MAKING A TORSION BALANCE

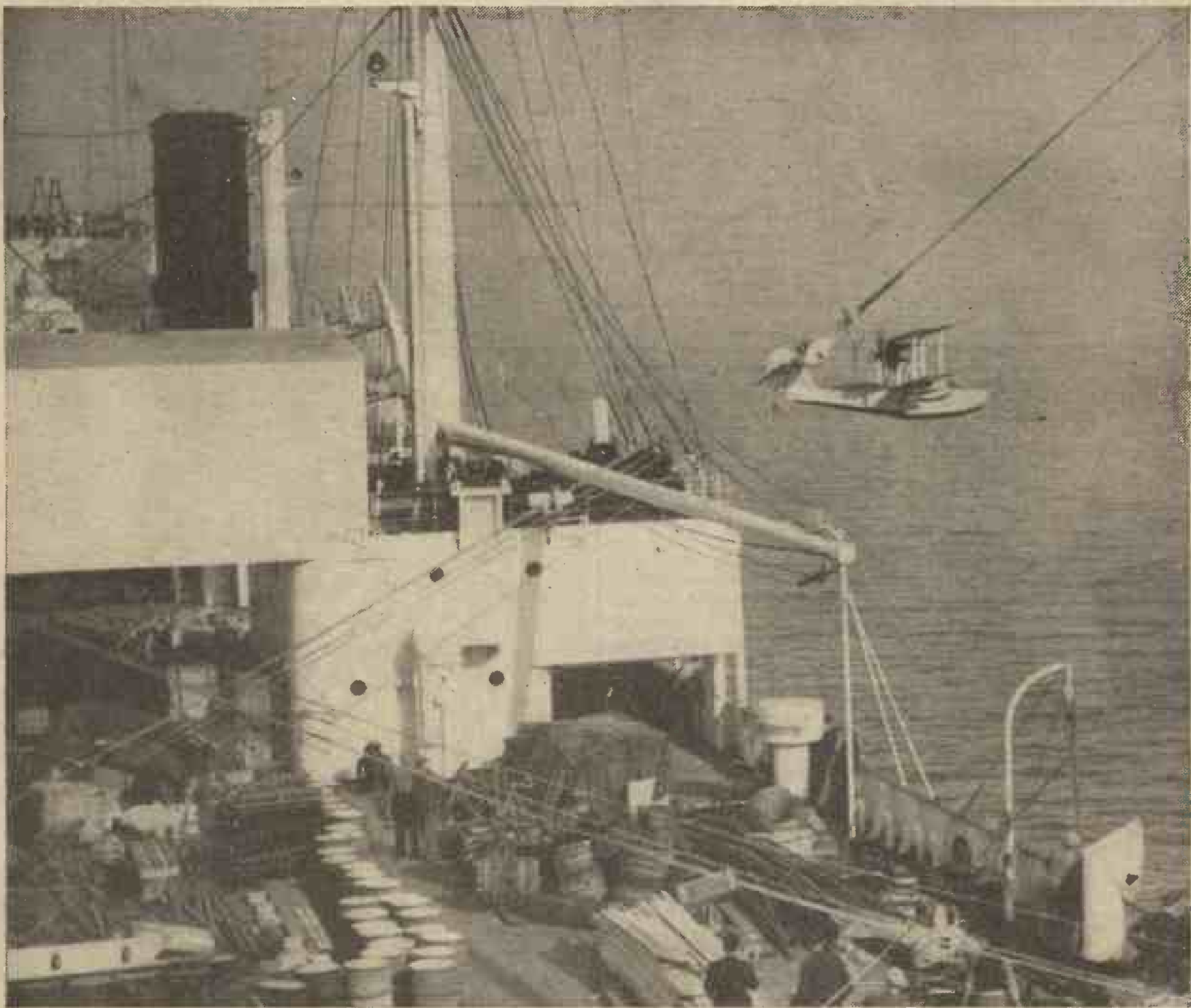
NEWNES

PRACTICAL MECHANICS

9d.

EDITOR: F. J. CAMM

DECEMBER 1946



A WALRUS SPOTTING PLANE BEING CATAPULTED FROM THE WHALING SHIP *BALAENA* (See page 96)

78/133

SUBSCRIPTION RATES
(including postage)
Inland - - - 10s. 6d. per annum.
Abroad - - - 10s. per annum.
Canada - - - 10s per annum.
Editorial and Advertisement Office: "Practical Mechanics," George Newnes, Ltd.
Tower House, Southampton Street, Strand, W.C.2
'Phone: Temple Bar 4363
Telegrams: Newnes, Rand, London.
Registered at the G.P.O. for transmission by Canadian Magazine Post.

PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. XIV DECEMBER, 1946 No. 159

FAIR COMMENT—BY THE EDITOR

The Technical and Scientific Register

THE Technical and Scientific Register, which is a centralised branch of the Ministry of Labour Appointments Department, offers a valuable service to employers seeking professionally qualified technicians and scientists, and to technically and scientifically qualified people who are seeking employment or a change of employment.

The minimum qualification for enrolment on the register is, in general, a University degree or its equivalent in subjects appropriate to the profession concerned.

In the case of engineers the Higher National Certificate or the professional examination of recognised engineering institutions, or a regular training as a pupil or apprentice, followed by an executive position (normally for at least five years) above the rank of foreman, are alternative qualifications for enrolment.

The register is divided into sections as below, each in charge of technical officers with high professional qualifications and standing in the professions and subjects with which they deal.

Section A.—Mathematicians, physicists, engineering scientists, teachers of mathematics, physics, general sciences.

Section B.—Engineering graduates.

Section C.—Engineers, other than civil and electrical engineers.

Section D.—Electrical engineers (including radio engineers).

Section E.—Civil engineers (including structural and water engineers).

Section F.—Chemists, chemical engineers, metallurgists (including graduates and teachers), patent agents.

Section G. — Agriculturists, foresters, botanists, zoologists, pathologists, veterinary surgeons, geologists, geographers, archæologists (including graduates and teachers in these subjects).

Section K.—Architects, town planners, quantity surveyors, valuers, building-land surveyors, mining surveyors, fire-loss assessors, hydrographical and topographical surveyors, land and estate agents, etc.

Advisory Committees

SIX advisory committees widely representative of the professions assist the register in its efforts to provide the best possible service and also to maintain close relationships with the profession. These committees are:—

Mechanical Engineering Committee—(Chairman, Sir William Stanier, F.R.S., M.I.Mech.E., M.I.Loco.E).

Electrical EngineeringCommittee—(Chairman, Sir Arthur Fleming, C.B.E., M.Sc., D.Eng., F.Inst.Pet., M.I.E.E., M.I.Mech.E).

Architecture and Public Utilities Committee—(Chairman, T. E. Scott, F.R.I.B.A.).

Scientific Research Committee—(Chairman, Sir Lawrence Bragg, O.B.E., M.C., F.R.S., M.A.).

Chemistry Committee—(Chairman, Sir Robert Pickard, D.Sc., F.R.S.).

Civil Engineering Committee—(Chairman, Sir Peirson Frank, M.Inst.C.E., F.S.I.).

Close co-operation already exists and is being still developed between the register, Professional Engineers' Appointments Bureau, University Appointments Boards, and similar bodies, and by this means the register is able to keep closely in touch with the supply and demand position generally, and with the best methods of matching supply and demand.

The number of home and overseas vacancies notified average about 800 per month, and during the past five weeks vacancies filled total 589.

It is interesting to note that increasing use is being made of the Register's Advisory Service, particularly by ex-servicemen seeking advice on careers.

Employers are invited to visit the register, and special facilities are provided for those who wish to interview selected candidates for vacancies.

The address of the Technical and Scientific Register is: York House, Kingsway, London, W.C.2. Telephone: Temple Bar 8020.

Our Query Service

OUR query service is confidential. We ask readers to submit their names and addresses in good faith and to append a *nom de plume* if they do not wish this to appear in print. Readers should remember that all replies are sent through the post, and a selection of the more interesting queries is published each month. Such replies do not necessarily represent current queries. They are published for the information of other readers. Where samples are submitted, enclose sufficient postage for return, but remember that we do not undertake any responsibility in connection with the safe return of them, nor for any damage which may happen in transit.

World Engineering Conference

ARISING out of the International Technical Congress held in Paris, 16th to 21st September, 1946, the delegates and observers from 30 nations, appointed by the various Governments, and National Engineering Institutions and Associations unanimously adopted the following Resolution:

"To establish an international organisation under the name of 'World Engineering Conference' constituted under the French Law of July 1st, 1901, continuing from the date of its legal establishment the existing organisation now known as 'International Technical Congress.'"

The principal objects of the Conference are:

To prepare for the establishment of the future World Engineering Federation.

To assure, if need be, the holding of future International Engineering Congresses.

To establish contact especially with the Economic Social Council of the United Nations Organisation and with U.N.E.S.C.O

The Council, composed of two delegates appointed by the National Committees or by agreement between the Engineering Institutions or Associations who are members of the Conference, will elect an Executive Board, with a maximum of 12 members and a President, who will administer the Conference.

A provisional Board, comprising one person from the following countries, was appointed, whose duty will be to prepare the constitution and to form the Conference:

China, Egypt, United States of America, France, Great Britain, India, Poland, Switzerland, Czechoslovakia.

Mr. A. Antoine, Inspecteur Général à l'Electricité de France, President of the Congress, was unanimously elected the first President of the Conference, with Mr. W. R. Howard, Great Britain, and Mr. P. Soutter, Switzerland, as Vice-presidents.

The Resolutions were signed by the official delegates from the following countries and also by a number of individuals acting as observers, but having no mandate from their particular Institutions or Associations:

United States of America, Poland, Iran, Switzerland, Czechoslovakia, China, France, Great Britain, Egypt, Belgium, Luxembourg, India, Eire, Indo-China, Rumania.

Dr. Joseph Needham, Senior Councillor, Dr. Yeh Chu Pei and Dr. Bires Chandra Guha of U.N.E.S.C.O., the latter gentlemen having attended the Congress as observers, welcomed the formation of the Conference as a means of future co-operation with engineers of all nations in accordance with the policy of U.N.E.S.C.O. in furthering the free exchange of information on the applied sciences throughout the world.

A Simple Torsion Balance

Constructional Details of an Instrument for Accurately Weighing Small Quantities of Chemicals, etc.

By T. J. MULLIGAN

AMATEUR photographers and all who dabble in chemicals in the pursuit of their hobbies will find the delicate torsion balance to be described a useful accessory to the workbench.

Operations such as the preparing of solutions for developers, bleachers, toners, intensifiers, etc.; the weighing of chemicals required for silvering, lacquering, polishing and colouring of metals; all require careful measuring of ingredients for satisfactory results. The familiar practice of using "a little of this, and a pinch of that," may produce tasty results in the kitchen, but when applied to chemicals such methods can be disastrous.

Front view of the completed balance.

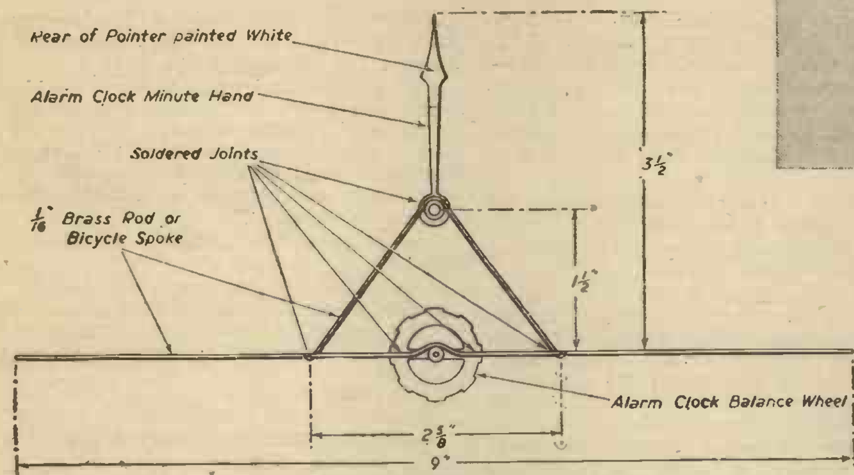


Fig. 3.—Balance arm and indicator pointer.

The delicate and precise scales used by chemists are very costly and usually out of the question for occasional home use, and this torsion balance has been designed to meet the need for a simple and inexpensive method of weighing small quantities.

The torsion balance in its original form has a long and honourable history; it has had an important rôle in many far-reaching scientific discoveries. One was used by Coulomb in his researches into the fundamental laws of electrical and magnetic attraction; Cavendish used a torsion balance to measure the density of the earth. The type of balance used in these experiments was exceedingly delicate, and the forces measured correspondingly small.

The balance which is the subject of this article is of a more robust nature; instead of a single straight fibre a steel spring is used, giving a range of about 18 grammes to 360 degrees of torque.

As can be seen from the photographs, the instrument consists in effect of a spiral wire spring with a wire beam attached at right angles to the axis of the spring. One end of the spring is anchored, this anchorage being adjustable, and the other end is fixed to the dial spindle.

A balance indicator is placed above the instrument for ease of observation instead of at the side, the more conventional method.

Principle of Operation

In principle the torsion balance is a mechanical equivalent of the Wheatstone Bridge, in which an unknown quantity is balanced against a measurable known one.

A weight placed in the pan applies a tangential torque to the spring, and the balance indicator is displaced to the left, or "high" side; the dial is then rotated in a clockwise direction until the twist or torque thus imparted to the spring is sufficient to return the indicator to zero. The balance being once more in a state of equilibrium, it follows that the torque due to the rotation of the dial must be exactly equal to that originally produced in the opposite direction by the weight; therefore the amount of rotation of the dial is a direct measure of the weight. This can be read off in degrees and converted to grammes or grains, or the dial can be calibrated to read grammes or grains directly.

It will be noticed that the balance-arm and indicator assembly is "top-heavy." At first sight this would appear to represent a source of error due to the unequal disposition of weight which would be caused by slight inaccuracies of construction; such, however, is not the case, as a little reflection will reveal.

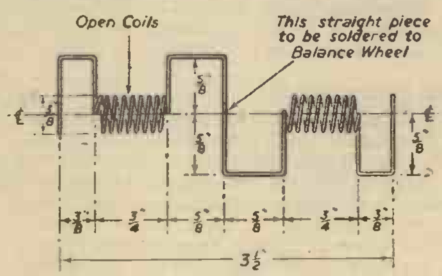


Fig. 2.—Details of the spring unit.

Before the balance can be used, the dial is set at 0 degrees and the indicator pointer brought exactly to zero by means of the rear zero setting screw. Fig. 1 is a diagrammatic representation of the balance arm and indicator after this adjustment has been made.

Let us consider the forces acting on point P.

It is clear that there is an excess of weight on the left-hand arm due to the weight of the empty pan (W). There is therefore a turning moment exerted on P equal to WL, where L represents the distance of the pan from the point P.

Since, however, the balance is in a state of equilibrium, it follows that the adjusting screw has applied an opposing torque to the spring which is exactly equal to WL. Any extra inequalities of weight, such as blobs of solder, etc., which would tend to bias the balance to one side or the other, are taken up by this initial adjusting torque and become constants.

The placing of the centre of gravity so far above the pivot is an asset, since the sensitivity of the instrument is thereby increased.

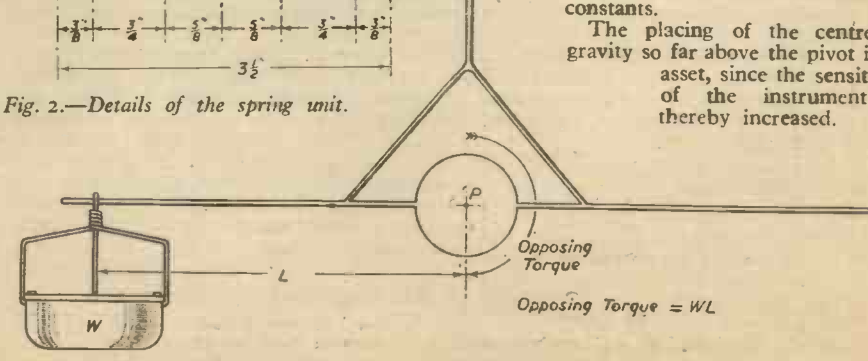
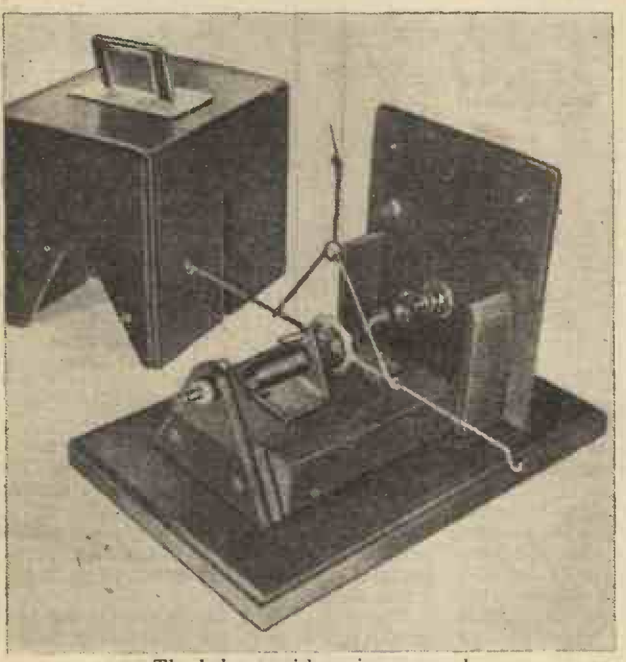


Fig. 1.—Diagram indicating the principle of operation of the balance.

A test made with a lighted cigarette gives some idea of this sensitivity: the cigarette was placed across the pan and its weight noted; the dial was left in this position for one minute. The indicator during this period was observed to drift to the low



The balance with casing removed.

side; the dial was adjusted at the end of this period and the new reading noted. The difference of the two readings represented the loss of weight due to the combustion of the cigarette and was a measure of the weight of the smoke leaving the cigarette in one minute.

The indicator pointer must always be brought exactly to zero for accurate measurements. For this reason a mirror is fitted behind the pointer so as to avoid parallax error; the rear of the pointer is painted white for ease of observation. Accurate dial readings are facilitated by the inclusion of a vernier scale; this is purely optional, and can be replaced by an arrow. A slow-motion drive for the dial has been provided; this has another important function—that of a brake to prevent the dial from slipping back when it is desired to hold a reading. This is a useful factor when weights are to be compared or when several identical weighings are required.

Materials

The materials used in the construction of the torsion balance are such as might be found in any junk box.

A discarded alarm clock was robbed of its balance wheel and minute hand for use as the spring pivot and indicator pointer. The dial and spindle fitting were taken from an old variable condenser; the spindle used in this case was of the old-fashioned screwed variety, but the more usual type of spindle would serve just as well; in this case a collar and grub screw would be used in place of the two locking nuts and the dimensions modified accordingly.

One-sixteenth-inch brass rod was used for the balance arm, but a bicycle spoke would suit this purpose admirably.

The pan was made from a scoop supplied with a patent food.

A suitable spring can probably be found, or, if not, one could be purchased; if steel wire of a suitable gauge is available, the spring can be wound, using a 5/16in. mandrel. The sensitivity and range of the balance depend upon the gauge of wire used; a heavy gauge spring will give greater range, but reduced sensitivity and a "crowded" dial; a light spring will provide high sensitivity over a small range. It should be noted that provision is made for weights to be added to the right-hand arm to increase the range of the balance.

Three-ply wood is used for the box cover and panel, and the whole assembly is screwed down to a stout base.

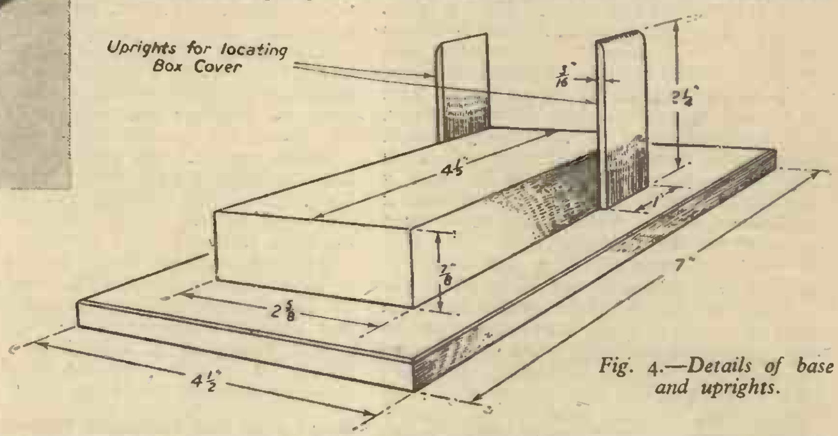


Fig. 4.—Details of base and uprights.

The Spring

A light spring, about 24 S.W.G. and about ⅜in. diameter, is chosen, and a piece cut from it about 4in. long. The spring must be "pulled" so that the turns are clear of each other; this is very important, as the balance will not function correctly if there is any friction between adjacent turns. A really good elastic spring should be used for this purpose, a soft spring being quite unsuitable. A steel spring which is inclined to be soft can often be brought to a satisfactory temper by plunging into molten lead or solder and withdrawing it when it has reached a deep straw colour, then cooling in air.

The middle coils are opened up with a pair of pliers to form a straight portion 3¾in. long. This is bent to the "S" shape shown in Fig. 2. The extreme ends of the spring are then opened to a point ¾in. from the ends of the "S" and bent to form the "U" shapes. The form of these ends is to provide a longitudinal tension along the spring. The two ¾in. spirals remaining should have their axes in alignment.

The spring is now ready for soldering to the balance wheel and balance arm.

Balance Arm and Indicator

Two pieces of 1/16in. brass rod, or bicycle spoke, are cut and bent to the dimensions shown in Fig. 3. The alarm clock minute hand is soldered to the short bent piece; this joint must be sound, as must all other joints. A constant zero setting and accurate measurements are impossible if there is any looseness anywhere.

The hooks for suspending the pan and additional weights are not to be formed at the ends of the balance arm until the balance is calibrated.

The balance wheel is carefully placed into position in the bend provided for it in the centre of the long arm and soldered into place.

The centre bend of the spring—the cross bar of the "S"—is now laid alongside the balance wheel and bound to it with a few turns of fine copper wire; this is to simplify the soldering of the spring to the balance wheel, which would otherwise be a difficult and exasperating operation. The spring is soldered into place with its axis in line with the balance wheel spindle.

A touch of white paint to the *rear* of the minute hand and the balance arm assembly is complete.

Balance Assembly

The block used for this purpose was a

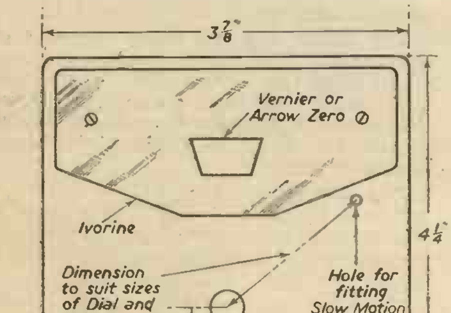


Fig. 5.—Front panel with dial removed.

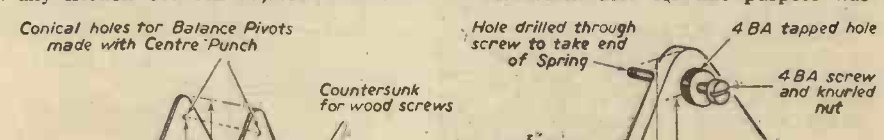


Fig. 6.—Balance wheel brackets and rear adjustment plate.

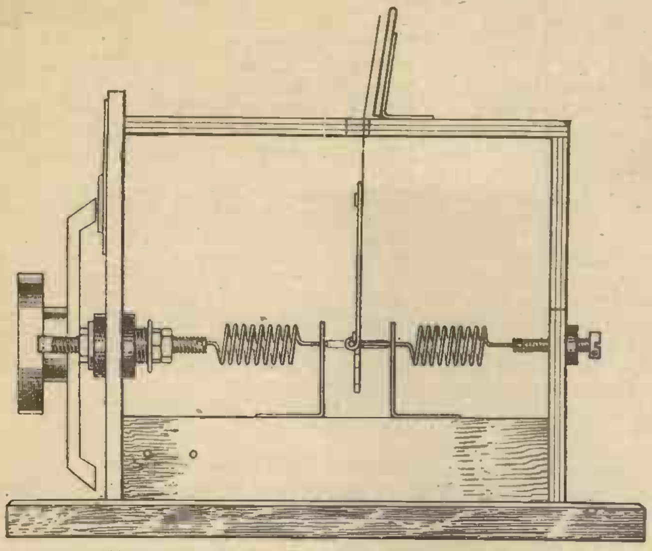


Fig. 7.—Side view of the complete assembly.

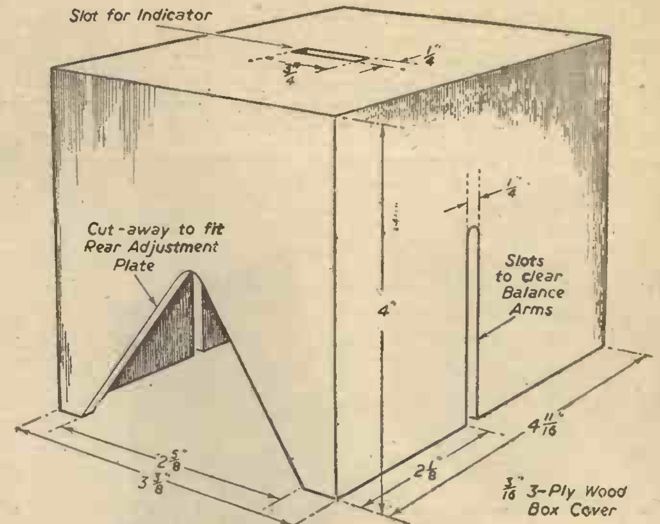


Fig. 8.—Plywood casing, or box cover.

piece of thick wood $\frac{7}{8}$in. thick; this is cut to the dimensions shown in Fig. 4, $4\frac{1}{2}$in. x $2\frac{5}{8}$in. If a thinner block is used, the brass brackets which support the balance arm assembly should be raised on packing pieces to bring the axis of the spring to the level of the dial spindle and rear adjusting screw.

The front panel is cut from 3/16in. 3-ply wood to the dimensions shown in Fig. 5; ebonite or metal can be used if preferred. The hole for the dial spindle is drilled to fit the bush used, care being taken to keep the centre height $1\frac{3}{8}$in. The hole for the slow-motion drive will have its position determined by the diameter of the dial and the type of rubber washer used. A piece of ivorine or white card is cut as shown and screwed to the panel; this can be used for indicating the dial calibration, as shown in the photograph. The vernier was made from a piece of thick card, which is glued to the ivorine. The vernier scale can be replaced if desired with an arrow, drawn with a fine pen in indian ink.

The panel is screwed to the block, using countersunk wood screws so as to clear the dial.

The rear adjustment plate is cut from 3/16in. ebonite and drilled and tapped as shown in Fig. 6. Ebonite has been chosen because a good thread can be tapped in it. A 1in. 4 B.A. screw is screwed in the tapped hole with a nut, knurled preferably, for use as a locking nut. The screw should have a small hole drilled diametrically to receive the end of the spring.

The adjustment plate is screwed to the rear end of the block.

The two brass brackets, also shown in Fig. 6, are cut to shape, drilled and bent. The conical holes which serve as bearings for the balance wheel pivots are made with a slightly blunt centre punch.

The brackets are screwed down to the base block; no dimensions can be given in this case, since balance wheel spindles may vary in length.

To determine the position of the brackets the dial and spindle are assembled and pushed home into the bush; a hole is drilled in the end of the spindle to take the front end of the spring. The spindle is secured in its bush by means of lock nuts and washers as shown in Fig. 7.

The balance arm and spring assembly is laid along the block, and the ends of the spring are inserted in the holes provided in the dial spindle and adjusting screw.

It should be necessary to pull the spring slightly to insert the spring ends; if the spring is at all slack, the "U" ends must be bent inwards until this condition of longitudinal tension is achieved.

The position of the ends of the balance wheel spindle is marked on the block with a pencil.

The spring assembly is then removed, and the two brackets mounted in the position indicated. A little latitude is allowable here, since the brackets can be bent as required to support the balance wheel spindle.

When replaced into position the balance arm assembly should swing freely, but no slackness in the bearings can be allowed. The ends of the spring are soldered into the holes provided.

The two uprights shown in Fig. 4 serve to locate the box cover. They are cut from 3/16in. plywood and are rounded, as shown, and screwed to the block.

The baseboard is a piece of $\frac{3}{8}$in. thick wood, 7in. x $4\frac{1}{2}$in., and can be drilled for screwing down to the bench.

Box Cover and Indicator Mirror

Plywood 3/16in. thick is used for the box cover, the dimensions of which are shown in Fig. 8. The position of the slots is given as a guide, but these may require to be modified to suit the position of the balance wheel. The parts are panel pinned and glued and finished off nicely with sandpaper. The triangular cut-out serves the purpose of locating the rear end of the box cover.

The dimension given for the pointer slot can, if required, be increased to avoid damage to the pointer when placing the cover into position; the ivorine indicator stop will cover a large hole and prevent it from having an unsightly appearance

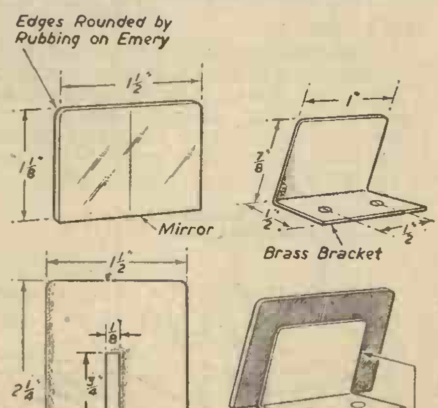


Fig. 9.—Mirror and indicator stop plate.

The brass bracket on which the mirror is mounted is made as shown in Fig. 9. The dimensions of the mirror are also shown; this is cut from a discarded pocket mirror with a glass cutter The edges are rubbed smooth by rubbing on successive coarse, medium and fine emery paper so as to give a nice finish.

The central zero line is cut on the back of the mirror with the glass cutter in one firm stroke, using a straight edge. The cut is blacked with indian ink or black paint and allowed to stand a little time to dry. When dry the mirror is cemented to the bracket, care being taken to set the zero line square with the base of the bracket.

The mirror bracket and ivorine plate are screwed down over the indicator slot so that the pointer is clear of the mirror.

The Pan

The pan used on the balance illustrated was improvised from a scoop supplied with a patent food, the handle being removed. Something of the sort should be available about the house; shape and dimensions are not particularly important so long as the article selected is reasonably light.

The suspension is made as shown in Fig. 10, using iron wire. Small holes to receive the wire are pierced in the edge of the scoop 120 degrees apart.

One piece of wire is used for two arms; a loop is twisted in the centre of this piece and the two ends neatly bent to form the two arms. A shorter piece is bent to form the third arm and joined to the other two arms with a touch of the soldering iron.

Slow-motion Drive

The sketch (Fig. 10) shows the type of drive used. The rubber washer was one of the small type rubber "feet" which are often used for the bases of clocks, etc. The slow-motion drive can be dispensed with if desired, but should be replaced with some form of brake.

Calibration

It will be assumed that the instrument is to be calibrated in grammes. A standard gramme weight should be obtained for this

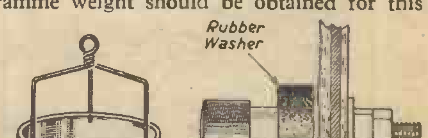


Fig. 10.—Pan, and enlarged detail of slow-motion drive.

purpose; if such a weight is not available, one cubic centimetre of water, dropped into the pan from a graduated tube, makes a sufficiently accurate improvised standard gramme.

By means of the rear adjusting screw the balance is adjusted so that the two zeros, indicator and dial, coincide, the empty pan having been placed in its approximate position on the right-hand arm. A nick in the arm at this point made with a three-cornered file will serve temporarily to prevent the pan from slipping from this position.

The standard weight is placed in the pan, causing the indicator pointer to move to the left. The dial is then rotated in a clockwise direction until the indicator pointer is once more opposite the zero line on the mirror. The number of degrees the dial has been rotated is noted.

Let us suppose that to balance one gramme a rotation of 18 degrees is required. Fractions of grammes would be very awkward to compute when one gramme equals 18 degrees, so that the position of the pan on the arm will require to be altered so as to bring the reading to 20 degrees. The amount of torque required to balance the weight in the pan is in direct proportion to the distance of the pan from the pivot; in this case it is desired to increase the torque from 18 to 20 degrees, or one-ninth, so the pan must be moved away from the pivot by a corresponding amount.

The weight is removed from the pan, which is then moved to its approximate position. This movement will have altered the original zero setting, so the two zeros will require to be adjusted by the rear adjustment before proceeding further.

The standard gramme is replaced in the pan and balanced as before; this time the reading should be nearer 20 degrees.

