INSTALLING DOMESTIC ELECTRICAL DEVICES

NEWNES

# PRACTICAL MECHANICS

MAY

6D.



Super Power Stations

LIVING FOR 200,000 YEARS • THE ROMANCE OF SUGAR • HOME-MADE MAGNETS • HOUSEHOLD PLUMBING HINTS • A.B.C. OF PHOTOGRAPHY • FACTS ABOUT AURA • BUILDING MODEL AEROPLANES, RAILWAYS AND BOATS • MONEY-MAKING IDEAS • LATEST NOVELTIES AND TOOLS ETC.

86, St. Peter's Grove,
Canterbury.

Class Number L 131682. 17th Dec., 1934.

Dear Sir,

You may remember me as a pupil of your College, taking a correspondence course for the recent Civil Service Examination. The result of this examination has now been published and I learn that I was fortunate enough to secure the top place out of over 1,400 other candidates. I consider that this result reflects great credit upon your course and your tutors, for their interest and their willingness to help me with my studies.

May I wish you the compliments of the season and every success in the future.

Yours very gratefully,
C. P. Cayley.

# 3 LETTERS

**Read them—then you will realise what is happening and why.**

**A VOCATIONAL TRAINING FROM THIS COLLEGE IS A CAREER—A SUCCESSFUL PROGRESSIVE CAREER**

110, Victoria Road, Dundee,
Angus.
16th January, 1935.

MR. J. H. BENNETT,
Bennett College Ltd.,
Sheffield.

Class Number L159929.

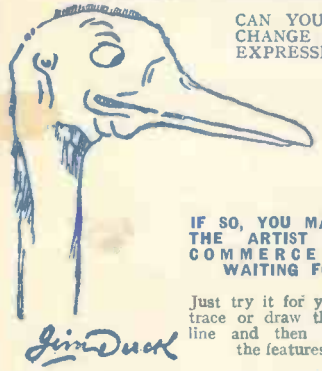
Dear Sir,

A short time ago I enrolled as a student of the Clerk of Works Architecture, etc., course; although still in my twenties, I have, through the excellent tuition provided in the above course, been successful in my application for the position as Clerk of Works with the Dundee Town Council.

Yours faithfully,
George Moffat.

## OPEN LETTER TO PARENTS

**Dear Sir or Madam,—When your children first arrived they brought with them a wonderful lot of sunshine. Later you became proud of the intelligence they displayed, but still later you became anxious as to what would become of them in the future. Perhaps you were anxious when you visualised them as grown men and women. Even with plenty of money it is not always easy to select the right career, and a parent is sometimes inclined to ask advice of some relative and in ninety-nine cases out of a hundred that relative knows nothing at all about the possibilities of employment. Why not let me relieve you of some of your anxieties? In fact, why not let me be their Father? We do not profess to act as an employment agency, but the nature of our business compels us to keep an eye upon the class of men and women that are wanted and who wants them. There are some people who manufacture an article and put it on the market to sell. We do not do that, we work in exactly the opposite direction. We find out what employers want and we train our students to fill those jobs. We have to be experts in the matter of employment, progress and prosperity. If you have any anxieties at all as to what your sons and daughters should be, write to me, or better still, let them write to me personally—Fatherly Advice Department—and tell me their likes and dislikes, and I will give sound, practical advice as to the possibilities of a vocation and how to succeed in it.** Yours sincerely,



CAN YOU CHANGE MY EXPRESSION

**IF SO, YOU MAY BE THE ARTIST THAT COMMERCE IS WAITING FOR**

Just try it for yourself, trace or draw the outline and then put in the features.

**There are hundreds of openings in connection with Humorous Papers, Advertisement Drawing, Posters, Calendars, Catalogues, Textile Designs, Book Illustrations, etc.**

60 per cent. of Commercial Art Work is done by "Free Lance Artists" who do their work at home and sell it to the highest bidders. Many Commercial Artists draw "retaining fees" from various sources, others prefer to work full-time employment or partnership arrangement. We teach you not only how to draw what is wanted but how to make buyers want what you draw. Many of our students who originally took up Commercial Art as a hobby have since turned it into a full-time paying profession with studio and staff of assistant artists; there is no limit to the possibilities. Let us send full particulars for a **FREE TRIAL** and details of our course for your inspection. You will be under no obligation whatever.

Art Dept. 76.

## YOU CAN HAVE A COLLEGE TRAINING IN ALMOST ANY CAREER FOR A FEW SHILLINGS MONTHLY

- Accountancy Examinations
- Advertising and Sales Management
- A.M.I. Fire E. Exam.
- Applied Mechanics
- Army Certificates
- Auctioneers & Estate Agents
- Aviation Engineering
- Banking
- Boilers
- Book-keeping, Accountancy and Modern Business Methods
- B.Sc. (Eng.)
- B.Sc. (Estate Management)
- Building, Architecture and Clerk of Works
- Cambridge Senior School Certificate
- Civil Engineering
- Civil Service
- All Commercial Subjects
- Commercial Art
- Concrete and Structural Engineering
- Draughtsmanship. All branches
- Engineering. All branches, subjects and examinations
- General Education
- G.P.O. Engineering Dept.
- Heating and Ventilating
- Industrial Chemistry
- Insurance
- Mathematics
- Matriculation
- Metallurgy
- Mining, all subjects
- Mining, Electrical Engineering
- Motor Engineering
- Motor Trade
- Municipal & County Engineers
- Naval Architecture
- Pattern Making
- Police, Special Course
- Preceptors, College of
- Pumps and Pumping Machinery
- Radio Service Engineering
- Road-Making and Maintenance
- Salesmanship
- Sanitation
- Secretarial Exams.
- Shipbuilding
- Shorthand (Pitman's)
- Structural Engineering
- Surveying
- Teachers of Handicrafts
- Telephony & Telegraphy
- Transport Inst. Exams.
- Weights and Measures Inspector
- Welding
- Wireless Telegraphy and Telephony
- Works Managers

*If you do not see your own requirements above, write to us on any subject.*

## HOW TO STUDY

In your spare time when it suits YOU. You fix your own time, you do not GO to your studies—the postman brings THEM TO YOU. There is nothing that a class-room teacher can show on a blackboard that we cannot show on a white paper. The lesson on a blackboard will be cleaned off, but our lessons are PERMANENT. A class-room teacher cannot give you a private word of encouragement, but a Correspondence Tutor can do so whenever your work deserves it. On the other hand he can, where necessary, point out your mistakes PRIVATELY.

## TO STUDENTS LIVING ABROAD

or on the high seas, a good supply of lessons is given, so that they may be done in their order, and despatched to us for examination and correction. They are then sent back with more work, and in this way a *continuous stream of work* is always in transit from the Student to us and from us to the Student, therefore distance makes no difference.

Also ask for our New Book (Free of Charge)

## THE HUMAN MACHINE

SECRETS OF SUCCESS

**IT IS THE PERSONAL TOUCH WHICH COUNTS IN POSTAL TUITION**

## YOUNG MEN

Young men physically fit and whose careers are not definitely fixed should join the Police Force. We have Special Courses for Entrance and Promotion.

1/- per week brings success. Full particulars free.

**Address: Police Dept. 76**

The Bennett College Limited.

FOUNDED 1900.

Dept. 76, THE BENNETT COLLEGE, SHEFFIELD.

**EVERY DEPARTMENT IS A COMPLETE COLLEGE.**

**EVERY STUDENT IS A CLASS TO HIMSELF.**

All applications respecting Advertising in this Publication should be addressed to the ADVERTISEMENT MANAGER, GEORGE NEWNES Ltd., 8-11 Southampton Street, Strand, London, W.C.2. Telephone: Temple Bar 7760.


# Practical Mechanics

VOL. II. No. 20
MAY
1935

Edited by F. J. CAMM

SUBSCRIPTION RATES :
Inland and Abroad, 7s. 6d. per annum
Canada - - 7s. per annum

Editorial and Advertisement Offices : "Practical Mechanics," George Newnes Ltd., Southampton Street, Strand, W.C.2.
Registered at the G.P.O. for transmission by Canadian Magazine Post.


