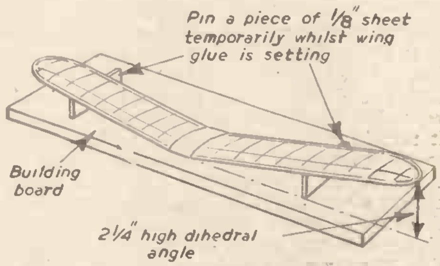


Fig. 4a.—Setting the wings to the correct dihedral on a building board.

straight, and throw the model like a dart at only a medium speed along a *level line,* and not upwards nor downwards. If the speed of throw is approximately correct, and the wind light, and the model's balance correct, it will glide flat and long, landing like a feather. The wing surfaces and tail must be square to the fuselage. (See Fig. 8.)

If the nose is heavy the model will dive slightly. Put a little piece of lead in the tail (temporarily retain it there under the tail rubber band), and try gliding again. If correct the nose will now come up and the glide will be good. It might be helped by a 1/16in. slip of balsa under the tail trailing edge, if it is still a trifle nose down.

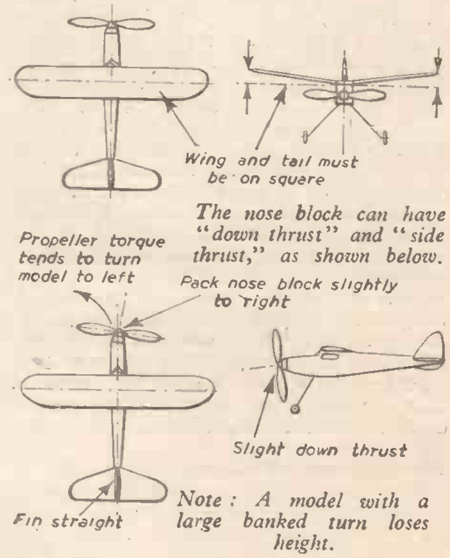
If, on the other hand, the nose has risen on the glide and the model balloons up in a stall, or even looks stallish, put a tiny bit of lead in the nose, and if the subsequent glide is better but not quite right, pack a 1/16in. sliver of balsa under the front (leading edge) of the tailplane.

Having got this long, flat glide right, build in the pieces of lead (if any have been found necessary) or the bits of balsa packing by cementing into or on to the fuselage with a little plastic wood, to prevent movement in a rough landing. *Your model is now a good glider when the power ends,* provided you now trim it so that it does not end in a stall during power flight, which is what so many modellers permit. The best climb of a model aircraft, unless it is grossly overpowered, is in an even climb, and not at some impossible angle like a helicopter.

At this stage, power flight in easy stages can be tried. First, wind up about 50 turns and have a 1/8in. slip of balsa between the *top* of the nosepiece and the fuselage former. Try a launch as for a glide, *with all glide settings untouched*; NEVER TOUCH THESE SETTINGS for general purpose flying.

If the model flies at low altitude, take away the packing and try again with about 50 turns. If it now slowly gains height try 80 or 100 turns and gradually increase turns in subsequent flights, using down thrust by the packing strip if necessary. It will be observed that a certain amount of down thrust has been built into the nose in the design. It may not be necessary to give more. During these test flights we must keep control of the turn by alteration to side thrust by strips of balsa, if necessary. It must be realised that a sharply-turning model will put its nose down on a banked turn, and a turn will prevent climbing. If excessive it will even nose the model into a spiral dive, which may end its life! In progressing with the tests it is necessary to keep the model TURNING UNDER POWER WITH A SLIGHT LEFT TURN. The natural propeller torque reaction will tend to turn it in left circles. Therefore it is usual to try the first flights with a slip of balsa of up to

(*Continued on page 245*)

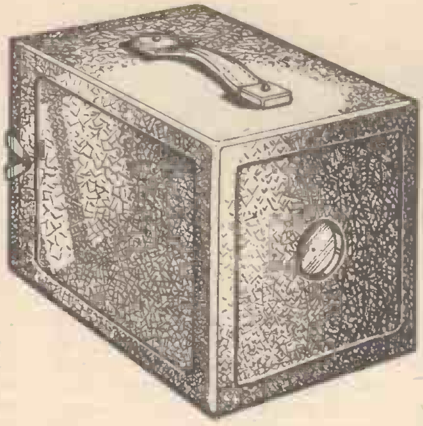


Gliding tests.

If model dives to the ground, as at A, put weight in tail.

If a model climbs and stalls, add a little weight to the nose.

Fig. 8.—Flying the model.



The Pinhole Camera

With Notes on Some of its Uses

By JOHN H. HAMMOND, A.R.P.S.

THE image-forming qualities of a small hole have been known since quite early times. The great master of science and art, Leonardo da Vinci, has left us a drawing of a camera obscura, which depicted a darkened room with a small hole in one of the walls, and on the opposite wall is shown the inverted image of the outside scene. In the early days of this century it was possible to purchase a pinhole camera, already loaded with a sensitive plate, together with packets of the necessary chemicals for developing and fixing.

To understand how an image is formed by a pinhole one should consider an object being visible because it reflects light in single rays from point sources over its entire area. If a screen with a hole the diameter of a ray of light is placed near the object then one ray from each point source will pass through the hole. A second screen placed near the first and parallel with it will receive the rays and so an image will be built up as illustrated in Fig. 1.

Size of Hole

Whilst we may be able to conceive a hole with the diameter of a ray of light, its production would be quite a physical problem. The hole, however, may be enlarged to visible proportions, thus allowing several rays of light from adjacent point sources to pass through. A narrow pencil of light would be admitted by the pinhole and received by the screen. The image so formed would be made up by a series of very small discs; such an image may be of an acceptable standard of sharpness and would not worry the beholder unduly. The sharpness of the image is governed by the diameter of the hole and the distance of the receiving screen from it, that is, the camera extension. A hole of too small a diameter would set up diffraction, causing unsharpness of the image. A series of diameters suitable for various camera extensions (the latter being somewhat variable) have been related to sewing-needle numbers, and a table of these appears in "The Dictionary of Photography."

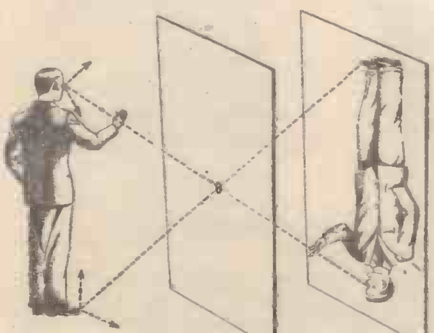


Fig. 1.—Diagram showing image formation.

Needle No.	Working Distance	W.P. No.	"f" No.
7	10in.	6	60
9	6in.	7	42
12	4in.	10	40

The "f" number is calculated by multiplying the W.P. number by the working distance.

The making of a pinhole presents little difficulty providing due care is taken. The most satisfactory material is a thin sheet of metal such as copper foil. The needle is pushed through and the burrs rubbed down on an oilstone. The edges of the hole should be as thin as possible, and this may be achieved by tapping the foil with a ball hammer before puncturing with a needle. For ease in handling, the pinhole may be sandwiched between card or metal plates and mounted in the place of the camera lens: the section and completed pinhole is shown in Fig. 2. The side of the completed mount facing the plate should be coated with matt black.

Exposure Times

Exposures are, of course, lengthy, and may be a little difficult to estimate. A relationship between pinhole size and an "f" number has been suggested. The exposure is calculated for this "f" number. The resultant time in seconds is converted directly into minutes and becomes the exposure for the pinhole in use.

For demonstrating image formation to beginners and students of photography the pinhole camera is ideal. Even a cardboard box with a hole pierced in the bottom by a compass point and a piece of tissue paper in place of a lid will illustrate the principles.

Needle No. 9; working distance 7in.; exposure 30 seconds on HP3 ½ plate flat film; diffused sunlight.

The technician and scientist sometimes require extreme wide-angle photographs and have resorted to the pinhole camera on occasions. At an R.P.S. exhibition a few years ago there was a photograph taken from the pilot's seat in a German aircraft by means of a pinhole camera. The purpose was to demonstrate the free vision of the pilot. The pinhole has also been used in the field of medicine for making photographs of cavities in the body.

Landscape Photography

Many fine landscape photographs have been made by a pinhole camera. This is perhaps the field to be enjoyed most by the amateur, for the pinhole is a lens which, within reasonable limits, is of variable focal length and of infinite depth of focus. The

Needle No. 9; working distance 9in.; exposure 30 seconds on HP3 ¼ plate flat film; sunlight; indoors.

former quality means that the required portion of the field may fill the plate exactly. The latter will give the fine, broad effects of a slightly diffused image which can make the rendering of landscapes so very attractive.

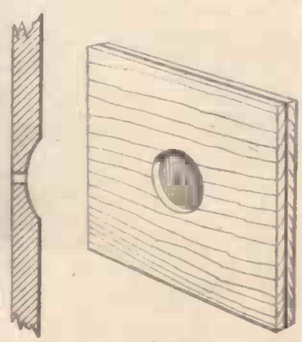


Fig. 2.—Enlarged section of pinhole and detail of mounting.

Writing in Sound

How Records are Made in the E.M.I. Studios and Factory

IT is one of the marvels of our age that any family can spend long evenings at home enjoying the very best of vocal or instrumental music. The gramophone brings them just what they'd like to hear at the time they want to hear it. They can listen to world-famous symphony orchestras, military bands, great violinists, or concert artists. The golden voices of prima donnas are there on the appropriate records. They can listen to the wisecracks of famous comedians, the sonorous periods of great statesmen, or the records of national singing festivals. The gramophone brings such pleasure within reach of all, so perhaps you will like to read something of how these records are made.

The Recording Studio

Not far from Lord's cricket ground there is what is probably the largest and best recording studio in the world. It was built by Electric and Musical Industries, Ltd., and it has studios ranging in size from 30,000 to 300,000 cubic feet. The largest is capable of accommodating an orchestra of over 250 performers and includes a large modern theatre organ in its equipment. There is room for an audience of a thousand people.

A famous orchestra is about to make a series of records. The scene is most impressive. Beside the conductor sits one of the recording staff with the full score of the work to be played in front of him. On the other side of a glass panel are the recording staff and engineers. They can see all that is going on in the studio, but they hear only through their sound reproduction instruments.

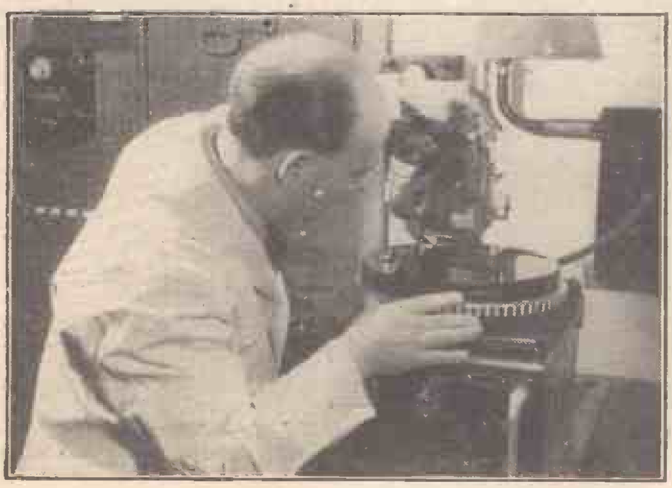
The work to be recorded is played over. Criticisms are made by the engineer through the telephone to the member of his staff standing by the conductor—too much trombone, too little of this, that or the other. The work is sometimes played over again, or maybe parts of it, to secure just the right effect. Then, when everybody feels happy about it, there comes a peremptory tap from the conductors' baton. A buzzer sounds and red lights glow to show that the engineer in charge has placed the cutting stylus upon the beautifully polished wax disc on which the performance is to be recorded.

A dead silence reigns. You feel afraid to breathe. You are conscious of the ticking of your watch. Then the music begins and carries on in crescendos of marvellous sound, everybody intent. The conductor almost seems to extract the music from absorbed figures around him. Nobody's attention wavers for a moment.

The record is finished, and once more we hear that pleasant babble of sound which represents a group of some 200 musical performers at their ease. Then silence once

The B.B.C. Symphony Orchestra records.

(Right) The recording engineer looks into the studio.



Cutting the run-in groove on the wax.

Engraving the eccentric groove operating autc-brakes on record players.

Dusting the wax surface with a fine, electrically conductive powder.

more for the play-back, which is made by recording tapes that have been receiving the sound at the same time as the wax disc from which the records are to be made if all is well.

The Wax Discs

You can imagine with what critical ears that play-back is listened to. Engineers and musicians all have to be satisfied. It may be that all is done over again for just a single fault; but this time everything has gone well. The play-back seems to satisfy everybody and the wax discs upon which the sounds have been written are carefully packed in special containers and sent to the record factory at Hayes.

The recording is an artistic and emotional experience that no witness of it will ever forget. The making of the record is an experience of another character. The wax discs are taken from the containers and dusted over with a metallic powder so incredibly fine in its texture that it makes no difference to the delicate impressions of the stylus upon the wax. It is sufficient to attract the particles of copper in the plating bath, in which the wax disc is placed and left revolving for several hours. By that time a thin but relatively strong negative shell has appeared upon the wax, from which it is carefully stripped—a work that requires highly trained skill and long experience. One of the illustrations conveys an idea of the ticklish nature of the work.

The sound traces which were on the wax appear in reverse upon this shell, which is termed the "Master." It is a negative of the original recording, the grooves made by the stylus appearing in relief as ridges. Records could be pressed from it, but it would soon show signs of wear, so the Master is again immersed in the plating bath and a "Mother" shell grown on to it.

The "Working Matrix"

This is a positive and no use for pressing records, so the Mother is put back in the plating bath and a third and final shell deposited, called the "Working Matrix." These are taken from the Mother as often as is necessary.

The Master is filed in a fire-proof vault, in which are stored thousands upon thousands of Masters, which represent the best of recorded art during nearly forty years. There the Master remains ready for use if damage to a Mother shell makes necessary the making of a new one.

The Working Matrix is now used for pressing sample records, which are rigorously tested for technical and musical quality before bulk production takes place.

The record material is an extraordinary fine mixture of shellac, resin, copal and other materials. It is a black substance which is hard at normal temperatures but becomes plastic under heat. The mixture is very thoroughly refined before being passed through heated rollers, which grade it to a uniform thickness and mark it in sizes suitable for 10 and 12-inch records. When broken up these pieces of material are known in the factory as "biscuits." They are taken to the pressing room, where an operator has fixed two working matrices into position in a press for making a two-sided record.

Pressing the Record

From the heated slab by the press the operator takes a "biscuit," rolls it into a ball and places it in the centre of the press, which closes with a force totalling nearly 100 tons. Steam is circulated behind the matrix as this pressure is applied, and that is followed by water cooling. Then the press opens to reveal one of the familiar black, shining discs. The edges are buffed, the discs are polished, and away they go for final inspection. A conveyor takes them to the stores, which carry a stock of some four million records. They emerge for the despatch room whence they go to the shops to gladden the hearts of music lovers all over the world.

The organisation behind the production is complete in every respect. Whilst recordings are made in the studios, others of equal

The copper shell or Master being removed.

Left) Joining the matrix to the backing.

(Right Moulding a record in a press.

(Photos by courtesy of Electric and Musical Industries Ltd.)

quality and interests are recorded by the vans and travelling staff that make records all over the world.

This business of making records has been organised to the last dot. All the studios in this great house where they write in sound can be linked together at any time through the central amplifier room, and that is done when the necessity arises for recording performances on several waxes or tapes simultaneously.

Recording "Noises Off"

There are separate rooms for the maintenance of the recording gear and the grinding of the sapphire styli by which these wizards of sound record the art of generations. There is a special recording department which provides recordings of background music and effects, noises for films, plays and the radio. They cover every conceivable type of sound, from those of farmyard animals to planes flying and artillery in action. Yes, Electrical and Musical Industries, Ltd., have made an art of recording art, by which they bring pleasure and education into thousands and thousands of homes all over the world.

Two-note Door Chimes

A Simple and Efficient Conversion Utilising a Standard Door Bell

By P. F. HAMM

THE striking unit of these chimes is so arranged that, when the door press is operated, the armature is drawn over and stops, making the clapper and wire whip far enough to hit chime one. On release the armature spring reacts and chime two sounds. As both oscillations are damped, careful adjustment of the chimes prevents a second strike. The results compare well with the more conventional solenoid.

Many readers will no doubt find most of the few required materials handy, probably left over from the previous job, except perhaps for the tubes.

The materials required consist of about 14in. 18-20 s.w.g. piano wire; 1in. of ¼in. OD copper tube, thick walled; 9in. of ½in. by ⅛in. M.S. strip; 2 electrical terminals of the type with an annular groove; 2 more complete for base fixing; 3in. of 2 B.A. rod; 5in. of 12 s.w.g. wire. Also a piece of hardwood for base, 5½in. by 4in. by ½in.; wood or leather for clapper faces; and a small piece of rubber for a buffer. Any type of bell will do, though it is doubtful if the small buzzer types would produce enough power.

The Bell Unit

The bell and its immediate mounting are removed. So is the fixed contact and its mounting, as they are not required; nor is the moving contact.

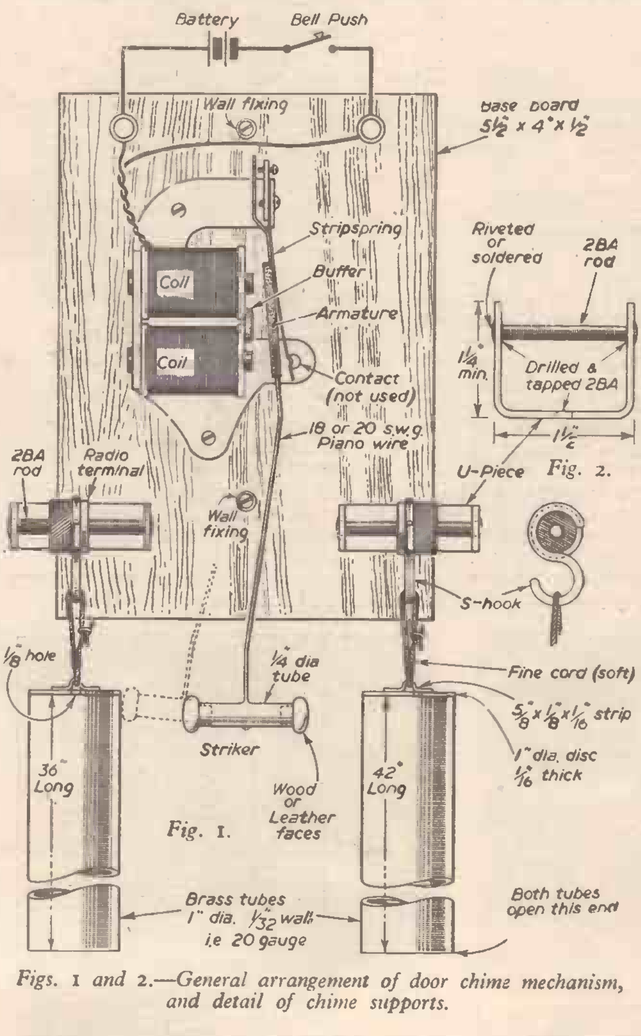
The clapper and wire are removed from the armature and the piano wire soldered in their place. The ¼in. diameter tube is drilled transversely with a No. 56 drill and sweated to the other end of the piano wire. If thick-walled copper tubing is not available, the substitute should be loaded inside with solder. The unit can now be screwed to the base board leaving the two coil ends visible. (Fig. 1.)

Chime Supports

The strip metal is cut in two and each bent to form a square U shape, as shown in Fig. 2. They are drilled No. 24 and tapped 2 B.A. Run the terminals on the rods and rivet or solder the ends. The 12 s.w.g. wire is formed into two S-hooks, one of which is fitted into the groove of each terminal, just free enough to allow easy rotation of the terminal. The supports are now fitted to the base with c/s machine screws from the rear, in the positions shown.

The Chimes

For these, 3ft. and 3ft. 6in. lengths of 1in. O.D. 20 s.w.g. brass tube will be found to give a pleasing tone. One end of each is closed with a brass disc and an eyelet formed to take the cord loop. The disc has a ⅛in. diameter hole in its centre. The other ends are filed clean and left open. Two buffers, shaped from wood or leather, are fitted to the striker tube. They affect the tone to a considerable degree. Wood produces a loud, and leather a softer but mellower, tone. The base is now hooked to the wall to enable the length of cord to be decided upon. With the S-hooks in a mid position, vary the length until the buffer strikes at the top edge of the chime at its nearest point, i.e., with the striker in a line with both chime centres. The cord is then knotted and the chimes removed.



Figs. 1 and 2.—General arrangement of door chime mechanism, and detail of chime supports.

Back on the bench the details can be attended to. The two coil ends are taken to terminals at the top of the base board either direct or through convenient holes and channels under the base. The polarity is not important. On the wall again final adjustments can be made. With the coils energised the striker should not quite touch the left-hand chime, adjustment being made by rotating the terminal. The exact position will be obvious from the sound. A similar adjustment will position the other chime. The base must be secure on the wall or the adjustments will be thrown out. The rubber buffer shown between the coils reduces the noise of the armature and should protrude just beyond the pole faces. Leather or resilient plastic could be used.

Batteries

The dimensions quoted for the base board are for use with external power. Mains transformers, 6v. and 2v. accumulators have been tried and found satisfactory, though these will depend somewhat on the coil size.

If a dry cell is to be used it could more conveniently be built in. The twin-cell cycle battery (E.R.800) is recommended.

The design of the casing is left to the reader. By elongating the clapper hole in the original bell cover this could be used, or a more distinctive affair can be made up of sheet metal.

The advantages of this unit have no doubt occurred to the reader. Simplicity and cheapness are obvious. Battery economy is another. The power consumed is appreciably less than for a similar solenoid unit, one reason being that there is no friction other than air to be overcome. So the impedance can be higher and current lower. Another advantage is that it can be made up in an evening or two.

The writer obtained the chime tubing (and at various times much other material) from Messrs. Stantons, of Shoe Lane, London, E.C.4, though it is not guaranteed as a source of supply since the recent restrictions.

LOCOMOTIVE VALVE GEARS

Constructional Details of Models of Valve Gears in Wood and Metal

By E. W. TWINING

WHY models of valve gears and, if made, what purpose do they serve? The answer to these questions lies in the difficulty which the mind of the uninitiated has in understanding exactly what happens in the cylinders of an engine when steam is turned on and the valve, which admits it to and cuts it off from, the cylinder, is moving.

Even to the skilled locomotive designer, the draughtsman and the shed foreman such models are most useful because by means of them it is possible to study not only the points in the stroke of the piston at which steam admission ceases, and when, having completed its work by expansion, it is released to the exhaust pipe, but also the effects of "linking up" in all positions of the reversing lever for the purpose of obtaining earlier cut-offs, with longer periods of expansion and with the resulting economy of steam, water and saving of fuel. Through the use of such models it is possible to plot, with a fair degree of accuracy, a whole series of indicator diagrams so that the power and performance of the engine can be forecasted before it is actually built.