This procedure is repeated as often as necessary until the gramme weight is balanced by a torque of exactly 20 degrees. When this has been accomplished the rear adjustment is locked by means of the lock nut.

The distance from the pan suspension point to the balance wheel pivot is carefully measured.

The arm is now bent around this point to form a hook; this is to be done in such a manner as to ensure that the lowest point of the hook is the measured distance from the pivot. The right-hand arm is now measured and bent in the same manner, the distance from hook to pivot being the same as the left-hand arm.

Notes and News

New Halton Aircraft for B.O.A.C.

LADY WINSTER, wife of the Minister of Civil Aviation, recently christened with the name "Falkirk" the first of the fleet of Handley Page Halton aircraft which have now gone into service with the British Overseas Airways Corporation. The Halton is the civil transport version of the Halifax CVIII bomber with its interior completely transformed in order to provide comfortable accommodation for the carriage of passengers. Alterations include a new, large entrance door on the starboard side of the aircraft, a galley and toilet accommodation, and a large window adjacent to each of the passenger seats. Seats are upholstered in blue all-wool rep, there is a blue carpet and curtains of a contrasting rust colour. Adjustable tables are provided, and there is a wardrobe for the stowage of top coats and similar articles. Ten passengers will be carried in the Halton, and the bomb-bay has been converted into a compartment which will accommodate 8,000lb. of baggage, freight and mail. These aircraft, 12 of which have been ordered for B.O.A.C., will be operated on the United Kingdom-Cairo and Karachi (India) route and the United Kingdom-West Africa Trans-Sahara route. Their still air range will be some 2,700 miles. Payload is 11,000lb.; cruising speed is 260 m.p.h. at approximately 10,000ft.; maximum speed is 320 m.p.h.

New Electrical Resistance Alloy

A NEW electrical resistance alloy with a wide variety of uses is now being manufactured by a famous United Kingdom firm. It is claimed to be specially suitable for such apparatus as voltage regulators, switch-gear controllers and instrument shunts. In addition it can be used for all kinds of resistances, the properties of which must be constant during service.

Another advantage of the new alloy, which is known as kumanol, is that it can be easily spot-welded and needs only slight abrasive treatment before being readily brazed or soldered.

Kumanol has a copper base, and the tensile strength of annealed wire is twenty-eight to thirty tons per square inch (44 tons in hard drawn wire).

The manufacturers are Metals Division of Imperial Chemical Industries, Witton, Birmingham.

Decca Navigator for Merchant Navy

THE Decca navigator, claimed to be the most accurate and reliable navigational system in the world, may be installed in all ships of the British Merchant Navy.

This system, which is a British development, enables any traveller by land, sea or air, to tell his true dead course and exact position by the simple reading of two dials; no other instrument is necessary. At present accuracy to within 200 yards at a range of 300 miles is claimed, and an extreme range

Two views of the "Falkirk," the first of the fleet of Handley Page Halton aircraft to go into service with B.O.A.C.

of 1,500 miles gives an accuracy of half a mile in daylight and two miles after dark.

D-Day and After

The Decca navigator was used to good effect on D-Day by the leading ships of the minesweeping flotilla as they approached the French coast. Since the end of the war its field of operation has been widened considerably. It is now being used in Scandinavia (with the exception of Norway), France and the French colonies, and Holland, in this case for the clearance of minefields along the coast.

A Simple Photo-electric Cell

A Cheap Home-made Apparatus for the Experimenter

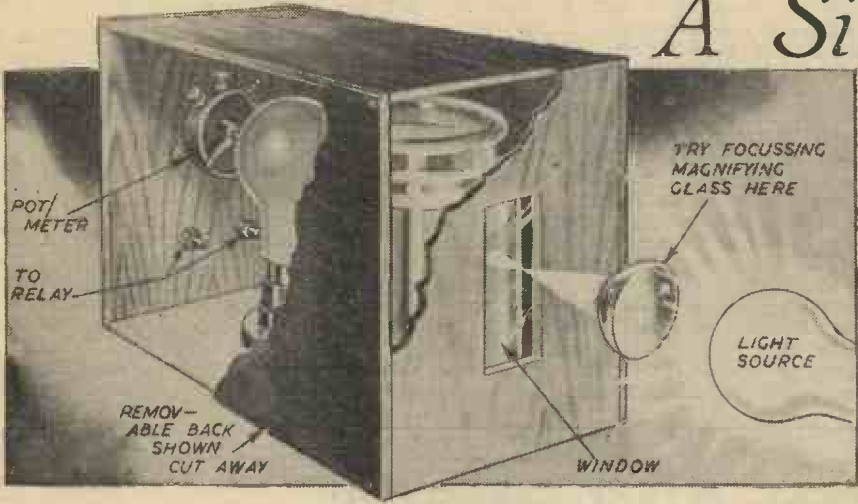


Fig. 5.—The complete "electric-eye" is fitted together as here shown.

MANY interesting experiments may be conducted with the easy-to-make chemical "photo-cell" to be described. Although inexpensive to make, the cell is quite efficient and passes a current of several microamps. when light from an 80-watt lamp is directed on one of the plates or "electrodes."

Two thin copper plates, each measuring about 4½in. by 1½ in., form the electrodes; to these are soldered short flexible leads. Ebonite strips, about ½ in. by 1½ in., space the plates at top and bottom; rubber bands support the assembly. This is placed in a clear glass jar or tumbler, and a solution made with copper sulphate 33 grains, distilled water, 3 oz., added to the level of the top ebonite spacer. The cell is now complete, but before use should be placed in a dark cupboard for at least two days.

It is suggested that a wooden box be made to house the completed cell; this should be light-tight save for a front slot measuring 1 in. by 3 in. to expose one plate. Constructional details are given in Figs. 1 and 2.

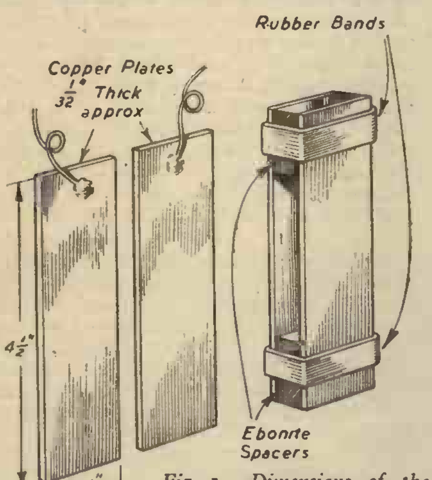


Fig. 1.—Dimensions of the plates and method of assembling the principal parts of the cell.

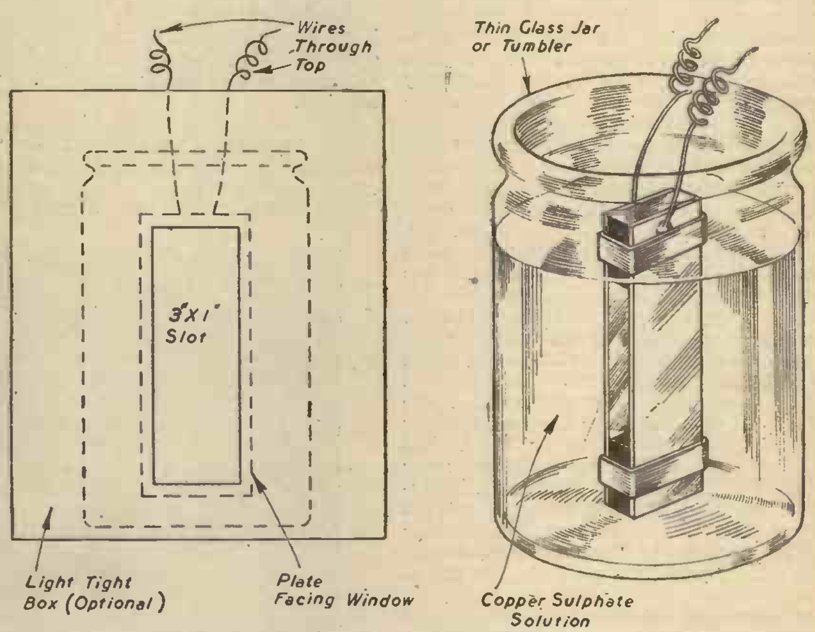


Fig. 2.—The completed cell is mounted in a light-tight box in the manner shown in these diagrams.

Practical Applications

If the photo-cell is connected in series with a neon lamp and battery, light from a 40- or 60-watt lamp falling on the exposed plate causes electrons to flow to the opposite plate, the cell becomes conductive and the neon lamp lights. Placing the hand or a cardboard screen between the lamp and the cell instantly extinguishes the light in the neon lamp (Fig. 3). To increase the minute photo-electric currents for the operation of a relay or similar device, valve amplification is essential. A suitable "electric-eye" circuit is given in Fig. 4. As there are but three components in the amplifier it could be accommodated in the same box as the photo-cell (as in Fig. 5). A small power valve, a 2-volt cell and 100-volt H.T. battery complete the installation.

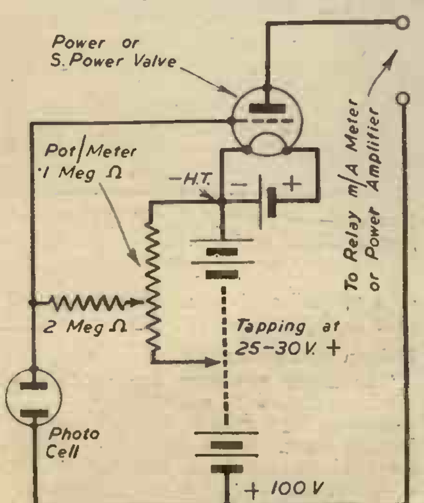


Fig. 4.—A circuit arrangement to increase the power of the cell and enable various apparatus to be operated.

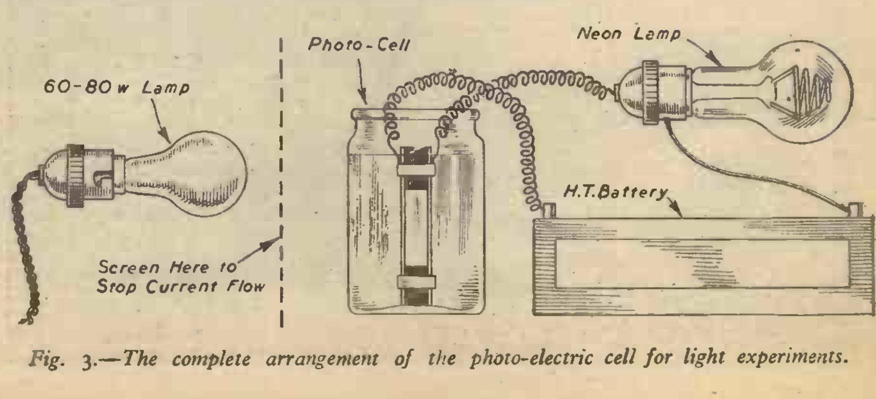


Fig. 3.—The complete arrangement of the photo-electric cell for light experiments.

The Aircraft Gas Turbine

The Mitchell Memorial Lecture

By Air Commodore FRANK WHITTLE

GIVING the first of the annual memorial lectures, inaugurated by the Stoke-on-Trent Association of Engineers, in honour of Reginald Mitchell, Potteries-born designer of the famous Spitfire aircraft, Air Commodore Frank Whittle, C.B.E., M.A., Hon. M.I.Mech.E., inventor of jet aircraft propulsion, read a paper in Hanley Town Hall, on October 14th, on "The Advent of the Aircraft Gas Turbine."

Air Commodore Whittle said there was nothing new in the basic idea of the gas turbine as a prime mover, but it was only within the last ten years or so that it had become a practical proposition. A gas turbine, working on the constant pressure cycle, consisted basically of a compressor, a combustion chamber, and a turbine. The useful work produced was the difference between the power generated by the turbine and the power required to drive the compressor. It was obvious, therefore, that the ratio of positive to negative work was of great importance. That ratio was limited by the temperature the turbine materials would stand. It may, therefore, easily be seen that the materials available, and the compressor and turbine efficiencies, were very important factors in the consideration of the gas turbine. Up to a few years ago compressor efficiencies were of the order of 70 per cent.; turbine efficiencies were not much higher, and the materials available limited the positive to negative work ratio of the ideal cycle to about 2:1. With those figures, an efficient gas turbine was not possible. To-day, material developments had made possible a considerable increase in the positive to negative work ratio, and the efficiencies of compressors and turbines had been raised very substantially.

Important Factors

In the jet propulsion application of the gas turbine only a sufficient part of the expansion took place in the turbine as was necessary to drive the compressor, and so only a part of the expansion was subject to turbine losses. Two other factors operating in favour of the aircraft gas turbine, as compared with other applications, were:

(1) A certain degree of compression could be obtained by the ram effect of forward speed at high efficiency, thereby raising the average efficiency of the whole compressor process;

(2) the low temperature of high altitudes made possible a greater positive to negative work ratio for a given maximum cycle temperature.

The lecturer continued:

"There are two basic types of compressor commonly in use in aircraft turbines—the centrifugal type and the axial flow type. The combustion problem was the biggest obstacle in the development of the aircraft gas turbine, and it remains to-day the most uncertain feature in any new design. Some designers have favoured an annular type of combustion chamber on the ground that a very much smaller diameter can be achieved, and that it fits in very much better with an axial flow compressor and axial flow turbine. I, personally, have always avoided it, because the development problems it presents are very much more severe than with the multiple combustion chamber system. Moreover, I am a great believer in complete symmetry about the axis of the fuel nozzle.

"Aircraft gas turbines usually have only one or two stages. They develop enormous power in proportion to their size. We can, for example, expect to get about 10,000 shaft horse-power out of a single stage wheel of about 22in. diameter.

Axial Velocity of Gases

"In the turbine of a jet engine we can afford to have the gases leaving the wheel with a very high axial velocity, and that is the chief factor which enables us to get such enormous powers in proportion to size. That axial velocity ultimately contributes to the kinetic energy of the propelling jet, and so is regarded as part of the useful output. When we talk about turbine efficiency we include the kinetic energy of the leaving velocity on the credit side. In modern turbines, we can expect to get about 90 per cent. That is to say, the shaft power plus the kinetic energy of the gases leaving the wheel is about 90 per cent. of the adiabatic heat drop.

"We owe a tremendous amount to the work of the metallurgists in developing materials which will withstand a combination of high stress and high temperature. Any further advances in this direction will show big dividends in engine performance."

Air Commodore Whittle showed illustrations of various turbo jet engines, and said that the low weight was by no means the only advantage of the jet engine. There was virtually a complete absence of vibration, so much so that he had heard of one case where vibrators were fitted to the instrument panel in order that the instrument could be shaken into giving proper readings. There was also much reduced noise within the aeroplane, though from the outside it sometimes seemed that they were noisier than the more conventional power plant.

I am told (said the lecturer) that people who have flown in the Lancastrian, which has been experimentally fitted with Nene engines in place of the outboard Merlins, had some difficulty in believing that the jet engines were running after the inboard Merlins had been stopped and the propellers feathered.

Jet engines, as well as other aircraft gas turbines, use low-grade fuels, with consequent big reduction of fire risk. We started using kerosene in the very early days when we were trying to make a vaporiser system of injection work, and we stuck to it when we changed over to atomised liquid injection, chiefly because, as compared with other low-grade fuels, it has a very low freezing point.

In quantity production, the first cost of a jet engine should be very much less than that of the piston engine and propeller, especially in the case of the very simple engine with a centrifugal compressor. Jet engines are intrinsically more reliable and easier to maintain and service. For example, the establishment for engine maintenance personnel in the jet fighter squadrons of the R.A.F. has been reduced to half that of the piston engine fighter squadrons

Easy to Start

The jet engine is very easy to start and does not require warming up. Neither is it necessary to run up to full power as a check, though I am afraid it will be a long time before the habit dies out. The

A Lancastrian fitted with two Rolls-Royce Merlin engines and two Rolls-Royce gas-turbine units. In a recent test this 'plane flew 100 m.p.h. faster on the two jet units alone than when operating on the four Merlin engines.

installation is very simple and uncomplicated by elaborate cooling systems, etc. It is possible to change an engine in two hours or less, and most of that is due to the time taken in undoing and refastening the cowlings.

The development time is also very much shorter than for piston engines; at least that is true once more for the engines with centrifugal compressors. Another important factor is that jet engines are very amenable to scaling. That is to say, that if an engine is required similar to one already in existence, but of different power, then it can be quickly obtained by scaling up or down from the existing engine.

Air Commodore Whittle continued: "The use of turbo jet engines makes possible big improvements in aeroplane design. Undercarriages can be much smaller than with conventional types; moreover, a much better streamline can be obtained. That is one reason why jet aircraft have intrinsically a much lower drag than the conventional type. The drag coefficient of one well-known type is said to be not more than two-thirds that of the best of the piston-engine types. The absence of propeller slipstream is a factor contributing to this."

The D.H. 108 jet-propelled 'plane with de Havilland Goblin gas-turbine engine. An experimental aircraft designed for research into high-speed flight.

Properties of Jet Engines

On the properties of the jet engine Air Commodore Whittle made the following points:

The thrust of the turbo jet does not vary much with speed. It drops off a little from its value when stationary, then remains more or less constant over a wide speed range, and at very high speeds begins to rise again. This means that the effective thrust horse-power is almost proportional to speed. With the conventional power plant, on the other hand, thrust power does not vary much with speed, and tends to decrease at the top end of the speed range when the propeller begins to lose efficiency due to compressibility effects.

The thrust of the jet engine is very sensitive to rotational speed of the engine; in fact, near the maximum speed it is almost proportional to the fourth power of the r.p.m.

The efficiency of the jet engine as a device for producing a high velocity jet is quite high. The overall thermal efficiency measured in terms of the increase of kinetic energy produced by the engine in the air passing through it can be of the order of 34 per cent. when flying in the stratosphere where the maximum benefit is obtained from the low temperature; but, because the speed of the jet is very much higher than the speed of the aeroplane, the propulsive efficiency is low. It is basically more efficient to induce a small increase of velocity in a large mass of fluid than to induce a large increase of velocity in a small mass of fluid.

The jet speed is usually of the order of three times the forward speed, and at this condition the propulsive efficiency (the "Froude efficiency") is about 50 per cent., giving an absolute overall efficiency of about 17 per cent. This is better than one could obtain with a piston engine and propeller at speeds of the order of 600 miles an hour, because at those speeds the propeller efficiency would be unlikely to be more than 60 per cent. At lower speeds, however, the overall efficiency of the jet is definitely lower than that of the piston engine and propeller. Both the thermal efficiency and the propulsive efficiency improve with speed, so that there is a double reason why high speed is necessary for efficiency. Height improves efficiency up to the stratosphere at least, because of the low atmospheric temperature, but, generally speaking, speed is much more important than height in its effect on efficiency.

Speed and Range

At 600 miles an hour the turbo jet engine is the most efficient propulsive device for aircraft that we have available, even if we think purely in terms of fuel consumption per unit effective horse-power. Height is of tremendous importance in its effect on the range of a jet-engined aeroplane. At 40,000ft. the range is nearly three times as great as it is at sea level. The effect of speed on range is relatively small, so that one might as well fly fast, because there is nothing to be gained by flying slow. The aeroplane with conventional power-plant, on the other hand, is very sensitive to speed, but not very sensitive to height, though the speed corresponding to maximum range increases very considerably with height.

The lecturer continued: "A great deal of work is going on in this country and in America on gas turbines for propeller drive, and several engines are now in an advanced state of development. In the turbo jet engine only sufficient power is developed by the turbine wheel to drive the compressor, but in the propeller gas turbine a much greater proportion of the expansion takes place in the turbine system. I use the expression 'turbine system,' because in some cases the propeller is driven through reduction gearing from the turbine-compressor shaft, whereas in the Bristol Theseus, for example, a turbine mechanically independent of the compressor drives the propeller, also through reduction gearing.

The Ducted Fan

"There is yet a third way to use the gas turbine in aircraft propulsion. It can be used to drive what we call a ducted fan. This is really a compromise between the pure turbo jet and the turbo prop. In this arrangement the gas turbine drives a low lift compressor inside a hollow fuselage or nacelle. Whereas a propeller produces a slipstream of very large mass with only a small increase of velocity, and the jet engine produces a low mass high velocity jet, the ducted fan produces something in between the two, so that its propulsive efficiency lies between that of the pure jet and the propeller.

"One big advantage of the ducted fan is that it is possible to obtain a very large temporary increase in power by burning additional fuel in the low pressure air from the ducted fan. The fuel consumption is enormous when this is done, but that is not important where the boost required is purely temporary, as, for example, for take-off or for short periods of combat. It is argued by some that the range of speed over which the propulsive efficiency of the ducted fan is superior to that of both the propeller and the turbo jet is so small that it is not worth while. My own view is that the absence of slipstream, reduced noise and vibration, and the possibilities of power boost by after burning, are very powerful arguments in its favour."

Future Possibilities

In conclusion, Air Commodore Whittle said: "I hope I have said enough to convince you that the piston engine is dead for aircraft propulsion, except possibly in the field of light aeroplanes. I make this reservation because we do not yet know enough about the problems involved in designing gas turbines of very low power. At present it seems easier to design for much higher powers than we are using to-day than to design for power of the order of 200 h.p. We are as yet only at the beginning of this field of engineering. The possibilities are immense. In the piston engine the compression, combustion and expansion all take place in the one organ, the cylinder, and that seriously limits the possibilities of variation. In the gas turbines these processes take place in specialised organs, each of which may take many forms. As you have seen, you can have centrifugal compressors, axial flow compressors, or combinations of the two types. There are wide possibilities of variation in combustion chambers and turbines, and there are all sorts of ways in which these major components can be combined together. Added to all that are the possibilities involved in heat exchangers, intercoolers, and so on.

"The next few years will see a very rapid development in the aircraft field as a result of the advent of the aircraft gas turbine.

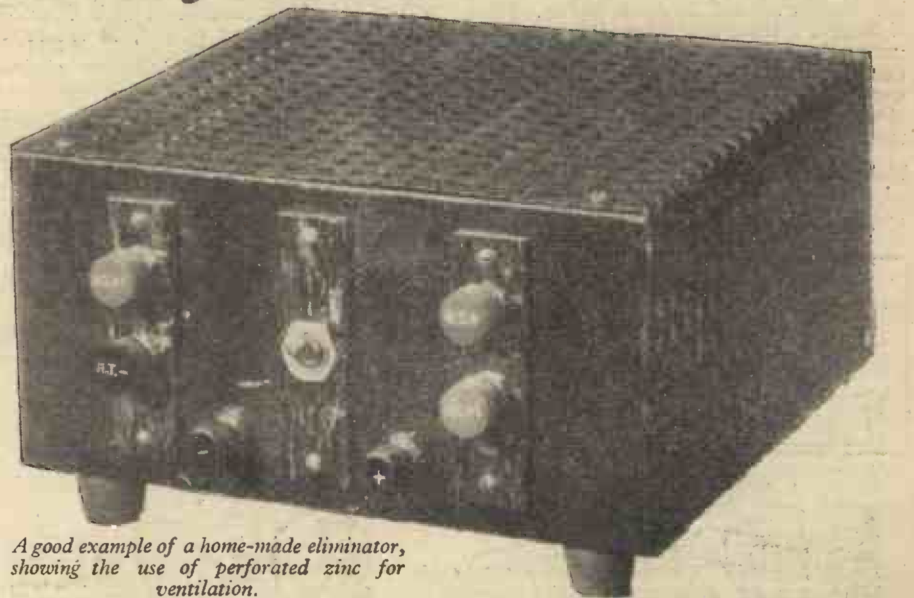
"I believe that speeds of the order of 500 to 600 miles an hour will soon be quite common in commercial aviation. Most people find this a rather horrifying thought, but then there was a time when people were horrified at the thought of travelling at 30 miles an hour in a railway train."

H.T. Battery Eliminators

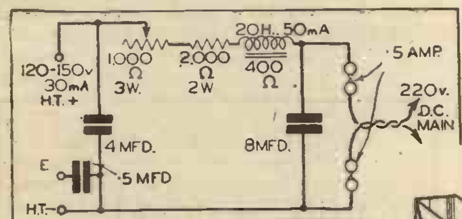
A Few Alternative Circuits for Units Suitable for Use with D.C. and A.C. Mains Supplies

(Reprinted at the request of many readers, from an issue now out of print.)

ALTHOUGH it has become customary for those who have a mains electricity supply to use a normal type of mains-fed receiver, it is clear from the correspondence we receive that there are still many battery-set users who wish to obtain their H.T. current from the mains supply. Some of them explain that they consider that a battery set gives better reproduction; others apparently feel more confident to build a battery set than one of the all-mains type. It is not for us to dictate, for everyone is entitled to his own opinions, but we are in favour of the mains set every time. In spite of that, however, it is often cheaper to build a battery set, whilst the constant experimenter who frequently rebuilds his set can certainly effect a saving by making battery sets and keeping a power-supply unit that can be used with practically any type of set that he might construct.



A good example of a home-made eliminator, showing the use of perforated zinc for ventilation.



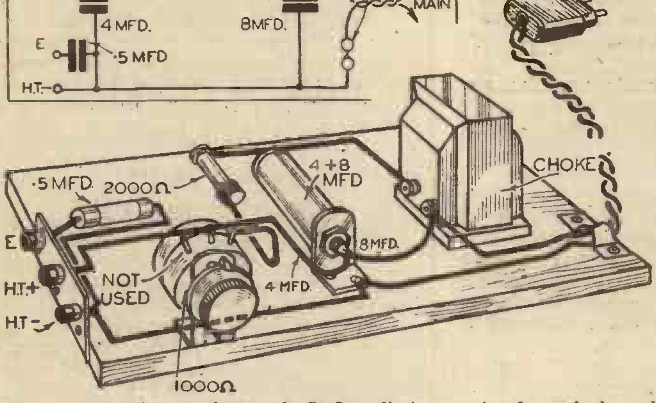


Fig. 1.—A simple form of D.C. eliminator in theoretical and practical form.

The D.C. Unit

The simplest type of eliminator is, of course, that intended for use with D.C. mains. All that is normally required is a smoothing choke, a couple of smoothing condensers, a fixed and variable resistor, and a few connectors and small items. A circuit and pictorial illustration of a unit of this type are given in Fig. 1. It will be seen that there is only one H.T. positive lead, and that the voltage supplied can be varied to suit any type of battery set. Extra tappings could easily be arranged if desired, but they are seldom necessary with a fairly modern type of receiver. This is because voltage-dropping resistors and potentiometers for screening-grid supply, and the like, are usually included in the circuit of the set itself.

In case any reader wishes to provide additional tappings, however, we show how this can be done in Fig. 2. The three positive output terminals are marked with the voltage and current which they will provide when the mains voltage is about 220. Of the three outputs shown the first would be suitable for a leaky grid detector, the second for the screening grid of the H.F. or I.F. valves, and the third for the L.F. and output valves. We are not strongly in favour of providing tappings on the eliminator, for it is in many ways better to include the necessary voltage-dropping resistors in the set, placing them and their corresponding by-pass condensers as near to the points they feed as possible. The fixed resistors shown can each be rated at one watt, the potentiometer should, for preference, be of the wire-wound type and the variable resistor should be rated at not less than three watts.

Components

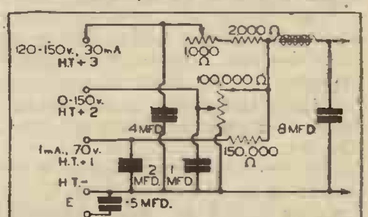
Note the inclusion of a fused connector for the mains supply, and also observe that the smoothing choke is rated at 20 henries, 50 mA, and has a resistance of 400 ohms. Actually, these values are not critical, but it would be unwise to employ a choke with a lower inductance than 20 henries, or with a lower maximum current-carrying capacity than 50 mA. Nearly all chokes of this type and of medium price have a D.C. resistance of between 300 and 500 ohms; any value between these two limits will provide the approximate outputs indicated.

The smoothing condensers can be either electrolytics or of the paper type, rated at not less than 250 volts working. A very convenient system is to employ a twin tubular electrolytic condenser mounted on a small metal bracket, as shown, from which the negative lead can be taken. Alternatively, a twin block condenser bracket is not required.

The components are shown mounted on a wooden baseboard, but it is a good plan to make a cover from perforated metal or tinplate with ventilation holes drilled in it. This must be clear of all connections, but should be earthed to the common H.T. negative-earth terminal.

Negative or Positive Earth

When the eliminator is used on a D.C. supply with negative earth it is necessary only to connect it in place of the H.T. battery, although it is generally desirable to take a second earth lead to the appropriate terminal on the unit. This can consist of a short wire from the earth terminal on the set. If the positive side of the mains is earthed, greater care must be taken, and the earth lead to the set must be taken through a fixed condenser with a capacity between .1 and 1 mfd. That is, the earth lead is joined to one terminal



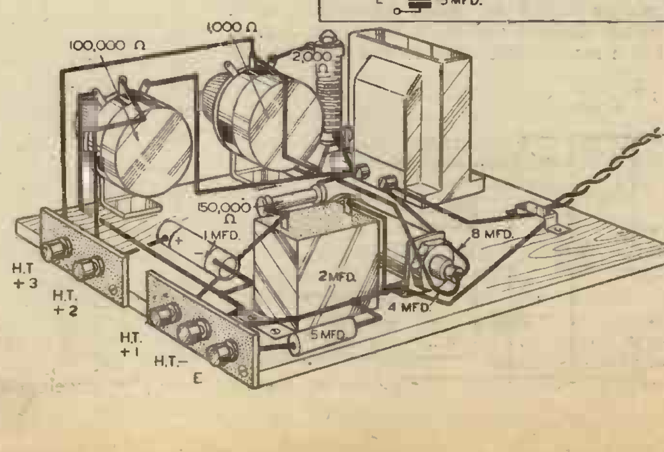


Fig. 2.—How additional resistors can be added when voltage-dropping arrangements are not included in the set.

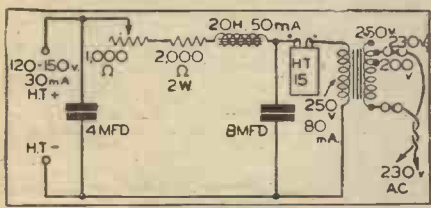
of this condenser and the other condenser terminal is joined to the earth terminals of the set and of the eliminator. It is also important that a condenser be included between the set and the aerial lead-in. Even if there is a small condenser in this position inside the set it is wise to fit an external one of not less than 250 volts working. The omission of the condenser might result in shocks being received should the aerial be touched.

Simple A.C. Unit

An A.C. eliminator is slightly more complicated, due to the fact that a rectifier and transformer are needed in addition to the parts used in the circuit already explained. When an H.T. current of not more than 30 mA is required—and, this is sufficient for most types of battery set—a very satisfactory arrangement is to use a Westinghouse style H.T. 15 metal rectifier in a half-wave circuit as shown in Fig. 3. When this is fed from a mains transformer giving a secondary output of 250 volts, 30 mA the maximum, unsmoothed output from the rectifier is 230 at 30 mA. This is, of course, approximately the same voltage as that of the D.C. mains used for the circuit first described. Consequently, any additional voltage tappings can be provided in the same manner as shown in Fig. 2.

The general form of construction can be the same as that mentioned in connection with the D.C. unit, and the eliminator can be used in the same manner, except that an earth connection is not required unless there is a long lead between the unit and the set.

In those rare cases where a current in excess of 30 mA is required, a larger metal rectifier could be used, preferably in a voltage-doubler circuit as shown in Fig. 4. For a maximum output of 330 volts 60 mA a suitable rectifier is the H.T. 16, and it should be fed from a transformer providing a secondary output of 240 volts, 200 mA. For either of these A.C. units it is best to use smoothing condensers with a maximum working voltage of 500, to ensure a reasonable factor of safety.



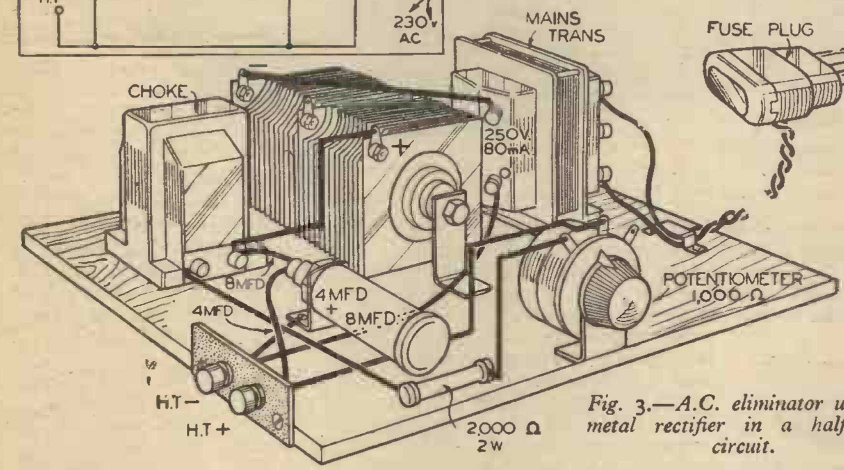


Fig. 3.—A.C. eliminator using a metal rectifier in a half-wave circuit.