# Notes, News and Views

### A Vertical Flight

THE autogiro, which is now in extensive use, has at last achieved a direct lift off the ground without any forward run. This amazing performance will thus enable the machine to rise in a very restricted area. The autogiro has already shown its ability to ascend with a very short run and to alight in confined spaces.

### Into the Stratosphere

WE learn that a rocket is being prepared by Russian scientists which, they declare, will be capable of reaching a height of 28 miles. A small model of the rocket, weighing only 33 lb., and propelled by a mixture of benzene and liquid oxygen, will be tried out at a Moscow aerodrome. This is expected to rise to a height of 2½ miles, where it will automatically release its barograph, which will descend safely by parachute.

### A New Streamlined Express

THE G.W.R. express, "King Henry VII," has recently been streamlined at Swindon. It has been fitted with a "bullet nose" front to reduce wind resistance, and certain modifications have been made to the boiler, cab and tender by use of light steel plates.

### A Discovery

A NEW land, which has been named Ingrid Christensen's Land, has been discovered in the Antarctic by a Norwegian oil tanker, "The Throshavn." Possession has been taken in the name of Norway.

### World's Largest Airship

THE new German dirigible, "LZ 129," the biggest in the world, is expected to be launched this month. With this airship the designer, Dr. Eckener, claims that the performance of the "Graf Zeppelin" will be greatly surpassed. It will be able to cross the Atlantic in forty-eight hours westward and in fifty-five hours eastward. The "LZ 129," which is nearly twice the size of the "Graf Zeppelin," will be capable of a speed of 83 m.p.h. and will carry fifty passengers and a crew of fifty-four. She is 813 ft. in length, and will contain 6,710,000 cub. ft. of gas as compared with "Graf Zeppelin," 3,709,000 cub. ft., the late U.S. "Macon," 6,500,000, and the two defunct British airships, 5,000,000 cub. ft. The "LZ 129" is to be fitted in part with engines of the Diesel type.

### The World "on the Phone"

THE recent successful inauguration of the Anglo-Japanese radio-telephone service now makes it possible for a telephone subscriber in Britain to pick up his receiver and call Tokyo. The minimum cost for this will be £6 for three minutes. The new Japan service is limited to the period between 8 a.m. and midday, English time (5 to 9 p.m. in Japan).

### THE MONTH'S SCIENCE SIFTINGS

*Lighter aeroplanes capable of a speed of 275 m.p.h. will be under construction before the end of this year in preparation for competitive tests.*

*A streamlined and petrol-driven pneumatic-tyred train reached a speed of 65 m.p.h. during a recent demonstration run.*

*To minimise as far as practicable interference with wireless programmes, all new trolley buses will be fitted with stopper coils or other apparatus.*

*During 1934 the R.A.F. flew about 400,000 hours, a computed distance of 47,000,000 miles, at an average speed of 116 m.p.h.*

*The world's first high-definition television service was recently opened in Berlin.*

*The discovery of an uncharted submarine mountain ridge in the Atlantic Ocean, 180 miles south-west of Portugal, has been made by the cable ship "Ampere" whilst repairing cable from Brest to Casablanca.*

### An Experimental "Air Train"

IT is stated that experiments are being carried out in Moscow for an aeroplane to tow nine gliders from Moscow to Irkutsk, a distance of 3,000 miles. To avoid collisions in mid-air the gliders will be towed at different levels. Regular lines may be established if the above experiment proves successful.

### "Thermometer" Tuning

A UNIQUE development in wireless receivers is "thermometer" tuning, introduced by Messrs. A. C. Cossor Ltd. Station names and wavelengths are instantly visible on an illuminated scale, and as the tuning knob is turned a dark column rises and falls, giving immediate and accurate tuning of stations.

### Long-playing Gramophone Needles

A NEW gramophone needle has recently been produced by H.M.V. research engineers. These high-fidelity needles will play thirty to sixty record sides without causing serious high-note loss when used on an ordinary acoustic or radio-gramophone. This is a record track length of about 5 miles.

### 30,000 Feet above the Atlantic

AN Irishman, Mr. C. L. Fowey, has invented several devices designed to increase safety, weight-lifting capacity and speed of an aeroplane. He hopes to demonstrate their efficiency by a return Atlantic flight in an aeroplane that is being secretly constructed in New York. Mr. Fowey intends to fly at a height of 30,000 ft. during the flight, and the plane will be fitted with a two-way telephone apparatus with which he intends to keep in touch with America and Europe. To generate the necessary electrical power to make this possible the inventor proposes to occasionally make a long dive at a high speed towards the ocean. Mr. Fowey will carry an oxygen supply and be enclosed in an almost hermetically-sealed cabin.

### Television To-day

ON April 10th was published the first number of a new serial work entitled "Television To-day" (1s.). It is to be completed in about sixteen weekly parts.

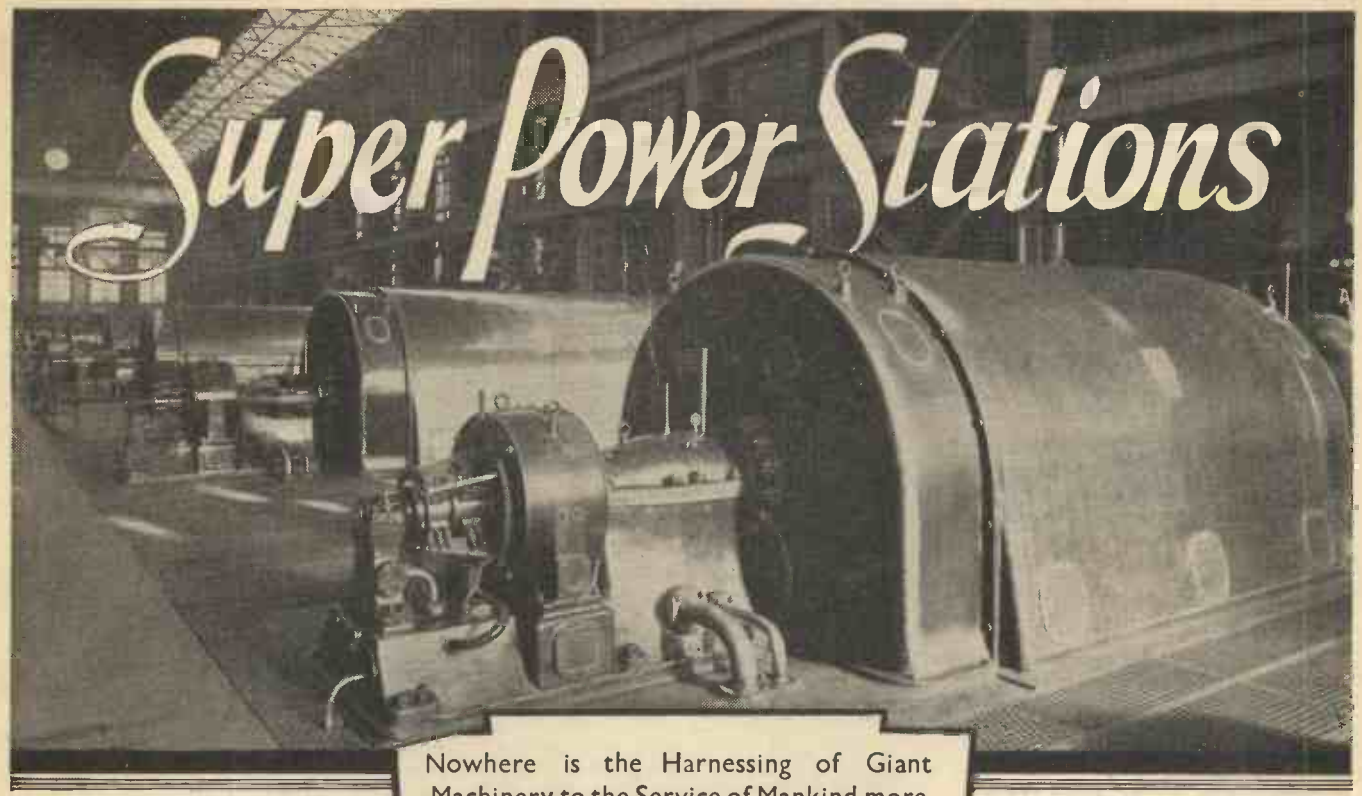
One of the most interesting features in No. 1 is a survey covering all the chief systems used in this country, in Germany, and in the U.S.A.