The chief use to which models of valve gears are put—and were put in the years before the last world war—is the education of locomotive drivers and firemen, especially in Crown Colonies and foreign colonial possessions where native labour has to be trained. Prior to the year 1939 the writer's firm, Twining Models, in Northampton, made many of these valve gears chiefly for abroad—India, Australia, South Africa, Rhodesia, Nigeria, The Argentine and Egypt. Not one of the four grouped companies at home ever officially ordered models, but a few of the Mutual Improvement Classes formed amongst the enginemen at large depots did so.

A Full-scale Model

The most perfect and complete model made under the writer's supervision and from his drawings is illustrated in Fig. 1. In this the central portion of a 2-8-2 type engine is reproduced with bar frames and both of the cylinders, with their valve chests sectioned, so that both sides of the engine can be studied at the same time. The scale was: one-quarter full size, the coupled wheels being 13½in. diameter. All parts were of aluminium, for the sake of lightness in carrying, and were machined, with a few exceptions, from castings; even the axles and crankpins were cast, and the axle boxes, connecting-rod big-ends and coupling rods were lined with soft material, oil-saturated to prevent abrasion.

The piston stroke was marked off on the sectioned cylinder wall and divided into ten parts, numbered from 0 to 100; thus the position of the piston could be read off on either forward or backward stroke to the exact percentage of that stroke to accord with the precise cut-off and release positions of the piston valves.

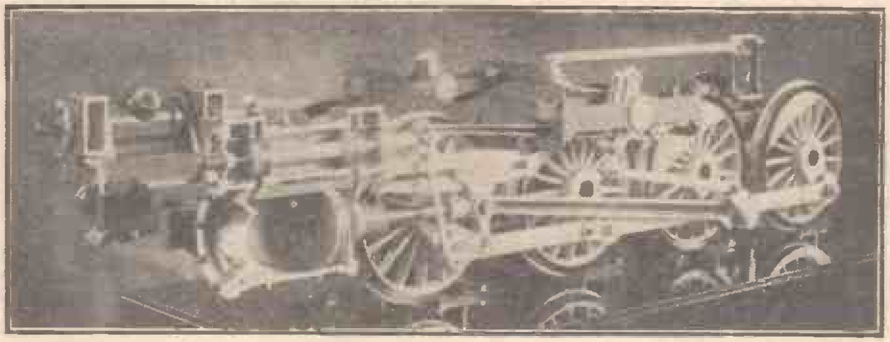


Fig. 1.—A three-quarter front view of a Walschaerts gear model showing both cylinders.

When the model was completed it was gratifying to find that the cut-off in full forward gear came out rather better than those projected by the drawing office for the full-size engines. In back gear cut-offs were the same as designed. The actual figures were: forward gear (front port), 77 per cent. of stroke; back port, 76 per cent.; backward gear (front port), 78 per cent.; back port, 75 per cent. Both cylinders gave the same results. Certain parts were polished bright, the rest enamel-painted in two shades of grey relieved with black. The whole model was mounted upon a polished mahogany, framed-up baseboard.

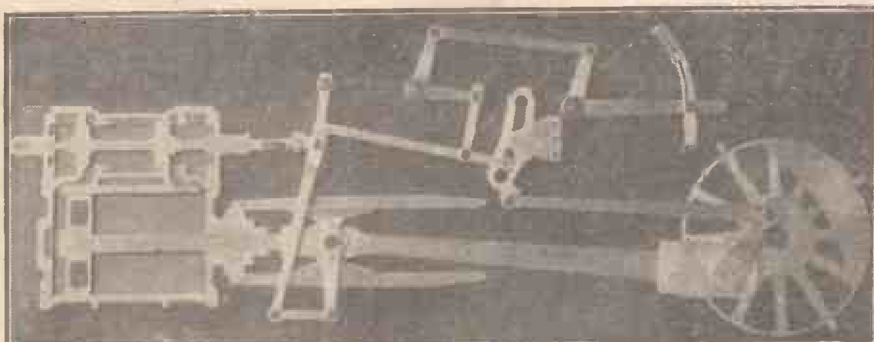


Fig. 2.—A flat model of the Walschaerts gear for Rhodesian Railways.

Fig. 3.—A flat model of the Stephenson gear.

Flat Models

By far the cheaper method of making models of valve gears is to cut all the parts from plate which, especially for rods and links, must be stiff enough to prevent buckling under compression; this means that for their lengths they must be thick. At the same time, when the models are to be used for instruction and lectures they must be large enough to be seen by the whole class; consequently, in order to make them readily portable they must be light for carrying.

Fig. 4.—A small mass-produced diecast model of the Walschaerts gear.

From the point of view of class visibility nothing less than one-quarter full size is of much use and that was the scale adopted in all the many flat models turned out for class instructional purposes by the writer's firm. Two of these are shown in Figs. 2 and 3. The first is of the Walschaerts gear, of which a great number were made. The other is of the Stephenson gear, representing one side of an inside cylindered engine with cranked driving axle. Since this type of engine is almost obsolete in the Colonies, only a few of these models were ever made. In order to watch the valve events, it is necessary to look down upon the slide valve, which is of the flat or "D" type, working in a valve chest between the cylinders and having, of course, outside admission.

On one-fourth scale the length of these models averages about 4ft. 6in., and the maximum thickness from back to front, including a mahogany plywood back panel, a fraction under 1½in. All the parts, excepting screws, pins, etc., are cut from aluminium sheet of two different gauges. The backplate, representing the engine frame, is of No. 12 S.W. Gauge, so are the cylinder parts and a few of the smaller links, but the majority of the working rods and levers and the expansion link are of No. 10 S.W.G.

Stephenson Gear Model

The Stephenson gear model is a little shorter and, measuring through the crank axle, considerably thicker. This increased thickness is, of course, due to the fact that next to the frame there is a large washer; then come the two crank webs with crankpin and clearance for connecting-rod big-end; then the two eccentrics, each sheave made up of three plates and, outside of all beside a washer, the bracket to support the free end of the shaft. In these models the eccentric outer plates were of brass, polished and lacquered.

The next illustration (Fig. 4) depicts a very much smaller flat model. This was designed and produced, with working parts of diecast metal, to meet a demand for a valve gear for personal study. The length was about 14in. and thickness about 1in. The scale was ¾in. to 1ft. and represented a cylinder of 20in. diameter by 26in. stroke. The backplate was of No. 12 sheet aluminium and there was no wooden backboard. The sectioned face of the cylinder was calibrated in tenths, as in the large models, and there was a fine adjustment for correctly positioning the valve.

Wooden Models

A model constructed of wood, similar to that shown in Fig. 4, could be made by any locomotive enthusiast or builder of model locomotives in hardwood, and the cylinder fret sawn from several thicknesses of plywood. All the parts could be cut from plywood, including the expansion link but excepting the connecting and eccentric rods which had better be of straight-grained hardwood. Wood screws can be used in many places for pivots, and some parts can be glued and pinned together. The writer's first valve gear was made of wood, nearly 50 years ago, at a time when he was preparing drawings for a large-scale model locomotive. The gear was the Stephenson link motion, but the model gear was not of the flat type. A full double web inside crank was made and two normal eccentrics. The "D" slide valve, valve chest and the cylinder were all sectioned horizontally. That model served its purpose admirably and lasted for over 30 years.

Should anyone feel inclined to make a flat model (such as those in either Figs. 2 or 3) of wood, it is recommended that, even if it is required only for individual study, a scale of not less than 1in. to 1ft. be adopted and even then it would be best to make the expansion link of metal.

Walschaerts Gear Model

Coming now to something more practical: a layout for a Walschaerts gear model is reproduced in Fig. 5. This shows an elevation and below it a horizontal section indicating all the parts. It is intended that this model shall be made in exactly the same way as was the subject of Fig. 2, that is to say: cut from aluminium plate and mounted upon a plywood panel. But it is quite possible to make it of wood, preferably hard oak or Honduras mahogany. If wood is used all thicknesses will have to be increased and consequently all pins and screws increased in length. It is, however, strongly recommended that metal be used throughout for the sake of obtaining the greatest possible accuracy.

Size and Scale

In order to avoid being too arbitrary regarding size and to render it possible for any scale to be adopted, no dimensions have been written on the drawing; instead a scale of inches has been appended which scale was of actual inches in the author's drawing, from which the accompanying reproduction has been made. By means of a pair of dividers, and the scale, it will be found that the cylinder measures 2½in. diameter by 4in. stroke. All other dimensions can, of course, be taken off in the same way.

Scale Reduction

But the reader will doubtless like to know what this cylinder represents from the point of view of scale reduction and what size engine is produced by this 2½in. by 4in.

(To be continued.)

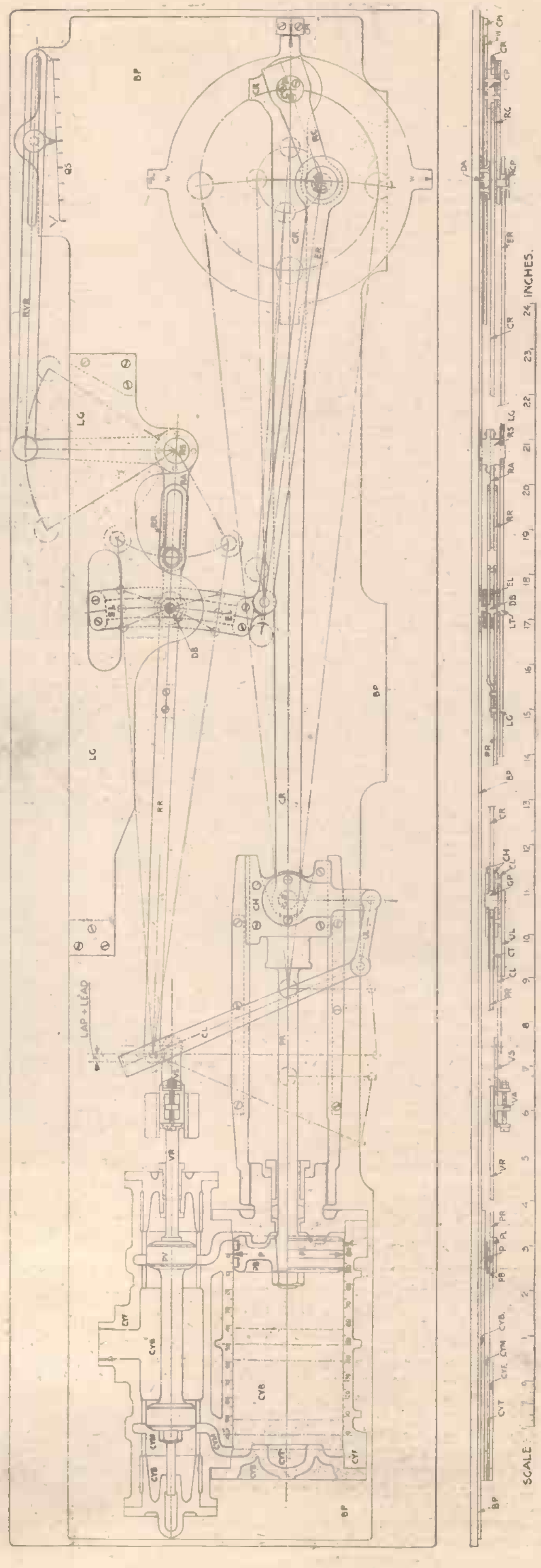


Fig. 5.—Elevation and sectional plan of a valve-gear flat model.

The Electron Explained

The Still Mysterious Particle and its Overwhelming Importance in the World of Matter

By J. F. STIRLING

FIFTY-FIVE years ago the electron, after an existence reaching back through the illimitable depths of time to the very beginnings of material creation, revealed itself to mankind. At the behest of a modern genius of electrical physics, son of a Manchester book-dealer and a one-time locomotive-works apprentice, the electron, for the first time in history, made its bow to the world of science.

That was fifty-five years ago and now, as a direct result, we have the atomic bomb, which is, perhaps, a consequence on the debit side of this fundamental discovery. Equally attributable to the electron's discovery, to the subsequent development of the science of electronics and to the investigation on the electrical properties of the atom, there have come to us radio, television, and atomic energy, creations which surely are to be placed to the credit of the electron's introduction to thinking humanity.

The story of Sir J. J. Thompson's demonstration of the electron's existence reads like a romance, which, indeed, it is; but space precludes us from entering into a detailed description of his patient investigations of the various phenomena set up as a result of forcing electricity through different degrees of vacuous space. For the time being, we must accept Thompson's discovery of the electron in 1897 as a fact, and leave the narration of the various proofs of this momentous revelation of science to be dealt with on some other occasion.

Nature was in a very self-revealing mood at the end of the last century. Cathode rays, the then highly mysterious "X"-rays, the electron, radium and radioactivity, the beginnings of scientific research on the atom and a knowledge of the fundamental nature of electricity, all came within the space of four or five years, so that at the close of the century the scientific world was very busily engaged in elucidating matters of the very highest and the most fundamental scientific importance.

It all began with a sort of scientific curiosity to see what would happen when a current of electricity was passed through a vacuous space. Air is an electrical insulator, and, for this reason, it takes a very high electrical potential to force a passage through even a single inch of dry air; but when electrical potentials were applied to the electrodes of glass tubes which had been exhausted of most of their contained air, a very different thing happened. The current passed through the tube with relative ease, but instead of generating a thread-like spark, it filled the exhausted tube with a diffused glow, a phospheric radiance which was very characteristic and which gave rise to innumerable experiments.

A remarkable photograph which renders visible the electron path between the filament and plate of a radio valve.

The "Dark Space"

Strangely enough, however, it was found that if, by more refined methods of pumping, the gas pressure inside the tube was made very low, say 1/10,000th of an atmosphere, a non-luminous space was formed in front of the cathode or negative electrode of the glowing tube. This was the famous "dark space" of Sir William Crookes, one of the first pioneers in researches dealing with electrical conduction through gases. As the degree of vacuum within the tube was progressively raised, the "dark space" became greater and greater until eventually it filled the entire tube. At this stage the glass walls of the tube began to glow vividly with a greenish phosphorescent light.

The late Sir J. J. Thompson, discoverer of the electron.

This greenish glow was really the commencement of the electron's discovery. It was clear to Crookes that the glow was caused by some invisible influence or radiation proceeding from the cathode of the tube, although what exactly this radiation was, Crookes was unable to fathom. He thought that the substance of the radiated influence was matter in a fourth state. By this theory therefore, there were solids, liquids, gases and the new "radiant matter."

The theory did not receive much support and there was a competing theory which held that the invisible radiation which set up fluorescence when it impinged on glassware was an electromagnetic radiation of wave structure and very closely akin to light and to the then newly discovered wireless waves.

Dr. Joseph Thompson, of Cambridge (as he was then), showed that the mysterious radiation from a highly evacuated tube normally travelled in straight lines only and that, like light, it would not ordinarily "go round corners." He showed that when a solid object was placed in the path of the mysterious "something" ejected by the cathode a shadow was formed at the opposite end of the tube.

Going further, Thompson showed that the "rays" from the cathode could be deflected from their path by means of a magnet, and that this deflection might be observed by a consequent movement in the glow of the excited glass. Hence, said Thompson, this particular radiation, these "cathode rays," cannot consist of electromagnetic wave-motions, similar to light, or wireless wave or "X"-rays. They must be made up of particles.

Negative Particles

They were negatively-charged particles, because they come from a negative electrode, and by simultaneously deflecting the cathode rays by an electric and a magnetic field placed at right angles to each other, Thompson was able to measure the ratio of the electric charge of the particles to their mass and, also, to determine the actual speed of the particles.

It turned out that the mass of these particles was about 1/1,850th that of the smallest material unit then known—the hydrogen atom. Further still, identically the same particles were produced whatever the nature of the cathode might be.

Here Thompson felt himself confronted with something which was even more fundamental than an atom of matter, if only for the reason that it could be proved to be many times smaller than the smallest of atoms. The mysterious cathode ray particle always carried the same negative charge, no matter what its origin might be. Clearly, therefore, it must be a particle common to all matter. It must be a *constituent* of matter . . . of atoms.

Hence atoms must be complex. They must no longer be regarded as the solid, billiard-ball types of entities which old John Dalton and the rest of the scientific philosophers, ancient and modern, had postulated them as being. Atoms must be made up of parts, and because one of the parts of

The old type of frictional electric machine, which generated static, spark-giving electrical charges mainly by virtue of its tearing away of electrons from the surface of the revolving glass discs.

the atom which Dr. Thompson had revealed was negatively charged, other parts of the atom must be positively charged, for the atom itself is quite neutral in electrical reaction.

Mystery of Matter

Always mysterious in its make-up, the atom of matter suddenly became even more perplexing and incomprehensible.

Thompson called his newly-discovered particles "electrons." The name, however, was not his own. It was first coined in 1891 by Dr. Johnstone Stoney, who was then arguing that electricity consisted of a flow of particles. To what he called the "natural unit of electricity" Stoney applied the term "electron."

Stoney was very near the truth, but he did not quite attain it. To him, an "electron" was an electrical *unit* only, in much the same way as an ampere is an electrical unit. Thompson's "electrons," however, were actual particles of *something*. They were tangible, not mere measurements of something.

Afterwards, it came to be realised exactly what the Thompson electron was. Not only is it a fundamental constituent of all things material, that is to say of all atoms, but it is, also, electricity itself in its negative condition.

At one stroke much of the mystery of electricity was solved. Electricity could no longer be regarded as a mysterious "fluid" which permeated all matter. The "flow" of electricity, the electric current, in fact, was nothing more or less than a stream of individual electrons flowing from one object or one place to another.

Because this electron flow is so readily brought about, given the right conditions, individual electrons, it followed, must only be loosely attached to their atoms. Whenever you created an electron deficiency in a mass of matter, electrons would always flow into it from other sources whenever they were able to do so, this electron-flow constituting the electric current. Nature, it would seem, always tries to keep her masses of matter electrically neutral just as she invariably endeavours to keep areas of water at the one dead level. Hence, just as water will always flow from high to low levels, so, also, will electrons flow from high to low electron potentials, that is to say, from areas of electron abundance to areas of electron deficiency.

Electric currents, therefore, are merely electron streams. Static charges of electricity are, in the case of negative charges, just accumulations of electrons which remain more or less stationary in one area.

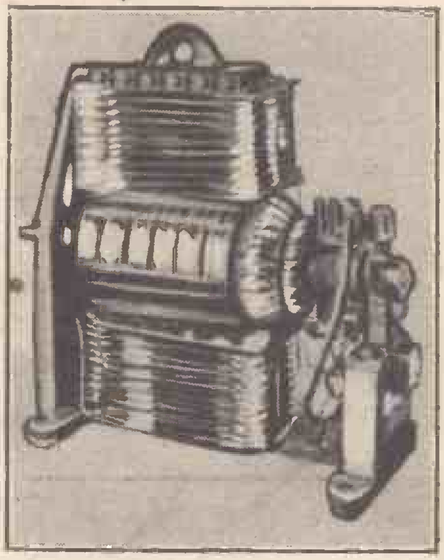
Glass-rod Experiment

Here the old experiment of the glass rod and the pith-ball is revealed in a new light.

When the glass rod is rubbed with a silk handkerchief, some of the more loosely held electrons of its surface atoms are actually torn away by the rubbing. Hence the rod becomes deficient in electrons. The rod, therefore, becomes *positively* electrified, because it has not now sufficient negative electrons to counterbalance the positive charges on its atoms. It becomes positively charged simply because it is deficient in electrons or, what amounts to the same thing, because it has an overplus of positive charges.

The handkerchief, conversely, *gains* electrons. Thus, it obtains an excess of these negative particles, and becomes negatively charged.

Exactly the same reasoning applies to opposite electrical potentials of all kinds and all magnitudes. When electrons accumulate between cloud and cloud, or between the earth's surface and the upper regions of its atmosphere, electrical potential grows. Were these mighty potentials to mount up in an unlimited manner, life would become impossible on earth. Fortunately, however, there is the phenomenon of thunder and lightning. It is life's great protector.



A simple type of dynamo. Essentially this machine is merely a pump for driving electrons through an external circuit.

Sir J. J. Thompson showed that no matter what sort of metal he used for his cathodes, the electrons which were shot off from it were always the same. In other words, there are no different kinds of electrons. Those derived from gold are identical with the ones which are ejected from nickel or iron or platinum. Electrons, it was realised, are all of the one fundamental kind. Their nature is quite independent of the character of the material from which they are derived.

Subsequent physicists, beginning with the late Lord Rutherford, were able to demonstrate exactly how electrons function as vital constituents of atoms, exactly how they are arranged and lined up in atoms and precisely how they can be made to behave by the different strains and stresses under which atoms can be placed.

How the Elements Differ

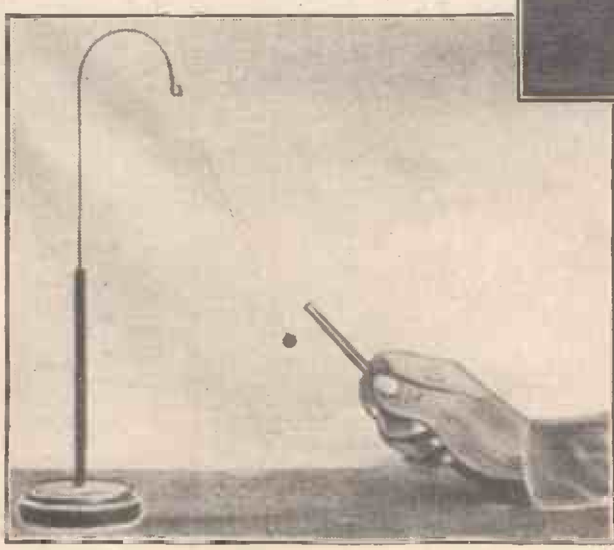
Electrons not only lie at the root of all electrical phenomena, but they are also responsible for all chemical actions and reactions. The elements of matter—carbon, oxygen, hydrogen, zinc, gold, platinum, and so on—merely differ from one another in regard to the number and the arrangements of electrons which they contain. Yet the electrons of, say, a carbon atom are exactly the same in nature and properties as those of an atom of zinc, or of silver.

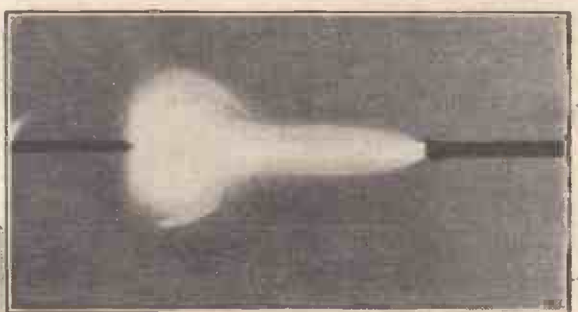
When elements unite and bind themselves together, as, for example, when two atoms of hydrogen unite with one atom of oxygen to form water, H_2O, it is by means of the electrons of the atoms that this chemical linkage is secured. When, by any means, we are able to break and destroy this electron linkage, the water vanishes and the constituent elements, oxygen and hydrogen, again appear.