Valve Rectification

A very satisfactory method of obtaining a D.C. output, before smoothing, of 230 volts, 60 mA, is by employing a full-wave valve rectifier such as the Cossor 506 BU. Connections for this are given in Fig. 5, where both theoretical and pictorial arrangements are illustrated. Here again the few simple parts may be mounted on a baseboard, with or without a metal shield. The shield, made of iron or tinplate, is always desirable since it helps to prevent mains interference, and also prevents the constructor from accidentally touching any "live" parts when the mains are connected. For the screen to be fully effective it should always be earthed.

Grid Bias

When using any type of eliminator it is a convenience to employ automatic grid biasing, although a G.B. battery is perfectly satisfactory, and will last for at least six months. An alternative system when using an A.C. eliminator is to use a transformer with an additional secondary winding in conjunction with a low-voltage rectifier, but that is rather an expensive method and not one that most readers would favour.

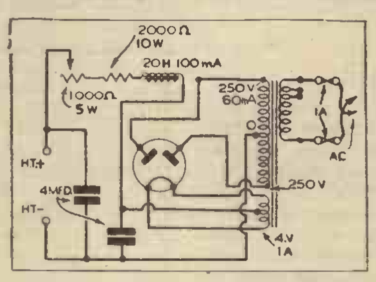
Trickle Chargers

As we are dealing only with the simpler types of mains unit we are not going to describe an eliminator with trickle charger built integral with it. As small trickle chargers suitable for two-volt accumulators of average capacity are not expensive, we are inclined to favour the use of two separate units. If two small accumulators are obtained, one of them can be charged while the other is in use, or a single accumulator can be used, a change-over switch being fitted to bring the charger into circuit when the set is switched off.

Switching

There are two simple rules which should be borne in mind when using eliminators: the filaments should be switched on before the eliminator, and the eliminator should be switched off before the filaments.

If these rules are reversed additional strain is thrown on the valve filaments and also on the various fixed condensers in the set. It is just permissible to switch on both eliminator and L.T. at the same time, but this is not very good practice when using a metal rectifier, because a fraction of a second elapses between the time that the the rectifier supplies the H.T. and the time that the filaments reach their working temperature.



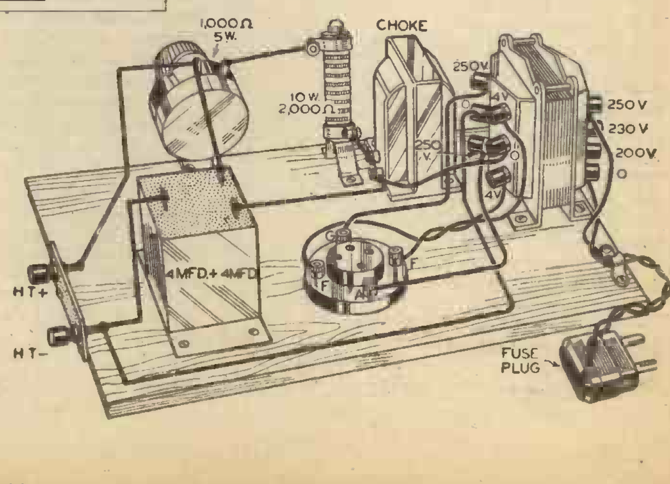
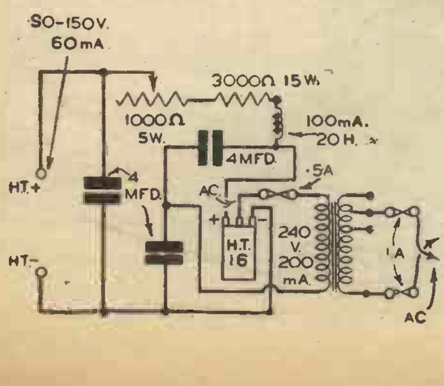


Fig. 5.—This A.C. eliminator uses a full-wave rectifier.



(Left) Fig. 4.—Circuit of an A.C. unit with voltage - doubler rectification.

Rocket Propulsion

Projected Rocket and Composite Rocket-athodyd Fighters

By K. W. GATLAND

(*Continued from page 53, November issue.*)

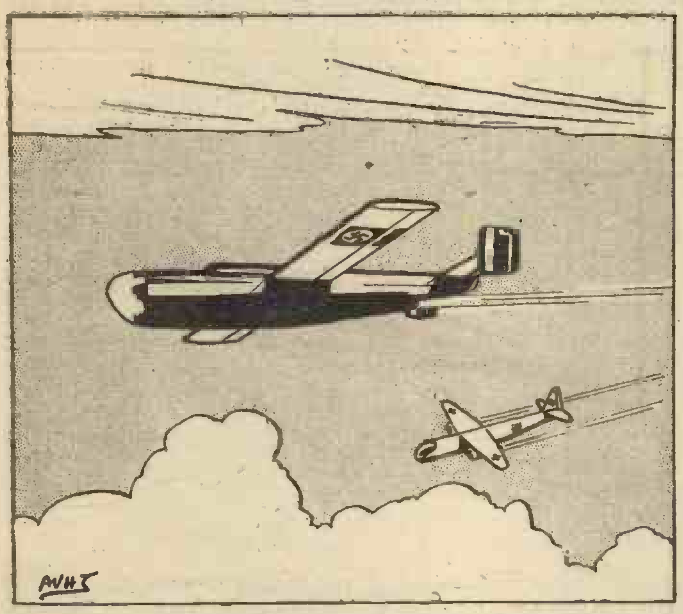


Fig. 82.—An Arado development in early stages of production at the time of the surrender. This tiny rocket fighter was to be carried into action beneath a jet-powered bomber.

ANOTHER special purpose fighter making use of the Walter 109-509A1 rocket engine was found under construction in the Arado works. This was an exceptionally tiny monoplane (Fig. 82), and its small proportions can be gauged from the fact that it could not accommodate the rocket unit in the extreme tail, a "step" having been embodied in the lower fuselage through which the exhaust emerged at a slight downward angle.

The mainplane had a high root fixing, and twin fins were fitted at the tips of an oblong tailplane. A prone piloting position helped to reduce the cross-sectional area of the fuselage and to delay critical "g" pressures, but most interesting of all was that it was intended to operate the machine from a jet-powered bomber.

Test flights had, in fact, already been made, using the then newly produced Arado 234C-1 as the parent. This four-engined "jet" was a particularly enterprising aeroplane, for despite a fully fuelled weight of 24,200lb., its maximum speed (between 530 and 550 m.p.h. at 20,000ft.) was greater than most of the fighters which accompanied Allied bombers. The tiny Arado fighter was fixed beneath its broad fuselage and, under combat conditions, would have been released just out of range of enemy fire.

In comparison with the designs which other manufacturers had in stages of project, the Arado development seemed no great departure from the orthodox. It was just another bold attempt to "out-fly" Allied aircraft, but like the majority of its contemporaries, came a trifle too late.

A further interesting project was the D.M.2 (Fig. 83), a rocket-powered flying-wing. Again, intended as a high-speed interceptor, this particular design was originally the work of Professor Lippisch, and was based on a standard pattern which had been evolved as the result of extensive tests with rocket-driven research models.

It was not simply a "tail-less" machine. There was no fuselage at all, the all-wing structure, thick in section at the root and tapering sharply towards the tips, sweeping back within a contained angle of 60 deg. A large vertical fin emerged on the centre-line at the rear.

The pilot was accommodated in a semi-prone position entirely within the contour of the wing section, and there was no cabin "blister" or other excrescencies to spoil the shape. His cabin afforded excellent vision in all directions except rearwards, the nose being completely covered with "clear-view" Plexiglas. Flight at high altitudes was made possible by pressurisation, supplied by three large oxygen cylinders.

The propulsion unit was of a type similar to that employed in the early versions of the Messerschmitt 163, known as the Walter R2-211. Its main difference was a more slender combustion unit to suit the thin wing section, having a smaller chamber and a long tapering nozzle. The tanks, designed to have a total capacity of 8,000 litres of T and C stoff, were naturally disposed over the c.g., so that balance would not be upset as the propellant was consumed.

A retractable tricycle undercarriage was embodied, the nose-wheel folding directly backwards between the pilot's heels, while the two main wheels came upwards, rotating through 90 degrees to lie flat in wells situated at the sides of the grouped engine accessories and behind the main propellant tanks.

It is obvious that the landing speed would have been high, and for this reason the designer had embodied a large flap area. The flaps, in fact, extended almost the entire length of the trailing edge, and it would appear that the outer pair also operated as elevons (single aerofoils serving the dual purpose of elevators and ailerons). A 2in. gap separated all control surfaces from the main structure, wing and fin, and this refinement in the case of the flaps was probably to increase the lift when they were lowered for landing as it permitted air from the upper wing surface to be deflected downward to supplement the under flow. The increased mass of air deflected when the elevons and rudder were operated made for increased sensitivity, which was particularly desirable for a machine of this type at low speeds.

The control column, which, owing to the prone piloting position was only about 1ft. 6in. high, was coupled to a servo gear to compensate for the decreased leverage.

Although no performance figures are available, it is obvious that the machine was intended to operate at high speeds, possibly bordering on supersonic speeds. It was, however, only one of several all-wing projects designed to Lippisch formulæ.

Another was an athodyd powered fighter with rocket booster (Fig. 84), said to be capable of travelling at 1,500 m.p.h. The remarkable feature of this machine was the fact that it used no fuel other than blocks of carbon, these being set inside a simple "straight-through" duct and preheated to incandescence just prior to flight. The pilot was to be installed near the nose, lying prone, the air entering from a central intake being ducted around his slim cockpit and flowing to the single heating chamber.

Launching was to have been by powerful assisted-take-off rockets, the machine accelerating along an inclined ramp, and once the air began to ram into the intake the high-velocity draught would serve to inflame the carbon, raising its own temperature in the process. At high speeds, large masses of air would be continually ramming through the duct and at a pressure so great to make any mechanical means of compression entirely superfluous. Expansion in the heating chamber would be rapid as the result of the intense heat thrown off by the carbon, the resulting jet finally emerging through a narrow slit in the trailing edge.

As far as is known, only model research had been conducted, but the numerous free-flight tests the Germans had been able to make in the few months available to them

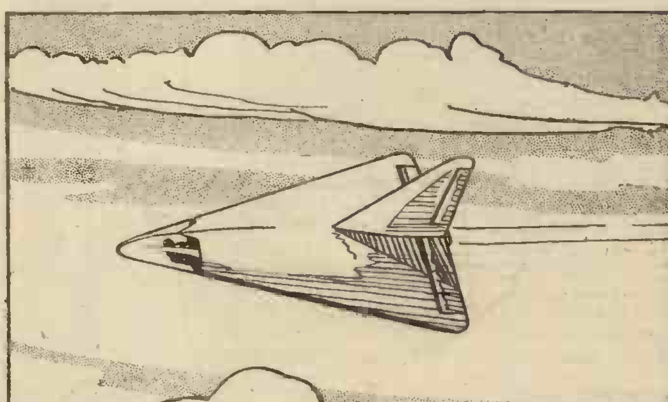


Fig. 83.—From research with flying models came this design for a rocket-driven "flying-wing," the D.M.2.

prior to the surrender would seem to have been particularly encouraging. The original experiments using carbon alone permitted a flight of 45 minutes' duration, but employing a paraffin spray to prolong the life of the heating blocks, the period of power was said to be virtually doubled. With this system, however, there would have been little opportunity for varying the thrust, although two possibilities that come to mind are the obvious ones: (a) of varying the area of the exhaust duct, and (b) the provision of bypass ducts so that a proportion of the air could be deflected away from the heating chamber should it be desired to "throttle-down."

A further machine making use of athodyd propulsion was one projected by the Focke-Wulf company (Fig. 85). This was a type not far removed from the normal high-performance fighter, though with two outstanding differences, namely, a 45-degree wing sweep-back and the unique mounting of its two propulsive ducts.

The fuselage was exceptionally slim, tapering smoothly to almost a point at the nose. The shape of the rear was almost identical but the provision of a rocket unit had necessitated a slightly larger section towards the tail. A neat "Plexiglas" hood emerged slightly more than half-way back from the nose, the single fin joining the line of the cabin and projecting beyond the fuselage end.

The tail-plane itself raked back at an even greater angle than the wings, and at its tips were fitted the two 4.4ft. diameter athodyds, an arrangement made possible by their light weight. This must have involved something of a nightmare for the company's stress department, and it is clear that the necessity for a strong angular transport member was the main reason for the acute tail sweep-back. It did not, however, interfere with the control system, which remained orthodox with normal rudder and elevators.

The Walter bifuel rocket engine developed a thrust of 6,600lb. and was to be used in take-off to accelerate the machine to the speed at which the ram pressure was sufficient to operate the ducts. A kerosene fuel was specified as the heating agent, the resulting jet to provide a 680 m.p.h. top speed at sea-level and a climbing rate of 31,000ft. per minute at 3,000ft. If, however, the 'plane was climbed to 36,000ft., the maximum speed in level flight would fall to 590 m.p.h., and naturally the climbing rate also suffered a loss, reducing to 5,100ft. per minute.

In consequence, it is suspected that the rocket system would have its main purpose in boosting the climb, and it is obvious that it would have been employed also in landing as athodyd units cut out at about 200 m.p.h.

At sea-level, the machine was said to be able to fly under full power for 13 minutes, but this could be much improved by a direct climb to 36,000ft., when 43 minutes' endurance could be expected.

The main weights and dimensions given in the design tender are as follows: an empty weight of 5,900lb., and a fully loaded weight (including fuel and pilot) of 12,000lb. The wings had an area of 205 sq. ft.

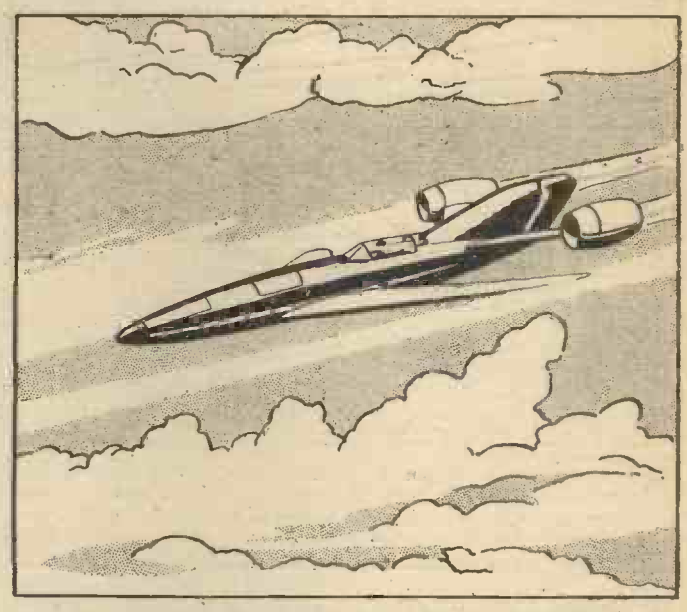


Fig. 85.—A "tail-drive" athodyd project from the Focke-Wulf stable.

A High-speed Helicopter

As the war in Europe drew to a close, yet another design for an athodyd fighter was taking shape in the Focke-Wulf project office, this time a high-speed helicopter (Fig. 86).

Of all the schemes, this was by far the most unorthodox, for it was an entirely new approach in aircraft design. The machine embodied a nicely streamlined fuselage with the pilot contained in the extreme nose, but there all semblance of conventionality ended. It was intended to stand vertically on wheels mounted on its four fins and tail fuselage and to take off from that position with the aid of a three-blade rotor which revolved *around the fuselage*. This rotor was unique in itself, for it had no means of internal drive. Its propulsion arose from athodyds mounted at each blade tip, and once started by rockets these would cause the rotor to spin round at high speed.

The launching procedure would consist first in driving the rotor up to a speed at which the athodyds could operate. The blades would be set to give zero thrust during this operation and thus the ducts could be functioned without causing the machine to lift.

Within a few seconds the ducts would be working smoothly and the pilot had then only to operate a control to cause the blades to assume a slight angular pitch sufficient for the machine to rise gently upward. The vertical speed could be increased to a maximum of about 75 m.p.h., and having gained sufficient height, the machine would be turned into a horizontal path by deflecting its rudders and elevators, appearing as in Fig. 86.

An increase in the blade pitch would progressively improve the forward component of the duct thrust, the rotational speed of the rotor naturally falling as the result of the greater load.

At sea-level, the maximum speed expected was 620 m.p.h., the rotor operating at 520 r.p.m., which in terms of the speed would be 690 m.p.h. The initial rate of climb quoted is 25,000ft. per minute, with an endurance of 0.7 hours and a 400-mile range. At an altitude of 36,000ft., however, the forward speed would be 520 m.p.h., the duration 2.3 hours, the range 1,100 miles, and the climbing rate only 4,000ft. per minute.

The descent was just the take-off procedure in reverse, the machine coming to rest gently on its tail—or so it was said. How it was proposed to remove the pilot from his precarious position remains a mystery.

The *profile drag* of this design was said to be about one-fifth that of a normal machine of the same dimensions, but the *induced drag* would have been twice as great as a wing equal in span to the diameter of the rotor—37.4ft. The ducts themselves were little more than 2ft. in diameter and involved practically no resistance.

The structural weight was 7,000lb., somewhat greater than that specified for the previous Focke-Wulf project, while the all-up weight at take-off was 11,400lb.

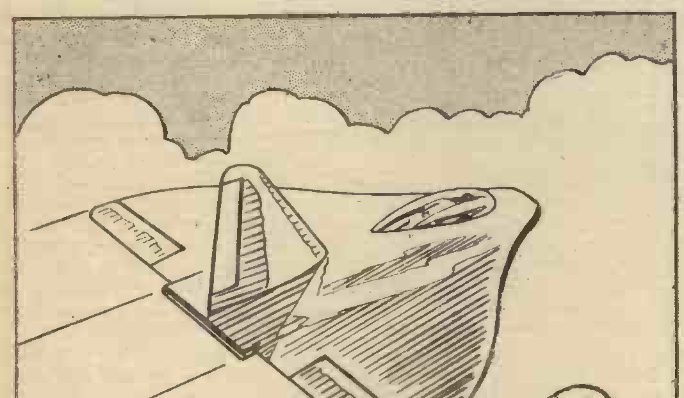


Fig. 84.—1,500 miles per hour—and on no other fuel than solid carbon. That was the estimate made by Professor Lippish for this athodyd-powered "flying-wing."

Other Athodyd Proposals

The projects illustrated in these pages were by no means the only ones to be based on athodyd propulsion. There was, for instance, the Heinkel P.1080, a tail-less machine with swept-back wings and two duct units, 16ft. long and extending quite two-thirds its overall length, fitted at each wing joint.

At the Skoda works was being planned an athodyd fighter in which a 31ft. Saenger duct formed the basis of its bulky fuselage. The general layout, however, was orthodox, with a mid-wing fixing and a single vertical fin on which the tail-plane was mounted just above its root fixing at the rear.

A nose cockpit enclosure was incorporated above the intake duct in which the pilot was to lie prone. There was provision for a heavy calibre cannon to be mounted just above his head, and a large capacity fuel tank, also installed on top of the duct, took up a position over the aircraft's c.g.

The machine was estimated to have a sea-level speed of 630 m.p.h., with a maximum thrust of 9,700lb.

Yet another proposal was for an adaption

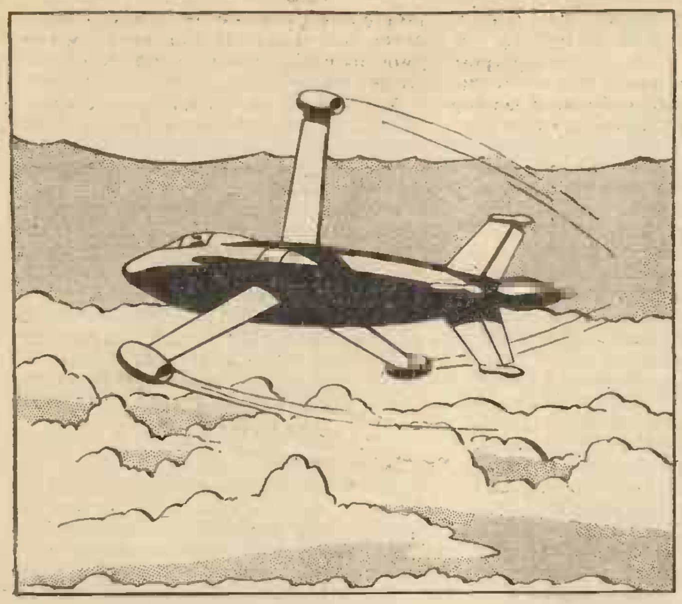


Fig. 86.—Another Focke-wulf project, this time a high-speed helicopter. Three athodyds were to drive its rotor, but most unorthodox of all, the machine was to stand vertical on wheels fitted in the tail-end. It would rise directly upward and then operate in horizontal flight, travelling at a maximum speed of 620 miles per hour.

of the Messerschmitt 262 with two Saenger athodyds in addition to its standard Jumo 004 turbo-jet units. The performance figures derived for this combination, however, were not particularly encouraging. The maximum speed at sea-level was estimated to be 620 m.p.h., but the climb to 36,000ft. would have taken over six minutes with fuel consumed within 40 minutes.

Summary

The foregoing is some slight indication of what promises for the future, though undoubtedly a great deal of further research will be required before the athodyd becomes a practical means of aircraft propulsion.

In very high-speed aircraft, the prospects are particularly great, for it has been calculated that at speeds upwards of Mach 1.4 and at a height of 40,000ft., the athodyd will develop a greater thrust per square foot of frontal area than the most efficient turbo-jet.

There are, however, serious obstacles. Even at quite high forward velocities, the athodyd's fuel consumption is between 50 to 100 per cent. greater than that of the mechanical-compression type.

It loses power with height because, unlike the rocket and turbo-jet, it is not "supercharged." The performance figures quoted for the Focke-Wulf "tail-drive" fighter tell their own story; a reduction of 90 m.p.h. from top speed at sea-level was registered at 36,000ft., while the climbing rate for the same conditions involved a loss of 25,900ft. per minute. For efficient operation, it is clear that a rocket booster is essential, and although extra tankage would be required to contain the rocket propellant, the fuel needed for the athodyd could be much less.

The higher the speed of the athodyd, the greater is the thermal efficiency. A speed of 1,300 m.p.h. at sea-level would produce an intake pressure of about 60lb./sq. in. (a figure which compares favourably with the 4-to-1 compression ratio of our best turbo-jets) with the fuel consumption then also a more reasonable proposition.

The U.S. Navy Department was one of the first to produce working examples of the athodyd. A number of various applications have been tried, and among the most successful were athodyd projectiles weighing 70lb. and capable of speeds up to 1,500 m.p.h.

An interesting point about them is that they required no auxiliary fuel feed. The fuel was contained simply within a double-walled liner positioned over the heating chamber, and it was only necessary to pre-heat this tank to cause the fuel to start issuing through the burner jets as the result of its own expansion.

Ignition

The jets were ignited immediately and the missile fired into the air with the aid of its auxiliary rocket. Its speed would quickly become sufficient for the ram pressure to take over, the high temperature created by the burners in the pressurised region producing expansion and jet reaction. The self-feeding process naturally continued throughout.

(*To be continued.*)

Modern Abrasives

Their Composition, Manufacture and Uses

THERE is no doubt of the fact that man has always been an abrasive-using animal. For, from far back in the mists of remote antiquity there have come to us man-made tools and implements which, crude although they may be, show unmistakably the marks of a rubbing-down process which has been applied to them.

The stone arrow, the ancient axe, the first attempts at the fashioning of knives and other metallic cutting instruments must all have been submitted to some process of grinding and shaping, and, indeed, on many of these prehistoric articles the actual marks of the grinding implement can be plainly seen.

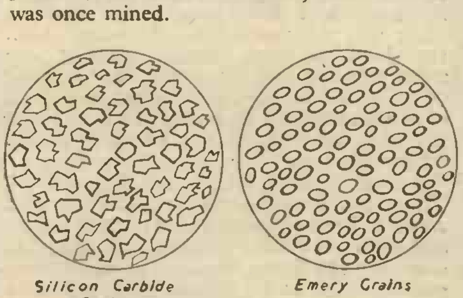
The earliest form of grinding, which, incidentally, has persisted right up to the present day, consisted in the rubbing of one thing over another, as, for instance, the frictional contact of one stone across another one of similar or, perhaps, harder texture.

Common Grindstone

The common grindstone forms an example of this, the earliest of abrasive operations. Actually, however, the grindstone as an abrasive agent is not a very efficient article, for it neither grinds nor cuts. The traditional grindstone merely rubs the article against it and exerts rather a haphazard tearing-away action on the object than a true grinding effect.

The first real scientific advance in the application of abrasives came with the more general utilisation of emery and its making up into compact stones and grinding wheels.

Emery is, of course, a naturally occurring mineral which has been known (yet surprisingly little used) for thousands of years. It occurs plentifully in Greece and, indeed, it derives its name from Cape Emeri, in the Greek island of Naxos, near which it was once mined.



Emery grains wear round with frictional rubbing, but grains of silicon carbide (carborundum) split under friction and continually present fresh cutting edges.

In composition, emery is an impure form of aluminium oxide mixed with iron oxide. It is reasonably tough without being unduly brittle and, although at the present time it has to meet much competition from the synthetic abrasive agents, it still retains its many large-scale and commercial uses.

Powdered flint used at one time to be a favourite abrasive, but such material is now less used, in view of the varying nature of its composition and physical characteristics.

Garnet

Garnet, however, is a natural abrasive material which still has its uses. In composition it is a silicate of aluminium mixed with iron oxide, resembling in this direction the precious stone, which is a crystallised form of it. Abrasive garnet, however, usually occurs in the form of a gravel, which is washed, ground, and carefully graded as to particle size and employed either as a substitute for emery or in admixture with it.

Sand, of course, has long been employed as an abrasive, as witness, for example, the now almost traditional sandpaper. So, also, have powdered glass, brick dust, and similar materials, although, strictly speaking, the particles of these substances exert a tearing rather than a true abrasive action.

The era of modern abrasive materials was initiated, perhaps, by the coming of carborundum, or silicon carbide, a material which was invented by the American chemist, Edward Goodrich Acheson, in 1891. This nowadays well-known and, indeed, indispensable material is made by fusing in an electric resistance-furnace a mixture of coke and sand, together with a little salt to make the mass more readily fusible and a small quantity of sawdust to render it porous.

During the 36 hours of continuous fusing which the manufacture of carborundum requires, a temperature of no less than 3,500 degrees C. is reached, a terrific heat in which all metals would not only be boiled, but actually gasified.

Yet it is at this enormous temperature that the two elements silicon and carbon enter into combination to produce silicon carbide or carborundum, which, when unloaded from the furnace, takes the form of massive and many-hued resplendent crystals.

Carborundum Crystals

The carborundum crystals are crushed and then acid treated in order to remove all impurities. Finally they are washed, dried, and then passed on to further crushing machines, which reduce the material to definite grain sizes.

A companion product to carborundum is fused aluminium oxide, which under the name of "aloxite," now forms a synthetic substitute for emery.

In aloxite manufacture, bauxite ore, which is a naturally occurring form of aluminium oxide, is electrically fused with coke, whereupon the bauxite melts and subsequently takes upon itself a crystalline structure.

From the aloxite furnaces, the abrasive material is extracted in the form of immense blocks, which are broken up, crushed, and then carefully graded for grain size.

Silicon carbide (carborundum) and aluminium oxide (aloxite) are the only synthetic abrasive materials known, yet, in many respects, they have ousted all the natural abrasives for many types of grinding work.

Both these synthetic materials may be used in the form of powders of varying degrees of fineness, or, alternatively, they may be employed in the form of compacted masses of various shapes, as, for instance, blocks, wheels, sharpening stones, and so forth.

Bonding

This bonding of carborundum and aloxite, and also, of course, of emery and other naturally occurring abrasive materials, is usually effected by mixing a small proportion of china clay with the material and by compressing the mixture hydraulically. The compressed material is then fired in specially constructed furnaces, in which operation the bonding clay is melted and converted into a porcelain-like substance in which the grains of abrasive are firmly embedded.

Of all known abrasive materials, with the exception of diamond powder, which is used by manufacturing jewellers for diamond polishing and drilling, carborundum is the hardest. Carborundum, however, is not tough, but brittle. Consequently, under great rubbing pressure, the carborundum grains do not wear down to smooth surfaces, but they actually split, thereby presenting new cutting edges.

Aloxite (aluminium oxide) and emery, on the other hand, possess grains which are tougher but not so hard as those of carborundum. Hence these grains wear down smooth and do not tend to produce the constant cutting action which is so characteristic of carborundum.

Carborundum cuts, but emery, aloxite and other materials grind. The difference between these two effects will be evident from the fact that the tiny portions of metal removed by the agency of a carborundum abrasive, when microscopically examined, appear as "curls" or shavings of metal, whereas metal removed by means of aloxite or emery, when similarly viewed, presents the form of tiny globules which have been rubbed away and melted by the heat of friction.

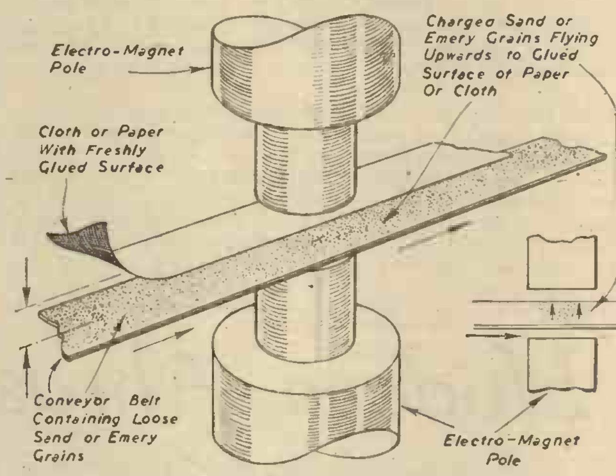
Cutting Action

The characteristic cutting action of silicon carbide or carborundum abrasive has resulted in the rendering of this material supreme for many purposes. Relatively speaking, carborundum is as non-tiring an abrasive as is diamond dust. Since the material cuts instead of rubbing or grinding, a better-finished result is usually apparent, and much less friction is produced during the process.

Dentists, for instance, employ carborundum-tipped drills when they proceed upon their unpleasant but highly necessary excavational operations in our mouths, the carborundum doing its work quicker, more cleanly and with less friction than any other material.

For the same reason motor engine cylinders are frequently re-bored with carborundum boring bars, since the carborundum grains can be relied upon to produce a clean result with the minimum of effort.

In the general run of engineering grinding work it is more or less a rule to employ a hard, brittle abrasive, such as carborundum, for the grinding of materials of low strength, as for example, aluminium, brass, copper, cast iron, hard rubber, stone, marble, and numerous other non-metallic materials. For dealing with materials of high tensile strength, such as steel and its various alloys, the tougher yet softer emery or aloxite is employed in abrasive operations, since, being tougher than carborundum, they are better able to withstand the frictional strain against a hard surface without breaking down.



Illustrating the modern method of sandpaper making.

Chromium Oxide

In addition to the abrasive materials enumerated above, there are, of course, a number which have lesser uses. Among these may be mentioned chromium oxide, the green polishing powder used in fine metal working and, of course, that gentlest of all abrasives, jeweller's rouge, which is, of course, merely a form of iron oxide, which has been heat-treated and carefully graded for particle size.

Added to these are the whiting and the Tripoli powder or kieselguhr (a diatomaceous earth) beloved of metal-polish manufacturers, and one or two other naturally occurring fine abrasive materials, such as cuttle-bone powder which is the ground internal shell or bone of the cuttle fish, and rottenstone, a finely ground mineral, occurring in Derbyshire, which is often employed for polishing operations.

Such materials, whilst being strictly abrasives, are only extremely mild ones, for they remove merely the thinnest of deposits from smooth metallic surfaces, and hence are employed merely as polishing agents.

Bound up with the developments which have taken place in the sphere of modern abrasives is the manufacture of abrasive cloths and papers.

At one time sandpaper was a very unreliable material, consisting of sand grains of very unequal size glued down to a thick brown paper. In recent years, however, a demand for improved abrasive papers and cloths of many varying grades has arisen in consequence of the increased activities of the light engineering industries, the result being that these modern papers and cloths have now become highly efficient and specialised articles.

Synthetic Resins

In addition to special glues, various synthetic resins now form the bonding agents for cementing down the abrasive grains of these rubbing cloths and papers. Paper mills provide special grades of tough paper for this branch of the modern abrasive industry, whilst the cloths employed are specially woven, sized and pre-coated with materials to render their shrinkage impossible.