In the list of contributors we notice many well-known names, notably Dr. V. K. Zworykin, the inventor of the Iconoscope; Philo Farnsworth, the inventor of the Electron Image Dissector; and Capt. A. G. D. West, the Technical Director of the Baird Co. A splendid shillingsworth for the man who wishes to bring his knowledge right up to date on this new phase of radio.

### A New Safety Razor

A NEW type of safety razor, the blade of which consists of a narrow ribbon of steel 57 in. in length, is now being manufactured in Sheffield. The blade, which is fitted on two spools, works on the same principle as a typewriter ribbon, and when the length of blade in use becomes blunt a fresh length is brought into use by turning the blade on the spool.

# Super Power Stations



**Nowhere is the Harnessing of Giant Machinery to the Service of Mankind more Imposingly Demonstrated than In the World's Great Electrical Power Stations. The Photographs and the Text of this Article deal interestingly with some of the Finest Examples of Electro-Generating Machinery In Existence**

TO visit any vast electric power station is to feel suddenly dwarfed by the majesty of things mechanical, as though an entry had been vouchsafed to some infinitely more progressive planet or remotely future age. Almost it might seem that whatever is dealt with fantastically to-day is by some-one made practicable to-morrow.

The power station at Barking, built on the left bank of the River Thames, is the largest in this country. The original building, containing 100,000 kw. of plant, was opened by H.M. the King in 1925. By 1931 the plant installed totalled 240,000 kw., and in 1932 the recent extensions, which comprise two units of 75,000 kw. each, were embarked upon, bringing the present installed capacity of the whole station up to 390,000 kw. If this huge plant were working continuously throughout the year and at full capacity, it would generate 3,400 million units—more than a quarter of the units turned out in the whole of Great Britain.

### Efficiency the Keyword

The two newer turbines are housed imposingly. The network of pipes on roof and walls is variously coloured, each colour denoting the work the pipe is doing. The grey, aluminium and black of the machines and boilers make an impressive background. Efficiency has been the keyword from first to last. The two new turbo-alternators are the largest in service in Great Britain, and are connected to the two largest transformers in the world, each of the latter containing forty-three miles of copper winding and weighing 120 tons. No bridge was strong enough to bear these huge transformers on their journey to Barking, and they had to be transported across the river on special ferries. Yet even they in their present setting are dwarfed by the immensity of their surroundings.

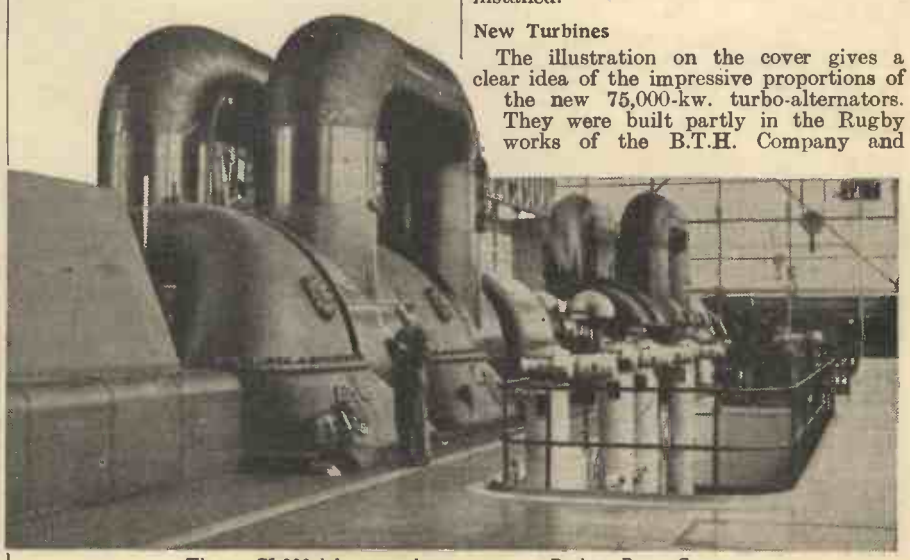
The energy from the Barking turbines leaves the station both above ground and below ground. Below the bed of the River Thames a tunnel 7 ft. in diameter carries the output cables to south-east London, to Surrey, and to Kent. Westward from the station, underground cables feed the east London areas. The overhead lines branch northward and eastward into Essex and beyond, whilst the whole of the transmission system is dominated by two towers—the highest of their kind in the world—one on each bank of the river.

### The Coal Conveyors

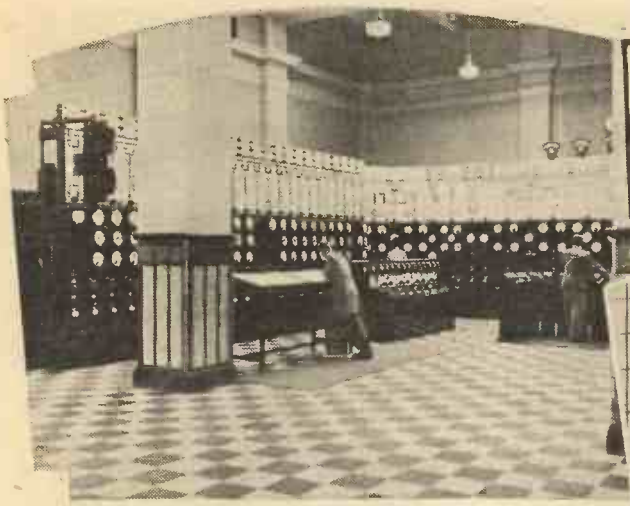
The coaling jetty is about 1,000 ft. long, from which two ships of approximately 4,000 tons apiece can be unloaded simultaneously by six cranes at the rate of no less than 1,200 tons per hour. Belt conveyors, linking jetty and station, can carry 1,400 tons per hour. About half a million tons of coal per annum are used. The new boiler house contains eight boiler units, burning stoker-fired coal, and having a normal evaporative capacity all told of 1,350,000 lb. of steam per hour, as contrasted with a normal evaporative capacity of 2,166,000 lb. of steam per hour obtainable from the twenty-six older boiler units installed.

### New Turbines

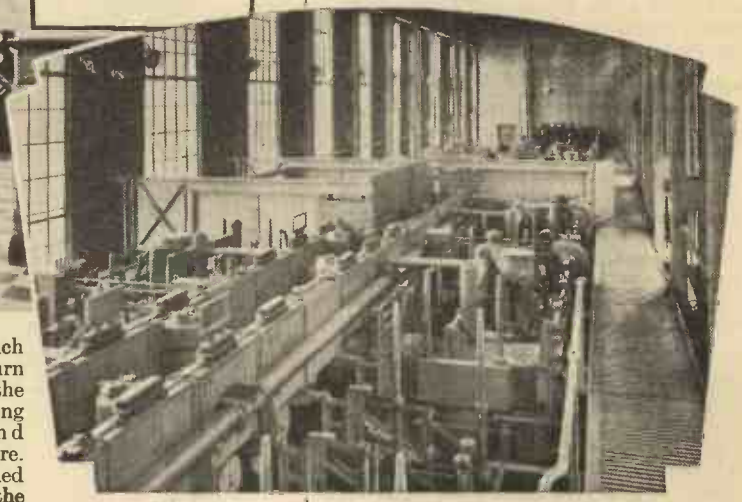
The illustration on the cover gives a clear idea of the impressive proportions of the new 75,000-kw. turbo-alternators. They were built partly in the Rugby works of the B.T.H. Company and



*The two 75,000-kilowatt turbo-generators at Barking Power Station.*



*On the left is shown the control room with its multitude of dials, and below an example of heavy-voltage switchgear.*



partly in the Trafford Park works of the Metropolitan-Vickers Electrical Company. The normal pressure of the superheated steam at entry is 600 lb. per square inch with a maximum of 700 lb. per square inch, the temperature being 800° F. or more. The turbines have three cylinders each—high-pressure, intermediate-pressure, and low-pressure respectively—steam passing from the high to the low as it expands and delivers up its store of energy. All connections between the steam chests and the high-pressure cylinders are below floor level. Efficient glands prevent discharge of steam into the turbine room. Flexible or semi-flexible couplings connect the high, intermediate, and low-pressure rotors and the alternator rotor, the axes of all four being, of course, in line. The freedom of the systems from vibration and noise is remarkable.