What are electrons? What is the make-up of these mysterious entities, so inconceivably tiny and yet so prodigious in their properties? The fact that they exist cannot now be denied. The fact that they possess well-defined characteristics and properties which are capable of being measured and observed is, also, too evident to gainsay: but what is the real and true nature of these sub-atomic specks, whose size, incidentally, has, on various theoretical grounds, been estimated as being about one-hundred-thousandth of the radius of an atom?

It is here that we come up against one of Nature's still unsolved mysteries. There are various theories—many of them well-grounded—which attempt to account for the true nature of the electron, but none of these theories is in any way completely satisfactory because, to us, the electron seems to have Jekyll and Hyde propensities. In other words, the electron appears at times to possess something of the nature of a dual personality. Usually it seems to behave as if it were a tiny particle of solid "substance" or matter, as if it were something almost at the limit of smallness yet definitely hard, unyielding and impenetrable. On the other hand, there are circumstances when the electron acts as if it were not material at all, as if it were materially nothing, and, rather, a mere vibration of incredibly minute wave-length—a mere vibration between two fixed points, something

(Below) The glass rod and pith-ball experiment. When the glass rod is rubbed with a silk handkerchief, loose electrons are removed from its surface and it becomes positively charged, in which condition it is able to attract light substances to itself.





The electron flow made visible between two electrodes charged to a very high potential.

akin, perhaps, to the vibration of a violin string.

Atom Replica

Then, again, there is a theory which would account for the make-up of electrons by assuming that they are all composite and that, almost unimaginably small as they are, they consist of a number of still smaller particles revolving around a fixed nucleus with the velocity of light, that is to say, at a mean speed of the order of 186,000 miles per second.

In other words, according to this "composite" theory, an electron is just another atom in miniature. It is a replica of an atom on a scale whose incredible smallness must practically transcend the bounds of our imagination.

Perhaps such may be the case: perhaps not, but, generally, it does seem that electrons, which have such definite and tangible properties, the entities whose flow gives rise to the phenomenon of the electric current, are something more than mere vibrations, mere waves.

Besides which, if an electron is only a wave-motion, what is the nature of the medium which thus undergoes the motion or disturbance? After all, you cannot have motion without having something to move. You cannot set up a wave-motion with *nothing*.

So that, on philosophical grounds such as these, it seems that we must allow the all-important electron to have a tangible existence, as, say, a sub-atomic particle whose nature is quite unknown to us precisely because it is pitched, at is were, beyond the range of all material entities. In other words, an electron is only a *constituent* of matter. It is not matter itself. Hence, individually considered, it must have quite different properties and, indeed, an inherent nature quite different from matter as we know and observe it every day of our lives.

The Electron Spins!

There are, however, physicists who have gone so far as to assert that the electron (whether wholly solid or a mere association of still more minute particles) is in a state of rotation on an axis within itself in much the same manner as our earth rotates on its own axis.

This supposition is derived from the phenomena of spectral analysis. If, for example, a grain of common salt is heated in a flame, it gives rise to a very strong yellow line in the spectroscope. Close examination with very refined instruments shows this apparently single line to consist of two lines spaced very close together. In order to explain the occurrence of "double" spectral lines such as this, mathematical physicists assert that it is necessary to assume that all electrons have an inherent rotary movement, or, in other words, that they have a spin.

We may, if we wish, picture an electron as a tiny sphere having a charge distributed over its surface. If we imagine this sphere to revolve, we shall see that the charge moves round a closed circuit, for which reason the electron can behave as a small magnet.

Direct measurements can show that an electron has mass or substance. But in some mysterious way, the mass of an electron is entirely dependent on its charge. Hence, the "substance" of an electron must consist of electricity and nothing more.

Facts About Hafnium

Some Characteristics of This Rare Metal

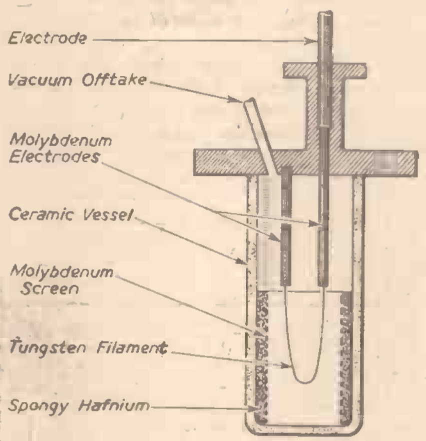
By "TECHNICUS"

UNTIL as late as 1920 the metal hafnium was known only on paper, for it had not been seen or examined. Its existence had been, first of all, suspected and anticipated on theoretical grounds. Then in 1920 came confirmation of its actual existence, and two years later it was isolated and examined in minute quantity. Radium and other radioactive metals are, by comparison, venerable old metals, which makes it all the more remarkable that we know so much about it, and have found a way of producing it in sufficient quantities to be able to put it through its paces with engineering tests, like steel. But more significant still is the fact that some of these rare metals, which seemed to be of little use to the metallurgist, are, unexpectedly, showing properties of considerable promise. Zirconium, for example, which is a relation of hafnium, gave very little hope of being useful until it was found to offer valuable alloying qualities in aluminium and magnesium mixes. And the story of this metal is now being unfolded at a pace which outsteps the production capacity.

At present little is known about the possibilities of hafnium, but from what has been gathered already of its physical properties, it cannot be turned down as "just another of those new-fangled metals." In its melting point alone we have a clue, for 2,130 deg. C. is very high, while its density of just over 13 (iron is 7.8) classes it as a heavy metal. It has been found recently that hafnium occurs in the world more abundantly than silver and mercury and other rare metals already in prominence, which is surprising, considering that it remained hidden for so long, after radium and a host of other metals had been discovered. Norway has deposits of a mineral called alvite, which contains about one-third of hafnium, while Brazil also has minerals holding it. The main trouble up to now has been to recover the pure metal from ores, it being difficult to disentangle, as it were, hafnium from its relations like zirconium.

Separated by Fractional Distillation

When it is desired to separate out the various components of petroleum the engineer distils it, collecting the fractions that come over it at convenient temperatures. This technique is nowadays used to separate metals, and this method has been employed by Felix B. Litton, in the United States, to



Apparatus for the production of iodide hafnium.

get hafnium away from zirconium. By its means he has prepared 350 grammes of pure metal to enable it to be tested for mechanical and other properties. Whereas before the metal isolated by other research workers had possessed little lustre and seemed to have been given artificial properties by occluded gases, that prepared by Litton offered lustre and more typical properties of the metal.

He prepared a complex mixture of salts of the metal with naturally occurring zirconium impurities, and distilled these under reduced pressure. The distillate consisted of hafnium chloride with phosphorus oxychloride, which was dissolved in alcohol. The oxide of the metal was then thrown out by ammonia and converted into a tetrachloride. This was turned, with magnesium powder, into impure hafnium metal in a spongy form. To purify this the impure metal was converted into the terraiodide and, finally, into pure hafnium.

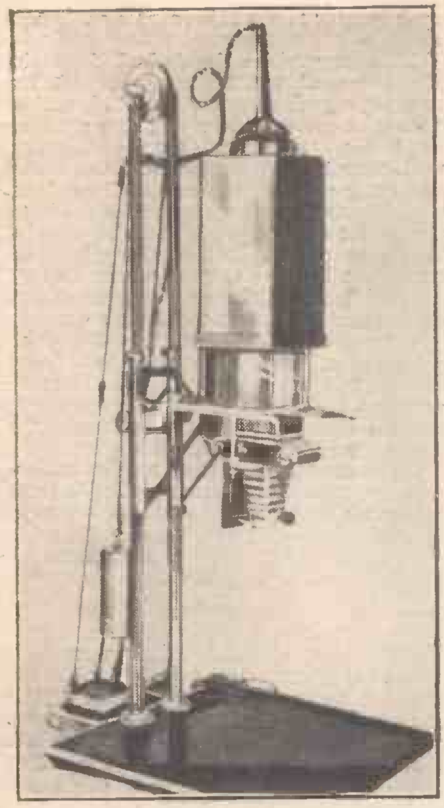
The final stages in the production of pure metal sponge, or iodide hafnium as it is called, are interesting, and the apparatus used is shown in the accompanying sketch. The principle depends on the fact that iodine reacts with hafnium to form a tetraiodide. The latter decomposes at 1,100 deg. C. to form pure metal and iodine. The iodine is drawn off by the vacuum, and a sponge of pure hafnium is held on the molybdenum screen shown in the sketch.

Some Recently Found Properties

It requires only a very small quantity of a substance to-day to permit the chemist or physicist to determine the properties of that substance, thanks to the spectroscope, X-rays and michrochemical analysis. But to probe the mechanical features of a metal one usually requires some pounds or, at least, sufficient to be able to prepare bars, to roll and extrude. Litton has found that the metal he has prepared was not as malleable as zirconium, and tended to be fractured when cold-reduced by more than 30 per cent. The following hardnesses were found for the iodide hafnium, or sponge form of the metal: Rockwell A43, Rockwell B78, Vickers 152.

It was found in the course of the work that ductile rods of the metal could not be formed until the spongy deposit had been thoroughly degassed. Previous workers had drawn attention to the fact that hafnium was not malleable when such gases as hydrogen were present. The resistance of the metal to oxidation is considered very good, but not quite as good as zirconium. Mention has already been made of its melting point, a crystallisation transformation occurring at around 1,310 deg. C.

With an atomic weight of 178, hafnium can be reckoned among the heavier metals, although it cannot be classed with the radioactive metals. Its resistivity is high, at least, for the spongy form of the metal, which tends to suggest that its future as an electrical conductor is limited. But adequate tests have not yet been made of its alloying properties, and in this alone there is an unopened chapter. One cannot underestimate the difficulties of separating hafnium from other metals which exist at present, but with the example of aluminium and magnesium in front of one there is little doubt that if some valuable property comes to light it will not be long before a large-scale commercial method of extraction will be devised.



General view of the completed enlarger.

Making a Ve

Constructional Details of Apparatus for En

TO the amateur photographer who has practised his interest to any extent at all, comes sooner or later the desire to indulge in one of the most fascinating branches of photography—enlarging. Present day prices, inflated as they are, are sufficient in some cases to debar him from this, and it was with this idea in mind that the "120 Vertical Enlarger" was built.

General Considerations

Whilst being inexpensive to build, it is of sound construction, and employs readily available materials and a minimum of machining. It was designed mainly for the user of the popular "120" folding camera, and it employs the camera itself in place of the expensive enlarging lens. Any "120" folding camera may be employed, providing it possesses some means of focusing, either a rotating lens mount or adjustable bellows, and it may be used without any alteration to the construction of the camera itself. No doubt, with suitable modification of the mount, other types of camera could be adapted for the purpose.

The model will enlarge up to whole plate without difficulty. With suitable masking in the negative carrier, negatives smaller than "120" may be used in the enlarger.

The accompanying photograph with side references will provide a useful guide during construction of the component parts.

Base

The base, which measures 16in. x 16in. x ¾in., is constructed from any suitable timber and fitted with four rubber feet so as to elevate the base 1in. from the surface on which it stands.

This allows for a reinforcing board 2in. x 6in. x ¾in. to be screwed to the underside of the base, projecting 5½in. to the rear.

The Columns

The upright columns are cut from ⅝in. electric conduit and each measures 3ft. Both tubes have ⅝in. of thread at one end. The tubes are screwed on to two ⅝in. electric pendant fittings and bolted in position on the base, as shown in the photograph (Fig. 5) by means of four 2in. 2 B.A. countersunk bolts. At the top, the columns are spaced apart by means of two ⅝in. conduit spacing saddles and two lengths of 5in. 2 B.A. rod.

The saddles are fixed 4in. from the top and clamped as shown in Fig. 2 by means of the 2 B.A. rods.

Stay Wires

The two stay wires are fixed to the rear screws of the spacing saddles and led down to the anchor plate, which measures 2½in. x 3¼in. The anchor plate, which is made of brass, is floating on four 2in. 2 B.A. screws and is adjustable, thus allowing for the final lining up of the finished enlarger.

Bracket

The bracket is assembled as in Fig. 2. Cut two pieces of ¾in. Yorkshire copper tube 8½in. long; from each cut 2¼ in. and insert both pieces into a ¾in. to ½in. Yorkshire copper T-piece. These are pre-soldered and only require the application of heat to make a sound sweated joint.

The arms of the bracket are cut from ½in. copper tube and sweated into the ½in. sockets of the T-pieces, the ends being stopped with copper discs. The two halves of the bracket are united by means of ½in. tubular crosspieces and 2 B.A. rods.

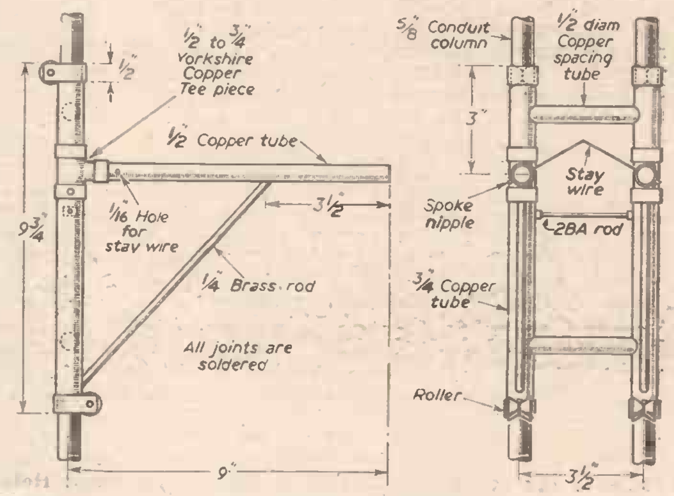


Fig. 2.—Details of bracket.

The 2 B.A. rod is screwed into the bracket sections; this allows the assembly to be held rigid in the correct position whilst the crosspieces are soldered in position. The stays for the bracket arms are filed to the correct angle and grooved at the ends with a half round file to make a snug fit. A well soldered joint is essential here as a large amount of weight is placed upon the stays.

A hole is drilled and tapped ¼in. in one

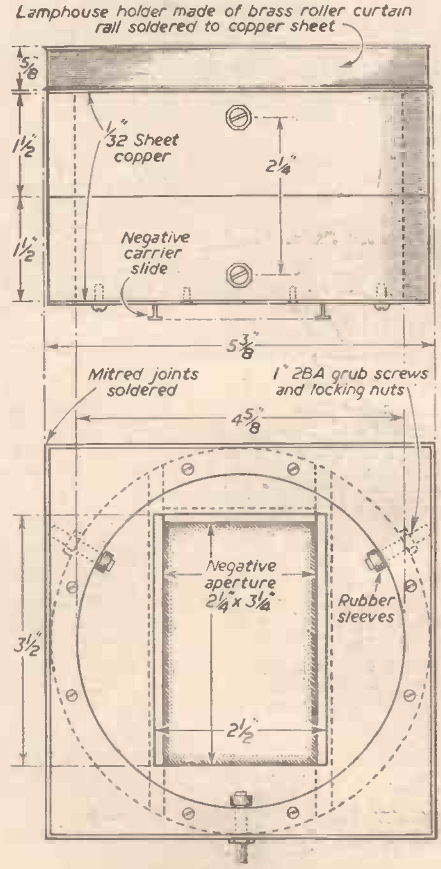


Fig. 1.—Elevation and plan of condenser mount.

Materials Required

Obtainable from an electrical contractor:
- 6ft. ⅝in. screwed electric conduit.
- 2 ⅝in. screwed electric pendant fittings.
- 2 ⅝in. "Coughtrie" ZA spacing saddles.
- 1 ½in. screwed brass lampholder.
- 9in. ¼in. brass tube.
- Length of twin lighting flex.
- Various 2 B.A. and 4 B.A. nuts and bolts.

Obtainable from a plumber:
- 2ft. ½in. Yorkshire copper tube.
- 18in. ¾in. Yorkshire copper tube.
- 2 ¾in. x ½in. Yorkshire copper T-pieces.
- Quantity 1/32in. sheet copper.
- Approx. 6in. of 2in. brass tube.

Obtainable from tool merchants or ironmongers
- 1 2½in. zinc alloy V-pulley for ½in. shaft.
- 1 1in. zinc alloy V-pulley for ½in. shaft.
- Approx. 4ft. brass roller curtain rail.
- Approx. 26in. of ¼in. brass rod.
- Approx. 15in. 2 B.A. brass rod.
- 1 4½in. length ½in. mild steel.
- 1 piece 2½in. x 3¼in. x 3/32in. sheet brass.
- 10ft. 6in. length of 3/32in. wire rope.

Sundries:
- Timber for base and lamphouse.
- Scrap lead.
- Scrap aluminium.
- Photographic or drop black paint.
- Water white cellulose lacquer.
- 4 rubber feet.
- 2 pieces 2¼in. x 3¼in. photographic glass.
- 2 4½in. block glass or optical condensers.
- 4 cycle spoke nipples.
- Brass terminal screws.

rtical Enlarger

rging "120" Films

By D. H. INGHAM

lug of each T for the locking screws. Two 3/16in. holes are drilled at an angle inclined to each other through the arms 1in. from the lugs of the Ts and in these are fitted two nipples from cycle spokes, into which a short length of stay wire is soldered, the stay wire being splayed at the ends before soldering in order to form a strong joint.

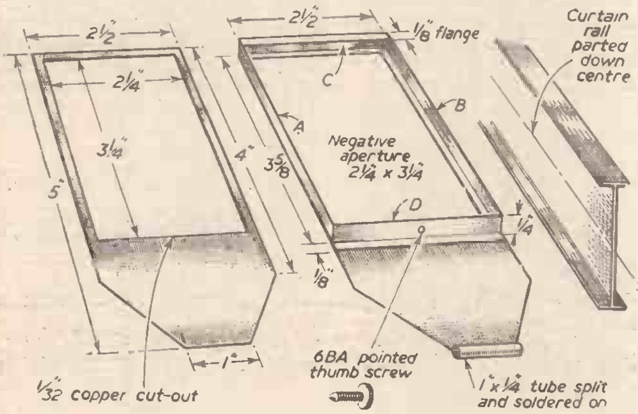


Fig. 3.—Details of negative carrier.

Rollers and Mounts

To form the roller mounts, make a saw-cut half way through the section of the tube, ⅝in. from one end; then make a saw-cut at right angles, so as to allow the ends to be opened out, as shown in Fig. 4. These ends are reinforced by sweating a strip of roller curtain rail round the mounts, the rail first having had its flanges filed off.

The holes to house the spindles are drilled as shown, one drilled clearance and the other drilled and tapped 2 B.A.

The rollers are made from brass terminal screws drilled 2 B.A. clearance.

It should be noted here that the top pair of rollers are to the rear and the bottom pair to the front of the bracket.

Condenser Mounts

The condenser mount, after various attempts, was cast in aluminium, using a cylindrical baking tin and a National Dried Milk tin as the mould. The metal, which was obtained as scrap, was melted on a greenhouse fire without much difficulty, but owing to its solidifying rapidly was cast in two parts and bolted through its section with 2in. 2 B.A. countersunk bolts. The casting was then machined to size and assembled as in Fig. 1.

The position of the condenser screws will depend on the depth of the condensers used. The rubber sleeves form pads for the condensers to rest on.

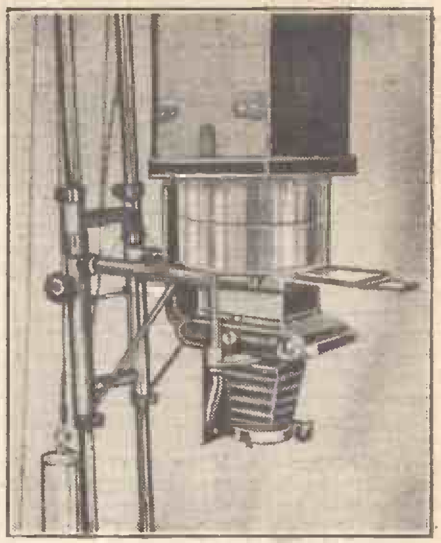
Lamphouse Holder

This is assembled from 1/32in. sheet copper and roller curtain rail as in Fig. 1. Cut a square of copper 5⅜in. x 5⅜in., with a hole in the centre 4½in. dia. Cut four pieces of roller curtain rail 5⅜in. long, mitre each corner, sweat to the edge of the copper cut-out and solder up each mitre.

Drill fixing holes ⅛in. from the perimeter of the 4½in. hole and bolt by means of 4 B.A. screws to the condenser mount.

Negative Carrier Slide

The negative carrier slide is also assembled



Enlarged view of the main part of the enlarger showing the camera in position.

from sheet copper and curtain rail.

Cut a disc of copper 5⅜in. dia., mark off the centre and cut off the negative aperture measuring from the centre point of the disc. Holes are drilled round the perimeter for 4 B.A. fixing screws.

For the slides, cut a length of curtain rail 12½in. long and part this down the centre as in Fig. 3. The length with the broadest flange is the length required for the slide. From this cut two pieces 5in. long. These are sweated to the edge of the negative aperture and the remaining piece is cut to fit the end of the slide as shown by dotted lines in Fig. 1.

Negative Carrier

The negative carrier is depicted in Fig. 3. The flanges A and B are strips of copper. The piece of curtain rail remaining from the slide is used for the sides C and D, one flange of this piece being filed off, thus forming an angle piece. The ⅛in. flange on side C forms a lip under which the glass for sandwiching the negative is fitted. The thumbscrew on side D holds the glass in position in the carrier.

Camera Mount

The legs for the camera mount are cut from the ¼in. brass rod and measure 4in.; each end is filed down to allow ¾in. of 2 B.A. thread to be screwed.

The condenser mount is drilled and tapped in the position shown in Fig. 5, the legs being screwed into position. The brackets were made from aluminium, and details of these will be given next month.

(To be continued.)

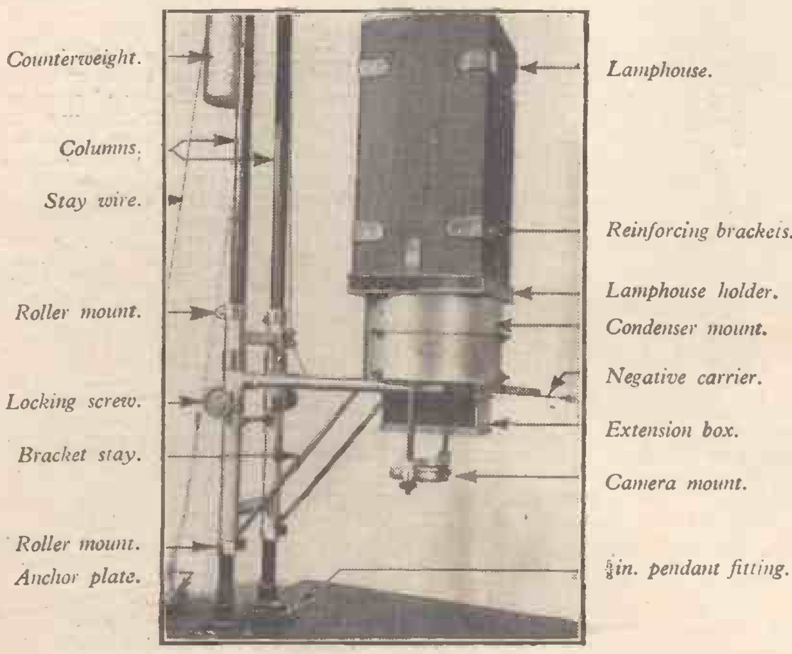


Fig. 5.—Side view of the enlarger, indicating the various component parts.