Perhaps, however, the most interesting development of abrasive cloth and paper manufacture is the modern mode of coating these materials. In order to secure absolute uniformity of distribution of the abrasive particles upon the surface of the paper or cloth, the glue-coated material is passed through an electric field produced by a current of between 40,000 and 50,000 volts. Through the same field, also, and about ¾in. below the glue-coated paper or cloth, is passed a conveyor belt carrying on its surface the grains of abrasive which are to be coated on the paper or cloth. Under the influence of the powerful electric field, the abrasive particles acquire an electric charge and fly upwards to the glued surface, to which they attach themselves in an absolute uniformity of distribution.

The "Whipping Machine"

Any excess of the abrasive grains which may be present upon the paper or cloth is subsequently removed by passing the coated material through a "whipping machine," which knocks off the surplus abrasive particles which have not become firmly embedded in the glue and returns them to the main feed of the coating machine.

Finally, the coated abrasive paper or cloth is passed on to a room in which it is hung up in festoons for the adhesive material to dry and harden, and afterwards, in special cases, an additional adhesive coating may be flowed over the abrasive surface in order to anchor the grains still more securely in position.

Such is one of the most recent of developments of the now world-wide abrasives industry, a development which, compared with the erstwhile simple peppering of dry sand on to a glued brown-paper surface, is almost as great a measure of progress as is represented by the superiority of the present-day synthetic abrasive over the age-old and tradition-haunted grinding wheel.

A Spot Welder for Use on A.C.

How to Adapt the Battery-operated Spot Welder, Described in the November Issue, for use on A.C. Mains Supply

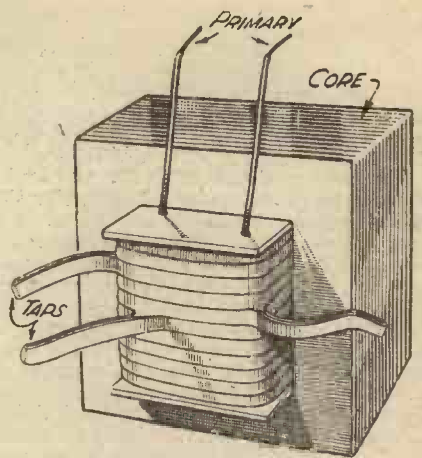


Fig. 1.—The finished transformer.

BRIEFLY, the differences between the battery-operated welder and the mains operated appliance are that the latter machine is operated from a transformer and the finger push switch dispensed with. A foot switch is used leaving both hands free to hold the work, etc.

Start the work by removing the contact switch and then drill another hole through the bottom arm so that the whole may be bolted down to the bench or a large wooden base.

The Transformer

The transformer is the heart of the machine and must be made with care. A 500-watt transformer can be operated from a light socket and is heavy enough for most work, but a 1,000 watt transformer requires a 5 amp. plug and this wattage is too great for the lighting wiring. If possible try to obtain a second-hand transformer with an open casing rated for your supply, and with an output of over 500 watts. On conversion it will be as efficient as a commercial 500-watt transformer, and the work of the conversion will be easy. The output required is a maximum of 100 to 200 amps. at 1, 1.5, 2, 3 and 5 volts. In watts this is 500 or 1,000 depending on the current required in the home shop. To carry over 100 amps. large cables are necessary, and as the resistance has to be kept very low we are using sections on the heavy side to allow for drops in voltage across joints, etc. On a core of this size, which must not be less than 3.5 sq. in., we can allow 5 turns per volt; thus, one needs a total of 25 complete turns with taps at the 5th, 7½th, 10th, and 15th turn respectively.

The length of strip of suitable section is obtained, and, if hard drawn, is annealed. The section must not be less than 0.7in. × 0.1in. It must be cleaned and then insulated from end to end with good quality tape. Do not try to economise by scraping off the tape from the section required for taps, but leave this until finished, and scrape off afterwards.

The Tappings

The taps are brought out as double lengths of wire to avoid soldering, etc., and they should be hammered flat so as to lie neatly together. The starting end is connected directly to the bottom bar as before, while the top bar has the flexible connector for use with the taps. In making a tap, bring out the wire for 6in., bend it over on itself, and take it back and continue winding to the next tap. Remove the insulation from the bent end, clean the copper and press together, and then run solder between the two to make a solid bar. Drill the bar and tap with a $\frac{1}{4}$in. fine thread, and fit with a cheese-headed screw.

When the transformer is mounted on the base, the taps also are screwed down to the wood by two small wood screws, countersunk and passing through the copper, one in front and one behind the tapped hole. The top surface of the copper is dead flat. A suitable washer must be used under the screw in order to make good contact. When different tappings are often required, the screws are fitted with an easily turning head. Do this by drilling a $^{3}/_{32}$in. hole diagonally through the head and then hammer a 2in. length of a $^{3}/_{32}$in. silver steel rod through it. The spade end of the connector is made to suit the taps. Arrange the five taps in a neat row behind the welder. Keep the leads as short as possible.

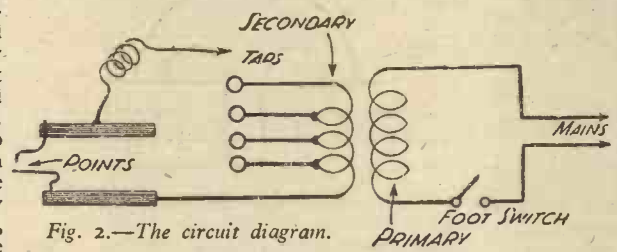


Fig. 2.—The circuit diagram.

The Primary and Secondary

If a second-hand transformer is used, do not dismantle it but thread the secondary through the spaces: this may sound tedious but remember you are dealing with only 25 turns. It is a matter of minutes with the core clamped in a vice. The reason for this is that we cannot reassemble the core and clamp it tightly as the maker does. Several that we have made are only about 25 per cent. efficient when tried out again. We have assumed that the primary was suitable for your supply. If not rewind to suit. This means 1,150 turns to take 5 amps.

As the transformer is short rated we can cut the wire size down a little to economise. Winding 1,150 turns on a fixed core when the wire is passed through and through is tedious work, but in this case you would have to dismantle the core and wind in the ordinary manner.

A 500-watt transformer of this type will cost from £7 10s. 0d. to make, and so we do not think it necessary to deal with the construction of a new instrument.

The Foot Switch

The foot switch will now be considered. Here we have the same idea as that used for closing the points. Mount both the Bowden Control to the points and the switch on the same base. The switch pedal is a piece of wood 3in. wide and 9in. long, and is hinged, at the end nearest the operator, to the base. The switch proper is a tumbler switch with a brass knob. It should be capable of carrying 5 amps. with a quick make and break. A cheap one will do quite well. This is mounted under the pedal and is connected to it through a short brass connecting rod. Make a saw cut at right angles to the pivot in the knob, open it out with a file until it will take a $\frac{1}{16}$in. pin through the knob. The connecting rod, which is a strip drilled with $\frac{1}{16}$in. holes at each end,

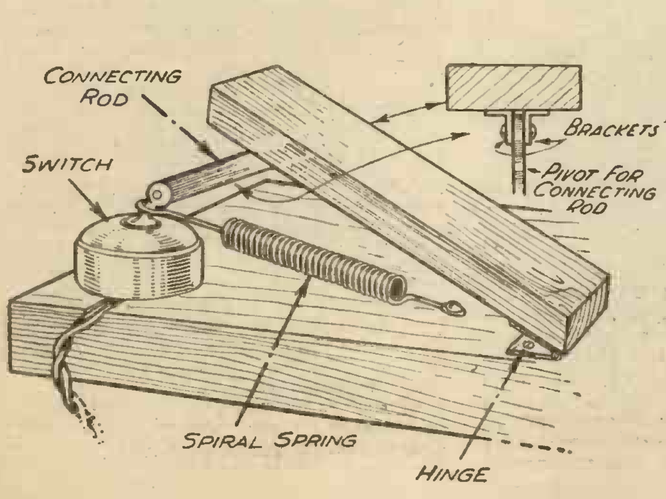


Fig. 3.—(Left) Details of the foot switch.

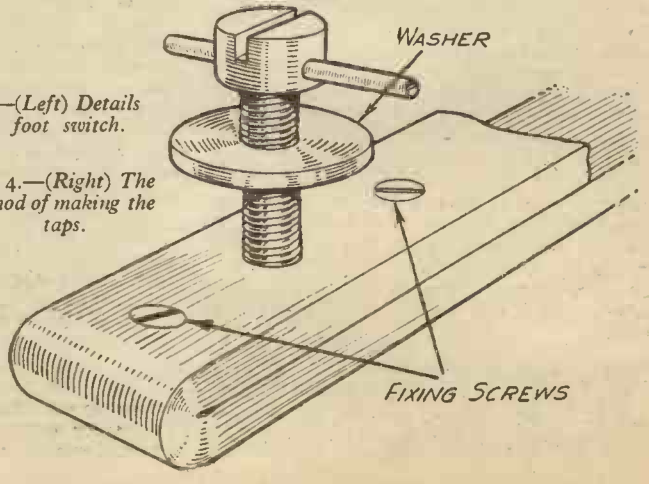


Fig. 4.—(Right) The method of making the taps.

is cut from sheet brass $\frac{1}{16}$in. thick. Put the switch in the off position, place the connecting rod in the knob and push the pin in, now work the switch by manipulating the knob.

Pedal Gear

The pedal must work the switch, and for this mount two small brackets on the under side of the wood, drill and put in the rod. The best position for the brackets and switch will be found by experiment, but it can be used with the bracket on the end of the wood and the switch about 2in. from the end, the rod being 3in. from centres. A strong spring is hooked round the knob and round a screw in the base so that the switch is always Off. It should take quite a good pressure to close the switch, and on removing the foot it should fly open. Fig. 3 shows the finished switch. With this means, it is possible to get very

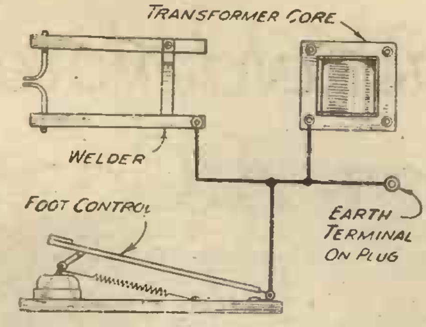


Fig. 5—The connections for earthing the welder and the foot pedal.

accurate time control and good work can be done. Twin flex from the switch is taken up with the Bowden wire to the welder base and there connected to a porcelain junction box. This gives a neat and workmanlike finish. Fig. 2 shows the circuit.

A Press Switch

A simple press switch can be made from pieces of brass similar to a bell push, but we do not recommend this because of the difficulty of protection, etc. The whole welder *must be* earthed, and so must the foot pedal, etc. (see Fig. 5).

Since the transformer is worked off the mains, and the little extra electricity used is not noticed, it is a good plan to arrange a small light just by the points. This should be a 6-volt car side lamp with switch on the base, and is run from the 5-volt tapping. Mount it on a small flexible arm, and cut a tin shade so that the light is exactly as required. It will dim a little when the 5-volt tap is used.

Wot! No Engineering?

The Marquis of Donegall Makes a Tour of the "Britain Can Make It" Exhibition With Mr. "Chad"

I HAD almost forgotten how to draw Mr. Chad when I ran into him at the "Britain Can Make It" Exhibition. And he said: "Wot! No Engineering?"

I replied: "My dear misguided Chad, all these things that transport toys round in circles, not to mention the chap whose little speech repeats itself through a loudspeaker every 45 seconds; or even the switching out of the lights just as you are getting interested, are far more important. Fancy all these engineering wonders in an old-established firm like the Victoria and Albert. They should both fair turn in their graves, they should!"

"Pshaw!" says Chad, rather rudely, I thought, "there is nothing here that Butlin doesn't make go round faster and better—and with more fun! Starts from scratch on the ground, he does. Engineering, my foot!"

However, I won't let Chad get away with this, so I grab the little wretch and take him on a compulsory tour. First we see the crashed Hurricane on the background of blitzed London. Strings leading from every part of it go to show what, from toys to plastic trays, can be made from its components.

"Isn't that Engineering for you?"

"Was," says Chad, "but it's had it!"

What can you do with a guy like that? However, I continued.

Plastic Drapings

We go through all the lovely plastic drapings festooning in wish-I-could-get-it pale dove grey. I try again and point out the engineering feat that made these plastics possible.

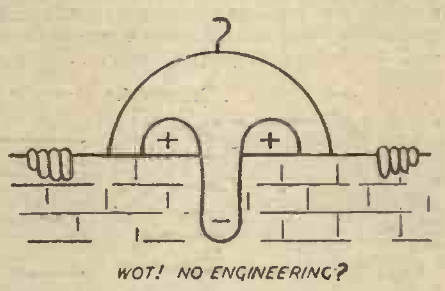
"Chemists," says Chad. "Atomic. Don't like 'em!"

The Hall of Fashion, with its giant revolving roundabout, embodies no new principles of Engineering. But it is nevertheless a major job very well executed and gives us a lazy view of these modernistic fashion dummies in their "creations"—and note particularly the nylon wigs.

Chad, however, is still looking over the wall (probably with one of the promised Government Inspectors) into Butlin's and is unimpressed.

By this time Chad is too much and I push him into the "Space Ship" with the remark that anyway *that* is Engineering. (Wot! Aren't we off to the moon?")

As a matter of fact, Chad is nearly right. You will not find an *Engineering* exhibit, as such, in the whole of the "Britain Can Make It" Exhibition. By that I mean that you will not find a Rolls-Royce Derwent 5 jet engine or even a Hillman Minx. I only mention that particular car because I happened to drive and service one 70,000 miles for the



Home Guard, and I consider it one of the finest things that Britain *does* make.

It so happens that we make very good lifts. In fact, we made the one with which a Shah was so impressed that he had one put up in his back garden. It didn't go anywhere except up its scaffolding; but it kept the harem quiet for years.

Machine Tools

Although few people seem to realise it, we are now making machine-tools on an increasing scale to compete with anybody. It is only due to British engineering that we are the only country that can stamp out a pair of spectacles in plastic to any prescription.

King George the Fifth wore a pair of British plastic spectacles for the last three years of his life. They were made by Combined Optical Industries (Slough), as far as I can remember.

I am not suggesting that the exhibition could house a full-scale N.F.S. pump and escape, recognised even by the New York Fire Service to be the finest in the world. Obviously, you could not have one of the new "Merchant Navy" locomotives, a De Havilland Dove or a Miles interchangeable Passenger and Freighter. This, incidentally, is so revolutionary in design that the mere sight of the thing gives the "willies" to antediluvian pilots like myself. (Wot! No proper tail!)

I do not know whether our Tube escalators are the best in the world. I could go on for ever with things that Britain can make, ending up with the *Queen Elizabeth*. People don't order a *Queen Elizabeth* every day, but the fact remains that the cruiser *Argentina* that I had the honour of inspecting off Greenwich recently was built at Barrow-in-Furness in 1939. I dare say half those 150 Argentine cadets who came here on their graduation cruise thought she was built in Buenos Aires, or, more likely, in Texas.

Reminders

You have to remind people of these things, just as you have to remind Americans that it was a Briton who invented the phonograph, the wireless, the marine chronometer, the bicycle, the pneumatic tyre, penicillin, and a few other useful little devices; not to mention that we have to take the blame for their misunderstanding of our Constitution which has resulted in their being stuck with that misunderstanding commonly known as the Constitution of the United States.

However, all that is by the way, and what I am really trying to say is that there could have been an *Engineering Section* in "Britain Can Make It" by the simple expedient of borrowing a few models that were shown at the Model Engineering Exhibition not so long ago. Possibly the Authorities were wise in that had they done so they would never have got the dense queue to circulate past it.

As Joad says, *ad nauseam*, it depends what you mean by *Engineering*. I can describe to you toasting-machines that throw the piece of toast at you (I had one in 1935), as also the standard lamp that wakes you up and starts the kettle (1938, and I still have the remains), portable gas heaters, standard-lamps cum bed-warmers, washing machines (Wot! No Bendix!), grand toys that are near-engineering jobs, radios (most disappointing in design), thermostatic beds, prams that convert into a cocktail cabinet or grand piano (I forget which!), lovely packaging, a futuristic bicycle that doesn't work and never could, watches that would make a Swiss wince and clocks to which he would give his approval.

There are alleged to be cameras and binoculars (I have a grand pair of Wraylite (×8) replacing my Zeiss stolen in Singapore, so I know we can make them), but as yet, on five tours of the Exhibition I have not been able to find them.

In fact, I am forced to agree with the Frenchman who, on first being confronted with a "Mild-and-Bitter," said: "C'est magnifique, mais ce n'est pas *Lager*."

Britain Can Make It is "magnifique" in lots of ways. But there is about as much Engineering as there was Lager in the Frenchman's Mild-and-Bitter.

Science Notes

By Prof. A. M. LOW

Trouble With the Law

I HAVE often photographed noise with a view to proving to a hard-hearted judge that Mr. Jones was suffering from noise nuisance. It is usually accepted that if the noise of which complaint is made is greater than that which might commonly be expected from such things as traffic, then the noise is a nuisance.

Now I had a case where a man complained of a perpetual singing due to a motor, so I went into court with a buzzer making the same sound, and asked the Judge how he would like to sit there all day with this half-heard sound in the air. In my view, things of that kind are very irritating.

You will remember the tale of the man at the hotel who was woken up by the resident above him throwing his boots into the corridor. He complained. The next night the offender threw out one boot, remembered his promise and carefully put the other down very gently. Three hours afterwards the man downstairs tapped on his door and said, wearily: "For heaven's sake throw out the other boot!"

The "ping" of a gnat is another trouble-some sound and no one knew how it is caused. So we took a glass chamber, greased the inside so that gnats could not buzz after one landing, and then took high-speed cinema photographs. The gnat produces much of its sound as it flies by rubbing together the inner portion of its wings. A pity we do not silence aircraft, for some are so noisy as to be a menace to health and comfort.

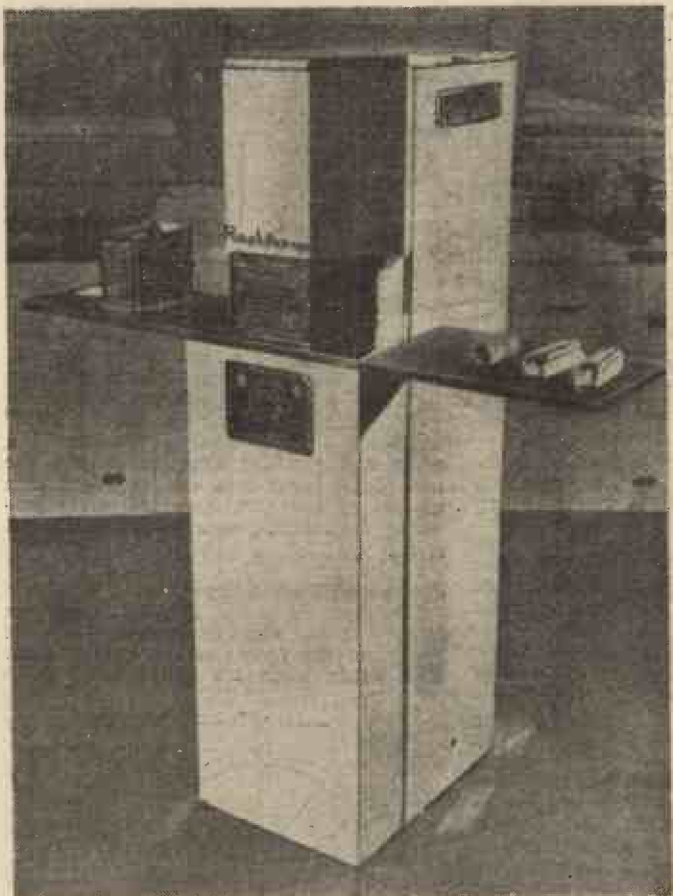
Pussy is not Crazy

I WONDER if you have read about cats and bats. Some people like cats best so let us put them first. Why do cats fall on their feet? It is true that they do, and a series of high-speed cinema pictures have shown the reason very clearly. Cats have been dropped from a suitable apparatus to make sure that they do not as it were kick themselves straight as they leave your hands should you try the experiment in that simple way. As a rule they put their front paws near their body, leaving their back feet extended. This increases the inertia of the rear part of the cat. Using this fact pussy twiddles the front half of his body right side up, then sticks out his front paws, draws his back feet close to his tummy and twiddles the back quickly against the increased inertia of his front extended paws.

It sounds very complicated but all these things are relative, and if in fact provision was not made to carry the twist of an air screw in a 'plane it would be quite as logical for the 'plane to revolve round the airscrew instead of vice versa. If you touch the accelerator of a car momentarily the car leans over sideways, and if it could do so it would gradually, having more inertia than the flywheel, begin to revolve round the engine. Cats seem to have learned all about this centuries ago, so I thought perhaps we ought to understand it as well.

Bats are not Batty

NOW about bats. I mean the winged mammal which startles everyone by flying round the belfry. For many years it has been known that the squeak of a bat was very quick. In short, it is pitched so high that only youthful ears can respond. But more wonderful is it that if bats are allowed to fly free in a pitch dark room across which innumerable wires have been stretched they will fly in and out of the wires without touching them at all. Is it that they see by infra-red light reflected from the bats? It is not. Careful tests with instruments far more delicate to higher pitches than our ears have found that the bat emits short bursts of squeaks with a frequency of about 50,000 per second. These supersonic sounds bounce off the wires, are picked up by the bats hearing apparatus, and the creature flies in safety exactly as if it was using radar with sound substituted for ether waves. The whole subject of these ultra-high-pitched sounds or supersonics is interesting, for they have been known to kill fish and to metamorphosise certain types of bacteria. It is not likely that they will be used one day as a death ray for although sound has great power, and can do great harm by battering our bodies, I think it more probable that the Walls of Jericho were pure allegory.



The Radarange, so called because it operates on the magnetron tube, the heart of radar, produces heat rays that penetrate the interior of food as fast as they do the exterior, and so cut cooking time to seconds. It will cook a six-pound beef rib roast in 2 minutes. The temperature is only about 220 degrees Fahrenheit. This model, suitable for restaurant or very large family, costs about 600 dollars. It is manufactured by the Raytheon Manufacturing Co., America.

Are You Right?

SO many things seem to me obvious and yet so much is a matter of opinion that I ought to be used by now to being wrong. Upon the few occasions in my life when I have been absolutely accurate knowing well that black was black and so on, it has given me enormous satisfaction. Once upon a time I went to see a stereoscopic cinematograph, and I was shown a report by a scientist of such international fame that I almost took off my hat before reading his words of wisdom.

When I read the first six lines I went back to the beginning and read them again. They stated that by taking a right and left picture of an object it was only necessary to show these alternately upon the screen when true stereoscopy would be obtained.

Being a cautious Scotsman I reserved judgment, but the conviction soon grew upon me that I was actually right. It is obviously true that real stereoscopy can only be obtained if the audience wears glasses and the method of showing alternative pictures only functions if the right picture is not allowed to be seen by the left as well as by the right eye.

Hence the coloured glasses which when used to look at pictures alternately dyed red and green on the film gave a stereoscopic effect which was positively astounding. Hardened old men ducked their heads as someone on the screen squirted a siphon of soda-water at the audience. There are now many methods for obtaining "shadow" stereoscopy by screens with curved surfaces or by the use of prismatic viewers, but none of them really achieves its object and glasses are still despised by every member of a well-conducted audience. It is, in short, like the printing of colour pictures at high speed, a very tricky problem.

To make it more impressive let me recount the other occasion when I was right. At least I think so! An annoyingly cocksure friend once explained at a lecture that the long-handled screwdriver was a farce. He pointed out that it was width of handle that mattered in gaining the necessary leverage. Try it for yourself. My theory is that with a very long screwdriver the blade can be tilted without jumping out of the slot, thus allowing the departure from vertical at the top of the handle to be appreciable. The screw is then pulled round, just as if one stuck the blade of a pen-knife into the screw slot to pull it round.

One can hardly deal with screws in summer-time without thinking of wasps. These creatures, appear to have stings like the blade of a stiletto. When you have been stung, you knock the wasp away with a howl of rage and the beast flies off seemingly none the worse for wear.

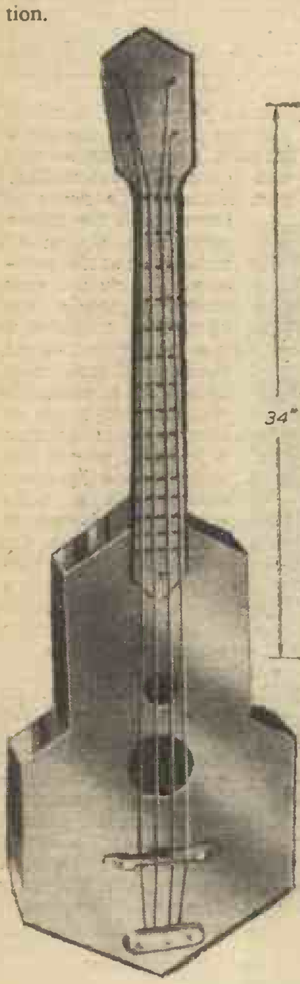
In the interests of science you should be prepared to suffer, so make the same experiment with a bee. The bee, like the dog in the poem, is the one that dies. The bee walks round and round your hand screwing out its sting which appears to be in the form of a corkscrew.

A Large Ukulele

Constructional Details of an Inexpensive but Efficient Instrument

By R. J. CHAMBERLAIN

THE reader wishing to construct a real "vamping" musical instrument, easily and cheaply, will find such a type illustrated herewith. It has been specially designed so that any amateur woodworker can make a success of its construction.



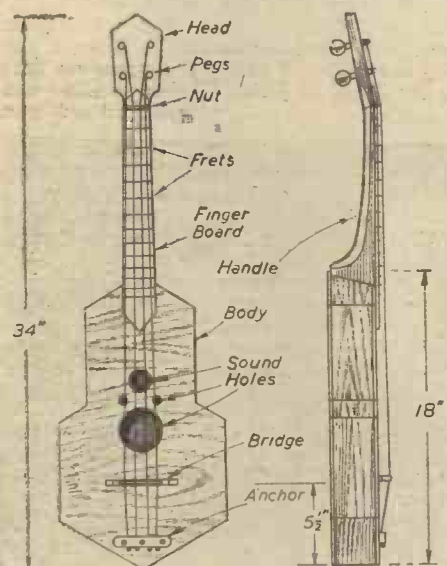


Fig. 1 (Above).—Front and side elevation showing the main parts. (Left) The finished instrument, after polishing.

It is the new shape which facilitates construction. There is no difficult bending of thin wood to form the sides. Only straight strips of wood are used, which require only to be mitred at the corners. Although the side strips are cut from ¼in. thick wood (the side strips on conventional-shaped ukuleles are often cut from veneer 1/16in. thick), this has very little effect on the resonance of the instrument.

The model constructed by the writer has excellent tone—in fact, its tonal qualities compete with those of a guitar. It is a pleasure to use the large ukulele. The many delightful, harmonious chords produced by ordinary-sized ukuleles are much amplified by the larger instrument.

One can, too, owing to the length of the steel strings, get a more sustained chord. For choir practice purposes, the big "uke" provides an accompaniment which is better than an organ. Vocalists are aided by the ukulele. It gives rhythm and harmony.

Being a ukulele, the chords are easier to play and memorise. A person does not need to know a note of music, because ukulele chords (vamps), as you may know, are indicated by small charts (above the treble stave on sheet music) which *show* the finger positions between the frets on the fingerboard. No "reading" of music is necessary, except in the case of new, unheard melodies.

The large ukulele should, therefore, be a "boon" to budding vocalists. If, on the other hand, a would-be performer cannot sing, he can at least learn to play the ukulele and provide a masterful accompaniment to a group of singers or a vocalist. And as most of us can hum and whistle tunes a good ukulele accompaniment is only necessary to help the "performformance" along in a professional manner.

Incidentally, it is possible to play *melodies* on a ukulele, but as the tuning is unsuitable for melody playing, the task is rather a difficult one. Still, it can be done, with practice. One of the easiest melodies that can be played is "In the Mood." By "holding" a vamp and plucking alternate strings, the first phrase (eight bars) can be played with touches of harmony, a second vamp providing the second phrase of the music, and so on.

Front and Back Shapes

The elevation in Fig. 1 gives a good idea of the size and shape of the instrument. It also gives the names of the various parts. The writer made his model from scrap plywood and deal. The pegs, however, require to be made from hardwood ; soft deal is useless. Alternatively, it should be possible to purchase a set of four pegs, such as, for example, violin pegs.

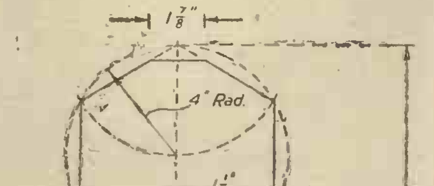


Fig. 2.—How to mark out the front and back piece.

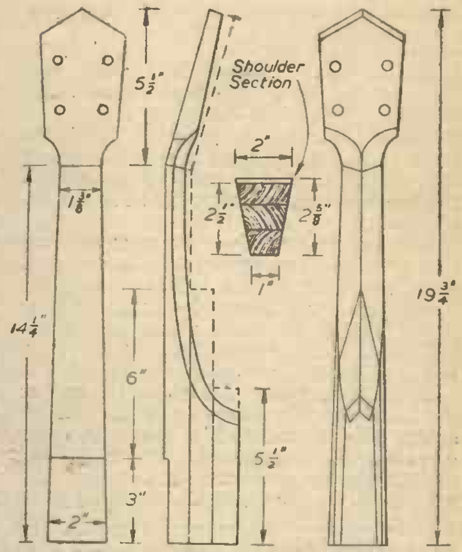


Fig. 3.—Constructional details of the handle and head.

The front and back of the instrument body should be cut from ⅛in. plywood. In the writer's case, a cheap "backing" plywood (alder) removed from an old cabinet was employed. It was somewhat rough and knotty in places, but after glasspapering smooth, with all crevices filled with plastic wood, it took an excellent polish, including the deal handle, head and body sides.

The shape of the body front and back is all compass work, as shown in Fig. 2. It is largely a matter of ruling a line, ticking off the length (18in.) and then setting the compasses to scribe a 6in. radius. Without adjusting the compases, two further radii lines are scribed (see dotted lines), these lines giving the "corners" of the shape where they pass through the 12in. circle.

The top half of the shape is found by setting the compasses to scribe an 8in. circle. Having obtained the shape of the front piece, scribe the sound holes, then cut the wood to shape with a fretsaw. The shape can be cut with a fine panel saw, if the fretsaw is not available, the sound holes being made with suitable centre-bits which, by the way, should be used at both sides of the wood to make clean-cut holes. The back shape is identical to the front piece, excepting that it is pointed at the top and not made flat like the front. The back, of course, is minus sound holes. The front piece, when cut, can be used as a template for marking out the back shape.

Handle and Head Construction

The most difficult part about the construction of the ukulele, perhaps, is the handle and head. The latter has to be dowelled at an angle to the handle, following which the handle has to be built up to thickness.

The best way to go about the job is to prepare the handle and head shape from ⅞in. deal. The head (see Fig. 5) is not shaped up until it has been dowelled to the neck end of the handle. Have three ⅛in. dowel stumps in the joint, as shown in the section. Use a hot liquid glue, such as boiled Scotch glue. A reliable cold liquid glue, such as "Certofix" or other brand, may be used. It is imperative that the joint is neat, true and strong. This will be ensured by having the dowel hole positions truly scribed and marked.

While the joint is setting, build the handle to thickness at the shoulder end. This is done by rub-jointing on a 9in. and 5½in.

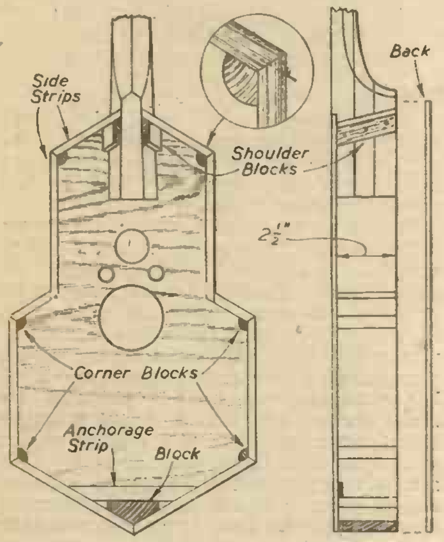


Fig. 4.—How the side strips are mitred around the front piece prior to adding the back part.

length of ⅞in. wood (see dotted lines in Fig. 3). When the glue has set, the handle and its thickening pieces are roughly cut with a knife, and planed to an angle, this being seen in the shoulder section.

When bevelled, mark out the side shape in pencil, cut away the waste by paring, then bevel the underside of the work in the manner indicated, using a penknife, rasp and spokeshave. Note that the underside of the head is cut to taper to about ⅜in. thick at the tip.

The Peg Holes

The four peg holes are bored with a ¼in. bit, then "reamed" via the underside with a tapering round file of suitable diameter. This is to make a "tapered" hole so that the pegs will obtain the maximum grip. After tapering, it is advisable to countersink the "rims" of the holes a trifle at each side, using a rosehead countersink bit or a "poke" of glasspaper.