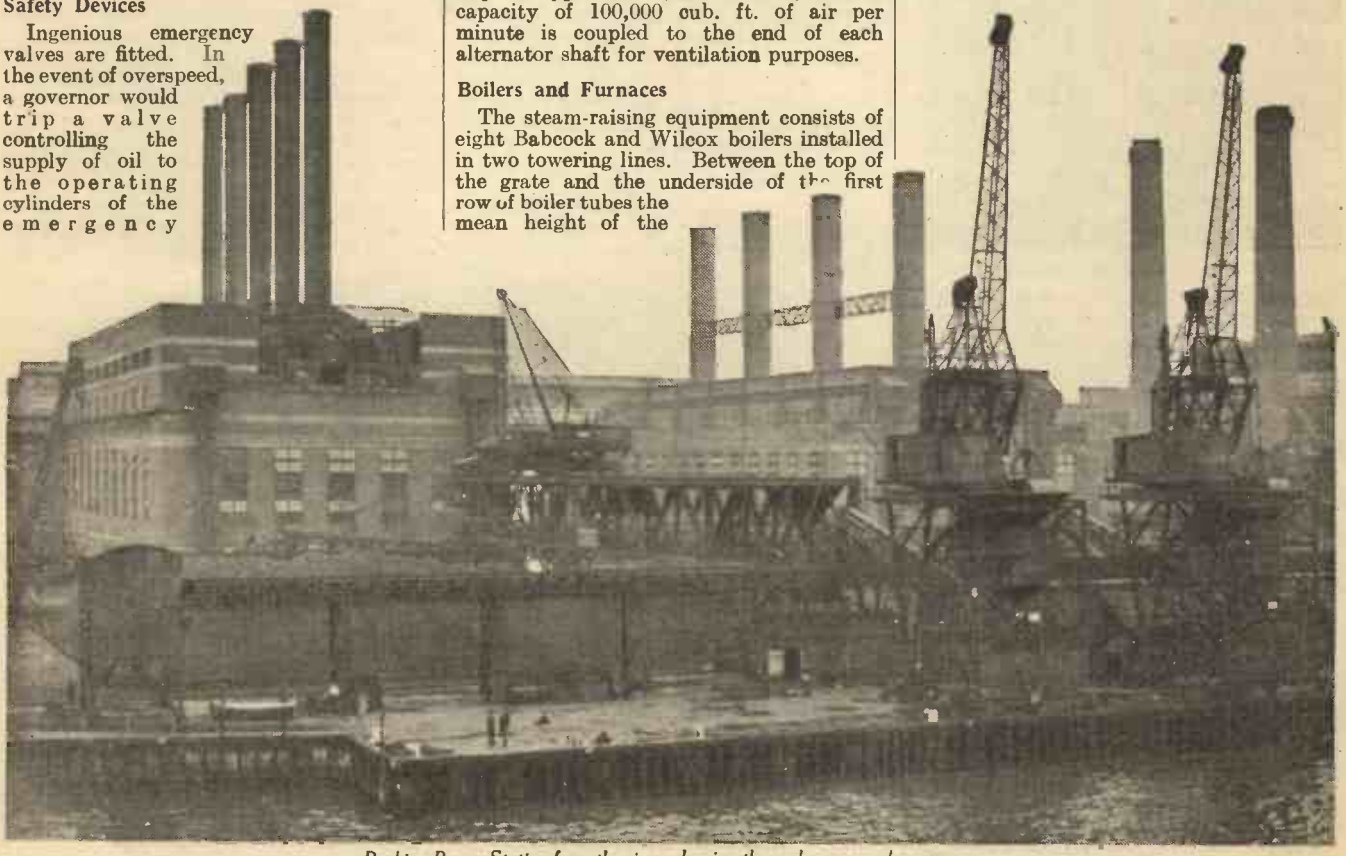
### Safety Devices

Ingenious emergency valves are fitted. In the event of overspeed, a governor would trip a valve controlling the supply of oil to the operating cylinders of the emergency valves, which would in turn close under the action of spring loading and steam pressure. As an added precaution the governor valves controlling the admission of steam to the high-pressure cylinder would also close. Failure in the lubrication system would similarly be the means of calling a halt before damage was done. Means are provided for limiting by hand the maximum valve opening on each steam chest in the feed system, so that the load on the unit can be predetermined and cannot be exceeded.

Weights of the component parts of the alternators are: stator, 150 tons; rotor, 72 tons; and exciters, 10 tons. A radial-impeller-type blower, of 12 tons, with a capacity of 100,000 cub. ft. of air per minute is coupled to the end of each alternator shaft for ventilation purposes.

### Boilers and Furnaces

The steam-raising equipment consists of eight Babcock and Wilcox boilers installed in two towering lines. Between the top of the grate and the underside of the first row of boiler tubes the mean height of the furnaces alone, with water-cooled walls on all sides, is 23 ft. Each water wall forms a separate unit connected to the boiler drum by its own downcomers and risers. The travelling grates of the stokers are 30 ft. wide and 22 ft. 6 in. long, giving an effective area of 675 sq. ft. An independent air supply has been provided for each grate. Secondary air is admitted fairly high in the combustion chamber, so that it intermingles with the gases in the hot combustion zone and creates complete combustion. Each boiler has two forced and two induced draught fans. Automatic control is adopted, the object being to maintain a constant suction in the furnace even under forced-draught conditions. A boiler instrument panel associated with each boiler provides every conceivable indication of the conditions under which the boiler is working, and even, by means of a photo-



*Barking Power Station from the river, showing the coal cranes and conveyors.*

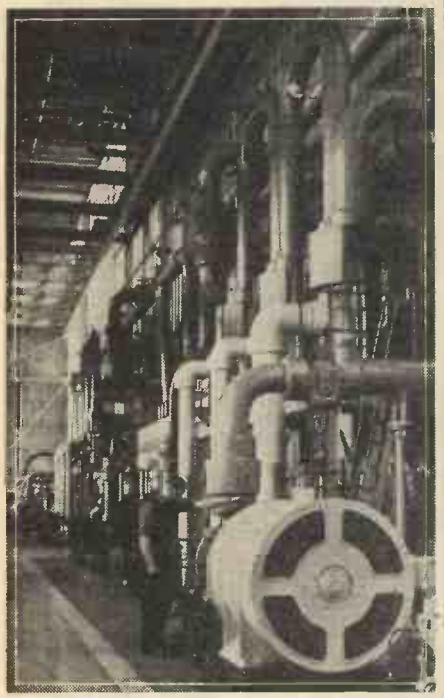
electric cell device, indicates the density of the smoke ascending the chimneys.

Before the water is allowed to enter the boiler system it is first softened in a special water-softening plant, and also chlorinated in the chlorinating plant illustrated. Softening the water prevents calcium deposits occurring on the inner surfaces of pipes, etc., and chlorinating the water prevents fungoid growths which might otherwise be set up.

**Switchgear**

Each of the switch-house buildings comprises two wings, part of one of which is shown in one of our illustrations. To prevent incorrect operation there is a system of mechanical and electrical interlocking. The control room shown in another illustration contains new Reyrolle equipment.