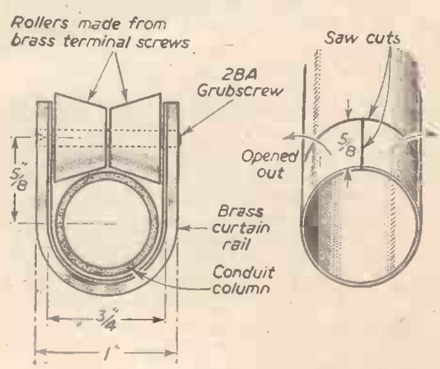


Fig. 4.—Details of rollers.

Tuning I.C. Engines for Speed

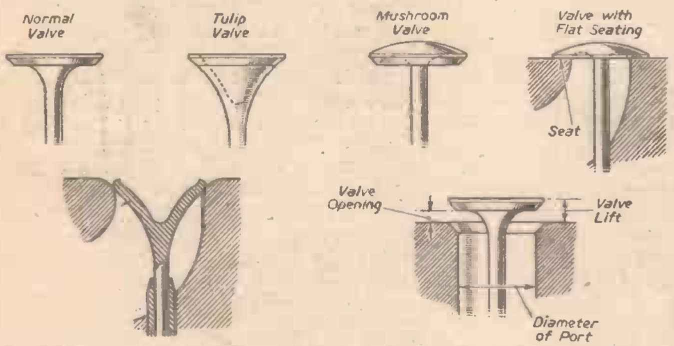
First Prize-winning Paper in the Institute of Mechanics "F. J. Camm" Essay Competition

By ARTHUR F. BULL

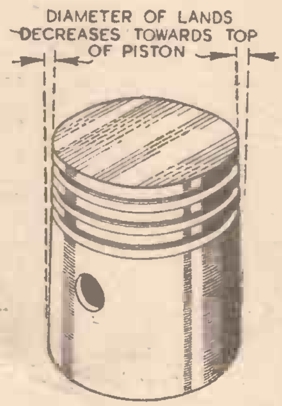
IF a fuel will detonate, a polished surface in the cylinder head will encourage rough running, but a matt finish will assist heat transfer from the charge and enable a maximum compression ratio to be used. The inlet port should turn the incoming charge towards the piston to assist cooling, the exhaust port should be as short as possible, and the pipe thermally insulated from the head. Exhaust valve guides should be in contact with the cooling medium (water cooling) and shield the stem from the hot gas.

A clearance should be given below the valve head to allow for expansion, particularly as the valve will reach working temperature before the guide. The plug-boss is a difficult spot to cool and should be as small as possible. A central electrode and insulator have been screwed direct into the head to reduce this mass, the spark taking place between the electrode and the head. It is advisable that the head be cool and the cylinder bores at a higher temperature.

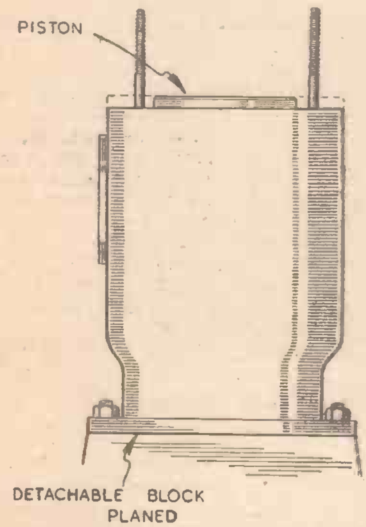
Theoretically the area of metal exposed to the charge should be at minimum when maximum power per unit swept volume is desired. The minimum area to unit volume is a sphere, but this is not practicable as the ratio obtained would be about $3\frac{1}{2}:1$. This is not high enough and more power can be obtained using a high ratio and a less ideal shape.



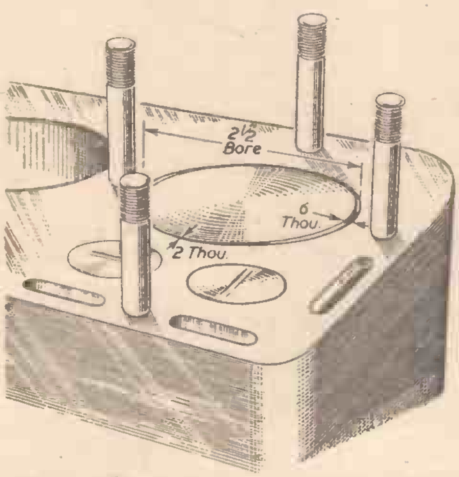
Four of the principal types of poppet valve and (below them) a line-contact seating and diagram showing the terms applied.



The piston crown is often tapered slightly, as illustrated, to allow for extra expansion at the hottest part. The skirt can have a finer clearance since it does not expand to a great extent.



The compression ratio can be increased by machining metal from the cylinder block itself.



Many modern pistons are ground oval to give clearances approximately as indicated here.

In the case of side-valve engines the combustion should take place over the valves—the piston clearing the head by .020in.-.030in. The firing should take place from the hottest part of the head, to reduce the liability to detonation.

Valves

The size of the valves is decided by the cylinder bore. Obviously, the larger the inlet valve the smaller must be the exhaust. The heat absorbed by the exhaust valve must be dissipated through the guide via the head and stem. The exhaust valve can be hollow and contain mercury or sodium salt to conduct heat from the head to the stem. For maximum power the inlet valve should be large and streamlined to assist in the breathing at high speeds; for acceleration the underside of the valve should be flat. A flexible valve will survive when a stiff valve will break.

If the exhaust valve closes too quickly and hammers its seating, it will break. If it closes gently, particularly with hydraulic tappets (e.g., no clearance), it will burn out. A compromise is needed. Gradual deceleration on the latter part of the cam and a clearance between the valve stem and rocker is successful.

Valve Springs

The coils may be insulated from the head temperatures by mica washers. Though the spring must not be coil-bound at maximum lift, surge can be damped by the coils being in close proximity. The hair-pin spring has less reciprocating weight than the coil spring. It permits the use of a shorter valve stem with corresponding lightness and leaves a better cooling air-flow. J.A.P. tried multiple coil springs but dropped the design. Inner springs coiled in the same direction as outer are supposed to give the valve a desired rotary movement. In practice I have yet to see this theory proved.

Valve Operating Gear

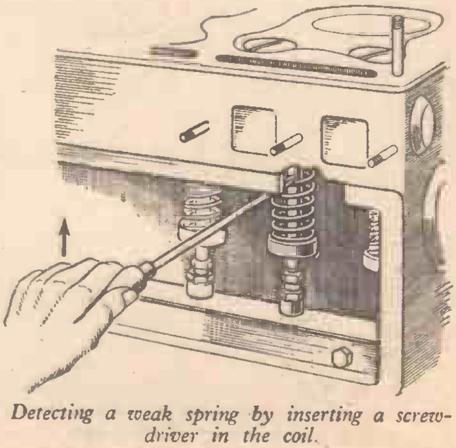
This should be designed with stiffness as the main aim and lightness as secondary consideration; at around 6,000 r.p.m. the inertia loading of the gear is about equal to the valve spring strength—some 150 lb

Piston and Piston Rings

Pistons are made of aluminium alloys. These can be run with greater clearances than would be acceptable for touring cars, as noise is of no consequence. Excessive clearance will cause tilting of the piston rings. This will lead to blow-by and also over-heating of the piston crown as the rings conduct a considerable amount of heat from the crown to the cylinder walls. Narrow rings are used as the oil film between the ring and the cylinder wall is reduced, the heat transfer assisted and the shear resistance lessened. No oil must reach the combustion chamber as this will cause detonation followed by pre-ignition. The piston should be relieved around the gudgeon-pin bosses to allow for distortion. In the case of side-valve engines the piston will need a clearance at the point where the cylinder is distorted by the heat from the exhaust port.

Cylinders

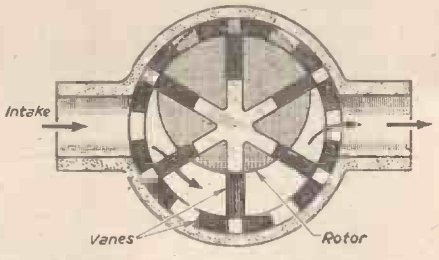
The cylinder-to-head joint is a weak point, particularly in the case of multi-cylinder engines, where the cylinder centres are too close because a crankshaft must be short and stiff, where the exhaust valves cause local distortion by their positioning along one side of the head. Bentleys use a non-detachable head, as do the 2.9 Alfa-Romeos.



Detecting a weak spring by inserting a screwdriver in the coil.

Even these accept cracks between the valves seats and plug holes as not unusual, so the strain is still present.

In the case of single-cylinder engines, the head can be ground to the cylinder, using fine and coarse emery paste. The highest area of the spigot should be smeared with the fine paste and the flat area of the head joint covered with the coarse. This method will ensure a heavier loading on the spigot-contact, which is desirable. In the case of multi-cylinders, the joint should be a scraped fit, but if the design or conditions of use cause leaks a copper or alloy joint will be necessary. The washer must have clearance around studs, etc., to allow for spreading and expansion. This applies to the cylinder bores and if a cut back of $\frac{1}{16}$ in. can be given this will fill with carbon and act as a seal.



The Cozette supercharger. An inner rotor revolves at the same speed as the outer revolving vanes.

Carburation

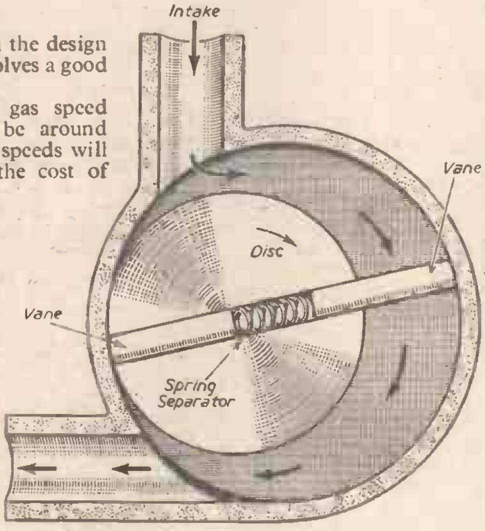
This is interconnected with the design of the exhaust system and involves a good deal of trial and error.

As a starting datum, the gas speed through the choke should be around 180 feet per second. Higher speeds will improve the acceleration at the cost of maximum power. Lower gas speeds can be used when the flow is intermittent as in the case of one cyclinder per carb. The use of a megaphone on the exhaust pipe will call for bigger jets while a restriction, as a silencer, for a smaller. Check tuning for full throttle running is done by switching off the engine and declutching while at speed. The plugs are then examined for :—

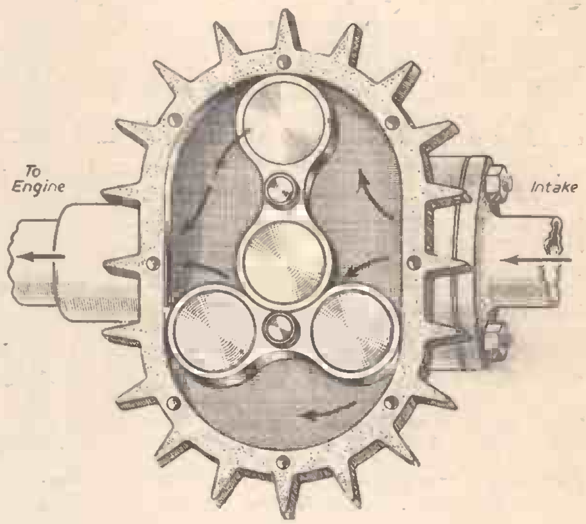
1. Rich mixture. Soot.
2. Weak mixture. Body a greyish or lightish colour.
3. Correct mixture; lower part of body a polished ebony finish.

The plugs must be clean before the test.

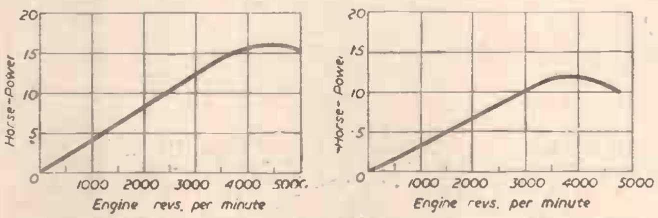
Sudden opening of the throttle with the corresponding increase in manifold pressure will cause the vaporising point of fuel to rise. Some of the fuel which was on the way to the inlet valves will fall from the air-stream to the floor of the inlet tract. Unless some means of enrichment is applied during this period, violent explosions will take place which can wreck the induction system. In some cases an accelerator pump supplies extra fuel.



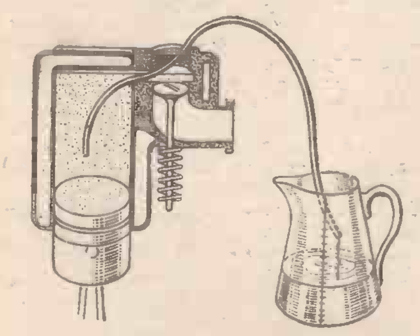
The Zoller supercharger employs a pair of vanes separated by a spring they are attached to and rotate by an eccentric.

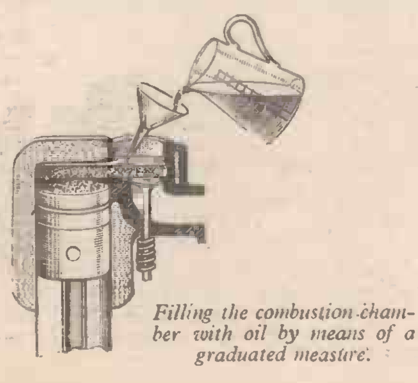


The Roots supercharger for increasing the power of the engine.



(Left) Graph showing how supercharging raises the point at which power begins to fall off. (Right) Graph showing how the power of an engine falls off after the attainment of maximum engine speed.


Method of extracting the oil from the cylinder.


Filling the combustion chamber with oil by means of a graduated measure.

Extractor Effect

When a megaphone is fitted to the exhaust, this will give an extractor effect when the natural frequency of the exhaust tract coincides with that of the exhaust valve opening. At some other times a pressure wave will arrive at the exhaust valve at the opening time, and there will be a charge dilution in the combustion chamber. A similar happening causes a two-stroke to four-stroke at part-throttle openings. It is necessary to use a rich mixture low down the r.p.m. scale when a megaphone is fitted in order to obtain acceleration; even so, below about 3,000 r.p.m. the performance will be erratic with eight-stroking and a tendency for the motor to "cut" upon rapid throttle opening.

Exhaust Systems

If the motor is to be used over a limited range of speed, the exhaust system can be of length and diameter to suit, a length of 3ft. to 4ft. giving the best results for power at high r.p.m. and a long pipe for acceleration and power lower down the r.p.m. scale.

The ideal can be found only by experiment, as the valve timing, length of ports and other factors affect the result.

In the case of multi-cylinders, each cylinder should have an individual pipe. These pipes can be mated after leaving the engine. Bad arrangement will be shown by local overheating. Too small a tail pipe will run hot and a wrongly designed junction will show evidence of heating.

Superchargers

The Roots-type and Vane-type blowers are usually used on cars.

The centrifugal type is of little use, as pressure generated at low and medium r.p.m. is small compared with the other types. It is used on American board tracks where acceleration is not important.

The "Roots" does not compress the charge before delivery, and there is a surge back into the blower when the outlet port opens. Its maximum pressure is about 12lb. per square inch. To obtain higher pressures, two are run in series, usually with an inter-cooler fitted.

Rotor Clearance

The blower has been fitted to deliver through the carburettor. The disadvantages are that the tanks and float chambers must be pressure balanced, also the blower must have sufficient rotor clearance to permit running at the temperatures attained without the cooling effect of the fuel. These clearances lower the efficiency of the unit at lower speeds and acceleration suffers. The vane-type in some cases suffers from the effect of centrifugal force on the vanes, and lubrication is difficult as oil in the combustion chambers is not desired.

Sparking Plugs

The plug makers are always helpful, but the final choice will be the result of experiment, a course calling for much full-throttle work will need harder plugs than one with slow corners. Solid copper washers, being better heat conductors, are more suitable than the copper-asbestos variety.

Fuels

With a few exceptions, racing fuels are almost all alcohol.

The latent heat of alcohol is from 400 to 500 B.T.U.s per lb.; petrol is about 135 B.T.U.s per lb.

The carburation of alcohol produces much greater temperature reductions than that of petrol, as a consequence of this and of the fact that about twice the amount of fuel is therefore needed for the correct mixture. This is beneficial in keeping down the temperatures of valves, ports, pistons, etc. This heat absorption also lowers the temperature of the incoming air, increasing its density and weight. The power of the engine depends on the weight of oxygen burnt.

The advantages of alcohol are :—

1. Freedom from detonation.
2. Cool running.
3. Greater volumetric efficiency.
4. High compression ratios can be used and greater power outputs obtained.

The disadvantages are starting difficulties, greatly increased consumption, the effect on certain metals, blowers, filters, tanks, etc., and its great affinity to water.

A Friction-driven Tap-holder

A Tapping Device for Use in the Drilling Machine

By W. M. HALLIDAY

INNUMERABLE objections arise when tapping small diameter holes in the ordinary drilling machine, wherein the tap is mounted in a chuck, and the spindle reverse mechanism employed for withdrawing the tap. With such a set-up little provision exists for safeguarding the tap against overloading since a positive drive is given the spindle.

If very small diameter *short, blind* holes have to be tapped tool breakage may be high, because of the inability of the operator to put the spindle into reverse sufficiently quickly to prevent the tap bottoming in the hole. Tap breakage, or damage to threads in the workpiece may also arise from excessive binding of the tool due to chip accummulation occurring in the in-feed of the tap.

The accompanying half-sectioned diagram illustrates an effective, and inexpensive holding fixture, the use of which will considerably simplify all such tapping operations in the drilling machine, and give better safeguards against tap breakage, etc.

Constructional Details

The simple construction of this friction-driven tap-holder comprises the following component parts:—

A hardened steel shaft, *A*, formed at one end with the usual "Morse"-type tapered shank *B* for fitting into the socket hole in the drilling machine spindle. If desired, the latter may be fitted with a simple check screw to bear upon the side of the shank *B* to prevent it from being pulled out of the spindle during reversal when the tap is being withdrawn. This is omitted from the present diagram.

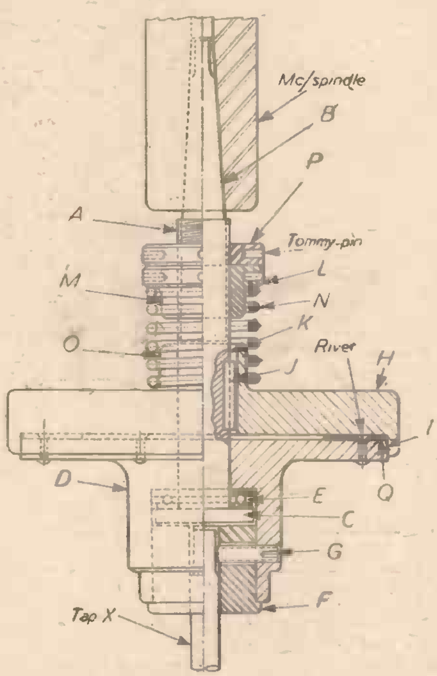
At the opposite end of the shaft is the integral head *C*, approximately twice the diameter of the shaft on its plain parallel portion. The circular flanged disc *D*, in either cast iron or mild steel is bored through its centre boss to be a close running fit on the shaft. It is situated immediately above the head, and interposed between the latter and the step in the bored hole in the disc is a standard ball-thrust set *E*.

The largest diameter of the hole in the disc *D* is slightly larger than the head *C* to afford due working clearance. Fitting closely within the lower portion of this largest hole is the hardened and ground steel bushing *F*, which is bored full length to suit the diameter of the tap shank *X*. The bushing has a shallow head at the bottom to determine its setting. A headless screw *G*, of the "Allen"-type, is threaded into a hole through the side of the boss, passing also through a clearance hole in the wall of the bushing, so as to bear upon one of the flat sides of the square head of the tap. By this means tap *X* is secured positively to disc *D*.

Mounted upon shaft *A* immediately above disc *D*, is a second flanged disc *H*, the outside diameter of this being slightly larger than part *D*. The thickness of the flanged portion is also about twice that of member *D*.

The lower end-face of disc *H* has the shallow circular recess *I* into which member *D* is a free running fit.

Disc *H* is keyed directly to the shaft by feather *J* which is a sliding fit in the keyway



Half-sectional elevation of a friction-driven tap-holder.

K. The disc should be free to slide along the shaft a certain amount, but rotates in unison with the member.

Compression Spring

An adjustable mild-steel collar *L* is threaded upon the upper portion of the shaft, such threads extending for a sufficient length to ensure an ample amount of movement for the collar. The periphery of the collar is knurled, and on its underside has a concentric cylindrical spigot *M*, of smaller diameter, upon which is mounted one end of the stiff compression spring *N*. At its opposite end this spring encircles a similar short length spigot *O* formed integrally on the upper side of disc *H*.

A knurled locking nut *P* is threaded on shaft *A* above the collar for locking the latter securely to the shaft in any desired setting. By tightly locking the collar in this manner any required degree of spring pressure may be imposed on the two disc members. If desired a number of tommy-pin holes may be provided in the peripheries of the collar and nut to obtain a more powerful retention.

Situated between the contiguous end-faces of the two discs is the fibre friction ring *Q*, this being affixed to member *D* by a number of small copper rivets as shown. The outside diameter of this friction ring is about 1/16in. less than recess *I*. This ring should be about 1/16in. thick, and have a face width of not less than ½in. This latter dimension, however, will largely be determined by the size of tap to be employed, the material of the workpiece, and driving force required.

Operation

The diagram shows the tap-holder set-up in the vertical spindle of a reversing drilling machine in readiness for tapping ¼in. dia. B.S.F. holes in a zinc-based alloy pressure die-casting.

A suitable reducing bushing *F* is inserted within the hollow boss of the flanged disc *D*, the tap being retained therein in the way already described.

Collar *L* and its locking nut *P* will have been set previously to the correct point along shaft *A* so that the requisite amount of frictional pressure is obtained between the two flanged discs. This setting will be made over a few trials to ensure sufficient driving pressure for the tap, but to allow slippage of disc *D* to occur when undue resistance is encountered by the tap.