Fixing the Front

Before the body front can be attached to the surface of the handle at the shoulder end, a ⅛in. deep recess must be cut here so that the front will lie flush. The recess is 3ins. in length.

Both the front and back body shapes should be cut from the plywood so that the grain runs across and not along the length. In other words, the grain runs crosswise with the length. This is advised in case the plywood is bendy in the centre.

A straight central pencil line should be ruled along the surface of the handle, and the body front piece. The latter is attached to its recess with glue and panel pins. Look along the length of both parts with the eye to ensure that the straight lines are in alignment, or else test with a straight-edged piece of wood, or by applying a stretched string. This test is very essential; if the parts are not in true alignment, the strings will not be properly stretched over the finger board.

Adding the Side Pieces

A piece of deal 4ft. by 2½in. by ¼in. will now be required. This provides sufficient material for making the body sides. In case of difficulty, a length of 3½in. wide by ⅜in. thick tongue-and-grooved board (sheeting) could be bought, free from cracks and knots as much as possible. The wood is cut to width, gauged to ¼in. thick, then reduced by planing; it can be done easily enough with a smoothing plane, this allowing for any slight curvature in the wood.

Beginning at the bottom end, cut, mitre and attach two 6in.-long strips. A mitre block, cutting a 60-degree mitre, would be handy. However, by having the strips cut squarely to size, the ends can be pared to the approximate degree of angle with a sharp wood chisel, then "trued" by trimming with a metal block plane.

The strips are glued and pinned to the interior side of the front. The work should lie on a flat surface. Continue to add the pieces until the shoulder end is reached. Here, owing to the bevel in the handle shape, care will be needed.

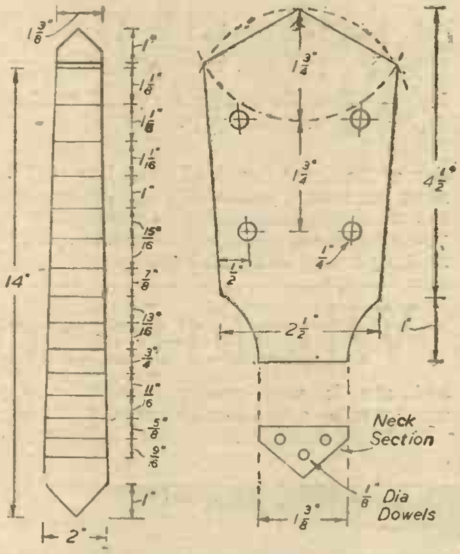


Fig. 5.—The finger board, with details of head.

To ensure true fitting, place the back shape temporarily on the work. Rule a guide line from its top end to the end of front. Attach corner blocks, keeping them 5/16in. inwards to allow for the thickness of the side pieces (see constructional side view at Fig. 4). When all the sides have been attached, glue in corner blocks, as shown. When the glue sets, trim the wood and attach the back, but not before an anchorage strip is adhered to

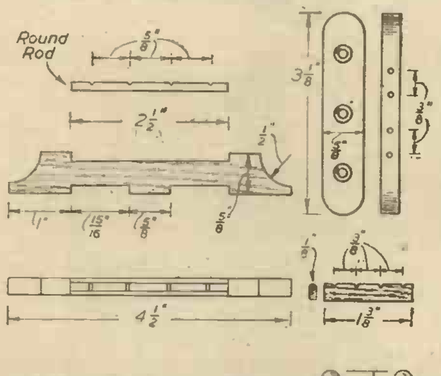


Fig. 6.—The bridge, anchor, and details of nut and pegs.

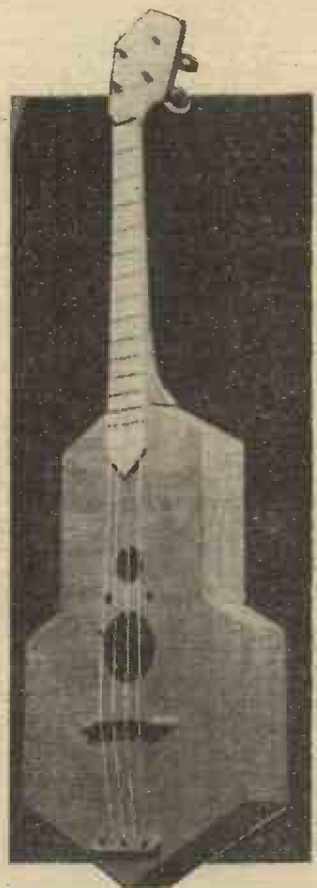
the inside of the front at the bottom, this strip being about ¼in. thick.

The Finger Board

The finger board is cut from 3/16in. birch plywood or plain wood, same measuring 15in. by 2in. Mark off the top "nut" piece, then the fret positions, using a small set square for the latter. It is then cut to the shape shown.

Glue the finger board on the handle so the nut end is level with the neck joint. If the wood has a tendency to rise, bind it on with tape. Nails should not be used.

While the glue is drying, the body could be cleaned up. All nail heads are sunk with a punch and filled with plastic wood. Edges are trimmed, then the whole thing rubbed



The instrument before polishing.

smooth with M2 and No. 1½ grades of glasspaper.

Nut and Frets

The nut is a piece of bone or celluloid buckle measuring 1⅜in. by ⅛in. by ¼in. It is rounded at the top edge, then filed to make four string nicks (see Fig. 6). The prepared nut is attached behind the finger board with glue and its backing piece (see Fig. 7).

The frets are strips of black celluloid about 1/16in. thick by 3/16in. wide. These strips are embedded in saw-cuts ⅛in. deep. The saw-cuts are best made with a small "Eclipse" hacksaw. However, to ensure neatness, the guide lines should be scored with a penknife, then "pared" slightly at an angle to make a groove for the hacksaw blade.

When fret positions are cut, tap in the fret material. Thin sheet brass could be used for frets, of course. The frets are—or should be—a force fit. When fitted, level them off with fine glasspaper held in a flat piece of wood. The frets should sit up 1/16in. The strings should "clear" them by 1/16in.

Anchor, Bridge and Pegs

Instead of having the strings anchored to the bridge which, as a result, is a permanent fixture and cannot be adjusted along the "belly" of the instrument, the strings are attached to an anchor glued and screwed down.

The anchor is made from a strip of hardwood 3¼in. by ⅜in. by ¼in., as shown at Fig. 6. It is bored for three fixing screws and four 1/16in. holes made through the edges for the strings.

While three roundhead screws may be used, it is better to use countersunk roundheaded screws. The position for the anchor is shown at Fig. 1. It must be central with the body.

The pegs are cut from ⅜in. hardwood, then shaped, as shown. The string holes should be ¼in. from the top.

The bridge is cut to shape from ¼in.-thick hardwood, as shown. A 2¼in. piece of ⅛in. diam. brass rod fits into the top recess tightly. The rod is filed to make string nicks ⅜in. apart.

Finishing Off

To finish off the woodwork, apply (with a soft brush) a thin coat of light walnut french polish to all parts of the work and allow to dry, following which the wood is rubbed down with a fine grade of glasspaper. Brush on a second coat, allow to dry, and add a third application.

This applies to all the work with the exception of the finger board. The surface of this must be several shades lighter. Following the third application, rub it down with a "four" grade of glasspaper, then finish off by rubbing a very thin polish on.

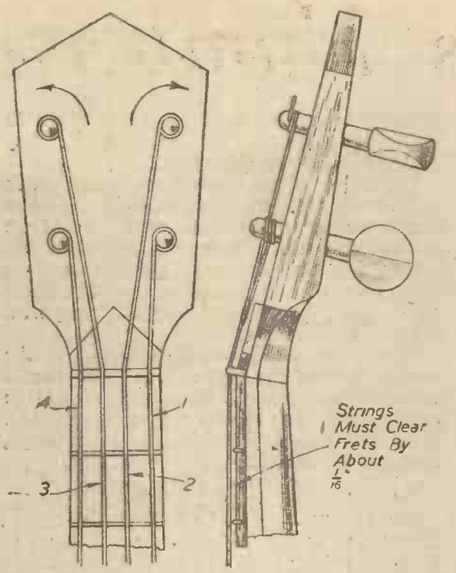


Fig. 7.—How the strings are fitted to their respective pegs.

The rubber is a piece of soft linen wrapped around a pad of cotton wool. Make the pad a conical shape so that it can reach all corners. You will find that polishing is much easier when the polish is thin.

The body should be a nice warm walnut colour. The grain in the wood will show through attractively. The bridge, pegs and anchor should be given a single application of the polish, or two coats, if necessary.

Tuning

You will require a half-set of guitar (steel) strings, i.e., the 1st, 2nd, 3rd and 4th string, the last two being covered. Have the strings attached to their respective pegs in the manner indicated at Fig. 7.

The strings are tuned similar to the tuning of an ordinary ukulele, i.e., A, D, F-sharp, and B on a piano. But, the tuning is an octave lower. Further, the *4th string* must be tuned an *octave* lower than written. A book highly recommended is The First Community Uke Book, this containing 120 songs, with complete melody line, words and ukulele accompaniment. It is published by Keith Prowse and Co., Ltd. It must be stated, however, that the above tuning applies to every number throughout the book. This means an extraordinary variety of different chords, some of which, due to the increased distance between frets in your home-made ukulele, may be hard to finger properly. The majority of chords can be played easily enough.

Modern Whale-factory Ship

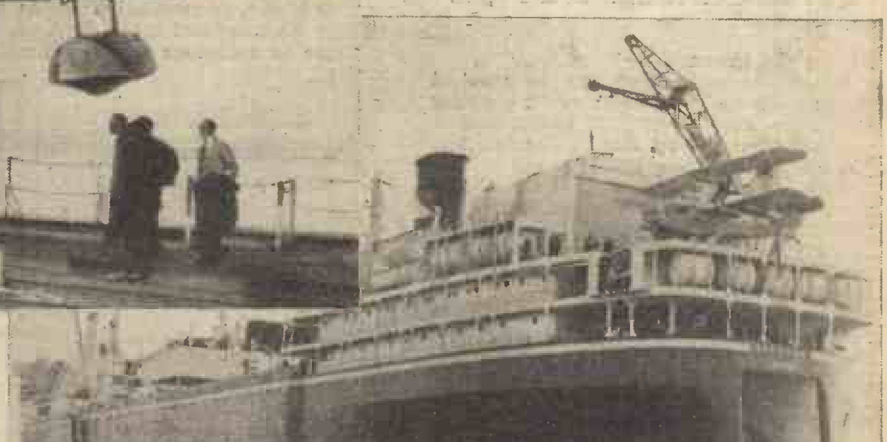
THE United Whaler's 15,000 ton factory ship *Balaena*, the first ship of its kind to be fitted with aircraft for whale-spotting and weather reconnaissance, underwent her trials in Belfast Lough recently. The ship carries three amphibian Walrus aircraft which will be piloted by former members of the Fleet Air Arm. The machines are housed in a hangar constructed at the after end of the boat deck. They are launched by a double-acting catapult, working on a cordite charge; this catapult was previously installed in H.M.S. *Pegasus*, the Fleet Air Arm training ship. The *Balaena* will act as mother ship for a fleet of about 10 whale catchers, and she is well equipped to carry out maintenance and damage repairs during the whaling season, which starts on December 4th.


One of the Walrus spotting 'planes on board the "Balaena," showing the catapult apparatus.

Factory Equipment

Her factory, for dealing with the whale meat, contains one of the largest oil-producing plants ever installed in a ship, and also elaborate plant for dealing with by-products. Refrigerating machinery will freeze the choicest parts of whale meat for human consumption. The majority of the crew are Norwegian, and the womenfolk of a number of them are coming to Belfast from Great Britain to make the return journey in the ship. She will call first at a Norwegian port and then at Buenos Aires on her way to the Antarctic.

(A close-up view of the centre deck of the "Balaena" is given on the front cover.)


The "Balaena" undergoing her trials in Belfast Lough recently. One of the Walrus 'planes can be seen on board.

Napier's Numbering Rods

Some Modern Improvements

By CHARLES H. KAY, A.M.I.Mech.E.

THE numbering rods, since known as "Napier's bones," were invented by John Napier of Merchiston in 1617. They have been fully described in the recent articles on "The Calculating Machine," by F. W. Cousins.

These rods were much used for facilitating the multiplication of numbers, and naturally inspired many slight improvements in construction to render easier reading and setting. There is, however, a slight mental effort required in adding the numbers along the diagonals from rod to rod.

Genaille's Rods

This repeated effort was eliminated by M. Genaille, who in 1885 invented a system of rods which added the adjacent figures together and gave a direct result. This operation of carrying the tens to the next rod was performed by triangular pointers. By commencing at the top right hand corner of the section required for multiplication, and noting the figures at each apex or pointer, the result can be read without any further mental effort. The triangular pointers not only added the adjacent figures together, but by allocating numbers up to nine to one triangle, and those above to another, the tens obtained by the addition of the diagonals are carried forward also. Genaille's rods are shown in Fig. 1.

The rods described are entirely for use in multiplication, and although there is a method of using "Napier's bones" for division, it is very indirect, and involves much trouble searching for the nearest dividend, and subtracting, when the rods are set to the required divisor.

There appears to be a scarcity of attempts to modify this type of calculator to give direct results for division.

New System of Rods

The writer has developed a system of rods which will not only give a direct reading, but will automatically carry on the division to as many places of decimals as required.

The rods are shown in Fig. 2, and are prepared for use with divisors up to nine.

They can be made, however, for numbers above this, but get unduly long when used in this way for higher numbers, as the sectors have to be capable of dealing with any number up to one less than the divisor as remainder. The use of the rods can be extended for divisors above nine, by resolving them into factors, and dividing one after the other.

Example: To divide 421,344 by 504

Using factors 9 x 8 x 7 = 504

$$\frac{421,344}{9} = 46,816$$

$$\frac{46,816}{8} = 5,852$$

$$\frac{5,852}{7} = 836$$

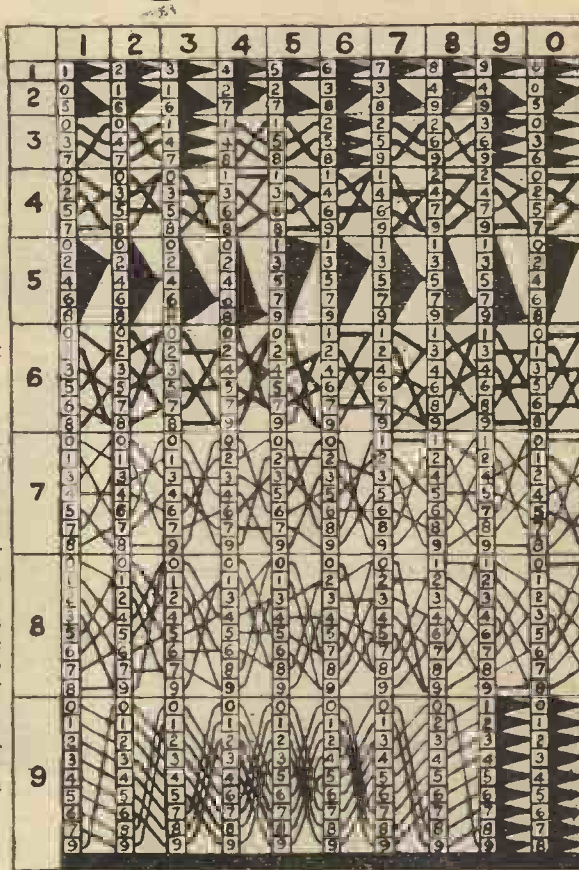


Fig. 2.—A system of rods for giving a direct reading.

To get the full benefit of division to many decimal places a number of rods under the heading 0 should be prepared. These should be placed to the right, after the number to be divided. By using more than sufficient 0 rods, it can be seen when the last of the decimal figures has been completed, as the lines finally lead to 0 and continue to do so if carried through to the next rods. Division can thus be carried on to as many as twenty places of decimals without mental effort, or further adjustment.

For Money Calculations

The writer has also prepared rods on this system for money calculations. They have to be specially made for shillings and pence, in order to carry forward the pounds remainder in shillings, and the shillings remainder in pence.

A section of these special rods is shown in Fig. 3, which is set for the example below.

Example: If the cost is £76 8s. 9d. for a dozen, what is the price each?

Commencing at the top, left-hand corner with 0, and passing through and following the line, leads to 6. Again passing through, and following the line to the shillings rod, leads to 7. Following the same process on to the pence rod is 4, and thence to the apex of the triangular pointer is ¾.

The answer is, therefore, £6 7s. 4¾d.

The rods thus described give a completion to the system started by John Napier, and enable tedious calculations to be performed merely by placing one rod alongside another and reading the result direct.

The writer wishes to acknowledge his indebtedness to the Science Museum, South Kensington, where he was shown many examples of this type of calculator, and which enabled him to apply, on these lines, the application direct for division.

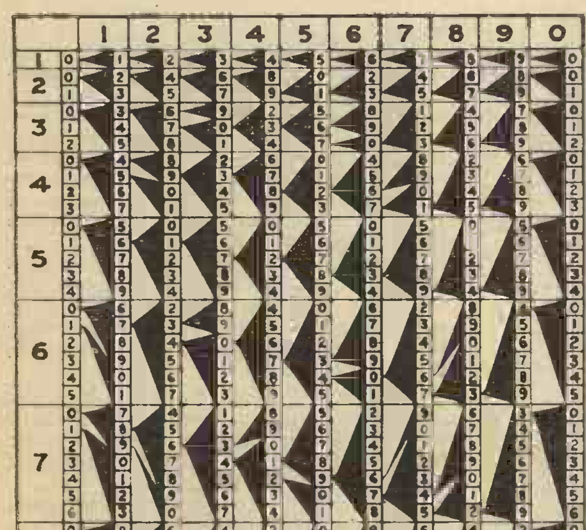
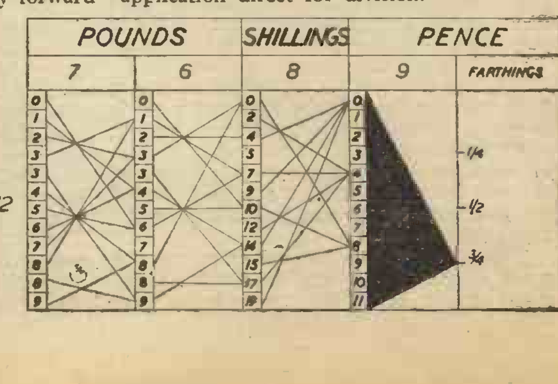


Fig. 1 (Left).—Diagram illustrating Genaille's rods.

Fig. 3 (Right).—A section of special rods for money calculations.



Inventions of Interest

Light Under Water

THE worker under water needs some method of illuminating the submerged region. This is particularly the case in under-water electric arc-welding and cutting operations.

An inventor who has devoted his attention to this subject remarks that it has been found that an ordinary electric inspection lamp in a watertight case has only a feeble penetrating power. And, in turbid water such as is produced by welding or cutting operations, this affords little assistance to the person using it, partly owing to the glare.

The inventor has conceived an improved illuminating device. This is a mercury vapour lamp mounted in an opaque water-tight case provided with a window through which a beam of light from the lamp can be directed on to the object to be illuminated.

Preferably, the beam of light is also passed through an optical condenser in line with the lamp and the window. As a consequence, the beam is concentrated and less liable to create glare by diffusion.

The condenser may be placed between the lamp and the window. Or it may be secured externally adjacent to the window.

An adjustable bracket arm may be provided. This can be affixed to the case at one end and furnished at the other end with means for attaching the arm to an object. Such means may consist of a magnetisable base, or a permanent magnet, so as to enable the device to be easily fixed to any position desired on ironwork below the surface of the water, for example, on the hull of a ship.

When a magnetisable base is employed, it may be energised from the same source as that which supplies current to the mercury vapour lamp.

If British scientists' ideas for an atomic-powered "space ship" are fulfilled, trips to the moon in from two to five days come easily within the range of possibility. Glasgow-born industrialist, Mr. Warnett Kennedy, has designed a five-foot model of a possible space ship, as shown in the illustration, and this model is now on view at the "Britain Can Make It" exhibition at the Victoria and Albert Museum, London.

To Prevent Car Dipping

AN inventor has devised a method for resisting dipping movements of road vehicles, particularly those having independently sprung wheel suspensions. He points out that it is well known that, when the front wheel brakes are applied on a vehicle and especially if violently applied, there result an overturning force acting forward at the centre of gravity of the vehicle. Such force is equal to the sum of braking forces at road level.

This force tends to lower the front of the vehicle and raise the rearward portion, producing the objectionable action known as dipping.

The new device uses the reacting forces of the front brakes to resist the dipping of the forward part of the vehicle.

The brake back-plate of each front wheel is mounted in such a manner that it will turn about the axis of the wheel axle. And a longitudinal and rearward extending arm is anchored at one end to the sprung part of the vehicle, and at the other end is connected to the brake back-plate in such a way that this plate is prevented from turning in a vertical plane in relation to the arm.

When the brakes are applied, the reacting force on the front brake back-plates tends to rotate them forwardly, that is to say, in the same direction as the wheels. Consequently, the forward arms tend to be raised to press up the front of the vehicle. And this tendency can be arranged to balance out the inclination to dip.

The lift from the forward arms may be made so as to overbalance the dipping effect. As a result, when the front brakes are applied, the front of the vehicle will rise.

Supplies by Parachute

IN modern warfare supplies occasionally have to be delivered from aircraft by means of parachutes. And difficulty is experienced in locating the position of the packages. This is particularly the case at night.

To assist the finding of these packages it appears to be a general practice to apply lights to them. But if they fall in long grass or growing corn, for example, these lights are not easily visible.

The object of a new invention is the provision of an attachment to the packages which will ensure that, upon reaching the earth, a light or pennant or both are disposed in an elevated position, so as to be visible above ordinary vegetation.

The inventor provides a position-marking device for application to parachutes or the like comprising a tripod or a similar arrangement, having its legs hinged and foldable side by side to a closed position. When in the closed position the tripod is detachably carried by a carrier attached to the package, and also attached to the same by means of a flexible lead. There are spring means for biasing the legs of the tripod to the open position and a retarding device on the tripod. The latter is adapted to separate from the carrier when the package is dropped. Thereupon the tripod opens and the retarding device becomes effective to keep it clear of the parachute. On reaching the earth, attached to the package by the lead, one of the legs of the tripod will adopt an upright position visible from a distance.

Supple Soles

AN inventor has been devoting his attention to footwear, and he is the originator of an improvement in the soles of shoes. He points out that, owing to reasons of economy and the dictates of fashion or other causes, there has sprung up a demand for the use in the manufacture of soles of materials which do not possess the flexibility of leather and rubber.

The demand exists especially in connection with footwear designed for sport and leisure. As a consequence, the soles of sandals, beach shoes and slippers are being made of wood, wood composition or cork board.

The principal object of the new invention is to provide soles made of stiff or hard material which are so constructed as to be flexible and supple, and, consequently, to contribute to ease in walking.

Further objects are soles which are comfortably light and also furnished with means integral therewith for the securing of straps, ribbons, laces, or other means for fastening them to the foot of the wearer or for the purpose of ornamentation.

Inflexibility is imparted to the new sole by a series of slots passing entirely through the thickness of the sole and extending transversely from opposite edges across a major part of its width.

In the manufacture of soles by this method there may be employed rigid materials such as moulded plastics, hard rubber, some kinds of glass, pasteboard, vulcanized fibre, ply wood, plain wood and cork.

Transformer Building—2

The Design and Construction of Small Static Transformers

By A. H. AVERY, A.M.I.E.E.

(*Concluded from page 63, November issue.*)

MENTION should be made in passing of special cores, again more useful in radio work, which are composed not of sheets or stampings, but of nickel-iron alloy in powder form. This metallic powder is mixed with a suitable binding material after being carefully graded for size and granular formation, and then is pressed into the desired shape and heat treated. The avoidance of the magnetic joints, and the adaptability of this construction to difficult shapes of core, is, of course, a valuable feature, but it is not a process that lends itself to amateur facilities.

Overlapping Stampings

Magnetic joints in a transformer core must be arranged so as to reduce air-gaps to a negligible amount. This is met by assembling the stampings in such a way that the joints of one layer are overlapped by the unbroken surface of the next layer. Fig. 14 illustrates this method. Here the succeeding odd and even layers are seen assembled with their joints alternately right and left, so as to avoid any serious interference with the passage of the magnetic lines. Another point to be noted in core building is that all bolting-up studs passing through the stampings for clamping purposes must be lightly insulated to prevent contacting with the edges of the stampings, otherwise they will short-circuit them and defeat the object of lamination.

Obviously, the least expensive type of core is the one that can be built up from plain strips without the need for special tools. These can be built up after the manner of Fig. 6, and a range of standard cores of standard dimensions arrived at that will cover the requirements of most experimenters. Each core will consist of two long and two short sides, all stampings being of the same width, sufficient being used to pile up to a depth equal to their width. The result is a core the limbs of which have a square cross-section when clamped up, which has the advantage that coils of circular section, wound in the lathe, can be employed, leaving small air spaces at the sides for ventilation (Fig. 16). The table of sizes (Table 1) will be found very useful for those who have limited experience in working out their own designs, the output capacity of each sized core being also stated for all ordinary commercial frequencies, between 25 and 100 cycles.

Output Obtainable

It will be noticed that the output obtainable from any core size in Table 1 is determined by the frequency of the circuit to which it is connected, that is the speed of the magnetic flux reversals. In this, a resemblance to the behaviour and output capacity obtainable from generators and motors will be traced; their outputs also largely depend upon speed, although in their case it is in the form of rotation of the armature instead of oscillation of the flux. Another thing to note is that although the weights and sizes of core specified are found to give satisfactory performances from extended use and trial over a number of years, it does not follow that they are the only possible dimensions from which these performances are obtainable. Larger and heavier iron cores with smaller copper coils could quite well be used to attain the same outputs and *vice versa*. But in general, there is a relationship to be found between the proportions of iron and copper which give best all-round results, and which entail the least expense in construction.

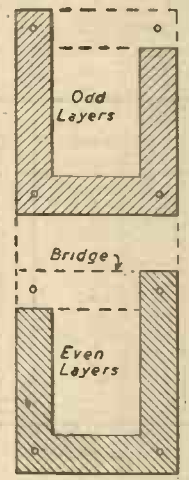
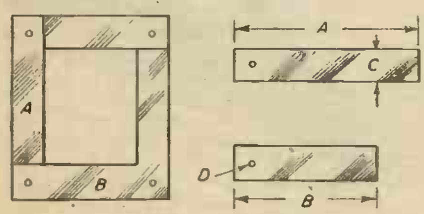


Fig. 14. Showing method of overlapping stampings.

When working at a definite flux density in the iron core of a transformer, the number of turns required in either the primary or secondary coil will depend on the cross-sectional area of the iron, and on the frequency of the circuit. If a stalloy core has a sectional area of one sq. in., for instance, and is working at a frequency of fifty cycles with an economical flux density, eight turns per volt would be required in either primary or secondary coils. If the core had a sectional area of two sq. in., there would be twice as many flux lines as before threading the coils and, therefore, only four turns per volt would be necessary. If the frequency were doubled to one hundred cycles, only one half the turns required for fifty cycles are wanted; if reduced to twenty-five cycles, twice as many turns would be needed. These facts are included in Table II, the factor "Turns per Volt" will be found given for each of the core sizes appearing in Table I for all commercial frequencies between 25 and 100 cycles per second, and can be applied direct to all calculations of voltage for either primary or secondary windings.

Core No.	Inches				Section in sq. in.	Weight lb.	Watts Output Continuous Rating			Core Depth in in.
	A	B	C	D			25 cycles	50 cycles	100 cycles	
1	4	2¼	1	7/32	1	3½	35	70	140	1
2	4¼	2⅝	1¼	9/32	1½	6	60	120	240	1¼
3	4½	3	1½	9/32	2¼	9¼	90	180	360	1½
4	5¼	3¾	1¾	11/32	3	15½	150	300	600	1¾
5	6	3¾	2	13/32	4	22	220	440	880	2

Table 1. Particulars of transformer cores.



(Left) Diagram showing forms of stampings.

Transformer Coil Calculations

Fifty cycles per second is almost universal for public services of A.C. supply nowadays, but the other frequencies mentioned were in constant use formerly, and are still sometimes met with. These two tables—I and II—enable the core dimensions and the turns per coil to be quickly arrived at in order to suit any specified output. For example, if it is desired to select a suitable size of core for a transformer to develop 50 volts 6 amperes on the secondary output, when supplied with an input of 230 volts 50 cycles, and to ascertain how many turns of wire there must be in each of the coils, turn first to Table I. Find the loading in watts by multiplying together the secondary volts and amperes; this is 50×6—300 watts. At fifty cycles frequency, Table I shows that core No. 4 is suitable for this rating. Next refer to Table II, and this at once gives the turns per volt as 2.6. The primary coil turns must, therefore, contain $230 \times 2.6 = 598$ turns, while the secondary will require $50 \times 2.6 = 130$ turns.

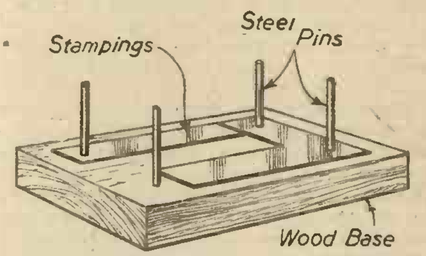


Fig. 15. Simple jig for assembling stampings.

Gauges of Coil Windings

The next step is to decide upon suitable gauges of wire for the two coils, and Table II must be consulted after first ascertaining the approximate value of current in each coil. The secondary current is, of course, already known by the specification as 6 amperes, and to find the primary current the loading in watts is divided by the primary volts, namely 300 watts $\div 230 = 1.3$ amperes approximately. As a matter of fact, the input current will be slightly greater than this, to allow for the inevitable copper and iron losses, and a 10 per cent. increase will safely cover the requirements in this range of small sizes, so that the figure of 1.3 becomes $1.3 + 0.13$—that is, 1.43 amperes for the primary current. Reference to Table III now indicates suitable

Core No.	Turns per Volt for Various Frequencies						
	25 cycles	33 cycles	40 cycles	50 cycles	60 cycles	83 cycles	100 cycles
1	16	12	10	8	6.7	4.8	4
2	10.2	7.7	6.4	5.1	4.2	3.1	2.6
3	7	5.3	4.4	3.5	2.9	2.1	1.8
4	5.2	3.9	3.3	2.6	2.2	1.6	1.3
5	4	3	2.5	2	1.7	1.2	1

Table II. Transformer coil specifications.

gauges of wire for each of these current values, namely No. 20 for the primary and No. 15 for the secondary.

The complete specification can now be stated as follows :

Rating.—Input : 230 volts, 50 cycles single phase. Output : 50 volts, 6 amperes, continuous rating.

Iron Core.—No. 4, Table I. Stalloy strips.

Secondary Coil.—130 turns of No. 15 S.W.G. d.c.c. copper.

Primary Coil.—598 turns of No. 20 S.W.G. d.c.c. copper.

If great accuracy is required in the voltage ratios a few additional turns should be allowed for on the secondary coil to compensate for drop of volts due to internal resistance when full load current is passing.

Workshop Hints

In conclusion, a few workshop hints may be useful as regards handling the various stages in general assembly. The first step consists in building up three sides of the iron core, leaving the fourth side open for the time being, so that the coils can be mounted in position before putting in the bridgepiece. The long studs used for bolting up the corners are fixed in an upright position at appropriate centre distances in a wood base, and the stampings threaded on them in layers, the joints coming alternately right and left, as in Fig. 15. When the stampings have been piled up to the required depth, allowing for compression, the nuts on the studs are tightened up and the partly-built U-shaped core set aside while the coils are prepared.

Except for the very smallest coils, it is best to use cotton covered wire, as enamel coverings are so easily damaged by inexpert handling, and the slightest defect in the covering may lead to internal short circuits and a general burn-out. One circular "former" does for winding both the secondary and the primary coils. This is a fairly easy job in the lathe, the former being shaped as in Fig. 17, the body and one flange being in one piece, the opposite flange being loose, and the whole held together by a long bolt through the centre. Note the shallow grooves running along the body, corresponding with saw-cuts made readily in each flange. This enables fine string to be threaded through the coil and tied securely in four places before removing the coil from its former, thus, preventing it from collapsing and losing its shape. Remember to wind the secondary on first, following this by the primary, placing at least two layers of 10-mil leatheroid sheet between them as insulation. Keep the turns even and closely wound; any turns that slip down at the ends in contact with the lower layers will have a tendency to break down owing to the increasing difference of potential which exists between layers as the coils build up.

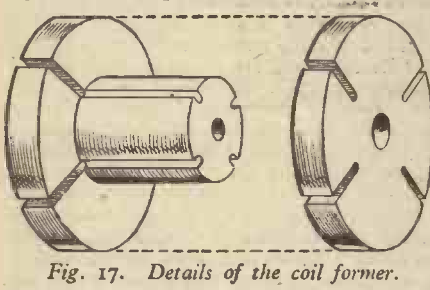


Fig. 17. Details of the coil former.