Current is distributed from Barking over a very large area, including the central boroughs of Finsbury and parts of Holborn, Bermondsey, and Southwark, and branching into Essex, Kent, and Surrey. Additionally,



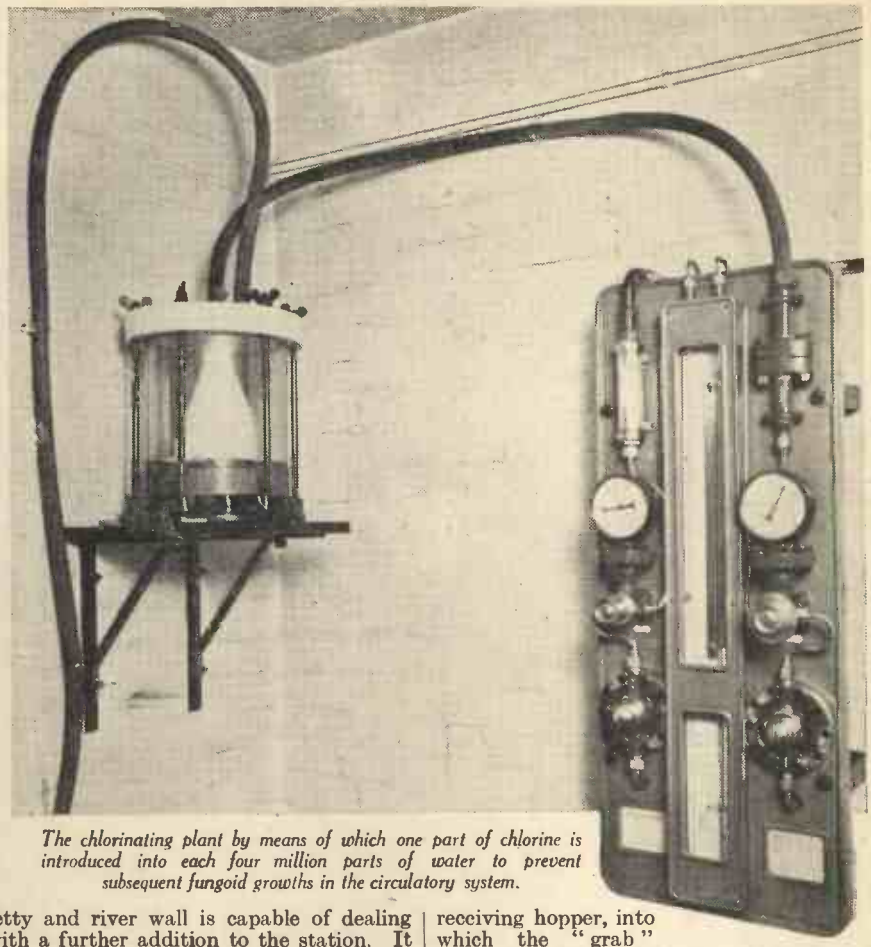
*A battery of feed heaters and pumps.*

electricity is supplied for traction purposes to the London, Midland and Scottish Railway, and the London Passenger Transport Board (Morden Tube).

**Extensive Use of Glass**

Turning for a moment exclusively to the new building, glass has been used extensively, resulting in well-lit plant and office accommodation. Above the structure, composed of red brick and white stone, glass occupies three parts of the total height on three sides of the building. The four brick-built chimneys are 250 ft. high, and taper from 30 ft. at the base to 23 ft. at the top. An important difference between the old station and the new is that the generating units in the new turbine-room do not use pulverised fuel and steam re-heating equipment, and are arranged longitudinally as illustrated on the first page of this article instead of crosswise. Again, of course, the new machines are on an altogether larger scale.

In conjunction with the extensions mentioned, steps have been taken with regard to possible further extension, and the layout of the new buildings has been planned with that end in view. The new unloading

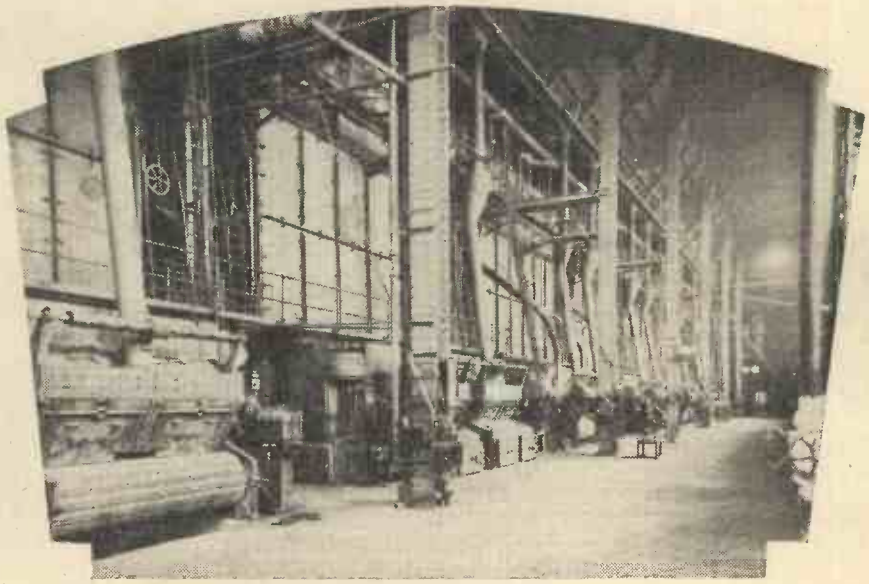


*The chlorinating plant by means of which one part of chlorine is introduced into each four million parts of water to prevent subsequent fungoid growths in the circulatory system.*

jetty and river wall is capable of dealing with a further addition to the station. It was considered thus necessary to be prepared for eventualities in view of the greatly increased demand made for electricity, more particularly for domestic purposes. The vast public living within the area of supply are finding it increasingly convenient to cook by electricity and heat water by electricity, apart from its universal use for lighting purposes.

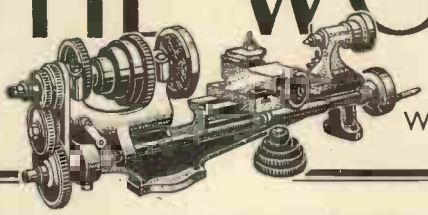
**Weighing the Fuel**

All incoming coal can be weighed, hopper weighing machines being provided for the purpose on two of the cranes. From the receiving hopper, into which the "grab" discharges, the coal falls into the automatic-recording hopper weigher, from which it is discharged on to the cross transfer belt conveyor and is borne forward in the normal way. In the case of two other cranes a belt weigher is provided, arranged so that the tare weight of the empty belt is subtracted from the weight of the loaded belt. In addition to this apparatus, which measures the sea-borne coal received, weighers and recorders are used in conjunction with each of the gravity bucket conveyors. These machines automatically record the total amount of coal being handled.



*A view of the boiler house at Barking.*

# LATHE WORK FOR AMATEURS



By W. H. DELLER

## BORING OPERATIONS

### Boring

WHEN boring holes from the solid, the work is first prepared by drilling a pilot hole and enlarging it to within reasonable limits of the size required, before commencing the actual boring. This is done by opening the hole in steps by means of suitably sized drills. Where the hole can be roughed out beyond the range of the largest drill available, a cutter can be utilised for the purpose. Such a cutter can be made with a mild steel shank, and several useful interchangeable hardened steel cutters will enable a drilled hole to be opened out rapidly for finishing by one or two boring cuts. The pilot should be made an easy fit with about five-thousandths of an inch clearance, in, say, ½-in. diameter hole, and case hardened. A 90 degree point on the locking screw engages with a countersink in the cutter. When making the cutters, the steel is cut off and the countersink made in the centre of the cutter blank, turned to correct diameter in the holder and backed off to suit the material being worked.