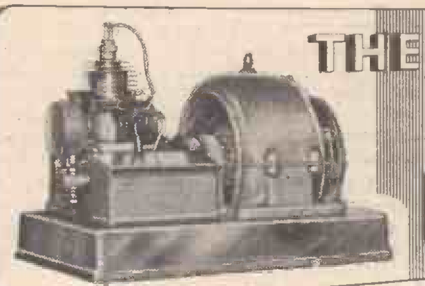
Tapping will proceed in normal fashion. Should the tool become jammed by chips, or contact with the bottom of a blind hole rotation of disc *D* will be arrested, and the remaining portions of the device will revolve without entailing any risk of breaking the tap by further driving.

It will be appreciated that the simple means for regulating the amount of frictional driving pressure on disc *D* will enable the holder to be adapted for use with taps of different size, or workpieces in soft, tough or abrasive metals.

Another important practical feature of this holder design is the relatively short amount of overhang of the tap from the machine spindle. This will prove particularly helpful when the device is to be mounted in the horizontal plane, viz., in the capstan or centre lathes, where tapping operations frequently may be performed with greater convenience. The negligible amount of "sag" thus occurring with the tap will promote more centralised entry of the tap into the workpiece and give greater freedom from binding, tearing of threads, or bell-mouthing of the leading edge of the hole.

Interchangeable Bushings

By making up a number of bushings *F* to be interchangeable in the disc *D*, each having a different size of bore, a large number of tap sizes will be accommodated very simply, giving, in fact, a greater range in this respect than may often be obtained with a special tapping head.



THE WORLD OF MODELS

By "MOTILUS"

High-class Amateur Model Making : Model Union-Castle Liner

NORTHAMPTON has recently lost a most interesting personality, Mr. Sidney J. Ward, who died in January this year. Mr. Ward was a business man whose chief interests outside his business were model making and public service. He was a member of the Northampton Borough Council and rendered the community valuable services through this medium. As I have similar interests myself, I know that Mr. Ward will be missed greatly in the town for his enthusiasm and enterprise ; I was extremely sorry to hear of his death.

Mr. Ward was an amateur model engineer of outstanding ability and merit, specialising in railway locomotive models and large, engineering models. His work was known and admired all over the country and especially in his home town, Northampton, where he was president of the Northampton Society of Model Engineers.

Fig. 3 (Right).—A close-up view of the stern portion of the model of R.M.M.V. Capetown Castle, *showing the intricate detail that has been so smoothly modelled. The model is to a scale of ¼in. to 1ft.*

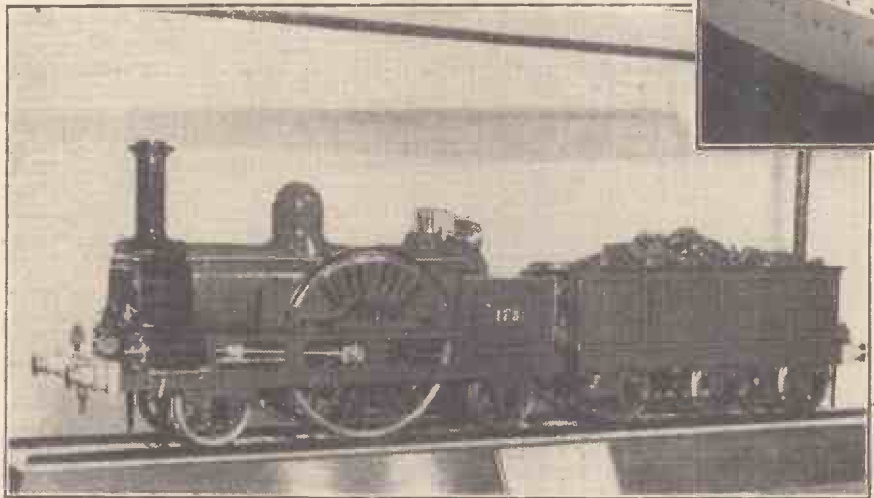


Fig. 2.—This beautifully detailed and finished model of the ex-L.N.W. locomotive, "Cornwall," is one of those built by the late Mr. S. J. Ward, of Northampton. The model is to a scale of 1¼in. to 1ft.

Five of Mr. Ward's models are on loan to the Northampton Borough Education Committee and they are displayed at the Northampton College of Technology. These are all extremely fine models and are well worth a visit from any enthusiastic model engineer who goes to Northampton or district. The full detail on all of them, which gives such wonderful realism, is the acme of good craftsmanship.

The models at the college were brought there in 1944. Previously they had been displayed at Euston Station in London, on loan to the L.M.S. Railway. It is interesting to record that Mr. Ward was anxious to obtain a footplate pass on the L.M.S.R. and this was the "price" that the railway company paid for the privilege of displaying these beautiful models in their main hall at Euston. A remarkable bargain!

Model of a Railway Service Crane

The most spectacular of the models is a working model of a Craven railway service crane, built to a scale of 1/10th full size and modelled in full detail (Fig. 1). The prototype is capable of lifting a weight of 36 tons and is a very massive piece of equipment. The model includes two Craven patent detachable relieving bogies: one is shown connected for relieving part of the weight of the crane when travelling and the other is released and moved away from the crane, to leave a clear working space.

Another impressive model is of a quadruple expansion marine engine, to a scale of 1/16th full size, again in full detail.

Scale Model "Cornwall" Locomotive

Then there are three railway locomotive models. The one illustrated in Fig. 2 is a working model of the ex.-L.N.W. "Cornwall," No. 173, to a scale of 1¼in. to 1ft. The "Cornwall" was designed and built at Crewe by Trevithick in 1847, and she was rebuilt by John Ramsbottom in 1858. The

(*Continued on page 246*)

Fig. 1.—This huge working model of a Craven Railway Service Crane is one of the most spectacular built by the late Mr. S. J. Ward. It is to a scale of 1/10th full size.

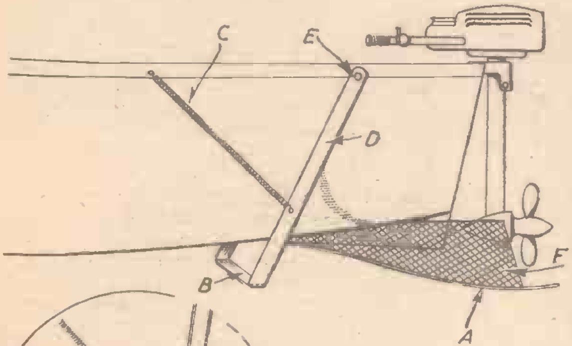
"Outboard Motor and Weed-ridden Waters"

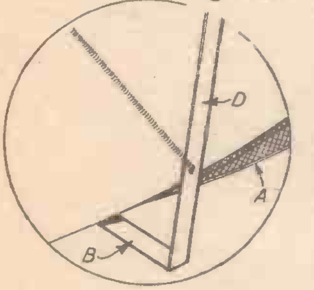
SIR,—With regard to the letter in the February issue on the above subject, I think patent specification No. 488618 for converting rotary motion into linear motion in two or more directions successively could form a basis on which Mr. C. F. Clements could base his experiments to drive a boat through weed-infested waters.

Paddles could be made to enter and leave the water vertically or at an angle, driven by a rotating shaft.—A. L. SIMS (Cardiff).

SIR,—In reply to your correspondent, C. F. Clements (Taunton), re driving a boat through weed-ridden waters, I think my suggestion will be of benefit to him.

Upon giving serious thought to this problem I realise that a path or track must be cleared through the weeds. I remember many years ago seeing two bargees lying on each side of the bow of a motor-driven barge, each holding a grass scythe down into the water.





Side elevation and detail of Mr. G. Fleming's suggestion for a device for attaching to a small motor-boat for clearing a path through weed-ridden waters.

The barge was the first for some time to use this section of the canal, and apparently they had trouble farther down with weeds. The scythes were held inwards, and as they cut the weeds the bow-wash drew them out from underneath and left the screw in clear water.

My idea is a modification of this. I suggest a light, straight blade (B), as shown in the accompanying sketch, fastened to the boat by two light steel arms (D), which are fixed by bolts, wing nuts and washers (E). A spiral spring (C) allows the blade to lower as the speed increases and the bow rises; this spring also allows for the blade striking some heavy underwater object—otherwise the stern would be damaged. As the weeds are cut (and a blade such as this would cut up to $\frac{1}{4}$in. thick at speed) they strike up against a thin zinc sheet (A) and are deflected from the screw. A wire cage (F) is fitted on each side of the zinc sheet to prevent cut weeds being drawn in by the wash, and also to prevent the zinc sheet from closing up against the screw when the boat is at speed. Your correspondent may make certain modifications, but the principle must remain the same—there must be a clear patch of water for the propeller. Floating weeds will be deflected by the zinc sheet. A cheese-wire may be substituted for the cutting blade, still further reducing the weight.

The drag which your correspondent fears would indeed be very little, and the weight would be about 4 or 5lb. The cost would be about £1. The zinc sheet I have in mind may be obtained from any lithographic printers. Two steel arms, approximately 1/16in. thick by about 1in. wide, and the two guards for each side, plus nuts and bolts and two spiral springs, complete the equipment.—G. FLEMING (Belfast).

Lens Grinding

SIR,—I noticed in a recent issue of PRACTICAL MECHANICS a reply to a query about making small lenses.

The machine mentioned is intended for very large lenses and would not be suitable for lenses of 10 mm. diameter unless a large number of similar lenses of shallow curve are to be made.

A better arrangement is a vertical spindle which can be driven by a small electric motor at speeds between 200 and 1,000 r.p.m. For rough grinding the lens is then fastened to the top of the spindle. For finish grinding and polishing the lap is fastened to the spindle and the lens pitched to a handle. An easy way to make laps is to press a ball-bearing into a piece of lead sheet, supported by a short length of tube.

Two books which give a little information on making small lenses are "Amateur Telescope Making," edited by A. Ingalls, and "Lens Work for Amateurs," by H. Oxford, published by Isaac Pitman & Sons.—B. MANNING (West Hagley).

Small Water-power Plants

SIR,—It is with great interest I have read the article "Small Water-power Plants," by Mr. J. H. Rapley, in the November and December issues of PRACTICAL MECHANICS.

In the November issue—page 59—Mr. Rapley gives the wheel speed formula: $76.4\ D\sqrt{H}$ r.p.m. I think this should read $\frac{76.4\ H}{D}$ where H is the working head in feet and D the wheel diameter in feet. The smaller the diameter the higher the rotation of the wheel and vice versa.—R. M. STEEN (Oslo).

The Tipsy Top

SIR,—I have discussed the problem of the top with two of my colleagues and we submit the following model to dispose of the mystery propounded by the observant Mr. B. W. Appleton in the February issue of PRACTICAL MECHANICS. If you consider an aeroplane propeller then anti-clockwise rotation to the pilot is clockwise rotation to an observer standing in front of the propeller. But this is not a valid example.

Make a model from paper and pins, as shown in the diagram, Fig. 1. Then, when the ball is rotated about XX the spin from the main axis is retained.

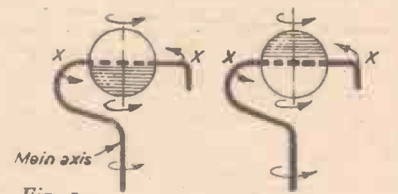


Fig. 1.

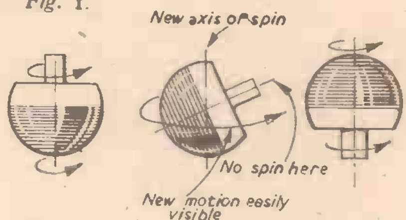


Fig. 2.

Diagrams illustrating the problem of the tipsy top.

In the top the motion we believe is as indicated in Fig. 2. The inversion is due to precessional forces.—FRANK W. COUSINS (Greenford).

The Problem of the Steam Car

SIR,—Some readers and contributors interested in PRACTICAL MECHANICS seem to be of the opinion that the steam car may yet oust the petrol engine. Surely the petrol engine ousted the steam car engine because it was more economical to use a fuel inside the engine rather than suffer the indirect heat losses of water-cum-steam before the power is applied.

One might say that paraffin and not petrol would be used as a heating medium for steam. But I can only think that a differently designed engine should be made to use paraffin internally for the car.

Probably this economic trend was best shown by Mr. Harman Lewis in PRACTICAL MECHANICS, where steam decidedly changed for the intake of fuel for internal combustion; where fuel and air were used with a carburettor and made to pass into a combustion chamber, at the top of the boiler, and ignited by an electric spark plug, thereby providing superheated steam.

If we substitute the fuel and air passing to the top of the boiler for an enclosed cylinder and piston with a spark plug, we have probably the first idea that prompted the design of the internal combustion engine.

Harman Lewis asks why steam cars have not been made in quantity. Unless he can prove that fuel-cum-steam is an economic one, then the answer is simply as already stated.

I have sometimes thought that the injection of fuel and water vapour directly into a cylinder under conditions of combustion—or jet for that matter—might prove economical, but I suppose the heat expansion of fuel and air is more economic than the expansion of steam generated by a cooling medium like water.

Even the use of coal at 6s. 5d. per cwt. might soon prove expensive for the steam wagon, with a preference for diesel-operated engines.

Fodens have largely changed steam for diesel-operated vehicles, I believe.—H. V. KELLY (West Drayton).

"An Electric Lighter"—Warning

SIR,—I consider that this device, described in the March issue of PRACTICAL MECHANICS, should be used with extreme caution.

It has bare metal parts connected to the supply mains, one directly, the other via a "resistance."

A reversible 2-pin plug is used, and no precaution is taken to ensure that the resistance is in the "line" side of the mains connection.

Such a device might be made by the unknowing for use with a gas stove. In such an application the natural action would be to turn on the gas with one hand—doubtlessly allowing the hand to remain on the tap—while the other hand operates the lighter. If the taps are metal, or the hand comes into contact with the stove body, and the other hand should touch the metal part of the lighter a very unpleasant shock is quite likely to be felt.—F. G. SWIFT (Blackheath).

"Rotarista" Protective Paint

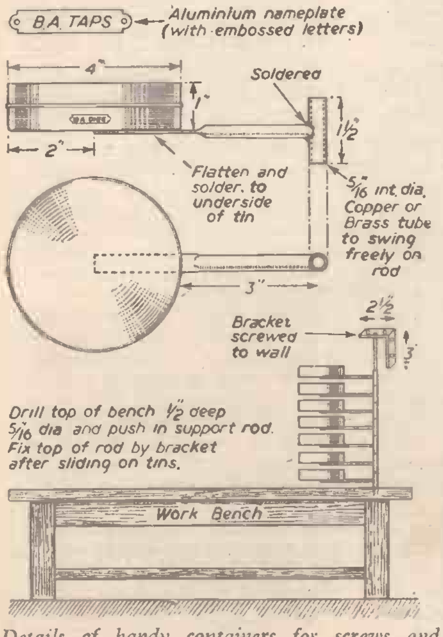
SIR,—On page 209 of the March issue of PRACTICAL MECHANICS you publish a letter written by W. E. Bryan (Derby) regarding painting over creosote. In this letter it is stated that Messrs. Dennis & Roberts, Ltd., of Nottingham, are the manufacturers of "Rotarista." We must point out that this is incorrect and that this paint was invented and is manufactured solely by Peacock and Buchan, Ltd., of Southampton. Messrs. Dennis and Roberts, Ltd., are the distributors for the Midlands area.—PEACOCK & BUCHAN, LIMITED (Southampton).

Containers for Screws and Small Tools

SIR,—Many and varied are the means of storing small tools, parts, etc., in the home or model engineer's workshop, but I find the arrangement shown in the sketch is very satisfactory, as it protects the items from rust and is neat and tidy. The containers are empty floor-polish tins. Dimensions will have to be modified to suit the kind of tin used. The vertical section of tubing must be of sufficient length to give about $\frac{1}{4}$-$\frac{5}{16}$in. clearance between tins as they are swung aside. The drawing is self-explanatory. A coat of black enamel and the fixing of the embossed tabs complete the job.

Any number of tins may be arranged, even in banks of a dozen, according to the space available. The tins can be swung in either direction.

It is advisable to slightly file the bead on the tin to make the removal of the lid an easy matter. The nameplates are punched on machines usually to be found on railway stations.—N. G. CREWS (Lowestoft).



Details of handy containers for screws and small tools.

"The Mechanics of Bull Fighting."

SIR,—I was very interested to read "The Mechanics of Bull Fighting" in the January issue, but there are some points that I think might be made more clear and detailed.

The photograph does show the first point, "Sol and Sombra"; that is, the sunlit part of the arena and the shaded part caused by the high wall behind the raised tiers of seats: the seats in the shade are the best side and about double the price of those in the sun.

The bull enters the arena in the centre of the *Sol* side and so faces a blinding light as he enters from his dark cell, and is, in consequence, dazzled for the moment.

Then the photograph shows a low barrier (covered with advertisements), but it is important to understand that there is a narrow space behind this and the higher barrier, which is shown white in the photograph: this space is a safe refuge for the various bull-fighters in case of need. The passage can be entered by gaps in the inner barrier, covered by short extra barriers, with just enough space for a man to wriggle through, but which would be impassable to a bull. Or the men could vault over the inner barrier into the space. When the bull is active this safe space becomes quite important: some men can be seen standing in it in the photo.

The description of the picador and his equipment is pretty clear, except that there is no explanation of why the protection is only on the port side of the man and horse. This is because the picadors are spaced out at intervals close to the barrier and facing in an anti-clockwise direction, so that the starboard side is close to the barrier. The picador is always attended by men on foot (*Moso* is the term for them, I think) in case he is in need of help.

After the bull has been somewhat tired by the effort of trying to toss the horses he is still very full of fight, and the *banderilleros* have a dangerous job in planting the *banderillas*, this being a very skilful and graceful performance. The man stands right in the way of the charging bull and holds the *banderillas* high up, with the barbed points pointing downwards and just as the bull is on him, with his head lowered for a toss, the points are placed behind the neck in the fleshy part, and they should hang down one on each side.

After a few pairs of *banderillas* have been inserted the bull, while still very annoyed, is getting baffled by the way in which the men avoid his onslaughts, and so he gets slower and more cautious and does not charge so freely: this is the time for the *torero* or *espada* to come in and kill. Some description of the sword is given, but the unique point was not mentioned: all swords made for slaughtering-men, if laid flat on the table, will have the edge parallel to the plan of the table, however much the blade may be curved or wavy, even. But if the *torero's* blade is laid as flat as possible on the table the point will be curled up or down, because though the blade is only slightly curved, it is bent as a clock-spring is curved, and not as a sabre. This is very important detail.

When the *torero* gets to work he has to persuade the bull to get into correct attitude, forefeet together and head down. He does this by gently waving his coloured *capa* in front of the bull, who has his attention directed to this moving object all the time and doubtless awaiting his time to charge, but his caution holds him in check. When the correct attitude of the bull has been attained, which gives the sword a good space between the shoulder blades, the sword is driven right home to the hilt and the aim is to place the point just between the shoulder blades, but to miss the spine, and then curve towards the centre line of the bull and enter the heart. If this is done the bull drops dead like a stone; less skilful efforts may pierce the lungs and the short sword may be used for despatching the bull. The short weapon used by the *mosos* for killing the bull is a very stocky sort of stiletto called a *punctillo*, and has a very obtuse point as it is necessary to crash it through the skull to pierce the brain. The photo of the kill shown looks as though the man was unlucky and the bull is charging with the sword only half-way through, and it looks as though the attendant on the right is rushing forward to make diversionary movements which will probably be necessary.

Perhaps I should make it clear that my visits have not been in the periods mentioned by the Marquis of Donegall, but were in 1898, and then about three horses were used for each bull, but apart from this I do not think there is much difference in procedure.—A. C. HYDE PARKER (Abingdon).

Neon "Flashes": Centrifugal Force

SIR,—It seems only proper to state that the principle of the neon "flashes" was discovered by a member of the Anson family (I forget his initials), and occurred when he was 18 and a student at Faraday House, in 1921, as I was also. He was certainly a brilliant scion of a gifted family, and his death in a car crash some years later was a loses to science.

On another subject: Mr. Grocock's annihilation of centrifugal force is truly staggering to an engineer who has had great cause to make careful calculations of tensile stresses in large rotating masses, but I hope he will inform us from whence the force "F," towards the centre, originates, and, if it exists, what prevents the acceleration of a mass in that direction?

Professor Einstein has jettisoned Newton's idea of gravitation, and substituted "curved space" to account for planetary movements; but even he appears to hesitate to ascribe "curved space" to the outward motion of the bobs of a steam engine governor! Now, Newton is completely refuted by "Grocock's Force" which causes an acceleration in the *opposite direction*. A truly astounding thing.—F. O. BROWNSON (Barton).

BUILDING THE CABIN HIGH-WING MONOPLANE

(Continued from page 228.)

$\frac{1}{8}$in. thick wedged between nosepiece and front former on the left side looking at the model from the top to the front. This will counteract the left turn. Gradually reduce this thickness of packing until the torque reaction carries the model round in slow climbing circles to the left under power with up to $\frac{3}{4}$ full wind, which is all that should normally be attempted if you want to preserve your rubber motor. Remember that after a few flights a rubber motor should be rested, when it will regain it natural elasticity. Never keep a rubber motor wound up for long periods.

Keep the fin straight, and all surfaces true, unwarped and placed on "square."

Trade Notes

A Review of the Latest Appliances, Tools and Accessories

Handy-Utility Abrasive Kit

FOR use with their Handy-Utility $\frac{1}{4}$in. electric drill or 5in. sander-polisher, Black & Decker, Limited, of Harmondsworth, Middx., have recently introduced an abrasive kit.

It includes a well-planned assortment of coarse and fine abrasive accessories, with four arbors to fit a $\frac{1}{4}$in. chuck. The drum of three of these arbors is of the expanding rubber type, and after the abrasive band has been slid on, a clamp nut is tightened so expanding the rubber and holding the band securely in position.

The Handy-Utility Abrasive Kit.

The fourth arbor is threaded and enables any one of three different abrasive rolls to be screwed directly on to the arbor.

It was felt that the introduction of an inexpensive kit, suitable for the rough cleaning or finish sanding of curves, irregular shapes or intricate designs both in wood and metal, would be a useful addition to the handy-utility electric tool range of accessories. Its many uses will be apparent to any home workshop enthusiast or handyman, and will enable many jobs to be performed more quickly and simply.

A few examples of its uses are the cleaning of irregularly shaped castings, smoothing fret-saw work, removing rust from wrought-iron scrolls, sanding edges of car mudguards or bodywork preparatory to retouching, or cleaning inlet and exhaust ports of a motorcycle cylinder head.

The kit is obtainable from most tool dealers, hardware stores or electrical dealers, and is priced at 35s.

Meter Movement for Exposure Meter

IN the article in the February issue of PRACTICAL MECHANICS on a photo-electric exposure meter, it is stated that the meter movement was obtained from Sussex Electronics, Ltd., of Brighton. This firm now inform us that they have been sold out of these meter movements for some time, and they are no longer available from them. Readers please note.