Counting Turns of Wire

The most important detail is to keep an accurate count of the turns and the best way to avoid mistakes is to use a "Veeder" counter attached to the lathe head, which will indicate the exact number of revolutions made. When both coils have been wound, tie them securely with fine twine, remove the loose flange and slide them carefully off the former body. A little french chalk applied to the latter before starting facilitates this. The coils must be thoroughly dried in an oven to expel any moisture, and while still hot immersed bodily in a tin of suitable insulating varnish. Shellac is not advised, being often acid, and special insulating varnishes, such as "Ohmaline," are preferable. After all air bubbles have ceased to rise, lift the coil out and let it drain well, then return it to the oven and bake out for several hours at about 180 or 200 deg. F. It is important that this is done before the coil is put to work, as "wet" varnish is a frequent cause of breakdown. Remember when drying out that the varnish gives off a highly inflammable vapour and guard against naked lights near it.

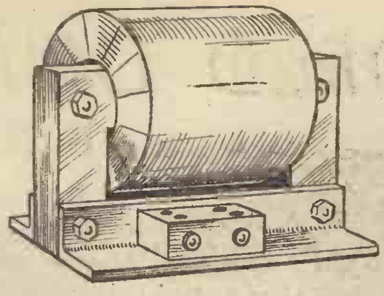


Fig. 16. Stampings and coil assembled, showing air spaces at the sides.

The final treatment consists of wrapping the coil radially with cotton tape, half-lapped, and brushing the surface over with one or two coats of air-drying, oil-proof varnish, such as Pakyderm. "Dry" coils (that is, unvarnished) will never stand up long without trouble, but the above doping process is well repaid in making a permanent job.

Finishing and Mounting

The finished coil after taping is then ready to assemble over one of the long limbs of the iron core, which should be first wrapped with two complete turns of 10-mil leatheroid. Finally, the bridge piece can be put in and the stampings clamped up by the studs and nuts, tapping them into line, if necessary, with a light wood mallet until flush on all sides and well squared up. Do not forget to insulate the corner studs by wrapping one turn of leatheroid round them as they are pushed through the holes.

S.W.G.	Diameter in Inches	Safe current in amperes	Ohms per lb.	Yards per lb.	Turns per linear inch		
					Enamel covering	Single cotton	Double cotton
14	.080	7.54	.082	16.7	—	11.3	10.6
15	.072	6.10	.140	21.2	—	12.6	11.9
16	.064	4.82	.202	24.8	—	14.0	13.1
17	.056	3.69	.420	35.1	17.1	15.8	14.7
18	.048	2.71	.639	45.0	19.8	18.5	17.2
19	.040	1.88	1.32	68.8	23.7	21.7	20.0
20	.036	1.52	2.01	80.0	26.1	23.8	21.7
21	.032	1.20	3.23	107.4	29.4	26.3	23.8
22	.028	0.92	5.52	129.4	33.3	29.4	26.3
23	.024	0.67	10.22	191.0	38.8	33.3	29.4
24	.022	0.57	14.48	215.3	42.1	35.4	31.2
25	.020	0.47	21.19	275.2	46.0	38.5	33.3
26	.018	0.381	32.21	340.0	50.6	41.7	35.7
27	.0164	0.316	46.55	410.0	55.9	44.6	37.9
28	.0148	0.258	70.12	503.0	61.4	48.1	40.2

Table III. Winding tables for small transformers.

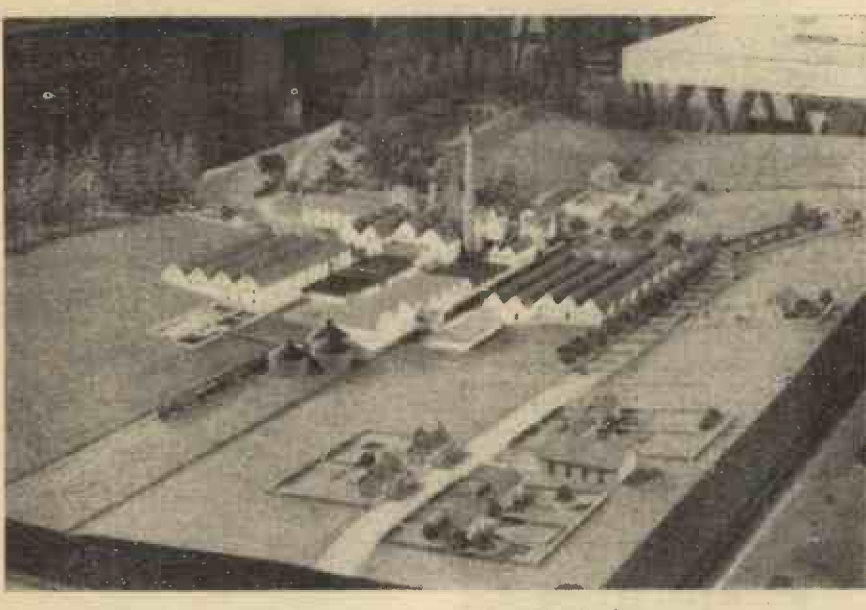
For mounting the finished transformer, angle iron strips can be attached to the bottom of the core to form a foot, as in the accompanying drawing of the finished job (Fig. 16). The two-way standard moulded terminal blocks make a satisfactory means of attaching the coil ends, and at the same time providing means for connection to the outer circuit.

Switchboard at Wembley Stadium

This huge switchboard, like the control panel of a large power station, is the link between the selling machines and the delicate machines which count the bets on every dog and combination. These finely-adjusted instruments, which act as the nerve centre of the totalisator, record every bet, whatever the amount, and translate them into terms of two-shilling units.

An operator at the switchboard.

THE WORLD OF MODELS



A scale model of a Scotch malt whisky distillery.

Seasonal Notes from "Motilus," including Details of a Model Marine Engine Thought to be the Smallest in the World

SCOTCH whisky is a "commodity" which requires scarcely any introduction to the peoples of the civilised world to-day. So with Christmas looming so near (a Christmas, let us hope, not too devoid of good spirits in every sense of the word!) we start off with a picture of a typical Scotch malt whisky distillery modelled to the scale of 20ft. to 1in.

The principal Scotch whisky, Highland malt whisky, is produced in a wide area of Scotland lying north of an imaginary line drawn through Dundee on the east and Greenock on the west, and this model shows the typical Highland setting of a modern distillery. Distilling in the Highlands was originally carried on as a subsidiary to farming, but demand has increased until the production of whisky has superseded agricultural pursuits, and the barley grown is practically all used to make Scotland's world-famous spirit.

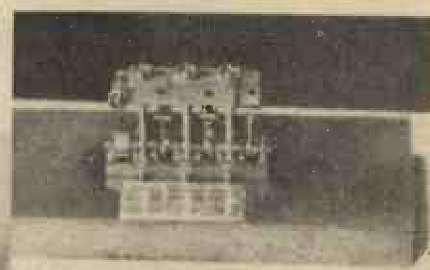
The process of whisky distilling, which goes back many centuries, and usually originated from a small still at the back of a farm, is plainly depicted in the model. The farm buildings still remain at the rear of the picture, while the modern distillery has grown up in front and is operated by a self-contained community. The model shows workers' cottages, exciseman's house, and the community possesses its own social hall. In the background can be seen a small lake, which which the water is drawn for cooling purposes.

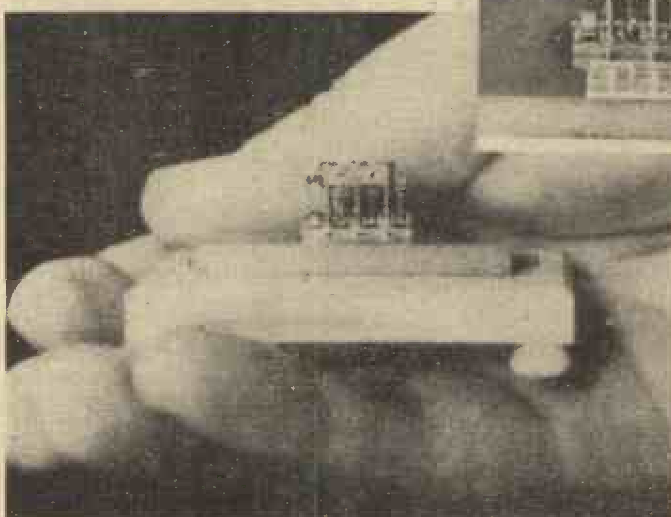
This model has been built by Bassett-Lowke, Ltd., for the Scotch Whisky Distillers' Association, and at the present time they are also engaged on a much larger detailed model showing the whole process of distilling. A model like this to a very large scale was shown at the Wembley Exhibition of 1926, and this new model in progress should be of interest to connoisseurs of both "Scotch" and the gentle art of modelling.

A Tiny Model Marine Engine

A reader from East Africa has sent me photographs of a vertical marine engine, which he believes to be the smallest working model in the world. Built by a Scotsman in Kenya, Mr. W. J. Ewing, it was seven months in construction, working on an average of three hours per day.

The description and overall dimensions are as follows: three cylinder double-acting, fitted with piston valves and Stephenson's link motion and screw reversing gear. The crank shaft is built up of 13 pieces with balance weights. There are eight bronze main bearings with mild steel bearing caps, and the connecting rods have marine type knuckle joints at the crosshead ends. The bedplate is machined from solid mild steel.





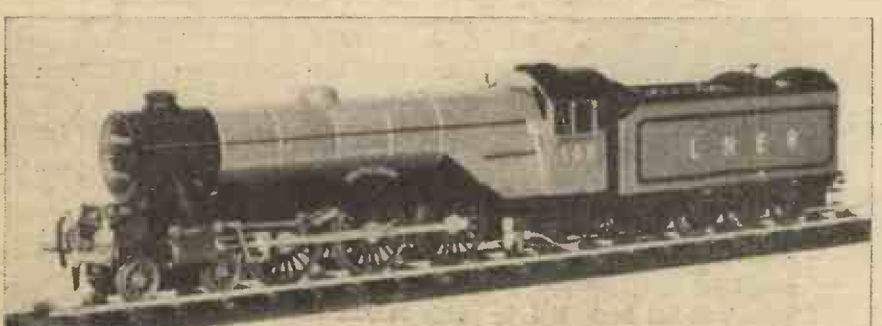
Two views of a tiny model marine engine, built by Mr. W. J. Ewing, in Kenya. The illustration on the left shows the model full size.

The cylinder bore is 3/64in. and piston stroke 1/16in. Steam passages are 0.008in. diameter. All bolts are 0.008in. diameter—not screwed, but a friction fit. The only part with a screwed thread is the reversing gear spindle, which is 0.015in. diameter.

The trunk guides are silver steel and continued up into the cylinder block, and act as liners. The cylinder block is made from bronze, also pistons and crossheads. The overall size of the engine is: length ⅝in., height 7/16in. and width ¼in., and it contains nearly 200 parts.

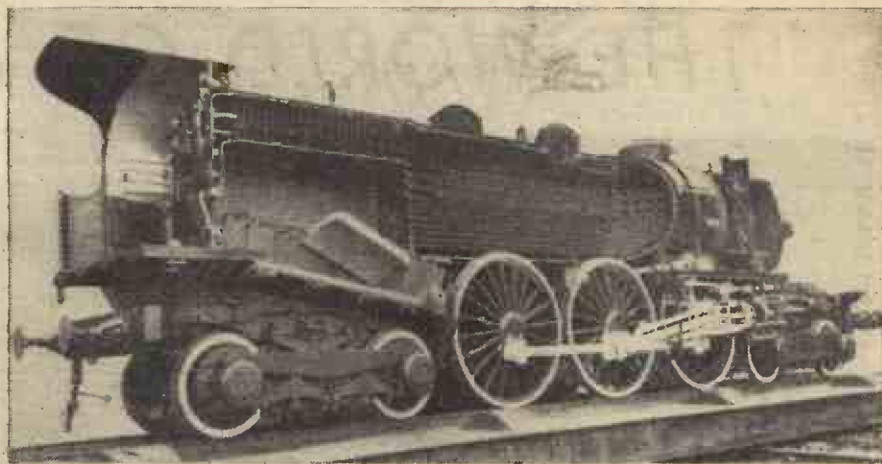
The engine works from compressed air obtained from a rubber bulb similar to those used on a scent spray. It will run from dead slow to high speed, and is reversible.

Mr. Ewing has now started to build a



A 2½in. gauge scale model "Flying Scotsman," made by Mr. A. Hale, of West Kensington.

railway locomotive to the same scale, and will use the boiler part as a compressed air cylinder. Some of the parts already finished are a pleasure to see, especially the bogie wheels, which are made from mild steel and only a little larger than a pin head, having spokes which can only be seen through a watchmaker's glass. Although Mr. Ewing has never been a watchmaker, he uses a watchmaker's lathe for making all the parts. These facts and photographs were sent to me by Mr. A. J. Haris, of Nairobi, and I shall look forward to hearing from this gentleman again.



Full-size sectional Baltic type 4-6-4 locomotive of the Nord railway of France.

Full-sized Sectional Locomotive

Several readers have from time to time asked if it would be possible to publish a picture showing the interior of a modern French locomotive. Fortunately I have been able to obtain a photograph of the Baltic type 4-6-4 locomotive of the Nord Railway of France. This locomotive was specially produced in section for the Paris Exhibition of 1937, and was very much admired by all who visited the exhibition.

The making of a model locomotive in section in this country is not very often done, but this full-sized sectional model might be an incentive to those who like to try fresh ventures in model construction. Models of this description are especially useful for museums and technical institutions.

I am indebted to the Société National des Chemins de Fer Francais of Paris for permission to reproduce this interesting illustration.

Mr. A. Daffern, Long Lane, Dalton, Huddersfield, a heavy engineering draughtsman employed by David Brown & Sons (Huddersfield), Ltd., with his home-made half-inch to one foot scale model of an R.A.F. air-sea rescue launch. C. J. Fitzpatrick & Co., Ltd., one of the companies within the David Brown group, made vee drive propulsion units for this type of craft and for M.T.B.s during the war (one of which is shown on the right of the launch), and Mr. Daffern's model is complete in every engine-room detail. It is 40in. long and has a beam of 8in. and does 3½ knots.

2½in. Gauge Model Locomotive

This 2½in. gauge ½in. scale "Flying Scotsman" was made up from the Bassett-Lowke set of parts issued before the war, which soon we hope will be back "in toto" on the market again. Mr. A. Hale, of West Kensington, the maker, says it took him about eight months to build. He started about two years ago, and made the main frames, tender frames and sides, but at the time he had no lathe, so could not do much more. Again, when he did obtain one, he was held up for finished parts, which were only available recently. He had no trouble in making the locomotive, working in the evenings and at week-ends. Mr. Hale wrote to me because he had previously heard that so-called "standard" castings did not work very well. "I have not found this so," he writes; "the model runs very well, especially considering that the cylinder ports are only drilled the size stated on the drawing, not milled slots, owing to the lack of a milling machine. This is only the second loco I have made."

Bassett-Lowke's London Shop

There has been a considerable change in the familiar appearance of that centre of models and model engineering—the Bassett-Lowke shop in High Holborn. The tremendous increase in the field of model work, which now embraces model aircraft and motor-cars, petrol and compressed ignition engines—in addition to model railways and ships—has created the need for an increase in demonstration and display room. To the original shop has been added a second showroom, in which are now displayed all kinds of equipment and sets of parts for the aeromodeller and accessories for the follower of the newest and most exciting hobby—petrol-driven model cars. Full use is to be made of the increased space to show demonstration layouts in gauge "o" and gauge "oo" model railways, and the long-awaited development in scale "oo" gauge model railway equipment will be shown to full advantage.

The double-fronted window display enables the visitor to see an attractive display of finished models of railways, ships, engines, aircraft, and a wide range of parts for the builder—these last are now reappearing in ever-increasing quantities. The showroom staff has been increased with specialists in the new developments of the hobby, and it now only remains for the supply of goods to gradually increase until models, like most other things, are no longer "in short supply."

The "Mariner" Inboard Motor

Details of a Compact Engine for Small Cruising Yachts

THE answer to the yachtsman's plea for a small, compact power unit which can be tucked away in the stern of a small yacht, or underneath the cockpit, has been developed by the British Motor Boat Manufacturing Co., Ltd., of Ampton Street, London, W.C.1, from their 4 h.p. "Mariner" inboard motor.

This motor, which gave sterling wartime service, is now being marketed in two designs; a standard model for normal fixing which is started from behind, and a special model with the power head reversed so that the engine can be started and all maintenance work carried out with the engine located right in the stern of the craft.

Since the complete engine, including fuel tank, measures only 14ins. high, 14ins. wide and 11ins. long, and weighs only 52lb., the value of this special model will be readily appreciated by owners of small cruising yachts on which space is severely limited. In its standard form, the "Mariner" is particularly suitable for installation in launches and dinghies.

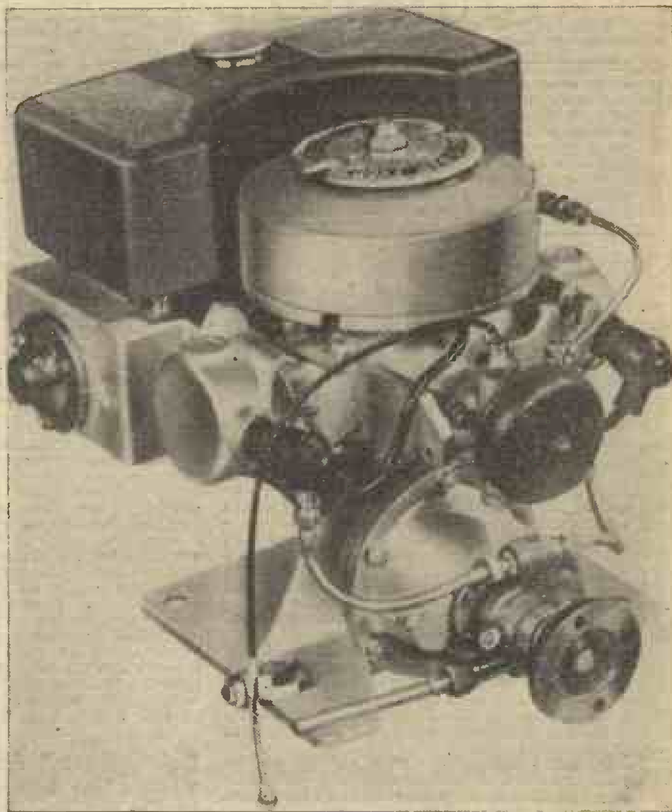
Horizontally Opposed Cylinders

Compactness has been achieved by designing the engine on the lines of an outboard motor, with horizontally opposed cylinders, a vertical crankshaft, and a flywheel magneto to which is attached a rope sheave starting pulley. The cylinders are cast in close grained nickel iron, and the pistons are of aluminium alloy and the connecting rods of phosphor bronze. All the shafts are made of stainless steel with ball bearings and phosphor bronze bushes. The entire unit is, in fact, a remarkable combination of lightness and durability.

The "Mariner" develops 4 h.p. at 3,000 r.p.m., and there is a reduction of 2 to 1 in the bevel drive to the intermediate shaft. Cooling is by means of a gear-type water pump, and the silencer is efficiently water-cooled. The engine is lubricated on the petrol system, and it has a tank capacity of 5½ pints. It is supplied ready mounted on a bedplate with water inlet and outlet skin fittings and pipes, so that installation is simply a question of bolting to the engine bearers and connecting up. The shaft is at right angles to the crankshaft and the engine can be installed to give a through drive up to an angle of 10 degrees, a flexible coupling being used if greater angles are necessary.

Equipment

The equipment which can be supplied with the "Mariner" includes a 10in. reversing propeller which provides neutral and reverse controls, a 5ft. length of ¾in. bronze shaft with trunnion operating gear, 1ft. of bronze stern tube, a bronze stuffing box, an outboard bearing, an auxiliary silencer, and 5ft. of copper exhaust pipe with all necessary fittings.



The "Mariner" inboard motor for small launches and yachts.

Letters from Readers

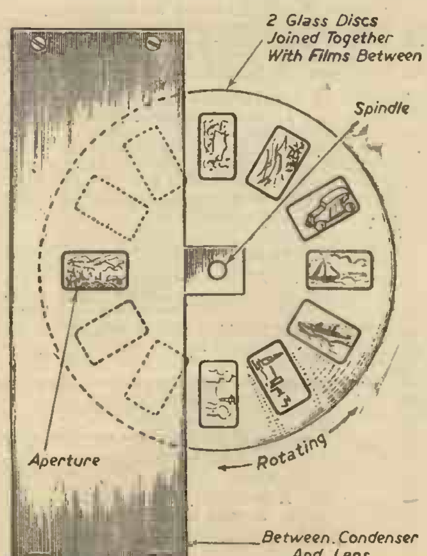
Film Strip Projection

SIR,—I was very much interested in the article on film strip projection published in the September issue of your journal, but I find that it is impossible to show a picture for even five minutes without damaging the film. The heat absorbing glass, as mentioned, is unobtainable, and so I have devised this gadget (see sketch), which I think may eliminate the trouble and so prolong the exposure without buckling the film.

The glass discs which prevent the film buckling are about 5in. diameter with a ¼in. hole drilled through the centre of both, and to lessen the risk of the glass breaking it should be annealed. The film strip is cut up into separate pictures, and so placed between the two glasses that when the disc is turned each picture comes into alignment with the aperture, which is the same size as the picture. The metal spindle helps to conduct some of the heat away from the glass. The rotating disc can be turned quickly backward or forward to the desired picture, and they would hold as many as 10-20 pictures each. The spindle should be so made that the disc can be quickly taken off and another one replaced. Canada balsam can be used for mounting the films between the glass plates.—WM. DE'ATH (Bristol).

Neglected Inventors

SIR,—I was extremely interested in your editorial in the October issue of PRACTICAL MECHANICS, especially in your comment that "Only a few firms take the trouble to watch Patent Office specifications for inventions in their own fields."



A rotatable holder for film strips.

I would like to put before you a very recent experience of mine, in this connection. There may, of course, be a good reason, but I am puzzled to know what, as I understand that once a patent is filed it is quite secure; added to which my request was without any reason other than learning of a new invention of great business interest to me.

I wrote the British Patent Office about two months ago requesting a copy of a certain specification, in the belief that on payment of a fee this would be provided.

The reply I received from the Patent Office was as follows:

The Patent Office,
25, Southampton Buildings,
London, W.C.2.
September 19th, 1946.

Sir,

"With reference to your letter of the 14th inst. I am directed by the Comptroller to inform you that British patent application No. . . . . is not open to Public inspection under Section 91 (4) of the Patents and Designs Acts, 1907-1939, and the desired photographic copy cannot therefore be supplied."

Perhaps this is explained in your previous paragraph that the machinery of the Patent Office is too slow and too costly, and further explains the lack of interest of commercial firms towards new inventions.—"ENQUIRER" (Belfast).

QUERIES and ENQUIRIES

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

French Polishing

WOULD you please tell me how to make "French polish," and method of using same? Also, can you suggest one or two books on the subject?—G. F. Aldworth (Poole).

FRENCH polish is merely a solution of shellac in methylated spirit. Success in its use depends on the skill with which it is applied rather than on the exact composition of the polish. A full description of the method of french polishing would be very lengthy, but essentially the polish is applied sparingly and in successive stages by means of a "rubber" or a flat pad of fine cloth which is damped with the polish, and by means of which the polish is gradually worked into the surface of the wood. In this way, a film of the polish is gradually built up on the surface of the woodwork so that when the final coat is applied it is able to take upon itself the perfectly smooth, homogeneous and glossy appearance which is characteristic of it. French polishing is a specific trade in itself, and skill in this art can only come after long practice.

A modern book on the finishing of woodwork of all kinds is:—H. T. Davy: Wood Finishing.

This was published in 1940 at 12s. 6d. nett. Other practical descriptions of french polishing are contained in practical books on cabinet-making.

We would advise you to write to Messrs. W. & G. Foyle, Ltd., Charing Cross Road, London, W.C.2, asking them to quote any books which they may have available on this subject.

French polish and other shellac polishes can be obtained from Messrs. J. Beard & Co., Ltd., Manufacturing Chemists, Great Ancoats Street, Manchester.

Manganese Resinate

COULD you answer the following two queries:

(a) What is "resinate of manganese"?

(b) In past issues I have noted that a 10 per cent. solution of formalin insolubilises glue. Can you tell me if the formalin causes a chemical change in the composition of the glue? Is there any other agent which has the same effect on glue?—Edward Polson (Edinburgh).

(a) Certain resin acids derived as by-products from the paper-pulp and other industries can be combined with metallic salts and oxides to form corresponding metallic complexes or "resinates." "Manganese resinate" which you mention is one such product. There are also copper, zinc, tin and other metallic resinates. Most of these, we believe, can be obtained, price about 3s. per lb., from Messrs. A. Boake, Roberts & Co., Ltd., Carpenters Road, Stratford, London, E.15, this firm being actual manufacturers.

(b) Formalin has the most powerful insolubilising action on glue and gelatine. Partial insolubilisation takes place after treatment of the glue with common alum, chrome alum or sodium tungstate. The mechanism of the gelatine or glue insolubilisation is not as yet completely understood. Certainly a chemical change takes place whereby the constituent "units" or atom-groups of the gelatine molecule are entirely re-arranged in a manner which renders the product immiscible with water, but exactly how this change is effected is not yet clear.

"Crackle Enamel"

COULD you please tell me where I can obtain an enamel or varnish which will give on metal a black or brown dull crystalline surface? I believe that this type of surface coating is known as "crackle enamel" finish, and is used for covers on photographic apparatus, trickle chargers, H.T. eliminators, etc.—L. Booth (London, S.E.).

"CRACKLE enamel" is not sold commercially. Indeed, there is, as yet, no enamel which can be painted on to a surface and then merely left to dry with the required wrinkled finish. The crackle effect is obtained by making-up a special varnish or enamel containing a substance destructive of the paint film, such as aluminium stearate. Immediately after painting (spraying) the articles are heated at 110-115 deg. F. until the wrinkles are formed. Baking is then continued at 300 deg. F. for three hours to harden the film.

Most firms maintain the exact technique more or less secret, but there is no doubt that, by experiment, you could get the results which you seek. Make trials with an ordinary black enamel, preferably of the cellulose type. Incorporate with it about 7½ per cent. of aluminium stearate. This material is as yet hard to obtain, but we believe that it is now being manufactured by Messrs. A. Boake, Roberts & Co., Ltd., Carpenters Road, Stratford, London, E.15.

Linseed Oil Emulsion; Electrically driven Stirrer

WOULD you please supply me with information on the following points:

(1) How can I obtain an homogeneous mixture of linseed oil and water in proportions 4:96 respectively? A suitable emulsifying agent seems to be indicated.

(2) I require to make an efficient mechanical stirrer (electric motor). Assuming the container to be about the size of a bucket and the liquid to be slightly more viscous than water, what horsepower would I require? Would a sewing-machine motor suit?—D. Hall (Stoke-on-Trent).

(1) Water and linseed oil are immiscible. Hence, in order to obtain a mixture of the two you will have to resort to emulsification. It is just possible that you might get a suitable emulsion by shaking up 4 parts of raw linseed oil with 96 parts of soapy water in which 1 per cent. of glue or gelatine has been dissolved. But if this scheme does not work, you will have to resort to one of the well-known emulsifying agents, one of the best of which is triethanolamine. In this case, the following formula should be followed:

Raw Linseed oil	56 c.c.s.
Oleic acid	6.5 c.c.s.
Triethanolamine	1.5 c.c.s.
Water	50 c.c.s.

Mix the triethanolamine, the oleic acid and one-half of the oil. Then add water slowly with rapid stirring until a thick cream results. Finally, add the remainder of the oil and then the remainder of the water. The result will be a creamy emulsion which will be quite stable. It can then be diluted with water to any required proportions.

We must point out that linseed oil slowly absorbs oxygen from the air, thereby becoming thicker and more viscous. This oxygen-absorption will proceed still more rapidly in the oil's emulsified condition. Hence linseed oil emulsions cannot be expected to remain effective for very long.

(2) Using a fairly light agitator, a sewing-machine motor would be quite suitable for the mechanical stirrer which you mention. For constant use, however, it would be better to use a more powerful motor, say one of ¼ h.p. Such motors can be obtained from Small Electric Motors, Ltd., Beckenham, Kent.

"Anti-freeze" Solution

I HAVE been informed that calcium chloride has anti-freezing properties of high potent value. Can you please tell me the correct quantity to be mixed with water, per gallon, to prevent freezing in radiator of motor-car?

Can you also tell me how long the mixture remains potent, and if it has any deleterious effect on metals?—J. Knott (Monaghan).

THE usual "anti-freeze" strength of a calcium chloride solution is about 5lb. of calcium chloride dissolved in 1 gallon of water. Its potency remains almost indefinitely, but the solution is open to the objection that it tends to attack metal.

A better anti-freeze solution can be made by dissolving 15 parts of glycerine in 85 parts of water. To this about 5 parts of calcium chloride can be added and dissolved without appreciably affecting the metal.

Staining and Polishing a Floor

I AM shortly taking over a new house with a large living-room, the floor of which is boarded with red deal, very close jointed.

As floor covering cannot be obtained for the surrounds I would be glad of your advice regarding an easily applied polish or stain.

The surrounds would not get much wear.—E. W. Fryer (Ormskirk).

YOU do not mention the colour you wish your floor to be. This is a very important factor. However, we presume that you wish the floorboards to have a dark and enduring colour, in which case the best and simplest method is to apply liberally to them a mixture of equal volumes of white spirit and boiled linseed oil. If you wish to have the boards dark, mix a proportion of Drop Black pigment with the liquid. Let the boards dry out well after treatment with this mixture. Then polish with beeswax.

This treatment will give a perfect floor like polished oak and it will wear for 20 years without requiring any further staining, provided that it is polished regularly.

An alternative method is to treat the floorboards with a liberal application of hot creosote. This will be absorbed readily and will act as a most efficient preservative against dry rot and wood-boring beetles. The surface of the floor can then be "built up" by the former linseed oil treatment, previous to its final polishing.

There is no possible doubt that a first treatment with hot creosote is most effective and preservative, and this is the treatment which we ourselves would give. Yet it is objected to by many on account of the strong, penetrating smell which lingers often for months.

Another alternative is to purchase a ready-made floor stain-varnish and to apply this in one or two coats. This sort of treatment is not particularly preservative, and the varnish-stain wears quickly.

Rectifying Alternating Current

IS there any way of rectifying or otherwise making an alternating current available for charging batteries when the A.C. dynamo generating the A.C. current varies in speed? I have in mind running an A.C. dynamo by wind motor.—Francis Martyn (Ballyvaughan).

WHEN an ordinary alternator is driven at a variable speed both the voltage and frequency will vary. A metal rectifier could be connected between the alternator and a battery, with a resistance in circuit to limit the current at high speeds, or a choke coil could be used for the same purpose. The voltage absorbed by the choke coil would be increased with increased charging current, and also with increased frequency.

There may be a possibility of designing a small alternator with a fairly high leakage magnetic flux and high reactance, so that the volt drop in the machine increases considerably with the frequency. This would reduce the voltage variation and tend towards a stable voltage at high speeds, although the arrangement would not be highly efficient. If a separate exciter is proposed to supply the field windings this should be designed to have as little voltage variation as possible on varying speed.

Filtering Dirty Oil

I HAVE a quantity of motor-car oil that I wish to purify owing to it accidentally being mixed with some oil that has already been used. Would you please inform me if it is possible to clean the oil by filtration, and the best method to use?—A. Smith (Penzance).

YOU do not give us an idea of the actual quantity of oil which you require to treat. We take it, however, that the quantity is not very large, in which case your best plan is to heat the oil (in order to reduce its viscosity) and then to pour it on to a bed of clean sand (or a mixture of sand and coarse charcoal) contained in a cylindrical metal vessel. The filtering bed need not be more than 4in. thick and it will work more rapidly if it is heated so as not to cool the heated oil. This process should render the oil quite usable.

If the oil is only slightly contaminated with solid particles, a simple filtration of the heated oil through a coarse mesh cloth will give the required result.

On the other hand, if the accidental mixture of the oil with used oil has only resulted in a darkening of the oil and not in the introduction of solid particles into the oil, no filtering will be required, and the admixed oils can be used in the normal manner without any detriment to the engine.

Colouring Electric Light Bulbs

COULD you please give me some information about the colouring of electric light bulbs? I desire to colour them red, yellow and blue for stage lighting.—C. J. Emberton (Walsall).

THE following is a suitable formula for the making of a coloured lacquer for tinting electric light bulbs:

Bleached shellac	25 parts
Powdered resin	8 "
Methylated spirit	75-100 "

To the above a little spirit-soluble dye is added in sufficient quantity to colour it strongly. When lacquering the bulbs, use the smallest possible amount of material in order to afford the maximum degree of transparency.

Artificial Marble Panels

I AM interested in the manufacture of artificial marble panels of the type mainly used for wall tiles for bathrooms and kitchens, and for bath panels.