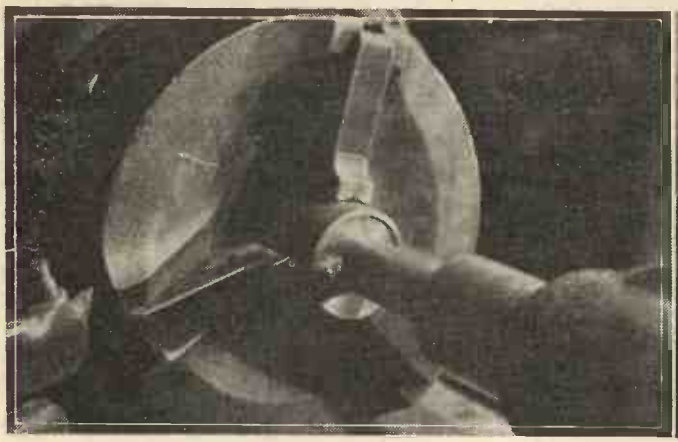


*Fig. 1.—Where the hole can be roughed out beyond the range of the largest drill available a front cutter like that shown above can be utilised.*

### Boring a Hole

An alternative method is to use a front cutter like that illustrated in Fig. 1, the side clearance being made sufficient to prevent rubbing. This type of tool is, however, unsuitable for deep roughing owing to "springiness."

To produce a good bored hole, it is essential that the cutting edge be rigid under working conditions. For this reason, select a tool or bar that is as near to the maximum size that the hole will admit, with sufficient allowance, of course, to permit the back of the bar to clear when the cut is removed. When an "Armstrong" type boring bar and holder are used, the bar should be allowed to project as little as possible beyond the front face of the holder.

When setting the tool for centre height, make sure that the heel of the tool will have enough clearance. Where the tool shows a tendency to set up chattering, the trouble can nearly always be overcome by narrowing the nose of the tool to reduce the area in contact with the work. It is most necessary to grind the tool to a fine shape when either the shank of the tool needs to be small in proportion to the length, or when the job being bored is of a thin character.

The failure of a lathe to bore parallel is nearly always due to incorrect alignment of the headstock spindle in relation to the track of the saddle. This is a fault that is easily rectified where the headstock is a separate casting, as jackscrews are mostly provided for adjustment, but in such cases where the headstock bearing housings are cast integral with the bed, the remedy lies in the direction of careful bearing adjustment.

### Mounting Work on the Face Plate

Where the work needs to be mounted on the face plate, and particularly when an angle plate is also used, it is most essential that the plate be balanced before commencing operations. Withdraw the driving pin connecting the back-gear to the cone pulley, so as to leave the mandrel free to rotate in the bearings. The face plate will then come to rest with the heaviest point at the bottom. Opposite to this point and near the edge of the plate a counterweight is attached. Change wheels form a ready means of providing the necessary compensation of balance as shown in Fig. 2. Failure to balance the mounted work causes the lathe to run at an unsteady speed, a

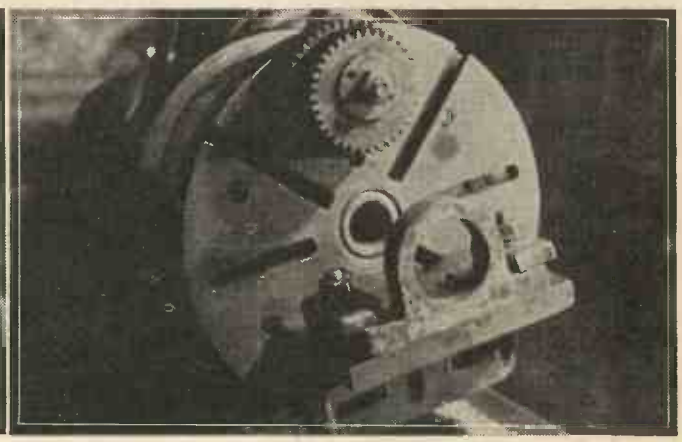


*Fig. 2.—Change wheels form a ready means of providing the necessary compensation of balance.*

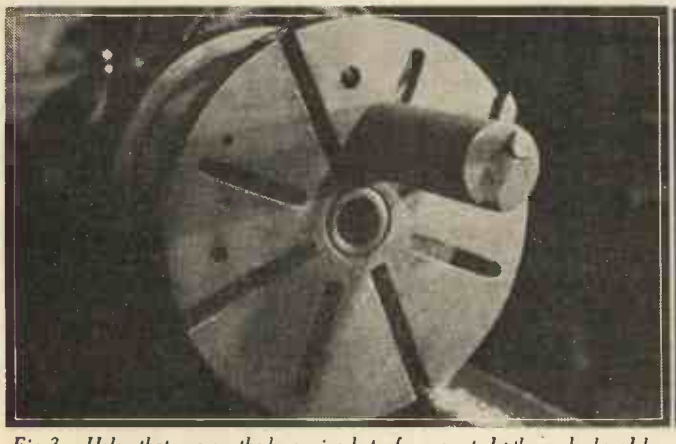


*Fig. 3.—Holes that are on the large size but of no great depth can be bored by means of a short bar mounted on the face plate.*

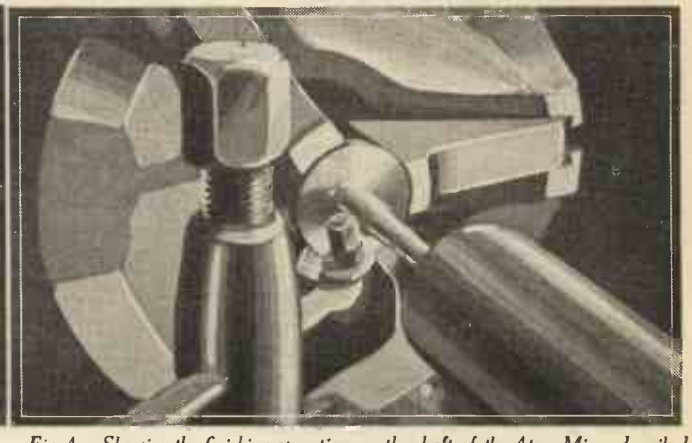


*Fig. 4.—Showing the finishing operations on the shaft of the Atom Minor described last month.*

condition from which an oval hole will result.

### Use of Pilot Bushes

For holes that are deep in proportion to diameter, and for which an ordinary boring tool would be too flimsy, use can be made of a special form of bar which is supported at the front end. The boring bar is made of a length equal to about two and a half times the depth of the hole to be bored from a straight piece of finished material such as silver steel. A true bush, having a hole in which the bar is a running fit, is fitted into the hole in the nose of the mandrel. The single-point cutter in the bar is held by a locking screw and the distance that it is situated from the front end is such that the end of the bar enters into the bush before the cut comes on. The bar needs, of course, setting so that its axis coincides with that of the lathe mandrel, and for this reason is more easily mounted in a special block. Such a block can be made by clamping a piece of suitably sized square metal in the tool post and making a reamed hole in it by means of tools held in the chuck. A set-screw passing into the hole holds the bar. It will be apparent that the cut must be adjusted by moving the cutter in the bar either by tapping or by means of an adjusting screw.

Should a hole with a reamed finish be desirable, the hole is bored a few thousandths under size and finished with a floating cutter. Such a cutter is made double-sided, measuring the size of the required hole over the cutting edges. The cutter is not fixed in the bar but is left free to float. On this account, therefore, the hole in the bar is made either square or rectangular, the tool sliding in with perfect freedom but without slackness in any direction. It must be mentioned that prior to using such a cutter the hole must be bored true, as the original hole acts as the guide.

### Boring Work held on the Saddle

The foregoing remarks have applied to work that can conveniently be held in the chuck or on the face plate. Work of an awkward shape or when the lathe will not swing in the ordinary way, may often be handled by clamping to the saddle and operating with a boring bar between the centres. Provision is made on most centre lathes for doing this by means of Tee slots in the saddle. With "American" type lathes it will be necessary to remove the cross slide and screw. The worst part of this class of work is the setting and, therefore, a few instances of what are considered the easiest methods to employ will follow.