Tyler Spiral Blade Saw

THE new spiral blade saw, marketed by Spiral Saws Ltd., Bedford Avenue, Trading Estate, Slough, Bucks, cuts on an entirely new principle. The 360 deg. cutting edge of the blade saws smoothly in any direction. Whatever the pattern to be cut, it is not necessary for the operator to turn or revolve the work. He can work from either the right or left hand side of a bandsaw fitted with the new spiral blade, which is equally effective in cutting any material from steel and iron, to rubber, wood and plastics. The spiral blade does not chip or tear the material and, on a Tyler bandsaw, selective speeds range from 70ft. to 5,000ft. per minute, the slower speed range for steel and other tough metals, and the higher speeds for wood, fibre glass, and other light materials. The latest machine fitted with the spiral blade is the Tyler Minor, a 7in. bandsaw with three speeds and driven by a $\frac{1}{4}$ h.p. motor, with built-in switch. Speed variation is by multi-groove V-pulley.

In addition to their use in bandsaws, spiral blades are obtainable for fitting into any standard hacksaw frame. Further information is obtainable from Spiral Saws Ltd., at the address given.

The Tyler Minor 7in. bandsaw.

Enlarged view of the cutting edges of the new Tyler spiral blade saw.

THE WORLD OF MODELS

(Continued from page 243.)

model, complete with all controls in the cab and with head and tail lamps, is most attractive in its green paint, with black chimney and smokebox, red buffer beam and polished brass fittings.

The other two are both working models of L.M.S. locomotives: the "Royal Engineer," No. 6109, a 4-6-0 engine, and the "Duchess of Buccleuch," No. 6230, a 4-6-2 engine. Both are painted in L.M.S. colours of maroon and black with red and yellow lettering and are to a scale of $1\frac{1}{2}$in. to 1ft.

The care with which Mr. Ward always finished his models is evident throughout, and his attention to such small details as buckets, shovels and even dusters in the cab has resulted in these models being more than usually fascinating to both experts and amateurs.

Model of the "Rocket"

Lately Mr. Ward was building a 5in. gauge model of "The Rocket," but this was left unfinished at his death and is still in parts in his workshop. It is hoped that permission may be obtained to finish this model in Mr. Ward's style so that it may take its place alongside the other five.

Model of R.M.M.V. "Capetown Castle"

The fleet of Union-Castle ships always seems to me one of the most attractive; the vessels are delightful in outline and in colouring, with balanced deck arrangement and excellent interior accommodation.

The illustration (Fig. 3), shows a stern view of a model of R.M.M.V. *Capetown Castle*, a ship of 27,002 gross registered tons and one of the largest pre-war vessels of the Union-Castle Line. She was built by Harland and Wolff in 1938, and has a speed of 21 knots and accommodation for 246 first-class and 497 cabin class passengers. She is engaged in the mail service between Britain and South Africa.

The model is to a scale of $\frac{1}{4}$in. to 1ft., which is large enough to show considerable detail, resulting in a most realistic model which is a fine example of British craftsmanship. The model has now been sent to South Africa, where it will form the centre-piece of the Union-Castle Steamship Company's display at the Van Riebeeck Tercentenary Exhibition at Cape Town.

BOOK RECEIVED

Electronics Everywhere. By Prof. A. M. Low. Published by Museum Press, Ltd. 190 pages. Price 8s. 6d. net.

THIS interesting book is not a scientific or technical work in any sense, but an account in simple language of a fascinating science which can be read by anyone. The author explains what electrons are, and how they are replacing necessary labour in factories all over the world. Particulars are given of how machines can now make abstruse calculations in a fraction of the time required by skilled mathematicians; how electronic "rays" can kill insects in grain, sterilise milk, warm your house, and catch burglars. A special chapter deals with the atom bomb, and the results that this branch of research is likely to have in peacetime through the agency of electronics.

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SWITCHBOARD METERS, 4 inch scale moving coil (D.C.) only 0 to 14 amps, 17/6 each, post 1/6. Ditto, A.C./D.C., 22/6 each, post 1/6.

MAINS TRANSFORMERS (NEW). Input 200/250 volts in steps of 10 volts, outputs, 350/0/350 volts 180 m/amps 4 volts 4 amps 5 volts 3 amps, 6.3 volts 4 amps, 39/6 each, post 1/6; another 350/0/350 volts 180 m/amps 6.3 volts 8 amps, 0/4/5 volts 4 amps, 39/6 each, post 1/6; another 500/0/500 volts 150 m/a. 4 volts 4 amps C.T., 6.3 volts 4 amps, C.T., 5 volts 3 amps, 42/6 each, post 1/6; another 425/0/425 volts 160 m/amps 6.3 volts 4 amps, C.T. twice 5 volts 3 amps, 42/6 each, post 1/6.

EX-RADAR MAINS TRANSFORMERS 230 volts input 50 cycles 1 phase, output 4,500/5,500 volts approx. 80 m/amps 6.3 volts 2 amps, 4 volts 1½ amps 2 volts 2 amps, these transformers are new immersed in oil, can be taken out of the oil and used as television transformers giving output of 10 m/amps, overall size of transformers separately 5½in. x 4½in. x 4in. and 3in. x 3in. x 2½in., price £3/10/- each, carriage paid.

ROTARY CONVERTERS. 24-28 volts D.C. input, 1,200 volts 70 m/amps D.C. output, 10/- each, P.F.

MAINS TRANSFORMERS (NEW), suitable for spot welding, input 200/250 volts, in steps of 10 volts, output suitably tapped for a combination of either 2/4/6/8/10 or 12 volts 50/70 amps, 87/6 each, carriage 7/6.

AUTO WOUND VOLTAGE CHANGER TRANSFORMERS, tapped 0/110/200/230 volts 350 watts, 48/6 each, post 1/6, as above but 500 watts 62/6 each, carriage 3/6; as above 200 watts, 35/- each, post 1/6.

RECTIFIERS (NEW), D.C. output 37 volts 50 amps, complete with mains transformer 230 volts A.C. input 50 cycles 1 phase output to match the required voltage for the rectifier, £15 per set, carriage 10/-.

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MAINS TRANSFORMERS (NEW), 200/250 volts input, in steps of 10 volts, outputs, 0, 6, 12, 24 volts 6 amps, 37/6 each, post 1/6. Another as above but 10-12 amps, 48/6 each, post 1/6; another, as above but 25/30 amps, 70/- each, carriage 3/6; another, input as above, output 0/18/30/36 volts, 6 amps, 42/6 each, post 1/6.

EX-R.A.F. ROTARY CONVERTERS. 24 volts D.C., input 50 volts, 50 cycles, 1 phase at 450 watts output, complete with step-up transformer 50 to 230 volts, £9/10/- each, carriage 10/-.

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A light-weight pick-up is fitted with high fidelity crystal head. The weight at the needle point is 9 grams. The weight of the head is reduced by a counterbalance, and not by springs, which always tend to unreliability. Two permanent sapphire styli are fitted, one for microgroove and the other for standard 78 r.p.m. recordings. Change over from one stylus to the other is easily effected by rotation of a small knob at the front of the head.

The automatic stop which is completely concealed below the unit plate is cleverly designed to operate on all types of records, irrespective of the diameter of the run-off groove.

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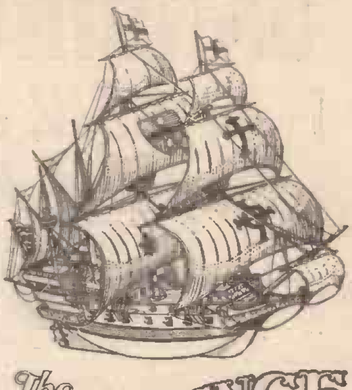

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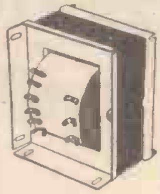

No. 4. 4v.-9v.-20v. 4 amp. For 2, 6 and 12 volt chargers, 16/-.
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RESISTANCE MATS.—Make ideal heating mats for Aquariums, Photographic solutions. Print dryers, etc. Mains voltage. Black heat, size 10in. x 6in. Price, 2/6, post free.

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Waterproofing an Oilskin

I REQUIRE a recipe for preparing a good waterproof dressing for an oilskin. Would the same dressing be suitable for a tarpaulin ?—J. Pritchard (Beddgelert).

THE waterproofing of an old oilskin is always a difficult job. The following dressing, however, is perhaps the easiest and the best which can be used for such a purpose:

Boiled linseed oil	8 parts.
Genuine turpentine	2 parts.
Beeswax	1 part.

Warm the oil, stir in the shredded wax. Allow the latter to dissolve and then, finally, stir in the turpentine. This dressing should be applied warm to the oilskin. The first coat must be well rubbed in. In an hour or so, wipe off any surplus dressing and, when the skin is thoroughly dry, apply to it equal parts of boiled linseed oil and the above mixture, to which, as a colouring agent, either yellow ochre or lamp black may be added as required. With this latter dressing give the material two more coats, allowing each to dry thoroughly in a cool, shady place. The drying time is usually prolonged over weeks, but it is essential to allow for good and thorough drying in between the coats of dressing, otherwise the material may, as is often the case, acquire a permanently sticky tendency.

The same dressing is quite suitable for tarpaulins.

Removing Fur from Kettles ; Books on Generating Plants

I REQUIRE an effective means of removing the scaly deposit left by hard water on the inside of kettles, etc. Please advise.

Can you recommend a book dealing with small generating plant and storage batteries for house lighting, with particular regard to switchboard wiring ?—D. F. Jefford (Axminster).

THE scaly deposit left by hard water on the inside of kettles consists mostly of calcium carbonate. This is readily removed by swilling the kettle out with dilute hydrochloric acid or dilute acetic acid (1 in 4), or by rubbing the vessel round inside with a rag saturated with either of the above liquids. The operation must be done quickly so that the acid is not given a chance to attack the metal. After this, the vessel is rinsed out thoroughly with water. Two or three of these treatments will probably be necessary to dissolve away hardened scales.

Suitable books on small generating plants, etc., are the following:

Newnes' "Electrical Engineer" Series, "No. 15, Private Generating Plant," and "No. 1, Electric Wiring (Domestic)."

These two volumes, in themselves, will probably meet all your difficulties. Other volumes of the same nature are:

F. H. Taylor: "Private House Electric Lighting."

Newnes' "Electrical Engineer" Series, "Switchboard Instruments."

Ciné Screen Material

FOR some considerable time I have been experiencing difficulty in obtaining proper material for a good 8 mm. screen, and I would appreciate your advice as to what you consider is the very best material for this, similar to my previous American crystal cloth. This screen was manufactured by the Day-Lite Company, Chicago, but I have already written to them without success.—J. T. Menaul (Enniskillen).

THE American "ribbed" or "crystal" screen-cloth is made by coating a strong white cloth surface with a layer of soft, transparent resin and then by placing it in a press with a flat-patterned steel die containing diagonal lines or channels. The resin quickly hardens and the cloth has the appearance of being covered with diamond-shaped or parallel-channelled lines, which are reflective on two sides and which, therefore, tend to give brilliance to the projected image. We do not think that such material can be obtained in this country, although you might send an enquiry to Messrs. Wallace Heaton, Ltd., New Bond Street, London, W.1, or to Messrs. Jonathan Fallowfield, Ltd., Newman Street, London, W.1.

A silver screen produced by spraying a fine aluminium paint on a flat white surface is very brilliant and reasonably long-lasting, but our preference has usually been for a plain white screen only, such a screen being made by spraying a flat white paint on to a stretched canvas or other fine fabric. This screen is the most reflective and the longest-lasting of all types. When soiled, it can usually be cleaned by a simple sponging, and it has the advantage of being visible clearly from all viewing angles. It also ensures the least loss of light. We do not think that you can better a plain white screen for ordinary 8 mm. projection, but we realise, of course, that there are opinions which are not in agreement with ours.

Jointing Paste for Hot-water Pipes

CAN you inform me how to make a good jointing cement for hot-water pipes ?—J. G. Huggins (Enniskillen).

YOU cannot unite hot-water pipes by means of mere plastic jointing cement, for the cement will invariably soften and the joint will leak more or less badly. The pipes should be screwed together in the usual manner and, before screwing up, the threads should be smeared over with a red or white lead paste. For any other pipe-jointing purposes which you may have in mind, you should use an ordinary white lead paste in which a small quantity of red lead has been worked sufficiently to give the paste a pink coloration. Such a paste will be fairly rapid-drying and will, in time, become dead hard.

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

Stencilling Rug Designs

I HAVE been stencilling designs for rug making on a rough, heavy and hairy material, using a mixture of resin, colour and french chalk. This powder is wiped over a perforated paper stencil; the design is thus transferred on to the rug backing and is then sprayed with methylated spirit to fix it. My trouble is that the colour in the powder discolours the tufting yarn as it passes through the backing and is most difficult to remove, thus soiling the rug. To obviate this I have tried several variations of the process, but without success.

Please tell me : (1) Is resin the correct binding agent or is it shellac or some other gum ? (2) What are the correct proportions ? (3) Is my procedure correct ? (4) Can you recommend a process or machine for perforating paper stencils by heat so that the hole is clear and clean cut ?—J. Callum (Carlisle).

THE whole of your trouble with the stencilled designs seems to lie in the fact that your colouring material is of a soluble type. Consequently, the colour enters into solution and becomes smudged over and impregnated into the fabric. You could overcome this trouble by using an insoluble coloured pigment for the job. A pigment, such as red iron oxide, yellow ochre, green chromium oxide, Prussian blue or lampblack, would be quite insoluble in water or in any other liquid which you could use. The pigment would lie loosely on the fabric and it could be brushed away afterwards by a stiff brush without any soiling or marking occurring.

Resin is a valuable binding agent for your purpose because, when dry, it so readily powders and can be brushed away from the fabric. A solution of 1 part of shellac in 3 or 4 parts of methylated spirit would possibly be more useful, but it would have to be dissolved away by means of methylated spirit and it might stain the wool in the process.

The only way to cut paper stencils by perforations is to drive needles, such as old gramophone needles, into a block of wood which is held firmly in a frame. The paper, in one or more layers, is then held in another frame and carefully pressed down on to the needles. Provided that the paper is sufficiently strong, a system such as this will produce holes which are clear and well cut, but if the paper is not strong the tendency will be for the holes to be ragged and torn.

Laying Glazed Tiles

WILL you inform me if it is possible to lay glazed tiles—the kind obtainable at cheap stores—on a wooden bench, to make a satisfactory job ? What kind of cement is used and what method is used in cutting the tiles ? Could I use a small hacksaw ?—B. Paton (South Shields).

IT is quite possible to lay glazed tiles on a horizontal wooden surface, such as a wooden bench. If there is not going to be much strain on the tiles you could lay them with ordinary white mortar, making a thin "bed" of mortar first, and laying the tiles carefully in this bed. For a stronger job, you would use a cement mixture—say, 1 part Portland cement with 2 or 3 parts of fine sand. Another suitable cement consists of a 50-50 mixture of builders' plaster and lime.

Glazed tiles will not withstand much traffic wear. They are brittle and are liable to surface chipping and abrasion. They can be cut by means of a sharp hacksaw, and this work is rendered easier if it can be done *under water*. Commercially, the tiles are cut by means of a carborundum saw, which is a high-speed revolving steel wheel whose edge is tipped with carborundum grains. Even in this case, however, plenty of water is used as a lubricant.

Before laying the tiles they should be soaked in water for several hours so that they are enabled to take up a maximum amount of water. This will enable the tile cement to get a maximum grip on them. If the tiles are not thus wetted beforehand, they will tend to abstract the moisture from the cement, with the result that the latter will dry too quickly and will not attain its maximum adhesive power.

Cleaning Fungus Film from Glass

MY greenhouse glass has taken on a smoky appearance, and a slight fungus is growing on it. I am told that there is a preparation on the market which will clear this glass without much labour in scrubbing, etc. Can you help me, please ?—S. H. Alabaster (Farnborough).

THE presence of the film of fungus on your greenhouse glass seems to indicate that the glass has been lying in contact with the wet ground from which it has picked up the fungus infection. Actually, the film which forms on the glass is not a true fungus but is a plant-like organism which belongs to the very large class of one-celled plants called "algae."

The best method of dealing with the trouble is to clean the glass thoroughly with hot soap-and-water and, if possible, with common soda dissolved in the water. Then rinse away all the soap and soda, and saturate a soft cloth with a solution of copper sulphate and wipe this cloth over the glass so that a very thin film of the solution is left on it.

This copper solution is toxic to algae. It need not be a strong solution, and you can make it yourself by dissolving 1 oz. of blue copper sulphate in one pint of hot water. The solution will be a brilliant blue and, in a well-corked bottle, it will keep indefinitely.

Dyeing Leather ; Electric Gas-lighter Wire Coil

I HAVE been experiencing trouble with the dyeing of leather, using some of the popular brands of dyes. The desired colour is obtained but it is not fast.

Could you suggest anything to increase the penetration, or some other agent ? The leather is the type used for upholstery work.

(2). Could you also tell me the type of wire used in the small electric gas-lighter (battery type), and where I might obtain same ?—D. G. Pinner (Aylesbury).

NONE of the popular types of leather dye is in any way fast, either to light or to chemical agents. Leather dyeing, in our opinion, is not an easy job and it cannot be done really effectively by means of the usual home-prepared dyes and stains. To a certain extent, the dye solution can be given added penetration power and a greater fullness of colour by mixing with it up to 10 per cent. of oleic acid. You would, we think, get a more satisfactory result by brushing a strong spirit stain on to the leather and then by rubbing oleic acid well into the material.

(2). The small electric gas-lighters to which you refer utilise a "Eureka" or nickel-silver wire coil of thickness approximately that of s.w.g. No. 44. This is an extremely thin wire but, since the wire is tough and springy, it is not difficult to handle. It can be obtained from most traders in electrical materials. Have you tried any of our advertisers?

Electro-depositing Copper

(1) When electro-depositing copper, does the copper deposited come from the solution or is it transferred from the anode through the solution? Does the solution ever become exhausted—if so, how is it possible to tell this?

(2). I wish to obtain a deposit 1/32in. thick on an area 3in. x 3in. in a reasonable time. Is this practicable?

(3). Is it practicable to use 230 volt A.C. mains through a transformer and rectifier? If so, state the type of transformer required; a circuit would be welcome.

(4). What is the area of tank required?—L. Barhem (Peckham, S.E.15).

(1) When copper is deposited electrolytically the copper itself comes from the electrolyte or solution. At the same time an equivalent amount of copper is dissolved away from the copper cathode or negative electrode. If the solution were used with an insoluble cathode such as one of carbon or platinum, the electrolytic and copper deposition would go on until the bath became almost exhausted of copper. When the exhaustion point was being approached the copper deposition would slow down and become tardy and inefficient. The best way of determining the state of exhaustion of a bath would be to analyse a sample of the solution and thus determine its copper content. There are speedy methods in use for this kind of analysis which are carried out by all electro-plating establishments.

(2). The rate at which any metal is electro-deposited depends entirely on the amount of current (in amperes) passing through the bath in any given time. It is in no way dependent on the pressure or voltage of the current. The average copper bath used with a current density of 40 amperes per sq. ft. of plated surface will give a deposition of about 0.0003in. thickness of copper in eight minutes. Hence, much longer time would be necessary to deposit copper of 1/32in. in thickness. There are, however, several types of copper baths as, for example, the straight "acid" bath, the cyanide bath, the Chevreul bath, and the Rochelle salt bath. Each of these baths gives a different rate of copper deposition, the straight acid bath giving the heaviest deposition in a given time, although the metal plated by this bath is of the coarsest texture. We notice that you do not give us any indication of the type of copper bath which you propose to use, and thus we are unable to help you further in this particular matter.

(3). It is quite practicable to use any type of transformer-rectifier combination for plating purposes, and, indeed, such devices are used on a large scale in many plating establishments. No special type is necessary. You must have a transformer-rectifier which will deliver to the bath a one-direction current. This is merely connected in series with the bath as you would connect an ordinary battery or accumulator. The negative output pole (cathode) of the rectifier is connected to a copper rod or sheet immersed in the bath, whilst the positive pole is connected directly to the work to be plated.

(4). No special size of tank or vat is required. The tank should contain comfortably the copper cathode and the work to be plated. The tank should be preferably of glass, slate, porcelain or of some other non-metallic substance.

We would advise you to procure and study a good book on the elements of electroplating of various metals, such as: S. Field and A. D. Weill: "Electro-plating" (Pitman).

Polishing Linoleum

I RECENTLY covered my living-room with inlaid cork lino, which has a dull, flat finish. The normal method of polishing is proving to be extremely slow. Can you recommend a suitable method of obtaining a fairly hard glossy surface or of forming a base for polishing in the normal manner? This preparation must be of a permanent nature and able to survive constant washing.—P. Derrick (Hornchurch).

GENUINE linoleum (which is based on compressed cork) has always a dull, flat surface, being distinguishable in this characteristic from the imitation "oilcloth," which latter has always a shiny surface produced by calendering through hot rollers. It is, therefore, most undesirable to attempt to get a glossy finish on a genuine lino surface, such an attempt being rather like putting gold paint on to a gold article.

There is no means of getting a shiny surface on a floor-lino which will be quite permanent and which will stand up to repeated washings. Even the thin commercial "oilcloth," with its highly glossy surface, will not withstand such treatment. The correct way to polish a genuine cork lino is to use a wax floor polish with plenty of rubbing. Alternatively, you could use one of the emulsified wax polishes of the "dry-bright" type which are merely wiped on to the surface and do not require rubbing. Probably, Messrs. Johnson's "Glocoat" is the best known of these polishes. You can make the surface bright by wiping it over with a solution of shellac (1 part) in methylated spirit (3 parts) followed by waxing. This will give a fairly good result, but it will not resist foot traffic or repeated washing with soap and water. Even a heavy oil varnish will not resist such influences. Clear cellulose lacquer will put up a fair resistance to such treatment, but its behaviour in this respect will not be perfect. If you take our advice you will be satisfied merely by developing up the dull sheen which can be produced on real lino by ordinary wax polishing.

Petrol Gauge Operation

I HAVE on my car a petrol gauge of the thermometer type which consists of a glass "U"-tube, a capillary tube, and some type of bulb or element which fits inside the petrol tank. Will you please describe the operation of this device, and also advise me as to how I may refill it. Also, where can I obtain the necessary liquid, as on my system the liquid has either leaked away or evaporated?—W. Taylor (Durham).

THE petrol-level gauge you describe is one of an old type. It consists of a U-tube connected by means of capillary tubing to an "element" inside the petrol tank. This "element" comprises a metal tube with a hollow, bulbous end, in which is drilled a very small hole. The tube is secured vertically in the tank with its bulbous end downwards. Its mode of operation is simple. The petrol leaks into the "element" tube through the small hole, tending to rise therein. By doing so it displaces the air upwards. As a result, an air pressure is developed within the tube. The air under pressure forces upwards the coloured liquid in the tube, which latter is mounted against a calibrated scale. Thus, a direct reading of the petrol level in the tank is obtained. The general principle of this type of device will be seen in the accompanying sketch.