I understand that the ingredients are : gypsum cement, lime, granite dust, and metal oxides (for colouring). Can you give me any advice on the mix and ratio ?—G. Rogers (Southgate).

THERE are several British Patents extant on the subject of artificial marbles, and a search through the Patent Office files would, no doubt, disclose to you information which would be of interest to you. A more or less standard formula for this type of composition is the following :

White Portland Cement	1 part
Quartzite or other powdered spar	2 „
Calcium stearate (or equal parts of stearic acid melted up with slaked lime)	0.3 „

The above is mixed intimately, and then slaked with water to mortar consistency. The mass is trowelled into moulds, and a little earth colour (red oxide, blue, etc.) is scattered here and there on the surface of the mass and then trowelled lightly in.

Another composition utilises as a base calcined magnesite, which is mixed with a suitable white filler in about equal parts and then slaked with a solution made by dissolving 40 parts of magnesium chloride in 60 parts of water, the earth colours being surface scattered as before. Unfortunately, however, magnesite and all magnesium compounds are at present very scarce, so that it seems you will perforce have to rely on white cement for your base.

"Crystalline" Paint

COULD you please let me know if there is any method of making black "crystalline" paint similar to that used on photographic apparatus, or whether it is obtainable ready made ?—P. E. Smith (Bath).

THE "crystalline" paint or enamel to which you refer is produced by heat treatment. If you paint an article with ordinary hard enamel and then, when the enamel film has reached the tacky stage, you place the object in an oven and heat it for about an hour at a temperature of 110-115 deg. F., the enamel film will be broken up so as to give the "crystal" or "crackle" effect. The object is then baked in the oven for three hours at a temperature of 300 deg. F.

By adding certain metallic soaps, such as aluminium stearate, to the varnish (to the extent of about 5 per cent.) the destructive action on the varnish film is greater. Even ordinary soap (sodium stearate) has an effect in this direction. "Crackle" or "crystal" varnishes and enamels are not commercial products.

Watch Cleaning Solutions

IN cleaning a watch I understand that four different solutions are used, the formulæ of which I have mislaid. Two of the solutions were petrol and carbon tetrachloride respectively, and, if I remember rightly, green soap was one of the ingredients of the first bath.

Could you please enlighten me on the correct formulæ for these four solutions, or any other solutions which will clean minute watch parts with the same result ?—Glyn Huckridge (Neath).

AN efficient four-fluid watch cleaner is the following :

Fluid 1.

Carbon tetrachloride or pure benzene.

Fluid 2.

This is made in two sections, viz :

(a) Boil 1oz. oleic acid with 1 quart of water.

(b) Add 4oz. ammonia to 1 quart of water. Then add 2oz. of acetone. Warm the liquid and then add it to liquid (a), which should be nearly boiling.

Stir the mixed liquids until uniform. The liquid will have a soapy feel and appearance.

Fluid 3.

Pure benzene.

Fluid 4.

Pure alcohol or rectified spirit.

Iso-propyl alcohol will suffice instead of ordinary ethyl alcohol. It is very much cheaper and is obtainable from Messrs. A. Boake, Roberts & Co., Ltd., Carpenters Road, Stratford, London, E.15, price about 3s. 6d. per pound.

Petrol should NOT be used for watch cleaning, since it is liable to contain greases, oils and various other impurities.

The above solutions are used consecutively : 1, 2, 3, 4.

Gelatine Moulds : Wood Flour

I WISH to produce a replica of an ornament made of plaster and copper-plated. Owing to the complicated design it will be necessary to use a gelatine mould. Can you give me a formula for such a mould ? Further, can you give me the name and address of a firm who can supply wood meal or wood flour ?—W. H. Crockett (Bungay).

TO make a gelatine mould dissolve 20 parts of cooking gelatine in 80 parts of hot water. This will set solid on cooling, and it can be used to take the shape of the original design. In the gelatine mould plaster-of-paris casts can be made. Remember, that before casting, the inside of the mould should be treated with french chalk, which is brushed on and then dusted off, this treatment being followed immediately by rubbing over the inside of the chalked gelatine mould with a cloth charged with paraffin-oil, in which a little paraffin-wax or candle grease has been dissolved. This treatment will make the interior of the mould nice and smooth, and will greatly facilitate the separation of the set plaster from the softer gelatine.

The gelatine can be made much stiffer and harder by brushing it over with commercial formalin solution and allowing the latter to evaporate. The formalin has a hardening and insolubilising effect on the gelatine.

In a similar manner, a mould may be made from ordinary glue, but gelatine usually gives better moulds.

Wood flour and meal are obtainable from the following firms :

Atomill, Ltd., Amber Wharf, Watt's Grove, London, E.3. Rothervale Manufacturing Co., Ltd., Woodhouse Mill, nr. Sheffield. Kinghorn Mills, Ltd., Kinghorn, Fife.

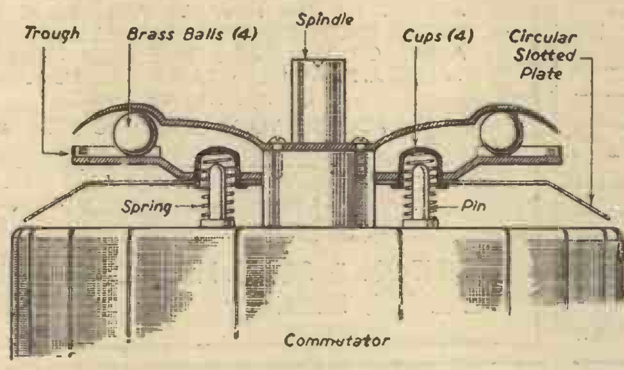
If you only want a small quantity of wood flour you will probably be able to obtain sufficient by passing fine sawdust through a fine wire mesh.

Induction Motor : Short-circuiting Device

I HAVE purchased an American-made electric motor, details of which are as follows : ¼ h.p., 110 or 220 volts ; 5 or 25 amps. ; 100 cycles, single-phase ; 2,000 r.p.m.

I am having trouble in running this motor as the field gets very hot and tends to smoke after a few seconds' running on 240 volts.

There are four brushes with no actual wired electrical connection. The wiring to the motor field consists of two pairs of wires, one pair of which has to be closed before motor will run. Also, there is a centrifugal device in front of the commutator consisting of a spring-loaded slotted plate and ball-bearings, as in accompanying sketch.



Sectional view of a short-circuiting device fitted to an induction motor. (K. Fountain—Letchworth.)

Could you tell me how I can run this motor with the minimum of modification, also the use of centrifugal device and two pairs of connecting wires ?—K. Fountain (Letchworth).

YOUR machine is evidently a repulsion-starting induction motor. It is intended to start up with a high torque as a repulsion motor, i.e., with the stator windings fed from the supply and the rotor windings short-circuited only by the electrical connections between the brushes. When the motor has accelerated to a certain critical speed at starting, the centrifugal device should operate to short-circuit the whole of the commutator segments by pressing the slotted circular plate on to the commutator, the motor then continuing to run as an induction motor with short-circuited rotor winding.

The stator windings are evidently arranged in two sections, hence the four leads. These sections should be connected in parallel if the motor is to be used on 110 volts, and in series for use on 220 volts, on a 100-cycle supply. On the higher voltage overheating would occur if the windings were connected in parallel, or if only one section was connected. It should be noted that the two sections should be connected to create the correct magnetic polarity ; if the connections to one section are reversed the coils will be in opposition.

In your case, the position is apparently complicated by the fact that your voltage is actually 240 volts, not 220, although this should not make a great deal of difference ; and by the fact that your supply is presumably at 50 cycles and not 100. The change of frequency will make a considerable difference : besides reducing the speed of the motor to half its original value, the motor will require a very high magnetic flux and high magnetising current. Even with the windings correctly connected in series, the effect of the lower frequency is almost certain to render the motor unusable. The windings really require completely re-designing for your supply. As an alternative you could probably use the motor with the sections connected in series and fed with 110 volts through a transformer ; the speed would then be about half normal, as would also be the permissible loading.

Eliminating Woodworm

I AM pestered with woodworms in my furniture and have been trying to get rid of them for the past two years with little success. I sent to Messrs. A. Boake & Co. for the copper naphthenate you previously mentioned for adding to creosote, but they do not supply it in small quantities. Could you tell me of any other firm where I may get a few pounds of copper naphthenate ? Will it kill woodworm and eggs if injected into holes with a small oil-can ? Also, what is the best time of year to start work on this pest ?—R. Atkinson (Bangor, Co. Down).

IF Messrs. A. Boake, Roberts & Co., Ltd., cannot supply copper naphthenate to you at the present time, we do not know from where you could obtain this material. However, you need not be at all discouraged. If you will exercise patience and persistence you will assuredly be able to eliminate the woodworm pest by the use of paraffin and creosote alone. The only advantage of the copper naphthenate is that it impregnates the wood and remains there, thereby rendering the wood permanently toxic to woodworms.

Mix together 10 parts (by volume) of paraffin oil or white spirit (or even solvent naphtha) and 2 parts of a good quality creosote oil. Stir well together and, using a brush, apply this mixture liberally to the affected and unaffected woodwork. If possible, use the liquid hot (by standing the jar containing it in a pan of boiling water), but be careful to remember that the liquid is inflammable.

The adult wood beetles begin to emerge from the woodwork during April, and they continue to do so until August. Hence, the treatment should be commenced during April and the same treatment should be applied every month during this period. Repeat the same treatment next year also, and, perhaps, once or twice during the following year. You will then have successfully eliminated the woodworm pest.

It is quite useless merely to apply the liquid to the woodworm holes in the wood. That would be merely locking the stable door after the horse has gone, for each hole in the wood represents a place from which the adult beetle has emerged and proceeded elsewhere. These beetles are able to fly during the summer months. Hence, they readily infect other furniture.

Your best plan, by far, in a badly infected room, is to apply the paraffin-creosote mixture to all the woodwork in the room, that is to say, to all the furniture in the room and to all the structural woodwork in the room, such as the floorboards, etc. Only then can you make absolutely sure that the room is made uninhabitable to the pests. Turn all the furniture upside down, and be most liberal with the application of the liquid to these hidden parts of the furniture, for it is in these areas that the beetles mostly lay their eggs. Polished surfaces of the furniture will not be harmed by the liquid, although, of course, they will require a subsequent rubbing-up with any ordinary wax or furniture polish.

De-gumming Pipes

IN servicing refrigerators I sometimes come across gas supply pipes which have a "gummy" substance coating on the inside, due, no doubt, to poor quality gas. Could you advise me as to the best method to get rid of this gum inside the pipe, say, by immersion in a solution, which would not be detrimental to brass or copper pipe ? The pipes have often many bends, and to straighten them out and clean with a brush is quite a job. The pipes are often short pieces which could be easily immersed.—J. B. Fleming (Edinburgh).

FOR small pipes which can readily be immersed in a solution, you will find nothing better for their de-gumming than gently boiling in a solution made by dissolving 10 or 15 parts of caustic-soda in 90 or 85 parts of water. A 15 minutes' gentle boiling should do the job, after which the pipes should be well washed out with water.

For the larger lengths of piping, stop them up at one end and then fill them with the above warm solution, allowing the solution to remain therein for several hours. Two or three such treatments will be necessary.

Alternatively, you can use white spirit or solvent naphtha for the same purpose.

Neither of the above liquids will attack the brass or copper pipes, but they will, of course, remove any paint which may be present on their external parts.

THE Cyclist
Editor: F. J. CAMM

VOL. XV DECEMBER, 1946 No. 298

All letters should be addressed to the Editor, "THE CYCLIST," George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

Phone: Temple Bar 4363
Telegrams: Newnes, Rand, London

Comments of the Month. By F.J.C.

New Plans for Herne Hill

THE disastrous blow to the prestige of British cycle sport struck by our poor showing in our first post-war events abroad indicates that some radical change is necessary in the control of international cycling sport. The joke to-day is "Join the N.C.U. and watch the foreigner's back wheel." This is not a criticism of British cycling sportsmen. They are superior to those of any other nation, but they must be given opportunities to train at present denied to them due to the attitude of the National Cyclists Union, which endeavours to exercise a stranglehold of control, and to frown upon any attempts to modernise the sport and to take it out of the atmosphere of the eighties.

Perhaps the N.C.U. thinks it is in keeping with the times in exercising control. It may even feel that it is the Government of sport. Certainly it has exercised the principle of the Closed Shop, and also certainly it is to some extent a dictatorship.

All of these things are realised by those who have the best interests of the sport at heart. These sincere people have endeavoured by normal democratic means to get these things changed. All of their efforts have failed, and so the N.C.U. has contributed to its own downfall by its endeavour to regard as antagonistic criticism all suggestions which have been made for its improvement and progress. It has taken these criticisms as a personal affront, and seems to have regarded itself as the personification of perfection when there is room for improvement.

When the matter of massed-start racing, for example, was raised, the N.C.U. chairman ruled the matter out of order on a technical pretext. All efforts on the part of some thousands of cyclists interested in cycling sport whom the N.C.U. preferred to regard as a "dissident" body have been abortive. Finding themselves frustrated in this way, they formed the British League of Racing Cyclists. The N.C.U. seems to forget that it has bred serpents in its own bosom by its attitude towards the end of the last century, when it threw all forms of cycle sport except racing on closed circuits overboard.

There is no need for us to reiterate the N.C.U. *v.* massed-start controversy. It is sufficient to say that the N.C.U. still continues to nail its flag to the tottering mast of track sport. This mast badly snapped in the latter half of the last century, is now rotting at its root, and the mast tends to fall upon the heads of those who have now endeavoured to prop it up.

Herne Hill Track

HOWEVER, having elected as a bulwark against future attacks to intensify its track programme, the N.C.U. has obtained a lease of Herne Hill Track from the proprietors, Dulwich College, and last year, with a great fanfare of trumpets, it launched a programme which failed to attract a crowd and was severely criticised by its own adherents, not only on the score of the poor quality of the events and the lack of management and promoting skill but also on the score of the lack of amenities provided for the crowds the N.C.U. hoped to attract.

Their programme for 1947 is nebulous, and those interested in this form of sport are highly dissatisfied with the way things are going. The possession of a lease is one thing, but the successful promotion of events on the track so leased is another, and it is thought by those best able to judge that the N.C.U. is not by its past experience the best body to ensure that the track is used to the best advantage for cycling sport.

Accordingly a number of those best able to deal with the matter have prepared some proposals for future cycling promotions at Herne Hill, and these proposals take the form of a report prepared by the Committee for 1947 Track Sport which will be submitted to the National Cyclists Union with a view to adoption for the 1947 season.

The N.C.U. relies upon the defeat of these proposals upon a clause in its agreement with the owners of Herne Hill Track which forbids sub-letting. It will depend upon the legal interpretation of these terms as to whether riders who are members of the National Cyclists Union and wish to rent the track from a body which is really their official representative are inviting the N.C.U. to commit a breach of its sub-letting clause.

We have not inspected the agreement, but we are quite prepared to advise the new committee that it would not be a breach of such a clause if the N.C.U. allowed them to promote their own events on Herne Hill Track. Presumably the clause really means that the N.C.U. may not sub-let the track to any other body.

The new Committee and its adherents would be held in law to be corporate entities and really signatory to the real agreement, since as members and affiliated members of the N.C.U. the agreement was reached on their behalf, and they are therefore entitled to have the use of what is already theirs.

The N.C.U. holds a 21 years' lease on the track, and those behind the new proposals feel that the track will be a white elephant under the present management. It is obvious that there is no effective liaison between the various promoters with the following effect:

There is no centralised publicity to build up the sport as a whole; no organised attempt to build up a pool of young riders of the future; no planned economies by sharing the cost of visiting Continental riders over more than one meeting; no common standard of entertainment for the public; no continuity of promotion, resulting in occasional blanks, and no carry-over of costs in the event of a wet day.

Competition

AS the promoters of the new scheme say, if cycle racing at Herne Hill is to be put on a proper footing as a public sport with regular gates it is obvious that it must compete with other attractions.

In 1946 these other attractions were but weak rivals, but as the effect of the war and its restrictions are thrown off, the competition will mount up.

It is understood, of course, that promoting clubs will wish to maintain their individuality, for they have kept the sport going through the lean years, and they must be allowed to continue not only to be prominently associated with races which they have built up and made famous but also to share financially in any profits which might result.

Provided that every cycling organisation currently promoting meetings at Herne Hill joins in the proposed schemes a limited company will be formed to undertake the promotion of all cycle events at Herne Hill Track. A graduated scheme of improvement will be put into effect as fast as materials, labour and the necessary permits become available, and first priority will be given to improving accommodation.

There would be a properly planned season-long programme of first-class meetings, together with a subsidiary mid-week programme of club meetings at which all London Clubs could, free of charge, run off their club events.

A Veteran's Birthday

EVERYONE associated with the sport and pastime of cycling knows the name of E. Coles-Webb, affectionately known as "Coley" throughout the trade and pastime. Those who know his spritely step, his quick mentality, his repartee and his ability as a raconteur may be surprised to know that recently he celebrated his 80th birthday, and a dinner to celebrate the event was given in his honour at the Waldorf Hotel, when a small cross-section of his thousands of friends in various business and sporting spheres met to wish him many happy returns.

Among those present were the Marquis of Donegall, W. G. Bailey, W. G. James, R. A. West, J. Dudley Daymond, W. J. Mills, H. H. England, Rex Coley, Vic Jenner, W. Hind, A. H. Bentley, H. B. Clarke, J. A. Masters and Peter Hunter.

This veteran, in years only, managed to extinguish the 80 candles on the cake with the proverbial one puff, and in a speech acknowledging the many gracious tributes paid to him he paid tribute to the effect on his longevity achieved by his cycling exploits. One of the earliest record breakers, he had raced on the old Ordinary, and prior to that had achieved great success as a runner. He won an enormous number of prizes and trophies and at the age of 73 won a Bath Road handicap. It is good that we have such veterans as Coles-Webb who remains a link with the past, an adviser for the present, and a guide for the future.

Mr. F. J. Camm was in the chair.

Is the N.C.U. Redundant?

By R. L. JEFFERSON

THE world's championships have come and gone with results that I, for one, expected.

There have been the usual excuses and hard luck stories, but the fact remains that we have come back from Zurich empty-handed and with our prestige lower than it ever was.

It would seem that the N.C.U. has decided to make Herne Hill its home for the next few years; if so, we can expect the "mixture as before," that is, dull and uninteresting meetings, the complete ignoring of the public, and the same clubby, cliquey atmosphere of old men infesting the centre, and the same sham amateurism that has prevailed for a couple of decades or so.

In view of the fact that the Olympic games will be held here in 1948, what does the N.C.U. propose doing about *that*. It is an insult to expect crack continentals to ride in a place like Herne Hill; it's just not good enough for them or the spectators.

What we need is a new track, and the only way we will get it is to get rid of the people who are stopping us from getting it; that is the N.C.U. Have any of these officials tried to whip up any interest with the trade; there is more money in the cycle trade than some people would think. Recently one manufacturer gave away enough money (to another cause) to have built a real track with real amenities, but he was not approached.

What we want is a track capable of accommodating a dozen cracks behind motor pacers at anything up to 60 m.p.h., room for 40,000 spectators, all elevated over the track, and under cover, an announcer who knows the game inside out, plenty of publicity in the national papers, and, of course, the riders.

We have these latter according to our contemporaries, and all they need is a chance, so we are told. Very well, give it to them, either by waking up or getting out.

One writer in a contemporary deplores the publicity that has been given to our failure in the cycling press; he advocates carrying on in the same old way and not bothering whether we beat the foreigner at all. His theory is that every now and then we will produce a Harris or someone who will beat the foreigner at sprinting, and he airily dismisses the road game as not worth bothering about. I respect this gentleman's opinions on a lot of cycling points, but I just can't stomach *that*.

By the sponsoring of specialist events run on selected courses we have developed a type of "racing" man without parallel in the world to-day. These men are selected to represent us abroad on the strength of a few so-called mass starts on enclosed circuits. To prove my point, at the so-called N.C.U. championship held recently in Finsbury Park out of nearly 100 starters only eight finished; the winner, of course, was an ex-B.L.R.C. man. If the riders are as good as the N.C.U. say they are, what happened to them? Quite a lot of them crashed, so did some of the foreigners who came over and rode at the Crystal Palace before the war, but the foreigners got up and chased the field, wounds or no wounds—put plainly, they had guts.

The faces of Maes, Leducq or a host of other continentals are not pleasant to look at finishing an event. These men are *trying*; is it beneath our dignity to do the same? Men like Meredith would have ridden through plate glass if necessary to keep their wheel in front; it's that spirit we need to-day, not the wishy-washy, clubby defeatist attitude of Doughty Street and Craven Hill.

The issue now is whether we want to be a first-class cycling nation or a back number. Ask yourself these questions: do you think the N.C.U. have the ability, brains and drive to put track cycling on the map in this country? Do you think the R.T.T.C. are likely to produce by their methods riders who will beat the foreigner at massed start racing? I say no, and if you are honest you will say the same. We *must* all get together and either overhaul the N.C.U. for track events, or give our support to the B.L.R.C., a modern body, who are in touch with modern conditions, and whose minds are not clogged with the cobwebs of 1898 and all that.

The road game is a *must* for the B.L.R.C.; in no other way can we hope to compete abroad. Give them your support, join them, and if you are young enough race with them, ask for and get tougher and tougher courses; get tougher and tougher yourself, ignore the bigots and old-fashioned "cyclists" who are completely out of touch with international cycling. Let us get *our* wheels—British wheels—in front and keep them there. Turn your back on defeatism, and look up and over the heads of the so-called cycling experts who have held us back for two decades. It's up to you, and you can do it if you want to—*do you?*

Paragrams

Bad Start

TWO fatal accidents marred the first day of Nuneaton's Safety First Week. In the first accident, a cyclist was riding behind a lorry when a large packing case fell from the lorry and crushed him. The case caught on the bridge just as the lorry had passed the cyclist. The second accident resulted in the death of a lorry driver upon whom the body of his lorry fell while he was looking underneath it.

Suggests Cycle Registration

IN the course of a talk to Wellingborough Rotary Club, Captain R. H. D. Bolton, Chief Constable of Northamptonshire, mentioned that when the Force was up to strength he hoped to introduce a voluntary register for cycles which, he hoped, would lead to the speedy recovery of any cycles stolen in his area. He also pointed out that if every cyclist locked his machine when leaving it, the police would be saved a great deal of work.

All from Junk

MR. ARTHUR BAKER, of Hough-on-the-Hill, near Grantham, a sufferer from rheumatoid arthritis, has built himself a hand-propelled invalid chair from the remains of half-a-dozen old bicycles which he obtained from a nearby dump. Mr. Baker designed the chair himself and built it in his back yard, using a good deal of improvisation to get the work completed to his liking. The chair is propelled by two handles in the orthodox manner and each wheel is fitted with an independent brake, and there is also a brake to hold the machine stationary while Mr. Baker gets in or out. The only part that Mr. Baker bought was a small front wheel, as the one he salvaged was not satisfactory.

Worse than War Years

MAJOR C. E. LYNCH-BLOSSE, Chief Constable of Leicestershire, speaking at a meeting of the Leicester and County Accident Prevention Committee, referred to the "striking" figure of 213 adult cyclists injured in Leicester during the nine months from January 1st to September 30th this year as compared with 174 during the 1945 period. A safety week for both city and county was organised for November, and one interesting feature was an errand boys' reliability test.

Keep It Dark!

RUTLAND, England's smallest county, is still apparently living in the 1940 invasion-scare days, or else it is desired to discourage "foreigners." Sign-posts are almost non-existent, and in a few cases where the posts remain they have no arms or there is just an indecipherable blur where a name was painted some time in the dim past. The Rutland attitude may, of course, be that local inhabitants know their way round their tiny county, and if any outsider comes to Rutland he does so at his own risk.

Full House

THERE was a record entry of 162 riders in the Leicestershire Road Club's open 25-mile cycle race on October 13th. The winner was E. James, of Birchfield C.C., in 1hr. 3 min. 41 sec. with W. Whiley, Halesowen C.C., second, and W. Cassey, Leicester, coming third. The winner of the team prize was Birchfield C.C.

Too Many

CONCERN was expressed at a meeting of Scunthorpe Accident Prevention Committee when it was stated that 10 cyclists were involved in road accidents in the town during July, as compared with one motor-cyclist, five pedestrians, one passenger, four drivers and one pillion rider. It was suggested that intensive propaganda was needed to make the cyclists take more care on the roads.

Mechanised Paper Boy

A DEVICE has been brought out in America for attachment to any standard bicycle to enable a paper boy to roll the papers for each householder into a neat bundle as he rides along. The device works off the front wheel. The papers to be bundled are put into a wire basket above the front wheel, and when a lever is pulled the papers fall into position and are rolled and wound round five times with thin cord. The cord is then automatically cut, and as the bundle is lifted from the basket a knot is formed. The whole operation is completed in ten feet at whatever speed the cycle is being ridden.

Job for the Parents

THE Police Traffic Department at March, Cambs, which is carrying out an inspection of the cycles ridden by local schoolchildren, states that in the majority of schools 75 per cent. of the cycles used by the children have been found defective. Bad brakes, one of the most serious defects, and one of the most easily remedied, are found in most cases. Until children are old enough to look after their own cycles it would seem that the parents might use a little common sense and see that they are kept in order.

£1 Worth of Energy

CHARGED at Loughborough (Leics) Police Court with failing to obey a Halt Sign, a cyclist wrote to the Bench: "It is common knowledge that one does not come to a stop if there is absolutely no need, because extra energy is needed to start off again." The Bench may have agreed that present-day rations do not allow much margin for extra energy, but all the same they fined the ingenious cyclist £1.

Unusual Offence

FOR an unusual offence, described in the summons as "having a four-foot wooden measure in his possession not bearing a stamp of verification," a Leicester cycle-dealer was fined 10s. by the city magistrates. Defendant pleaded guilty, but said he was ignorant of the law on this question.

Decorated Landmark

THE day following the Nuremburg executions, Caxton gibbet, a well-known and conspicuous landmark on the old North Road, near Cambridge, was found to have swinging on it a life-size effigy of the late unlamented Goering, complete with jackboots, medals, and all the trimmings. When times were less civilised than they are to-day, the gibbet was used to hang highwaymen who infested the North Road.

Too Much Dazzle

DURING the hearing of a charge of dangerous driving at Daventry Borough Magistrates' Court, the chairman appealed to the police to take action against all motorists who use headlights which dazzle other road-users. The police-superintendent agreed to do all he could, saying that private motorists were the worst offenders, but he pointed out that so long as the cars were fitted with devices to dim the lights they complied with the law, but he knew of no law to force the drivers to use such devices.

Around the Wheelworld

By ICARUS

Another Wisecrack

JOIN the N.C.U., and follow the foreigner's back wheel.

The Official's School

THE N.C.U. is running an officials' school! Apparently you appoint the officials first, and then train them! The London centre of the N.C.U. wishes it to be known that "permits" (how in keeping with the times!) are necessary for roller contests. Those sufficiently interested should write to S. Jones, 149, Dominic Drive, S.E.9.

The B.L.R.C. Irish Visit

ON the occasion of the visit of the Australian, Scottish, and English cycling teams to Ireland recently, upon the invitation of the National Cycling Association of Ireland, all the riders attended a reception at the Mansion House, Dublin, on the day preceding the race, given by the Lord Mayor of Dublin, Alderman John McCann, T.D.

At this reception Alderman J. McCann handed messages of greeting to Alf Strom, Australia; George Edwards, Scotland; and James Kain, Hon. Sec., B.L.R.C.; each message being addressed to the respective Lord Mayor (Edinburgh, Lord Provost) of the capital city of the bearer's country.

Sir Charles was keenly interested in the story of the race, and in the photographs (autographed by the Irish Prime Minister, Eamon de Valera) taken at the Mansion House, Dublin. Sir Charles will reply to Alderman McCann personally.

Transport of Cycles by Rail

THE sign "Cycle Store Full" became a familiar sight at stations during the war, and the practice of using the bicycle for transport between railway and home still presents problems of storage on station premises. We publish elsewhere a letter from the Chairman of the National Committee on Cycling welcoming agreement by the railway companies to consider both the further provision of cycle racks and the best means of transporting cycles by train. Accommodation problems are not the only ones presented by the bicycle. In Denmark, during the war, for example, passenger trains had to be given considerably extended stops at stations to permit traffic to be loaded and unloaded. The number of cycles carried by the Danish State Railways rose from 252,000 in 1938-9, to 2,181,000 in 1944-5, and on July 3 and 4 in the latter year 3,981 cycles were brought to Copenhagen Central Station for transport. On some days about fifty special wagons had to be loaded with cycles at this station alone. With cars in short supply and expensive, and public road transport vehicles liable to be increasingly subject to restrictions on standing passengers, the present is an opportune time for railways in this country to tackle a problem that has possibilities of increasing to formidable dimensions.

The Highway Code

MR. G. R. STRAUSS, Parliamentary Secretary to the Ministry of Transport, recently broadcast a message on the New Highway Code, which has been passed by both Houses of Parliament and is now being distributed to every household in the country.

The latest returns show that the number of accidents is decreasing, and, according to Mr. Strauss, recent figures are remarkable. In September, 1939, 559 people were killed on the roads. In September, 1945, 452 were killed, and in September, 1946, the number fell to 353.

Why, therefore, all this talk of carelessness on the road? Surely we are not attributing the drop last year to the War Widow poster? You know the one, which a Member of Parliament suggested should have the caption "She voted for a particular political party."

The important thing is that there has been no drop in the number of people injured in road accidents. Twelve people, including three children, are still being killed on our roads every day, and over 100 seriously injured. Those statistics were given by Mr. Strauss, and I blame his Ministry and the Ministries before his for this state of affairs. The Ministry of Transport listens far too much to police reports. It has so congested our roads by traffic control and by lack of traffic control, paradoxical though that may sound, that it continues to make our roads daily more dangerous. The fact that the number of fatal accidents has dropped is no doubt due to the circumstances that traffic has been brought practically to a standstill. It does not seem to have occurred to the Ministry of Transport, nor to the traffic branch of Scotland Yard that as more and more vehicles come on to the roads it needs to be speeded up, not slowed down. All they do is to increase traffic density by means of more and more controls.

Now the Highway Code has not the force of an Act of Parliament, but if an accident does take place, and it is proved that it was in any way due to the failure of one of the parties to obey the code, that fact will count against the party in any court proceedings.

Mr. Strauss went on to draw attention to the importance of the pedestrian crossings, which, in my views, are illegal crossings, in that no Government has the power to set aside the common right of every individual to use any part of the road on all lawful occasions. No Government has ever had the power to set aside a part of the road for the exclusive use of one very privileged section of the public, namely, the pedestrians, who, incidentally, cannot commit any offence on the highway except the mild offence of obstruction concerning which less than a dozen cases are brought every year.

Cyclists object to being "segregated" to cycle tracks. It seems also that pedestrians object to using pedestrian crossings for the same reason.

Mr. Strauss thinks that people have not yet regained the habit of using pedestrian crossings, partly because the police have not enough men to enforce the regulations. The police, with all respect to Mr. Strauss, have never been able to "enforce" regulations; they may bring prosecutions for breach of them, but it is only one person in ten thousand who is so prosecuted. A law which needs enforcing, or which cannot be enforced, is bad law.

B.L.R.C. 1947 Programme

AT the two-day meeting of the National Executive of the B.L.R.C., dates of events to be promoted by this national body during 1947 were fixed. I list them here:

Dates of Road Race Classics, 1947: Brighton to Glasgow. Six Day Cycle Marathon. Start, Brighton, August 4th.

British Road Race Championship: June 22nd. Approx. 129 miles, over a 24-mile circuit, starting and finishing at Weston-super-Mare.

"Circuit of the Cinque Ports"—Sandwich - Dover - Hythe - Romney - Hastings: Possibly a Two Day Race. Whitsun Bank Holiday.

Fifth Annual General Meeting: To be held in Birmingham, January 12th, 1947.

Professional Event Organisers: Owing to the increasing scope and importance of League road events, the time has come when the work entailed far exceeds the capacity of honorary officials, and Sections are now empowered to grant Event Organisers Licences to professional organisers, subject to the approval of the Section concerned.

Official League Journal: Advance plans for the production of a league journal were submitted by the hon. secretary, and authority given to start publication at earliest possible opportunity.

Union Cycliste Internationale: The hon. secretary was instructed to make further application to the U.C.I. for recognition as the competent controlling body of Road Racing in England, the application to be submitted in time for consideration by the next Congress of the U.C.I., to be held in Luxemburg, February, 1947.