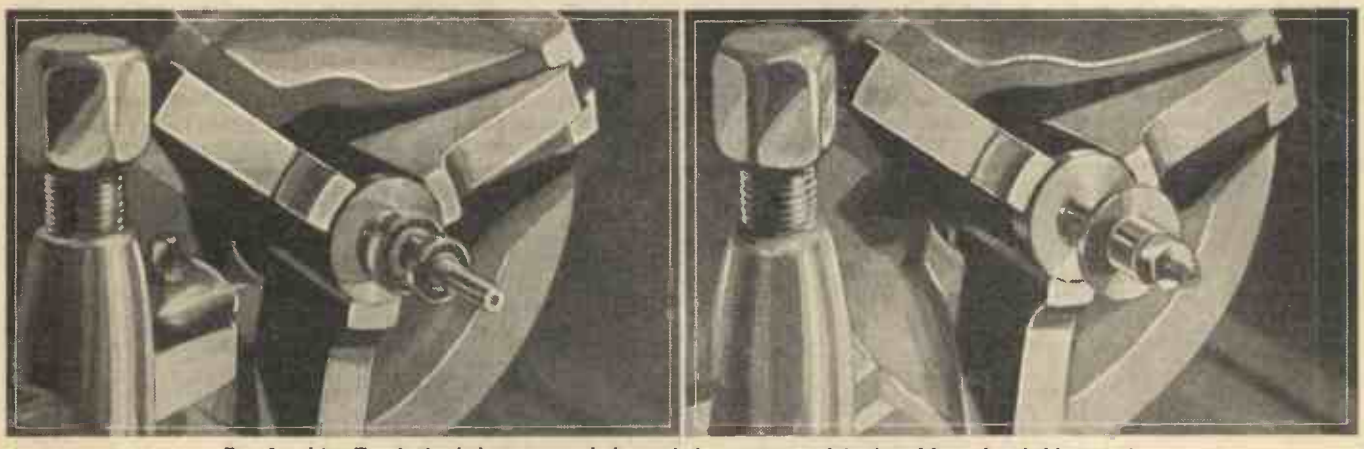
A long hole is to be bored from the solid through a boss-like formation in a casting having a flat base. First mark out the position of the hole centre on each end of the boss, suspend the casting between the lathe centres and pack up the base of the casting level and clamp down. Drill a hole through the boss with a drill held in the headstock and bore as described.

When boring a similar job with a cored hole, insert temporary hardwood ends into the cored hole, and mark a circle on each end of the casting concentric with the hole position. Remove the wood and insert approximately the correct amount of packing beneath the base of the job and test for correct position at each end of the boss with a bent scriber held in the cutter hole in the boring bar, adjusting the casting accordingly for height with packing, or by movement crossways.

The third example deals with a job that needs to be bored through square with a previously machined face. For the purpose of mounting, an angle bracket is required. To set the angle bracket square on the saddle, lightly bolt it in position and bring the vertical face to bear against the face plate. Pass a bolt through a slot in the face plate and through a slot near enough central in the angle plate, pulling the faces together with a nut. Finally tighten the angle plate to the saddle and release from the face plate. This will ensure that the angle plate is lying square without having to use an indicator.

For boring operations the boring bar is centred at each end and driven by means of a carrier and the work fed on to the tool by the sliding motion. Holes that are on the large size but of no great depth, such as in plate work, or bosses on long levers, may be (by mounting the work on an angle plate), bored by means of a short bar mounted on the face plate as in Fig. 3, or alternatively held in the chuck, for smaller bores). The foregoing remarks regarding cutter adjustment and floating cutters again apply.

If instead of fixing the bar direct to the face plate, provision is made to attach it to the top face of the tool slide, a sensitive tool adjustment will be obtained. By substituting a front tool in place of the tool bar a machined surface surrounding the hole may be turned at the same setting. The cut is put on by running the lathe slowly in back gear and giving the feed handle a portion of a turn each time it comes round, or as is sometimes done for the same purpose, a star wheel is attached in place of the handle to engage with a pin on the bed or saddle of the lathe. It should be pointed out that the slide is bolted flat on the face plate by the normal holding-down bolt holes.



*Figs. 5 and 6.—Two further lathe operations dealing with the construction of the Atom Minor, described last month.*

## TOOL GRINDING ANGLES

**This Table should be used in conjunction with the article on "Tools and Tool Angles," which appeared on page 257 of our March, 1935, issue.**

| Material. | Tool-grinding Angles. | | | Coolant or Lubricant. | Cutting Speed in Feet per Minute. | |
|---|---|---|---|---|---|---|
| | Clearance. | Top-Rake. | Side-Rake. | | Carbon Steel Tools. | High Speed Steel Tools. |
| Mild Steel | 8–10 | 8–10 | 20 | Suds or Oil | 40 | 80 |
| 3% Nickel, Annealed | 6–8 | 5–8 | 10–12 | Oil | 20 | 45 |
| Tool Steel | 5–6 | 5 | 10 | Oil or Turps. | 20 | 40 |
| Grey Cast-Iron | 6–8 | 5–8 | 10–12 | Dry | 30 | 60 |
| Hard Cast-Iron | 5–6 | 2 | 5 | Dry | 10–15 | 30 |
| Hard Brass | 10–12 | None | None | Dry | 65 | 130 |
| Soft Brass | 8–10 | 5 | 15 | Dry | 45 | 80–90 |
| Hard-drawn Copper | 8–10 | 5–8 | 15 | Dry or Suds | 40 | 80 |
| Aluminium | 8–10 | 5–8 | 15–20 | Dry or Paraffin | 80 | 160–180 |

Tool angles and cutting speeds may require modifying to suit conditions.
To convert cutting speeds in feet per minute to revolutions per minute, find inches per minute by multiplying given speed by 12, and divide by circumference of work in inches.

# MAKING A THERMOPILE

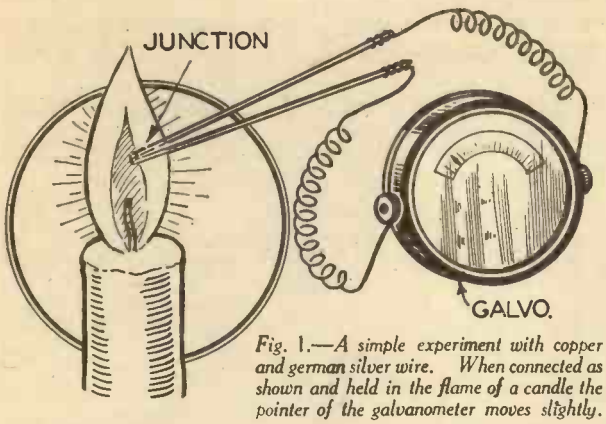



*Fig. 1.—A simple experiment with copper and german silver wire. When connected as shown and held in the flame of a candle the pointer of the galvanometer moves slightly.*

IT is a well-known fact that when the junction of two dissimilar metals is heated an E.M.F. is produced across the metals; this effect is made use of in various temperature-recording instruments and similar pieces of apparatus. Advantages of thermopiles for commercial use are many, since they can be mounted in a convenient place and the recording instruments grouped on a central panel. It must be remembered that the recorder is generally a sensitive milli-voltmeter or moving coil galvanometer; the construction of moving-coil mirror galvanometers has been described in this paper and these are quite suitable for experimental work.

Those who are not familiar with the experiment should twist together the ends of two short pieces of copper and german silver wire, connect the free ends to a sensitive galvanometer, and on warming the junction a deflection is noted (see Fig. 1). For general experimental purposes, a fairly sensitive instrument can be made from a short length of eureka resistance wire, or german silver may be used. This type of instrument is used for general demonstration purposes, especially when conducting experiments on radiation, as, when carefully made, it is capable of detecting the heat from a candle flame when held about 20 in. away. This is with a single element, but the sensitivity can be increased by incorporating several elements in the thermopile. It may be interesting to note that these instruments can be made of such a fineness, that they are capable of detecting the heat produced by a single muscle twitch, and have proved invaluable to physiology workers.