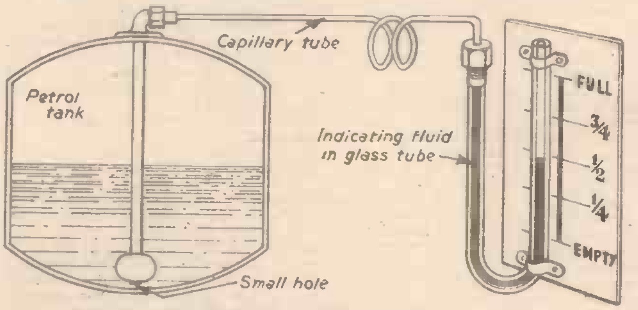

Diagram of a petrol gauge.

The indicating liquid generally used for this purpose is acetylene tetrabromide (tetrabromethane), which is coloured by a spirit-soluble dye. Acetylene tetrabromide is a heavy liquid of specific gravity about 2.9. It can be obtained from most laboratory chemical firms such as British Drug Houses, Ltd., Poole, Dorset, its price being about 2s. 6d. a lb. Since this liquid is not volatile, it seems clear that, in your case, the liquid has leaked away or has been spilled.

Waterproofing a Flying-suit

I HAVE an ex-R.A.F. flying-suit made of a kind of closely-woven canvas which I would like to rubberise to render it waterproof. Please give me the method.—E. W. Hudson (Ruislip).

IT is absolutely impossible to rubberise an already made-up garment. The whole process of rubberisation (which can only be applied to fabric in the length) is far too complicated and technical (and calls for the use of heavy calender rolls) for any individual person to attempt. It would be absolute waste of money for you to essay any such trials.

If you wish to waterproof the garment without staining, make up a solution of 1 part of aluminium naphthenate in about 8 parts of white spirit. Brush this on the affected areas (both sides) and then allow the garment to dry in a current of air. The naphthenate solution is an adequate waterproofer where it penetrates the fabric, but the solution will not penetrate any of the remaining rubber-coated areas.

Aluminium naphthenate can be obtained, price about 6s. per lb., from Messrs. Thomas Tyrer & Co., Ltd., Stratford, London, E.15, or from most chemical supply firms such as Messrs. Vicsons Ltd., 148, Pinner Road, Harrow, Middlesex. We estimate that about ½lb. of the material would be adequate for your needs.

Painting on Silk

I WISH to paint designs on parachute silk for magical purposes, and would appreciate your advice as to the correct procedure.

I have tried dyes and fabric oil paint without obtaining satisfaction.—Wm. T. Tunnah (Edinburgh, 3).

YOUR use of dyes is quite impracticable for the painting of lustre silk material because ordinary direct dyes can only be fastened on to the fabric by the use of boiling solutions. For the purpose, you should use an artist's fabric paint. This may be based on cellulose or it may be of a normal water-colour paint formulation. In either instance, the paint will contain an insoluble pigment and will thus be a true paint and not a mere dye or a stain, which latter will always "run" and give blurred outlines. These fabric paints can be obtained from any dealers in artists' materials or in craft materials for art workers. You will be able to obtain such paints from Dryad, Ltd., St. Nicholas Street, Leicester.

Your only alternative is to make up strong solutions of spirit-soluble dyes in methylated spirit and to brush these lightly on the fabric. Possibly the various colours used for tinting photographic prints, being of this nature, would be satisfactory.

Dry Cleaning Carpets and Leather Upholstery

PLEASE give me some formulae for making up "dry cleaners" for cleaning upholstery and carpets, not necessarily "foam" type.

What is the best cleaner for leather on upholstery?—C. H. Downs (Johannesburg).

THE following is an excellent soap for dry-cleaning carpets and upholstery in general:—

Oleic acid	14 lbs.
Butyl cellosolve	2½ lbs.
Ethylene dichloride	6½ lbs.
Triethanolamine	8 lbs.
Water	112 lbs.
Isopropyl alcohol	7 lbs.

The first three ingredients are mixed together and then added to the triethanolamine and water, which have also been mixed separately. The resultant mixture is well stirred and the isopropyl alcohol is added so that a clear solution is formed which yields a product readily soluble in water. This is the liquid which is used for cleaning purposes merely by being wiped or gently scrubbed into the fabric.

If you have any difficulty in obtaining the various ingredients we suggest that you apply to a British firm of chemical dealers such as Messrs. Baird and Tatlock, Ltd., 14/17, St. Cross Street, Hatton Garden, London, E.C.1, or to Messrs. W. & J. George & Becker, Ltd., Nivoc House, Ealing Road, Alperton, Wembley, Middlesex.

A cleaning material of the above nature is very good for dealing with leather upholstery. Alternatively, you could use a mixture of equal parts of soapy water and paraffin or white spirit, but in all such cases the leather, after drying, should be given a wiping over with the following composition to restore to it flexibility and soft surface:—

Castor oil (or neatsfoot oil)	22 parts
Oleic acid	2.5 „
Triethanolamine	.5 „
Water	20 „

Add together the oleic acid, triethanolamine and about one third of the castor or neatsfoot oil. Stir thoroughly and gradually add about one third of the above amount of water, stirring vigorously until a thick, uniform emulsion results. Continue the vigorous stirring; add slowly the remainder of the oil and then the rest of the water. Continue to stir until a fine, liquid emulsion has been obtained. This mixture is excellent for restoring softness and pliability to all types of leather surfaces after dry or wet cleaning.

Varnish-stain for Woodwork; Bending Conduit

COULD you give me a formula for repolishing chairs and legs of tables without removing the existing polish?

After marking off the measurement of where a bend or set is required in conduit work, where should the mark be placed, either in a conduit bender or when one uses a block of wood as the usual procedure?—V. Child (Llantwit Major).

A GOOD and easily applied varnish stain for woodwork of all descriptions can be made by dissolving one part of shellac in about four parts of warm methylated spirit. When the shellac has dissolved completely, you should add to the still warm solution sufficient spirit stain of the colour required to impart to the solution the shade which you desire. Spirit stains are cheap and can be obtained in all colours from black to yellow from most shops dealing with decorators' materials. About ½ oz. of the dry stain powder would be adequate to colour a whole pint of the dissolved shellac solution. We do not advise you to apply the solution with a brush, however fine it may be, because this will give a thick, treacly surface on the woodwork. The best way to apply this stain is to make up a little bag with clean cloth, the bag containing a wad of cotton wool. The spirit varnish which you have made should be poured on to the cotton wool, the ends of the bag twisted up, making a pad which is rubbed over the wood surface.

This will give a much better finish than the brush finish which you propose, but, of course, it will not be anything like the orthodox french-polish finish which can only be produced after a rather difficult and skilled operation.

We take it that you require to bend ordinary conduit tubing. The area of the bend should be marked on the outer side of the tubing itself. If you have devised some means of bending the conduit by means of wooden blocks, it is quite in order to mark the blocks as well but in all cases, for exact work, it is essential to mark the exterior of the conduit tubing. Chalk marks will usually be sufficient and show up readily.

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Comments of the Month

ERRORS OF JUDGMENT

By F. J. C.

IN the case of Simpson v. Peat which was decided before a full Court of High Judges on February 12th, 1952, case law has been set aside by the decision of the judges. It was laid down in Rex v. Howell in 1938 that when one is charged with reckless or dangerous driving he is entitled to be acquitted if he has merely made an error of judgment. The driving, owing to the error, may have been dangerous in its consequences, but if there was nothing culpable about it it was not an offence under the Road Traffic Act. That has been the ruling doctrine in all cases of dangerous driving; it was necessary to prove culpability and/or negligence.

That precedent, really a piece of case law, has been set aside by the later judgment. In the recent case the defendant was turning to his off-side in a main road, cutting across the line of traffic coming from the opposite direction. In so doing, he upset and injured a motor-cyclist. He had thought, erroneously, as it later turned out to be, that he could execute this manœuvre in safety. The Lord Chief Justice, in giving his decision, said: "A driver may not be using due care and attention, although his lack of care may be due to something that can be described as an error of judgment. If, in fact, he is driving without due care and attention it is immaterial what caused him to do so. Justices are to ask themselves: 'Was the defendant exercising that degree of care and attention which a reasonable and prudent driver would exercise?' If he was not, they must convict."

This seems to sweep aside any defence of error of judgment and to make all drivers of vehicles, including cyclists, responsible in law for errors of judgment. In other words, it is an offence to be guilty of an error of judgment. Alternatively, the law is where it was, and all the Lord Chief Justice said, in a complicated way, was, that it is possible to be guilty of an error of judgment and after discovery of that error to drive without care and attention.

Road Accidents

THE Government has announced that it is to spend £1,000,000 a year on removing road accident black spots. This is a tacit admission that accidents are not, in the main, due to carelessness, and an admission that road improvements can make a great contribution towards road safety. But £1,000,000 will not go very far. At least £10,000,000 needs to be spent per annum for five years at least on road improvements. That, unfortunately, is not possible in view of our present economic situation. Motor taxation totals £250,000,000 a year, and road transport accounts for three-quarters of all expenditure on transport in this country.

Perhaps that is why the motoring organizations are to press for a detailed analysis giving much more factual information about the cause of individual road accidents.

There has been an increase of nearly 215,000 vehicles on the roads during the past year, but practically nothing has been done to remove the hundreds of black spots where accidents continually occur and where they will go on occurring until improvements are effected. There is abundant official evidence to refute the fallacy so often promoted by the pundits of the C.T.C. that drivers of motor vehicles are primarily responsible for accidents. It has been proved beyond all argument that highway deficiencies are a main cause. The analysis asked for will help to put the problem in better perspective.

Subtle Move by the N.C.U.

THE N.C.U., one of the boneless wonders of the cycling world, in its latest gyration is endeavouring to take under its aegis mass start racing against which it has consistently set its face during the past 10 years. It thinks, by so doing, that it will kill the B.L.R.C. There have been delegations to the Ministry of Transport and the Home Office, and reports suggest that the N.C.U. is flirting with the idea of running mass start races on the open road. How it will do this remains to be seen, for it will need a change in its rules.

The R.T.T.C. which, with the N.C.U., has not hesitated to adopt subterranean methods on some occasions to get mass start racing stopped is naturally concerned, and if the N.C.U. succeeds by its *volte face* in operating mass start races the R.T.T.C. will call special district and national meetings.

The Ministry of Transport attitude to mass start racing remains unchanged. It "deplores" the fact that this form of racing continues and threatens that at the first opportunity it will take action to stop it. It has no justification for doing so in view of the clean record of mass start racing. It might equally stop time trials, in which a number of accidents have occurred. Only one public complaint has been received by the Ministry about mass starts. There have been a few police complaints.

The Home Office takes the view that police action is largely a local matter. The Chief Constables of Surrey and Yorkshire have warned the League not to race within those counties and if the N.C.U. butts in, as it vulgarly proposes to do, many other Chief Constables might follow suit. This attitude may be dog in the manger—if we can't run such races no one else shall.

There is no likelihood of any ban being placed on mass start racing at present. An emergency meeting of the N.C.U. laid down a programme of mass start races of one per month in each centre and 12 national events each year, if the Council gives its approval to the sport which it has been so viciously attacking since its inception. It seems reasonably certain that within the next two or three years mass start racing will be a recognised sport. Thus does N.C.U. history repeat itself. Once again it acknowledges that it has been the apostle of a lost cause; once again it acknowledges that its judgment has been unsound; once again it acknowledges that its gloomy prognostications about dangers have been proved unfounded.

The Ministry of Transport may reach the conclusion that its judgment is equally unsound on other matters where, quite erroneously, it pretends to represent the views of organised cyclists. The N.C.U. does not and never has, a fact of which the Ministry is by now well aware.

Copies of this plaque (actual size 4½ in. high) have been presented by the "Daily Express" to all competitors and principal officials who took part in the 1951 Tour of Britain.

The Cycle Show

THE Cycle Show this year will take place at Earls Court, from November 15th to November 22nd. The opening and closing days are both Saturdays. The whole of the floor space has already been booked.

Steel for Bicycles

THE bicycle industry is to be more favourably treated by the Ministry of Supply in regard to steel supplies for the second quarter of 1952 than had at first been thought.

The cut in supplies is less than was at first anticipated. Supplies of bicycles to the home market will still be cut by half, but the larger allocation, stated the manufacturers' union recently, will mean that there is good reason to hope that the industry will be able to maintain in 1952 last year's record export of bicycles.

The Case Against Shaft Drive

The Modern Chain is an Astonishingly Efficient Device

By "ENGINEER"

DESPITE the acknowledged efficiency and reliability of the modern roller chain as a means of transmitting the leg-power of the rider to the rear wheel of the cycle, there are cyclists who seem to hanker after the propeller shaft as a mode of energy transmission on a cycle.

There are, of course, certain advantages to be seen in the shaft drive as applied to bicycles. For one thing, such a drive is immensely strong and it possesses, when properly fitted and adjusted, high mechanical efficiency. Again, it would be easy to design a neat multi-speed gear-box to go with a shaft drive on a cycle, a fact which makes strong appeal to many keen adherents to the cycling pastime.

When, however, we come to consider the many inherent advantages to be had in the employment of the now almost universal chain drive on cycles, it is not difficult to appreciate the fact that were chain drives suddenly to be abolished on present-day cycles and propeller shafts to take their place, our gains on the swings would be far outweighed by our losses on the roundabouts.

The Perfect Chain

Regarded as a mere mechanical production, the modern chain is an astonishingly efficient device. It is also a relatively inexpensive production. The chain drive on a bicycle is a sweetly-running, yielding and highly flexible mode of energy transmission. It is capable of standing up to ill-usage without going out of action, and it needs the very minimum amount of attention and lubrication.

Not so, however, even the simplest of shaft drives. A propeller shaft, in the first place, is, with its accompanying cogs and gears, a more expensive article than the highest grade of cycle chain. Bevel gears and cogs, unless they are very finely adjusted, absorb more power than does a chain, and it is, of course, vitally necessary to maintain a condition of adequate lubrication around such gears.

The propeller-shaft drive on cycles, therefore, would bring with it the worry and complications of additional lubrication. Such a drive would not, as some cyclists appear to imagine, be any lighter than a chain drive, for nowadays a modern chain can be made very light and strong, whilst a propeller-shaft drive must necessarily, by reason of its accompanying cogs and gears, attain a very substantial weight.

Wider chain stays for the rear wheel would be rendered necessary by a system of shaft drive on a bicycle. Here again, some additional weight would be added to the rear wheel assembly, and the question of ease of detachment of the rear wheel would have to come in for a good deal of careful consideration, for formidable practical difficulties would immediately crop up in this particular detail of construction.

Harsh and Unyielding

The shaft drive is well suited to cars, where the power impulses from the engine are rhythmical and regular at nearly all speeds. Such a drive is less suited for ordinary motor-cycles as practical experience gained over many years has proved; whilst adapted to cycles, the shaft drive is harsh, unyielding, inflexible and generally unsympathetic in action.

If, by any chance, a chain breaks, it can be repaired without much difficulty. But if anything went wrong with the gears of a cycle propeller-shaft drive, the repair would be a much more costly job and in many instances a total replacement of the shaft gear might be necessary.

Again, it must be borne in mind that the modern cycle frame is not well adapted to take a shaft drive assembly. The cycle frame has gradually evolved to meet the requirements of the chain drive, and should at some future time the shaft drive come into popular demand, there is no doubt of the fact that an entire redesigning of the cycle frame would have to be forthcoming.

A Belgian Shaft Drive

The shaft drive, of course, is not unknown in the cycle world. For many years the Belgian "F.N." Co., enthusiasts in the production of shaft-driven motor-cycles, manufactured bicycles equipped with a system of shaft drive, and as late as 1930 such machines were obtainable on the Continent. But for all its individuality, there was very little demand for the shaft drive on such machines. Consequently, if any shaft-driven bicycles have been produced within very recent years, they are the creations of individual enthusiasts and experimenters.

Wear and tear on tyres, even with the best of shaft-driven cycles, must be greater than that taking place on chain-driven machines. This is on account of the fact that sudden brakings and stoppages are not partially absorbed by the propeller-shaft assembly as they are by a chain and sprocket wheel system. It seems, therefore, safe to predict that if ever the shaft drive does attain popularity and general usefulness as applied to the bicycle, that vehicle will have to be made with some additional shock-absorbing device incorporated into its transmission system.

It will be realised that the propeller shaft on a car is not unprotected from the shocks of the road like it would be on a bicycle. The road wheels of a car are sprung and the propeller shaft of the vehicle is thus guarded from all direct road shocks. Applied to a cycle, however, the propeller shaft, unless some efficient shock-absorbing device were incorporated into the machine, would have to take all the direct shocks of the road, a fact which would seem likely to bring in its train numerous breakdowns and fractures of the shaft-driven mechanism.

It will thus be evident that the non-adoption of the shaft drive on the present-day bicycle is not merely a matter of vested interests and sheer conservatism on the part of cycle and accessory manufacturers, as a few cycle enthusiasts have been tempted to suggest. The chain is, without any doubt whatever, the most efficient, the most reliable, the least expensive, and the most trouble-proof mode of power drive for the bicycle as we know it in modern times.

It is not, of course, implied that an efficient system of shaft drive for cycle use will never come into popular adoption. Modern conditions change rapidly, and maybe many of us will live to see cycle designs so modified that the shaft drive may attain the status of competitor to the chain drive.

Nevertheless, for cycles as we know them at the present time, the chain drive evolved by dint of many years of trial and experience, has proved itself to be unsurpassable in point of view of general efficiency and reliability. It occupies, one might say, a position of trust in the minds of cycle-manufacturers and users alike, from which it will only be displaced with the very greatest difficulty.

The moat and gatehouse of Little Moreton Hall, near Congleton, Cheshire. This is one of the finest examples of timber-built houses in the country.

AROUND THE WHEELWORLD

By ICARUS

Macmillan's Bicycle

I HAVE received an interesting letter from Tom Riddehalgh of Ribbleton relating to Macmillan's bicycle, a model of which was featured in last month's issue. He is related by marriage to the Macmillan family, his father-in-law being a Macmillan. He owns a framed copy of an old etching of Kirkpatrick Macmillan with his bicycle. The drawing, of course, is very crude and out of scale. I do not believe for one moment that it represents even a rough representation of Macmillan's machine. I know that this sketch has been reproduced in "The Devil on Wheels," in the "Gallovidian," and other works dealing with the history of the bicycle. It is my firm opinion that the copy in the South Kensington Museum more truly represents the original machine. In any case, the problem cannot be settled with any degree of finality because all records and trace of Macmillan's machine have vanished.

The Late Harold Johnson

THE illustration on the centre of this page shows the late Harold Johnson, for nearly seventy years a keen clubman and one closely associated with all aspects of cycling. He was co-president with Ernest Allen of the Finsbury Park C.C., which he joined in 1884, a past president of the Fellowship of Old Time Cyclists, and a vice-president of the Charlotteville C.C. At all club functions he was noted for the richness of his reminiscences and his nostalgic anecdotes. It would be untrue to say that he was a cycling "historian," any more than was the late "Sammy" (how he loved to give the impression of popularity, by adopting a christian name that was not his!) Bartleet. The only difference on that score was that Johnson was accurate in his reminiscences and his memory of what he had read where Bartleet was not. In some respects Bartleet was deliberately misleading.

A "famous tandem couple."

C.T.C. Pays £100 Damages

THE Cyclists' Touring Club lost the case in which it was sued by J. Cecil Paget, Ltd., cyclists' equipment manufacturers, for breach of contract in refusing to insert advertisements in the C.T.C. house journal, which is distributed free to members. The defence was a denial of liability and a plea of justification. They further claimed that it was an implied term of contract that all goods advertised should be of merchandisable quality. J. Cecil Paget, Ltd., have advertised in the C.T.C. house journal for many years, and the case arose because a retailer returned a pair of cycling shorts as being defective. The plaintiffs, however, contended that a hole in the left leg had been caused through excessive wear. The C.T.C. then took up the cudgels on behalf of the purchaser and sent the shorts back to plaintiffs,

The late Harold Johnson with his Ordinary.

at the same time criticising the material of which they were made. The plaintiffs returned the shorts and repudiated the criticism of the C.T.C., stating that as a gesture of goodwill they were prepared to supply a new pair of shorts at a specially reduced charge. Later the C.T.C. wrote to the plaintiffs cancelling their contract for advertising space and, in response to a request for the reason, they were informed that goods advertised did not always represent value for money and they referred to the case of the returned shorts. Defendants admitted breach of contract.

The secretary of the C.T.C., who is also the editor of the house journal referred to, stated that the advertising policy was rigid and that the club had always refused to accept anything suspicious, and did not hesitate to reject advertisements. He reached the conclusion in this case that J. Cecil Paget, Ltd., were no longer producing goods of the quality expected. The matter was referred to the C.T.C. finance and executive committee who were unanimous that further advertising be refused. The judge said, "This firm with whom you have been on the best of terms and whom you have never given the slightest suggestion they are going down hill, you just shut down on advertising, not only on the alleged defective article but everything they supplied. How do you justify that?"

The C.T.C. secretary replied that up to the time of the shorts incident he had believed in plaintiffs' products, and when he took the matter to the finance committee found that some of his doubts were shared. Council for defendants said that the advertising contract was completely different from any other newspaper. "No advertiser in any other newspaper would expect the editor to turn down an advertisement because he disliked the goods," whilst council for plaintiff said that defendants' refusal to take advertisements was peremptory and reckless and a matter of pique.

Giving judgment to the plaintiffs for £100 and costs, Mr. Justice Pilcher said that all the defendants were entitled to do was to say that they could no longer approve of reference to velvet cord shorts in future advertisements. "I do not think they had the slightest justification for condemning all the products of plaintiffs without giving them a chance to apologise or retract."

R.T.T.C. Climbs Down

YOU will remember that in a recent issue of this journal the slashing attack by the R.T.T.C. on the B.L.R.C. was fully dealt with. It was my view at the time that those remarks were libellous and without foundation. The B.L.R.C., I am glad to note, took legal advice on the matter, and as a result the R.T.T.C. has had to eat a humble pie and climb down from its lofty and supercilious pinnacle. In the January issue of the R.T.T.C. bulletin the editor, Mr. R. MacQueen, publishes the following comment:—

"Mr. W. C. Rains, the honorary general secretary of The British League of Racing Cyclists, Mr. D. Peakall, their honorary stage events co-ordinator, and Mr. A. H. Groves, their vice-chairman, have complained of the publication is the June 'Bulletin' of the council's statement on the menace of massed-start racing on the Highways (Reason 4) that 'The motive behind the majority of ring-leaders and their associates is financial; the possibility of extracting sums of money from unsuspecting commercial concerns or news-papers (to whom a distorted story has been told) and the further possibility that unsus-pecting newspapers would give valuable free advertisement to trade interests bound up with the promotions.'

"We are now informed that this statement is inaccurate and that in fact the newspapers and commercial concerns who sponsor those events are most anxious to do so and pay a sum only sufficient to provide for the expenses of the event and the prizes to competitors. Neither the organisers nor their officials re-sponsible for the promotion receive any financial benefit whatever and certainly no distorted stories are told to the sponsors.

"We desire unreservedly to withdraw the statements quoted above, which we realise should not have been made, and we tender to Mr. Rains, Mr. Peakall and Mr. Groves our sincere apologies for having made and published them." I hope the R.T.T.C. will itself take legal advice before publishing scurrilous remarks tinged with bitterness and acerbity in the future.