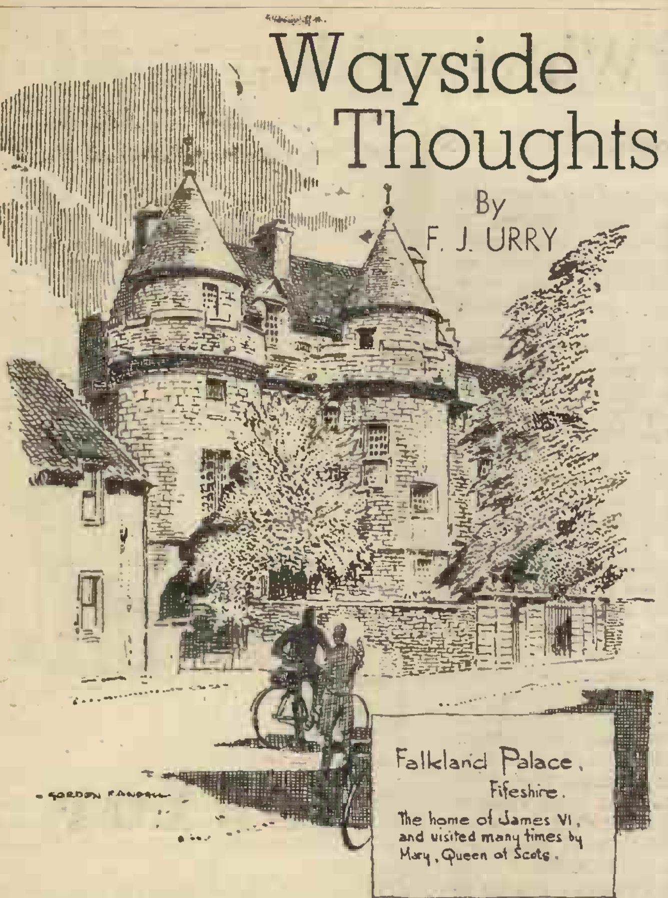
Election of New Clubs: *Shrewsbury Racing Club*. Hon Sec., G. M. Hughes, "Wynncote," Longden Road, Shrewsbury. *East Dorset Coureurs*. Hon. Sec., D. Cutts, 14a, Station Road, Parkstone, Dorset. *North London Racing Club*. Hon. Sec., G. Stone, 63, Barclay Street, London, N.W. *Sedgeley Racing Club*. Hon. Sec., R. W. Woodall, 87, Rosemary Crescent, Woodsotton, nr. Dudley. *Petersfield Bicycle Club. Bournemouth Olympic Racing Club. Leyton Camp Wheelers.*

Applications from the Strathmore C.C. (Dundee) and Scottish Road Club (Bothwell Haugh) were referred to the newly formed Scottish Cyclists' Union.

Statement of Policy: A new statement of policy, based upon proposals circulated by the hon. secretary, were approved. It will contain bold and far-reaching proposals affecting English road sport, and will be circulated generally as soon as ready.

Wayside Thoughts

By F. J. URRY



Falkland Palace, Fifeshire.
The home of James VI, and visited many times by Mary, Queen of Scots.

The Lighting Problem

WE are in the days of the equinox and some of our miles have to be lamp-lit. And we are still awaiting many improvements in cycle illumination, some of which I saw in token form more than a year ago, and those samples have probably been further improved by now. But up to the moment of writing I have not seen any great changes in the battery lamps; and that is a pity, for with all the popularity of the many types of dynamo, the battery lamp, front and rear, is still the most widely used and in my opinion will continue to be if its reliability can be improved. It is so convenient that on such ground alone it will command a big sale always. We want from it improvement in its contacts, a little sturdier case of the non-rattle type, and, if possible, a little longer life from the batteries. If these things can be done—and on that question I admit my ignorance—then the battery lamp will be my wear for the daily journey to and from work. When I go night riding for pleasure, it is usually the old Holophote inch wick oil lamp that shows me a mellow beam ahead, a job it has been doing most winters for over 35 years, which says something for its design and construction, when a famous firm used to advertise "we make light of our labour." You can't buy its kind now, and even the good acetylene headlamp is hard to come by; so the modern rider is rather thrown back on the dynamo if his pathway on winter nights is over unlighted roads; and that is another reason why the dynamo will become increasingly popular. Personally, I do not like it because I always feel I'm reversing the slogan of the famous lamp maker quoted above; but it seems I am a voice in the wilderness and am among those old cyclists—a decreasing band—who are out-moded. I should want my dynamo very light and very easily detachable, with the wires collected into a neat tube lying close along the top rail. Then I may fall for the work of manufacturing my own illumination.

This Needs Stern Attention

I SUPPOSE we cannot expect any considerable improvement in our catering establishments until food rationing is eased or cancelled. No doubt many of our roadside hostels are taking some advantage of the present situation, and the promiscuous traveller gets the cold shoulder far more frequently than the regular customer. Indeed, this question will need a lot of attention in the near future, for a publican holds his licence by grace of the public exercised by the licensing magistrates, and this hold on the individual who is supposed to offer us reasonable refreshment will require putting into force in some cases before we return to the status of a hospitable country. I had an experience of this utter indifference to the needs of a legitimate traveller at the end of July last, when riding from Newport (Mon.) to Birmingham. An excellent lunch at Raglan made me feel as idle as the day was warm, so I lounged along the beautiful road through Monmouth and Symonds Yat to Ross, expecting to pick up the refreshment of tea at the latter town. It was Sunday and every cafe was closed, and all the hotels politely informed me they had barely sufficient food for their guests; so I bethought me of several wayside pubs on the road to Newent and went over those switchbacks in search of sustenance. But the pubs. were shut tightly against wayfarers, and the proprietor of the only hotel in Newant, kept on repeating the formula that "we open at seven; nothing until then"; and I began to feel an outcast. I had intended to pack iron rations in Newport but forgot all about them, so perforce I took the hard Tewkesbury road by Corse Lawn with just seven sweets to see me over the fourteen miles. They did the job and kept me comfortable enough with a smoke or two, so no harm was done; but the annoyance did not easily depart from my mind and I wondered what a stranger in the land would have thought of our boasted British hospitality. We shall have to do a lot better than this if we are going to sell touring.

Perforation Performances

ON that two hundred mile journey to South Wales I had the extraordinary experience of suffering five punctures. The tyres were nearly new (Dunlop Sprites saved up for such a journey) and the five perforations were a surprise, for on the average of the years they were more than double the number I gather in my 8,000 miles annually. All but one were in the front tyre, and two of them were very fine slivers of glass which had probably been embedded in the tread for weeks, and happened to work through the casing with the aid of a few miles of wet road. The others were just slow mysteries, except one I know was a slight pinch as a result of the rough surface of the old coach road from Elan Valley to Cwmystwyth. And, by the way, that fine old way through the hills is, or was, as rough as I ever remember it, and I've known it fairly intimately for over forty years. Some day, and perhaps not in the distant future, it will be redesigned and serve as a relief road to mid-Wales; but at present the trouble in that connection seems to be that it passes through three counties, and the councils thereof cannot agree as to the division of cost and subsequent upkeep. Fortunately, all these punctures were considerate ones inasmuch as they allowed me to make a feeding place and do the repairs at leisure and with the convenience of a water test. What I should like to see undertaken is a regular clearance of the broken glass on the roads. It certainly has improved, but it is still bad, and to the workaday rider these fragments of milk bottles are a constant menace to his property, and often a deterrent to good timekeeping. And now let me give you a tip on easy tyre removal. Years ago I had shaped in the works a three-inch section of old hacksaw blade ⅜in. wide, the ends reduced to form a screwdriver, and the burrs taken off. It is the perfect tyre lever, for it is stiff, takes up less room than a pocket-knife, and is a handy little tool for innumerable purposes. I wonder such a small and useful tool has not been marketed.

They Are Coming

AWAY back in the merry month of May, I was informed by someone who ought to know that good tyres of real rubber and lively casing would be available in the course of the year. Up to the moment of writing I have seen no sign of them and I am anxiously waiting, for my little stock of pre-wars, which I bought and had stored for me in the middle of 1941, have all been used except one, and a couple of repaired covers which may see me over a few thousand miles on a front wheel. I have been lucky in the matter of tyres, or wise, for I've been travelling on the best of tyres all through the war period right up to the present moment, and folk who know the value and ease of good tyres will realise my good fortune. How great is the difference between war-grade and Sprite, measured in speed or ease? I do not know and can only guess, and my guess is a couple of miles an hour, used in my case to make travelling a lighter and happier progress. I know many riders do not believe the difference is so great, and also imagine the frailer cover means the risk of more punctures and far less wear. In practice I have not found this so; usually, my yearly average of punctures is three (it has been a trifle higher these late years because the tyres have been run to the very end of their usefulness), while pre-war six and seven thousand miles sound wear from rear and front was a normal performance. And, remember, I ride some three to four thousand miles a year over city roads, including six miles of granite setts daily. This record, for the pre-war price of 7s. 6d. a cover, was the cheapest thing connected with the running of a good-class bicycle. My tyres outwore my chains, and sometimes my pedal bearings. No wonder then that I am looking for an early return to the open market of the open-sided cover, to the days when the Sprite set the fashion so soundly in making cycling a more comfortable pastime.

A Wonderful Record

OF course, it is not surprising that we have been waiting for the return of the first-class tyre for well over a year, for consider this, that counting the war years as from 1940 until the end, the manufacturing members of the Tyre Manufacturing Conference made a total of well over 47,000,000 cycle tyres, and nearly the same number of all other vehicle tyres. A report on this remarkable effort has recently been issued under the ægis of the Conference of whom Mr. H. L. Kenward is the president, and it makes most interesting reading to anyone who has a regard for the value and comfort of the pneumatic tyre. It is a big switch-over to peacetime production that the tyre people are undertaking, and if the process is slower than we who are growing older quite like, I think it is understandable in the light of this recently-released information. The co-operation and co-ordination the Tyre Conference practised during the war years should mean, and will, I think, produce, better tyres than ever for you and me to ride.

Such Ignorance

ON various occasions during the summer and autumn I stayed at hotels as far apart as Pembrokeshire and Cumberland, places full of holiday folk, most of whom had travelled by car. In some of these places I was the only individual with a bicycle, and the mental reaction of my fellow-hostellers to a man who preferred cycling to motoring was most curious. Firstly, they did not believe it possible for an elderly individual to ride a couple of hundred miles in three days *and enjoy every furlong of the journey*, when he could make the distance in a car in one day. He must be doing it for a wager or some form of profit; and when I agreed to the latter suggestion designating the profit as health, observation and intimacy with the countryside and not a mere glimmer of it in passing by, they could not understand the activity and pleasure implied. Cycling was "hard work," yet because I did not look worn-out, thinned down or stale, they wanted to know what the secret of my apparent fitness was due to. The simple reply, cycling, could not convince them, so I trotted out all the old arguments—which, I'm afraid, have become assertions on my tongue—that the cycling way of life is the most satisfying expression of fitness and well-being that anyone of average physical abilities, irrespective of age, can undertake. Some of them examined my bicycle, remarked on its lightness and equipment; and it was then that the profound ignorance of the general public—of whom they were a kind of Gallup sample—was made manifest. It is difficult to define this ignorance: a Cyclo gear was a mystery, slightly-dropped bars awful, light tyres a risk, and felt bars to pedals a profundity. I wish some of the charming people of the trade, and especially their advertising experts, could have listened to these conversations, because I'm so frequently and sometimes forcibly told by them that the great G.P. know all there is needful for them to know about the modern bicycle and cycling.

Is It Lack of Faith?

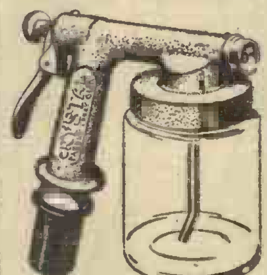
AND the reason for that is the innumerable diverse interests that have entered the lives of men since the advent of cycling. There is no need to name them; they are self-evident to anyone over 30 years of age. Cycling has not kept its "light shining before men" with a brightness comparable to all these new diversions. By making that statement I do not mean it should endeavour to directly compete with the new distractions and interests of life, but that it should make known the quiet joy of its peaceful ease, its perfect freedom from distraction, its outlook on the country scene and, above and beyond all, its benison of health and activity right down the ringing years of life. I have proven the truth of these values over and over again, and personally I am as certain of them as I am sure the sun will rise to-morrow. Yet I have heard people apologise for being a cyclist, as if it were something to be ashamed of, as if the very possession of a bicycle rated you as a kind of social outcast, an "untouchable"! Actually, the man who rides a bicycle is a man using himself as a man should; he is an athlete in the subdued sense of the term if he rides for joy, and an athlete of high standing if he races. But these national virtues of cycling are not widely recognised; they should be, for there is no finer tonic to life in all the gamut of games; and I blame, most of all, the industry of the bicycle for want of liveliness and that alert sense of possible expansion residing in their business. Plainly, I can see and sense this failure, but how can a few enthusiasts hope to remedy it without the backing of the dependent trade?

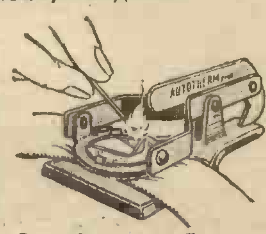
NEW FERODO DEPOTS

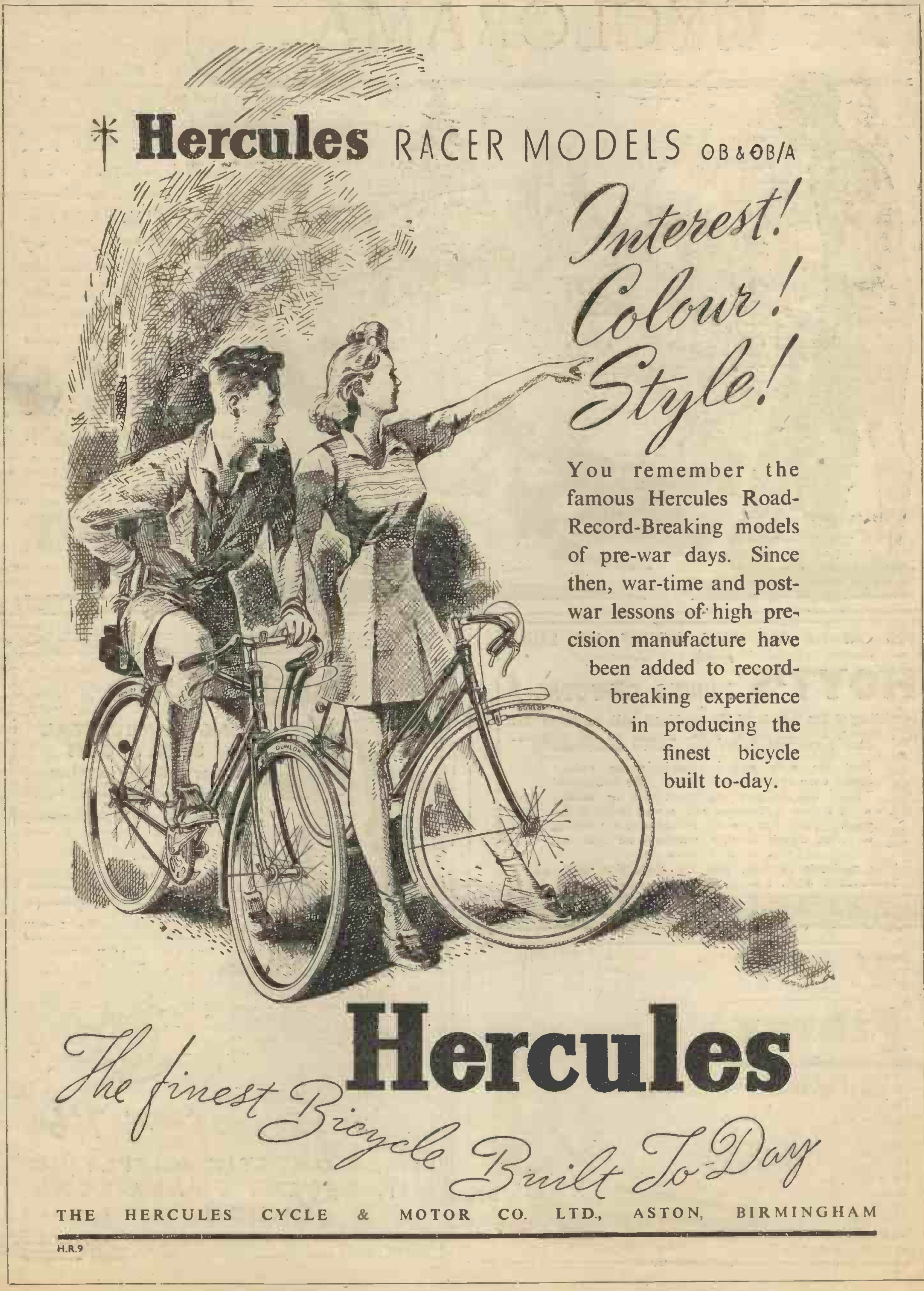
IN accordance with the policy of this company to give the best possible service to their many customers throughout the country, Ferodo, Limited, are opening new depots at Ferodo House, 84/90, Hanover Street, Edinburgh, and Ferodo House, 67, St. Matthew Street, Ipswich, on 2nd December, 1946.

Mr. W. S. Mowat, formerly depot manager at Aberdeen for the past 23 years, has been appointed manager of the new depot at Edinburgh, and new friends, as well as old, can rely on receiving from him the maximum service possible.

The manager at Ipswich is Mr. E. C. Berry, now returned from his service in the Royal Navy. Mr. Berry is already well known in the district, having been the Ferodo representative in the Eastern Counties since 1930, and will now be much better equipped for rendering adequate service to the trade.






Hercules RACER MODELS OB & OB/A
Interest! Colour! Style!
You remember the famous Hercules Road-Record-Breaking models of pre-war days. Since then, war-time and post-war lessons of high precision manufacture have been added to record-breaking experience in producing the finest bicycle built to-day.
Hercules
The finest Bicycle Built To-Day
THE HERCULES CYCLE & MOTOR CO. LTD., ASTON, BIRMINGHAM
H.R.9

CYCLORAMA

By H. W. ELEY

In a Surrey byway
A glimpse of Merrow church through the trees.

A Tip for Dealers.

NOW that we have the first signs of winter, and our thoughts turn to indoor pursuits, firesides, and we feel that the summer is past, I think it is wise to suggest to those who are engaged in the retail side of cycle selling that there is a very strong "sales story" in winter itself! Gone are the days, surely, when we regarded cycling as a summer pastime only? It is my belief that there is as much enjoyment to be got out of a winter ride as out of one undertaken when the sun shines strong in the sky, and all the land is gay and flower-strewn. Why not capitalise this fact? Why not enlist the services of the manufacturers from whom you buy machines, and see if they cannot help with the installation of a special "winter riding" display? Lots of points to be made: the all-weather character of the machines you sell; the need for tyre renewals for winter roads; the healthy side of winter riding . . . that glorious tang in the air on a crisp December morning; the beauty of the wintry landscape. To the live salesman, every season brings its own sales aids, and I commend this idea of capitalising winter riding to all who seek aids to the development of their businesses.

Sunday Morning Pilgrimage.

IT was in Hertfordshire, but only just over the Middlesex border—to be exact, at Elstree, that pleasant little place which achieved immortality when the film magnates selected it, and nearby Boreham Wood, as a scene for their picture-making. A pleasant place still, with those old timbered houses giving it an air of the medieval. And there are one or two fine old inns, notably the Old Holly Bush, which dates back over five hundred years; the little "Farmer's Boy" down the road whch leads to Aldenham lakes is good too . . . but I did not intend to write of inns, but of a Sunday morning pilgrimage by a band of young cyclists. I met them at the corner of the St. Albans Road, and we fell to chatting. They had cycled from somewhere in the Islington-Holloway labyrinth, and the object of their journey was to visit a country church; and here they were at Elstree, and I commended them to the church there, dedicated to St. Nicholas, and a quiet and pleasant place in which to perform one's devotions on a Sunday morning. Fields nearby . . . with fine black and white Friesians grazing therein; a well-treed countryside, with the leaves of the oaks and beeches turning to amber and gold. And, after service, if the fates be kind, the chance of a pint of ale from a pewter tankard, in an inn which maybe was dispensing hospitality to travellers prior even to Tudor times. . . .

The Cyclist's Ideal Road Surface.

WHICH is it? The smooth metalled road, the evenly-laid wooden block, the somewhat dazzling whitish concrete? I heard a heated discussion on the subject quite recently, and after hearing it I was really no wiser as to the solution. I am not a road-surface expert, but I must say that I do not greatly enjoy riding on concrete; on a very sunny day I have often thought that the glare was bad and uncomfortable. But I should like to hear the views of experts, for this question of selecting the best road surface is highly important—and not only for the motorist!

For Naturalists in London.

TO the man really interested in wild birds, and the wild life of the countryside, I suppose it is always rather an exile for him to have to live in London; in spite of the parks and lakes, he craves for the more open spaces, for the moors and thickets where he may study his hobby. But there are compensations, and it behoves the naturalist to keep his eyes open even in London itself. Surprising birds visit the city; even the fast-disappearing native red squirrel may be seen occasionally but a mile or two from the Metropolis, and one day in September, in a park-cum-wood quite near to Town, I watched a pair of goldfinches disporting themselves on a clump of Michaelmas daisies. They are dainty, colourful little birds, and are particularly fond of the Michaelmas daisy when it is seeding. Yes! London is more countrified than we sometimes imagine, and all summer wood-pigeons have been cooing in a tree which is within sight and sound of a Tube station. . . .

When You Send Your Bike by Train.

DID you notice that story in the newspapers this week about the resolve of the railway companies to take more care of bikes consigned by rail? We all know how, all too often, the machines are "pitched" into the guard's van, and how they get damaged by tumbling about, and jostling with other goods. Now, it appears, the railways have awakened to this fact, and propose to sling bikes to the roof of the van by special hooks—keeping them out of harm's way. It is a good idea . . . of course, long overdue. But I welcome it as further evidence that our railways (which bore such a heavy burden during the war years) are alive to the urgent need for many improvements. Maybe, one day, we shall say good-bye for ever to the traditional buffet bun!

Pyrford Mill, Surrey.
A fine timber mill on the River Wey between Pyrford and Ripley. (Sometimes known as Newark Mill).

Lullington Church.
Sussex.

One of Englands smallest churches. A lonely little building surrounded by trees off the main road from West Dean to Alfriston.
Only the chancel remains of the original building which was destroyed centuries ago by fire.

My Point of View

By "WAYFARER"

Grey Abounding

THE middle Sunday in October, in my part of the world, was a perfect study in grey. The sun steadfastly refused to shine; the morning air was permeated with moisture; and the wind sat persistently in the north-east, which is not (to put it mildly) the most popular of the points of the compass! Visibility was very restricted. But what a cycling day it was—this day of grey abounding! I did 32 miles in the morning and brought an outsize in appetites to the dinner-table, which was actually only half that distance from home, by the direct route. Another 23 miles made me more than ready for tea, and a final 21 miles in the dark carried me home in a fit mood to tackle my supper.

It was all very pleasant. The austerity of the day kept the traffic well within bounds, and I experienced no discomfort in this respect. As regards my fellow-cyclists, I saw a party of about 20 in the morning, and encountered them again in the afternoon. At the dinner-place there were about half a dozen. At the cottage where I usually have my Sunday tea, there was not a single bicycle—which was most unusual. I wondered whether I had gone to the right house! On voicing my doubts to the caterer she smiled and said nothing. "Stale bread all this week for you!" I murmured. "Never mind!" she replied. "Come in!" I opened the door of "the room," thinking to find it empty—and there found a party of 22 ramblers talking quietly amongst themselves. The place was not so deserted as it appeared to be!

Yes; this day of grey abounding was a truly excellent one. How good to conquer any little reluctance to turn out in the slightly repellent conditions of the morning; how grand to ride so many miles with such joy and benefit!

Heretic Views

WHILST I very readily acknowledge that our railway companies have lagged behind those of other countries in their treatment of cycle traffic—their progress, indeed, has been backwards; for instance, where are the buffer-mats which used to be provided for the protection of our machines when stacked in guards' vans?—I cannot help feeling that too much attention may easily be given to this whole question. If my views are those of a heretic, that cannot be helped. I have always held that bicycles were made to be ridden and were not simply a form of luggage to be carried about the country in trains—at ridiculously heavy cost—receiving there the treatment usually accorded to milk-churns. (A case came to my notice a short time ago where a congenital idiot, dressed in a porter's uniform, had actually lifted the rear portion of a heavily-laden bicycle by means of the celluloid mudguard—to the marked disadvantage of the said mudguard!)

In my view, we are thinking too much about giving our bicycles train-rides. If I lived in London—which, thanks be, I do not!—I have no doubt that my attitude would be different, and that I would be glad to buy "home rails" to get me quickly into the country, and to enable me to miss miles and miles of suburbia. I am fortunate in living in a provincial city which it is fairly easy to quit on a bicycle, and I would therefore think twice—perhaps three times—of using trains, save on very special occasions. The cost is a factor for consideration, as also is the bother of arranging one's programme to catch trains, whilst I, personally, would be very peeved at the waste of time if the train I wanted were running late. As a routine matter, I cannot see that the game is worth the candle, as the saying goes.

If, however, I were intent on touring in Scotland, I would certainly go thither (or, at least, to the border) by train, the folly of burdening a Scottish tour with a week's English travel being self-evident. If I were touring in the south-west of Ireland, I might take train to and from Fishguard, as I did on one occasion. On the whole, then, it is better to use the bicycle for the purpose for which it is intended—which is *not* giving it rides in trains!—falling back on public transport only on special occasions. That being so, can we expect the railway companies to go to much expense in the way of providing additional facilities for us? I hardly think so, but perhaps I am a heretic in these matters.

Touring Experiences

A FRIEND who carried out a late summer tour in the West Country reports very satisfactory experiences, except as regards that easiest of all meals, tea. Night accommodation was readily obtained without any booking, and breakfasts, lunches and suppers left little to be desired, making allowances for difficulties over supplies. But teas, on the whole, are written down as travesties, and this remark applied especially in Bath—not exactly a resort for cyclists!—where the food portion of the meal was just about one mouthful. There is no need for this ultra-skinniness, and caterers ought to have enough sense to realise that touring cyclists, using their own power, need a lot more sustenance than motorists. When I, personally, have tea at a place which looks as though it were accustomed to providing for people who sit in cars, I make it very clear at the outset that it's a meal I want—not two or three wafers of bread and butter that would go into a hollow tooth (if I had one). Another friend, who carried out an even later tour, also in the West Country, tells me that the search for nightly accommodation proved more troublesome than he expected. In fact, on one or two occasions he had "the wind up."

Good Hearing

IT is indeed good hearing that the standing joint committee of the Royal Automobile Club, the Automobile Association and the Royal Scottish Automobile Club has appointed a committee to secure the introduction of measures for the prevention of "dazzle" from vehicle lights. The reform is long overdue. I presume that we are all agreed that motor-cars should be adequately lighted, but there is no reason in the world why every other road-user (including other motorists) should be inconvenienced through the medium of "dazzle" and excessive lighting. Cyclists are the worst sufferers from this form of selfishness, and we shall welcome any measures which may be taken to abolish a real danger in connection with night riding. Moreover, we cannot help remembering that, at one stage of the late war, when our own lighting arrangements were eased, something was said as to the undesirability of our "dazzling" motorists! I hope that the committee above referred to will get down to their task with good heart and make such suggestions as will speedily put an end to a dangerous and unpleasant state of affairs, involving the temporary blinding of cyclists through the medium of excessive lighting.

It Broadens the Mind

IT has been my fortune (?) of late to ride much in motor-cars, buses and trams, out of all of which I have hitherto kept as much as possible. This newish phase of life broadens the mind: it helps one to understand (though not to approve or endorse) the impatience displayed by so many drivers. Some people get hot under the collar at the thought of their 10, 20 or 30 horses being restrained and obstructed by the funereal advance of a single horse drawing a quite unimportant cart. But, so long as the position endures where the roads, paid for by all, are for the use of all, it is to be presumed that the hurriers (with, very often, little cause for haste) will have to put up with the annoyances arising from the speed of non-mechanical dust-carts and delivery vans. Modern traffic conditions sometimes provide us, one and all, with an exercise in patience. If we can accept the position in the right spirit, so much the better for everybody—and particularly for those most intimately concerned with the delays which, for the moment, may be most exasperating.

Their Point of View

THE portions which I have read of the Scottish Council's Tourist Committee Report for 1946 are quite interesting. However "fed" we may feel at hitting a patch of what we call bad weather, we must surely agree that Scotland's "high rainfall contributes to natural beauty by preserving verdure and feeding beautiful lochs and rivers." That remark is true of other parts of the country, and we must all be aware—even if we admit it grudgingly—that a wet summer has its advantages, if only in the matter of water-falls. "Recently collected facts," says the Report, "prove that our climate is not so adverse as we have been led to believe," support for this dictum being found in the fact that the rainfall in the Western Isles is as low as it is in the Isle of Man, while the winter mean temperature is even higher than it is in the Isle of Wight. Be that as it may—and I see no reason for doubting what are admittedly surprising statements—I think we may accept the Committee's submission "that historical evidence supports the conclusion that the weather is an integral part of the varied experience to be offered to visitors." Varied? Yes—variety of the "infinite" type, with good days jostling bad days! And I think it may be added—the remark not being restricted to Scotland—that the most reliable feature of our climate is its unreliability!

Rewarding Policy

IT certainly is a remunerative policy to look over one's bicycle from time to time in order to ensure that everything is in apple-pie order. The machine as a whole should be scrutinised, with a special eye on the tyres, on which so much responsibility rests. Also, the nuts should be gone over with a spanner, to make certain that they are all fast, while the position of the brake-blocks in relation to the rims on which they operate should be noted, and corrected, if required. I suggest that this policy of carrying out a periodical examination is a rewarding one. It takes up little time—but what a lot of time it may save! One day recently, in looking over my No. 1 bicycle, I observed a tiny slit in the back rim, and that discovery sent me post-haste to my repairer, with instructions to provide a new rim forthwith. I may be ultra-careful in such a matter as this. I am not prepared, however, to run the risk of a breakdown "miles from anywhere," with the possibility of a long walk home and of the general inconvenience which such a catastrophe would entail. So I "played safe," and had the wheel rebuilt. I don't mind "living dangerously," but not—thank you!—in this respect.

What is Truth?

IT was Pilate of old who raised the question, and I do not believe a satisfactory answer has yet been discovered. At the end of August a man in Surrey wrote to *The Times* to say that "at the present moment tyres, inner tubes, rims, etc., are unobtainable." Curious! A few days earlier, in a Shropshire village, I bought an inner tube of best quality, and could have had several more had I desired, while on the day the letter in question appeared I bought a second tube, of the same make and quality, in Birmingham. So, where are we? Inner tubes may be scarce: they are not "unobtainable."

Opinions Differ

JUST as there is no prettiest village, and no finest view, and no best bicycle (though here I make a certain mental reservation!), so divergencies of opinion must exist with regard to caterers and catering. I recall once taking a family holiday at a Yorkshire inn where a man assured me that he and his friends had "lived like fighting-cocks." He was right—if birds of that type were sustained on poultry which had been far too long in the septuagenarian class, on coarse butcher's meat whose spiritual home was really a cobbler's shop, on bacon which was a fair imitation of canvas, and on cakes compacted of sawdust and lubricating oil.

I have been waiting for some time to sample a catering establishment of which a cycling acquaintance told me, speaking words of praise in a confidential whisper which was obviously intended to impress. Unfortunately, or otherwise, the place stands in an awkward position, and when, at long last, I was able to put my fortune to the touch, I was turned down on the score of sheer busyness. "Better luck next time," and "A treat in store," were my thoughts as I went on my way. Before a second opportunity occurred, however, a letter came to hand from one of my regular correspondents, and it said, bluntly: "Whoever put this place on the list ought to be severely reprimanded." So there you are, and we see once more that "one man's meat is another man's poison." In view of this second, and up-to-date, opinion, some of my enthusiasm for sampling that establishment has evaporated.

Priority No. 1

BEFORE taking a softening tyre to pieces in order to find the leak, it is well to pay a little attention to the valve. One evening recently, when I was completing a longish ride, I became aware that my front tyre was dragging slightly. Thumb pressure confirmed my suspicion that something was amiss, but I pumped up and hoped for the best. The "best" happened. A further supply of fresh air saw me right and on the following morning I decided that I had better tackle the problem—rather reluctantly, because it is an awful waste of time (from my point of view) messing with tyres. First I pumped the tyre very hard, feeling that, if the valve were at fault, that action would "put paid" to it. Then I held an egg-cup of water round the valve, and the series of bubbles told me all that I wanted to know, and the "trouble" was soon remedied. But how easy it would have been to dismantle the tyre without testing the valve! So let the valve be Priority No. 1!

"Practical Mechanics" Advice Bureau. COUPON

This coupon is available until December 31st, 1946, and must be attached to all letters containing queries, together with 3 penny stamps. *A stamped, addressed envelope must also be enclosed.*

Practical Mechanics. December, 1946.

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

CONDITIONS OF SALE AND SUPPLY: This periodical is sold subject to the following conditions, namely, that it shall not, without the written consent of the publishers first given, be lent, re-sold, hired out or otherwise disposed of by way of Trade except at the full retail price of 9d.; and that it shall not be lent, re-sold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade; or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.