The Heart of England Stone

MERIDEN, in Warwickshire, is popu-larly supposed to be the geometrical centre of England, although Buxton close by equally claims to be the focal point of this "tight little, right little Island." As a matter of fact if you cut out a map of England and poise it on a pin pierced through at the location of Meriden it will not balance, and neither will it if you insert the pin at Buxton. However, for all prac-tical purposes, Meriden can be considered as the centre of this island, which for 500 years has had a sandstone pillar on the village green to mark the spot. At the present time it is being dismantled, and by the time this appears in print it will have been exhibited at Olympia, from whence it is to be returned to Meriden and reset on an improved green at a safe distance from the highway and free from the menace of traffic on the main Birmingham-Coventry road which had hitherto threatened it daily. Cyclists have met there once a year for a

The shock-absorber unit of the Phillips' "Springlite."

service to the memory to those who fell in the 1914-18 war.

B.L.R.C. Seeks U.C.I. Recognition

THE B.L.R.C. this year celebrates the first ten years of its colourful history, for it was formed in 1942 to promote road racing under conditions which obtain in every other cycling nation in the world except Great Britain. Those ten years has seen the attainment of its original object. In 1942 less than 200 racing licences were issued and ten events promoted until in 1951 events were held all over the country, including several multi-stage events. In the ten years massed-start racing has made considerable headway and gained a great deal of public trade support. It is still gaining favour. This has been brought about by disregarding the secrecy and inhibitions of the past and the advice of old fogies who ought to have retired from the sport years ago. The B.L.R.C. has earned, and is entitled to, inter-national recognition and they recently asked the U.C.I. to acknowledge the B.L.R.C. as the controlling body for road racing in Great Britain, the N.C.U. to remain as the controll-ing body for track racing only—if track racing survives! The B.L.R.C. is the only organisation in this country promoting road races which conform to the U.C.I. formula. N.C.U. opposition resulted in the U.C.I. refusing to discuss the matter.

A Shock-absorbing Bicycle Frame

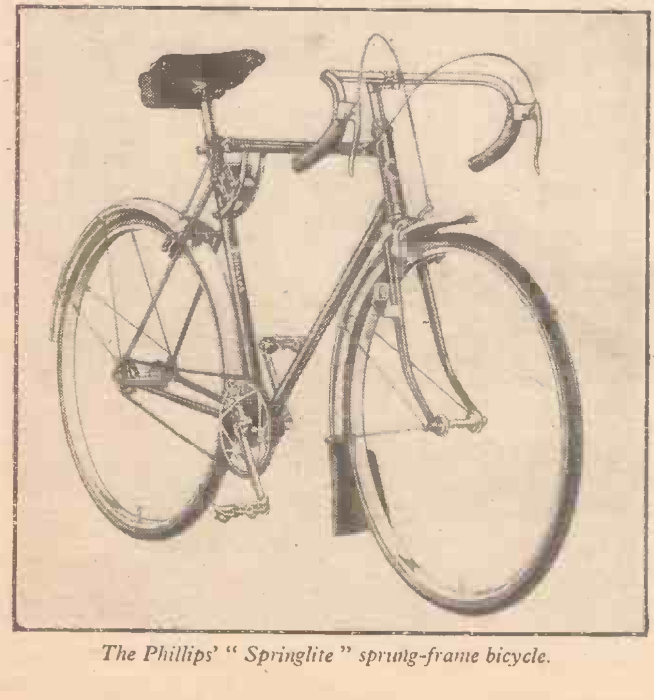
WITH their "Springlite" cycle, Messrs. J. A. Phillips and Co. Ltd., of Smeth-wick, introduce an entirely new conception of cycling comfort, by the application of scien-tific principles of shock-absorbing to frame design.

A rubber/aluminium shock absorber is carried by steel brackets in the angle formed by top tube and seat tube, and to this shock-absorber the upper ends of the seat-stays are connected. By mounting the chain-stays on bearings surrounding the bottom bracket, the entire rear triangle, i.e., the rear wheel, chain and seat-stays, and mudguard, can swivel *as one unit* around the centre-line of the bottom bracket. This ensures that the chain tensioning remains constant and chain-life unaffected no matter how bumpy the road conditions. Similarly the relative positions of rear brake and rim never alter because they both rise and fall together, and whenever the brake is applied the brake pads will always align correctly on the rim. Any type of multi-gear-hub type or Derailleur can be used with it.

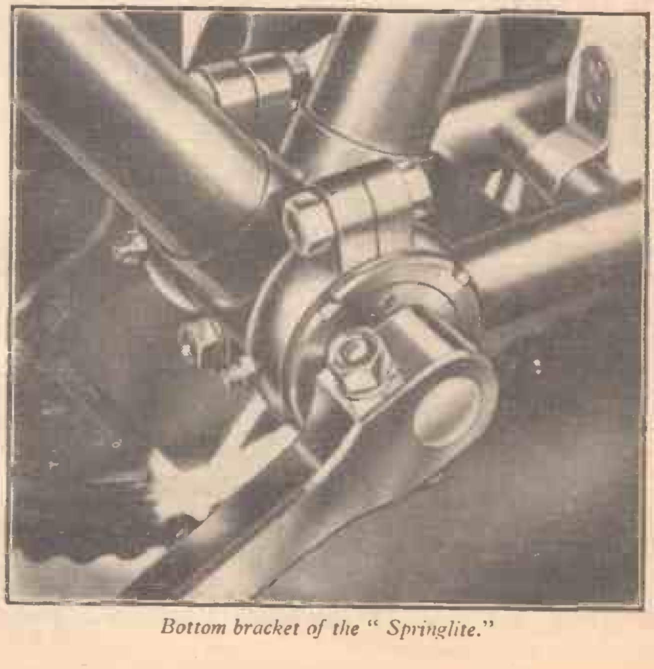
The action of the shock-absorber is con-trolled by parallel links in such a manner as to obtain a light reaction to light road shocks, and proportionately *greater* reaction to *greater* road shocks.

By absorbing road shocks through this controlled movement of the entire rear triangle, complete lateral rigidity of wheel mounting is obtained and stability of machine is unimpaired. Not only does the design absorb shocks which with an unsprung frame are transmitted to the rider via the saddle, but those vibrations which reach the legs through the pedals (and which the good rider finds so detrimental to a steady thrust) are appreciably reduced.

With all moving points of both shock-absorber unit and bottom bearing provided with pressure gun lubrication, and replace-able "car-type" anti-friction bearings, the "Springlite" is undoubtedly a revolution in British cycle design.



The Phillips' "Springlite" sprung-frame bicycle.



Bottom bracket of the "Springlite."

SIGNPOSTS IN CYCLING HISTORY

No 4 James Starley, 'Father of the Cycle Industry'

James Starley, born in 1830, was from his youth fascinated by all forms of mechanics. In 1859 he directed his inventiveness to the production of sewing machines. Ten years later the company he served was asked to produce "bone-shakers" of a type then popular in France. Starley's interest was immediately aroused. His first improvement to the French design was the addition of a mounting step. Then, by reducing the size of the rear wheel and increasing the size of the front, he produced the graceful "ordinary". Patent after patent went to Starley's credit. In 1874—by which time he was in business on his own account—he patented the first ladies' bicycle. This rather impracticable machine played a part in the development of the Coventry Lever Tricycle of 1876, illustrated above, which was built specially for those too nervous or too unathletic to cope with an "ordinary". It was in 1877, while riding a "Sociable" version of this machine, that Starley first thought of the differential gear. His gear, which enabled the driving wheels to revolve at different speeds when cornering, but still to transmit power, was the forerunner of the differential gears which are used in every car today. Even this tremendously significant invention was not the last to flow from this great man of cycling. One ingenious idea followed another right until his death in 1881.

ISSUED BY **DUNLOP** *—MAKERS OF THE FIRST PNEUMATIC BICYCLE TYRE*

1H/330

Orford Castle, Suffolk

One of the finest Keeps built by Normans in this country (1165). A feature of the interior is the splendid spiral staircase leading to the top.

Wayside Thoughts

By F. J. URRY

What a Year !

WHAT a summer 1951 was. It was no wonder I had ample chances to try out waterproofs, and that, too, without getting the uncomfortable, stuffy feeling that hot weather and rain imposes. There was no hot weather, or very little, and sometimes I wondered how the lightly-clad riders, and specially the campers, kept warm. I had a week in camp in August on the Pembroke coast, a very jolly week despite rain, high winds and autumn temperatures, and I know I was glad of full raiment and a bed of eiderdown, under and over. For a couple of days the storms tried to blow the tents away, but fortunately we were snugly pegged down and came to no harm. That was during the early part of August, and I think the rest of that month, if anything, was worse, for the tantrums slipped right down the autumn calendar until many folk began to wonder if our boasted English summers were departing never to return. How soon we forget the weather of 1948 in our holiday disappointments, that glorious summer the like of which will certainly return to us as the years roll on. A friend in Vancouver writes to say the inhabitants of that lovely city never had a better summer, and a water shortage was actually registered for the first time in the history of the district. So we can take it to our comfort that the good days will return and the flow of the seasons register their sunshine and rain in normal quantities. One can only hope at the moment that the winter solstice will be more kind to us than the immediately preceding seasons, otherwise we shall be chilled with fuel shortage and those log fires in the country pubs will disappear. Do not shut yourself up, get out and find those places where a warm welcome awaits ; they are scattered round about if you will search for them.

Old Acquaintance

A WEEK or so ago an old friend of mine on a visit to Britain had the grace to look me up after a lapse of over thirty years. That was good, for at least something must have happened between us to leave the desire to seek re-acquaintance after so long a lapse, and I asked him why this had happened. He told me quite frankly that occasionally he ran across an article of mine and the name at the head of it reminded him of many happy years he spent riding out his youth on a bicycle, frequently in my company, and wondered what kind of an individual I had become who still found joy and pleasure along the roads of the old country. And, he went on to say, " I'm not sure I've had the best of life when I look at you, nearly twenty years my senior, as fit and fresh and full of good, sensible living as on the day I saw you last, except for a wider waistband and whitened hair, and a bald spot." In its way a nice compliment, not merely to the individual, but to the land that bred him, and the pastime to which he has been wedded all his life. My friend had not been aboard a bicycle since he left these shores, and when I offered to lend him one, shook his head with a murmur of regret that he doubted his ability to ride it. After we had fed I took him to my cycle shed, switched on the light and showed him nine beautiful bicycles all ready for the road. " But why in heaven's name do you need nine bicycles ? " When I explained to him the need did not exist, only the desire, the love of cycling making possession of the mechanical means to exploit that love the sort of joy a collector of anything obtains from his collection, the only difference being that I use them for the purpose for which they are made. And when I reminded him that all my bicycles did not cost me a tithe the price of his car, comparatively nothing for upkeep and presented me with health and joy as the result of their progression, he just told me I was incorrigible—but he said, " wisely right."

Reasons Why

THAT evening before going to bed we talked very late into the night about old times and what had happened to the people we then knew, and he was again surprised to learn such a goodly number of them still rode bicycles on occasions, and one or two, verging on the three-score and ten, were regular performers. " It amazes me," he said, " that fellows who own cars, and who, judged by present-day standards are passing rich, should still be cyclists." I think the answer is the sound one of happy simplicity, the one quiet mechanical means of trebling the speed of walking and doing it with less effort, and yet obtaining nearly all the benefits of natural progression, and retaining the virtues of travel as defined by observation and the full enjoyment of the senses. " But why at your age," he asked, " don't you get tired as most folk do after reaching your years ? " I do get tired, it would be unnatural if it were not so, but I am content to rest betimes that I may the more enjoy the journey. And, again quite naturally, there are occasions when the old human engine creaks a bit, but if you take no notice of it in a mile or so the little aches depart and the day goes over you with all the old joy, and what it lacks in speed or mileage it more than makes up in scenic delight and contentment. It's a mistake to think you are growing old, for such a thought is father to the fact, and once you have become sorry about yourself on that matter the descent to the arm-chair and chimney corner may be quite rapid. To ride a bicycle is to enjoy life, and both are supremely worth while.

Testimony

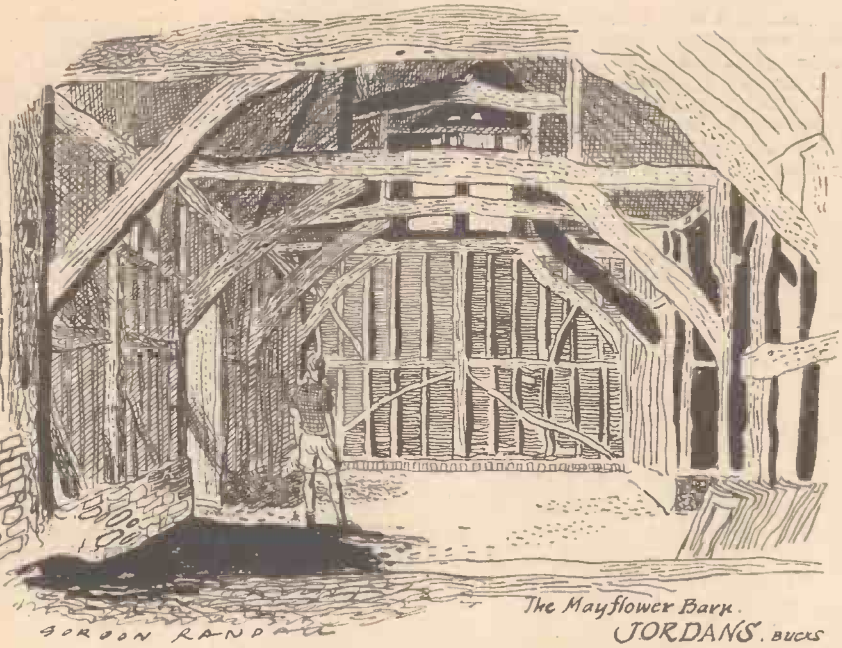
ONE of my cycling friends of the old times passes me regularly every morning on the way to work with a pip-pip greeting of the horn just to signify the observance. I was riding home early a few evenings ago, it was raining and blowing, but tucked in macs I was quite comfortable and, in fact, congratulating myself that the old tricks of meeting stormy weather were still within my province, albeit undertaken a little more slowly as befits a white-haired wight. A car passed me and pulled up, and out from the window leaned my cycling companion of 40 years ago. " I felt I must have a word with you on an evening like this, not of criticism but congratulation. Except for the widened beam and a white nob you look just the same as ever, and I wish I felt as well in health as you appear. How do you do it ? " I told him and he had to believe it because the example was in front of him. " What fools we are," he said, " to use our wealth to damage our health "; and I do not think I have heard the case for older-age activity put more succinctly. " We grow up full of good ideas, and in my early years cycling was prominent among them: we 'get on,' have a life of ease, get muscularly slack and hurt ourselves by over-indulgence in what we imagine are the good things of life, whereas they should be an extension of our youthful interests taken at a slower pace. I envy you because your activity is part of your joy in life giving you all you admit is worth while in freedom and individuality." Now that was a handsome testimony to cycling. It is strange that so many people seem to envy my good fortune when the same happiness is open to all of them.

Good Tests

THOSE three fellows who went cycling to Lapland to test the new service tyre made by the John Bull Company, The Royal Enfield bicycle and Cyclo gears, must have had a jolly and venturous journey, a little too hurried for me in these days, but one in which I should have revelled forty years ago. I am rather glad this reliability trial has taken place and hope it will be successful from the sponsors point of view, for we have had too little of this kind of thing in the cycling world of late years, probably due to the fact that bicycles and their equipment are now so reliable. Nevertheless, it is a good thing to put them through a really severe testing, not as racing machines, but as bicycles you and I can buy who have no pretence to speed. As a matter of fact, I own an Enfield and get a lot of good riding out it. I am now trying to wear out a pair of John Bull Service tyres and tubes, and they are certainly lively and exceedingly good value as far as they have carried me which is not yet a thousand miles, but they will have their test by the end of winter ; and as for the Cyclo gear, I used a four-change last year for about a couple of thousand miles and found it admirable in every way. My only trouble was with snow and sleet when the grip control gathered some of the weather into the revolving sleeve, but a little oil cured that and taught me to give this part of the gear regular lubrication. It does make a difference if you treat these things as machinery. Personally, I should like to see these reliability rides expanded, with a separate observer to report on performance of the machine and its components, for I believe such tests provide for better results for the makers and the cycling public to study, than all the races and records by specialists ; and giving a guess, I should think they also cost less.

CYCLORAMA

By H. W. ELEY



The Mayflower Barn. JORDANS. Bucks

This lovely great barn is made from timbers of the Mayflower (1620) A plaque records that a portion of a beam has been removed and sent to America as a token.

Historic Huntingdon

PLEASURE, combined with business, recently took me to Huntingdon, and I recaptured the sense of awe and reverence which I have always felt for the place. It is steeped in history, and I love the fine thirteenth-century bridge across the Ouse; I almost venerate Cromwell House, where the Great Protector was born; I love the two old churches, surviving out of the fifteen of which the town once boasted—All Saints' and St. Mary's. The first was built in 1520, and St. Mary's, after falling down in 1607, was rebuilt in 1620. Huntingdon has its ancient inn, too—The George. It was famous in the old coaching days, and possesses a fine galleried courtyard. I commend Huntingdon to all those cyclists who, taking the oldest great highway to the north, wish to find some place where history is embedded in the stones, and where romance still clings.

Rear Lights and Reflectors Again

THE old controversy is still on, and the arguments about rear lights, red reflectors, and white patches were renewed recently when a deputation from the National Committee on Cycling was received by the Parliamentary Secretary to the Ministry of Transport (Mr. Gurney Braithwaite, M.P.). The deputation explained its objections to the compulsory rear light, and put the case that the cyclist should be permitted to make the choice between a rear light and a reflector with a white patch. As is usual in such matters, the deputation was assured that its views would be considered, and submitted to the Minister. As far as I know, that is the position to-day.

"All Fools" and Cuckoos

APRIL!—and even in this unromantic age, the tradition of "All Fools" lingers on, and one is apt to be "caught napping" by some youthful member of the family who delights to sing out "April fool" after sending one on some silly errand. I have never been able to discover the true and authentic origin of April Fool's Day, although I have read many differing accounts. To me, April brings a greater joy—the curious, monotonous call of the cuckoo, the "wandering voice" of the fields and trees. He is a bird of mystery, this brown bird who comes so faithfully in April and stays with us till late August. "In June he changes tune," and, also according to the old rhyme, "in August, go he must," but in April, when the sunshine chases the rain and all is sweet with the music of spring, I love to hear the bird calling, for he is a harbinger of longer, sunnier days.

Maps, Guide Books and Holiday Plans

FEW things delight me more than a map. It has a fascination all its own, and I spend many happy hours poring over them, tracing out roads, marking places I must some time visit, noting hills, by-ways, churches and inns, and I suppose that most keen cyclists share my joy in map-reading. Now that spring is here again, maps and guide books take on a new and important significance, for the 1952 holiday tour has to be planned, routes mapped out, and notes made of places to see. Shall it be the West Country this year? Shall we ride in glorious Devon, visit war-scarred Plymouth and muse upon the epic daring of Devon seamen, and recall Drake and his game of bowls, and the sailing of the *Mayflower*? Shall we journey eastwards and find our delight in quiet Suffolk, amid the lanes which Constable loved, and find our history in such places as ancient Bury St. Edmunds and busy, bustling Norwich, where the modern and the medieval rub shoulders; or shall we ride to Cromer and climb the cliffs and wander in "poppyland"? Maybe none of these, but a trip to the north, with the sweep of the moors, the cry of the curlew, and a day of fascinating exploration in some such historic spot as Bolton Abbey. The fair face of England offers us rich and varying delights, and whether we journey north, south, east or west we may be sure of scenic beauty, ancient history, friendly people, and roads of romance.

Steel is the Key

I TALKED recently with a "high executive" of a big cycle-manufacturing firm and the conversation veered to raw materials, and particularly to steel—vital, essential *steel*. Allocations have been cut; the rapacious appetitite of the god of war must be satisfied, and, pity be, the cycle industry, doing such a valiant job in both home and export markets, has to be content with insufficient supplies. It is all very depressing for those business chiefs who have worked so hard to expand the industry; but the factory wheels keep turning, there is a spirit of quiet confidence, and I have no doubt that the industry will achieve wonders during 1952. Of one thing we may be sure—that the quality of the British cycle will be kept supreme!

Superstitions

THEY die hard, the old superstitions of the remote countryside! It is in the little hamlets far from big towns where the old beliefs still flourish, and some weeks ago, chatting in a tiny Derbyshire village inn, I found that many quaint beliefs survive, with astonishing strength and vigour. I was told by an old woman of gipsy origin that it was woefully unlucky to pass a white horse unless one spit three times over the little finger, and repeated this old couplet:

Bad luck to thee,
Good luck to me,
Good luck for every
White horse I see.

I fancy that the superstitious countryman may travel a long way to-day without seeing a white horse, and I do not suppose that any "charm" has been invented against the passing of a chugging tractor! It is a curious thing, but the act of spitting is quite a common antidote to ill-omens . . . in Kent I have heard that one should spit when one meets a load of hay, or when two wash their hands in the same water! My old lady of the Derbyshire inn had a wondrous store of queer beliefs and superstitions . . . and she told me, with all seriousness, that her "good man" always carried a sprig of alder in his trousers pocket, when going on a journey, to ward off the "evil eye." Our farms may be mechanised, our horses may disappear, helicopters may drop pest-cures on our ancient fields, but superstitions live on; and here, while I ride in the Derbyshire countryside, folk invest the magpie with magical powers!

Date Fixed

GET out your diaries and make a note that the 1952 Cycle and Motor-cycle Show will be held at Earls Court this year from November 15th to 22nd. With memories of the glories of Earls Court last year, I have made my resolution to be there, to revel again in the galaxy of beautiful bikes, to meet old friends, and to sniff a breath of the air of good old London Town.

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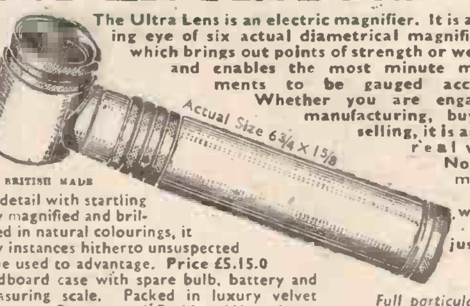

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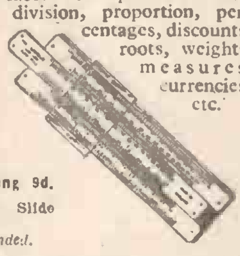

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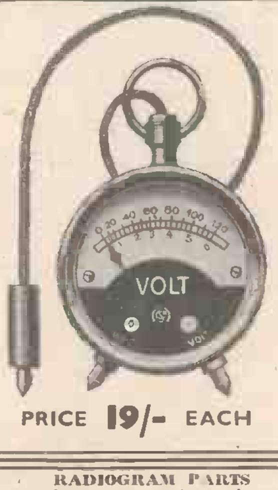

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