### Commencing Construction

Start the work by making a small ebonite former measuring about ¾ in. long, ½ in. wide and ¼ in. thick, and drill a hole in either end for terminals or for assembly rods. Now pass the end of a length of No. 26 bare eureka wire through one hole, or secure it to the terminal, wind about 20-25 turns on the former, pulling it tightly, and keep each turn separate from its neighbour. The finishing end is secured to the second terminal. When it is desired to build up a several element unit, the wire should be anchored by forcing through small holes in the ebonite; the elements are then assembled on long B.A. bolts with packing pieces in between each pair. The various wires are all connected in series and the ends to two bolts which serve as terminals. It is better to prepare each element completely before assembling (see Figs. 2 and 3).

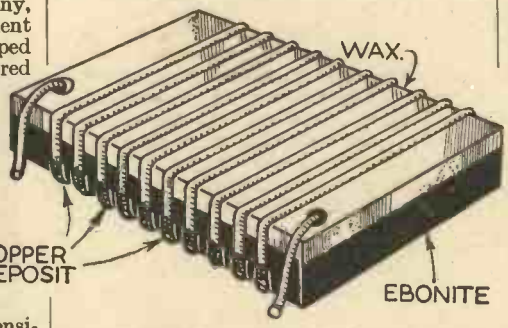



*Fig. 2.—Showing the construction of a single element.*

### The Plating Bath

Before winding, the wire should be cleaned bright with emery paper, since half of it has to be copper-plated. A plating bath must be set up for depositing copper, the solution consisting of copper sulphate crystals and a little dilute sulphuric acid. In domestic measure this would be about one dessertspoonful of copper sulphate in three-quarters of a cupful of water to which about 30 drops of sulphuric acid are added; stir only with a glass rod. To produce a copper-eureka junction, only half the wire is plated, and to do this half the wire is placed in molten paraffin wax. Obtain a small flat tin and melt paraffin wax into it to a depth of about ½ in.; now take the elements, and holding them with the long plane horizontal, carefully immerse in the wax until just half is covered, remove and allow to set. Care must be taken that the wax is not too hot or it will run up the wires where it is not needed. It should be just molten so that when the ebonite is dipped in it the wax sets on it immediately. Connect a wire to each end of the eureka and then to the negative terminal of a two-volt cell. A rheostat is connected to the positive terminal and to the anode of the plating bath; immerse the element and adjust the current until about 50 milliamps are flowing. Leave until a heavy deposit is obtained and remove and wash carefully to remove any acid. The wax is removed by placing the whole in a beaker of water, and warming until the wax melts and rises to the surface. When cooled it can be lifted off in one cake and the element removed from the beaker. It should then be dried with gentle heat and filter papers (see Fig. 4).

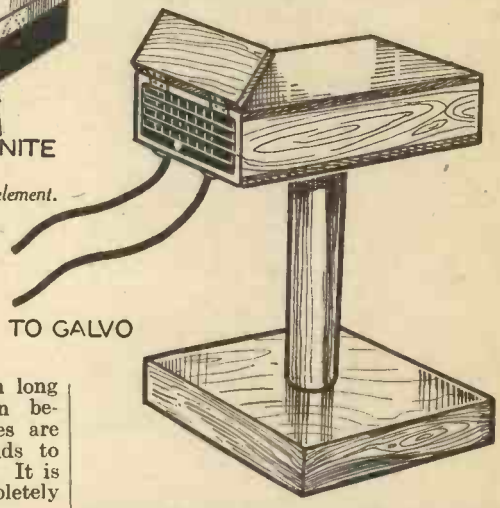



*Fig. 5.—Showing the completed instrument suitably mounted on a wooden stand.*

### Testing Out

When the element is completed and connected to the meter a deflection should be

(*Continued on page* iii *of Cover.*)

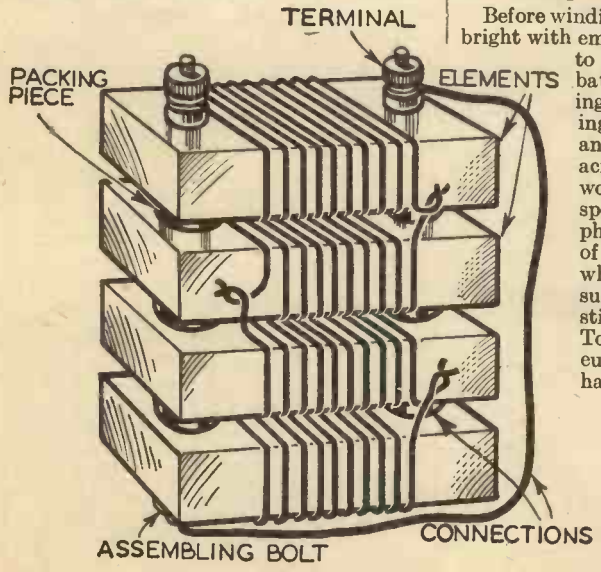



*Fig. 3.—Building up the elements.*

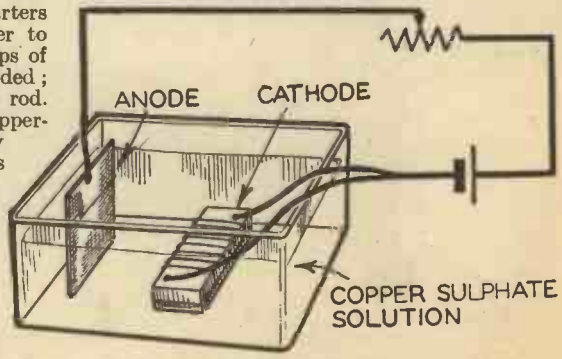



*Fig. 4.—Details of the plating bath.*

# INSTALLING DOMESTIC

## The employment of fractional-horse-power electric and these motors have been incorporated

*An electric hair drier which uses a $\frac{1}{50}$-h.p. motor.*

THE manufacture and production of fractional-horse-power electric motors is now an industry in itself. Whilst the majority of these small motors are for workshop industries, their employment for ordinary household work is rapidly increasing. This does not mean the use of cumbersome machinery about the house, but portable electric motors, suitably encased, used as real labour-saving devices.

Manufacturers of these fractional-h.p. electric motors, faced with the problem of designing a motor to suit the requirements of alternating-current and direct-current users, have introduced a standard type of motor, known as the universal electric motor, to operate efficiently with either source of power. This aims at standardisation, and restricts the number of types of motors for the same purpose, seeing that there is no necessity for one motor for A.C. and another motor for D.C. On the other hand, the consumer, in the event of moving to another part of the town or country where the supply is different, need have no fear of his electrical apparatus being useless.

It is this type of motor, the universal motor, designed to operate on the standard electric supplies of 200/250 D.C. and 200/250 volts A.C., 50 cycles, which, in the majority of cases, is used for all domestic motor appliances.

It is a type known as the series-commutator motor, and, besides its interchangeability between A.C. and D.C. supplies, its chief characteristic is its wide range of speed variation depending on its load, and its suitable starting torque for the applications mentioned below.

### The Vacuum Cleaner

Perhaps the chief application of the fractional-horse-power electric motor in the home is the electric vacuum cleaner. Cleaning by this method is effected by the suction of air either through the material to be cleaned or over its surface, and the collection of dust and dirt in a container (usually a canvas bag) fitted in or to the apparatus.

The suction is produced by a fan, driven by the motor and revolving at high speed. The fan can be used for blowing instead of for suction when necessary.

In one of the most popular types of vacuum cleaner the motor and fan are housed in a polished aluminium case, one end of which forms a nozzle to work along the floor, as shown in the illustration, the whole apparatus being fitted with an under-carriage of wheels or runners for easy movement along the carpet or other article to be cleaned. Attached to the case is a trunnion-mounted pole, with shock-proof handle containing the trigger or rotary switch to control the motor, the connection to the supply mains being made through the usual flexible cord (a few yards long) to the wall-plug or lamp adapter.

When the nozzle of the aluminium casing is not required, provision is made for the attachment of a flexible hose through which the air is drawn, and to the ends of this hose can be attached adjustable accessories for various cleaning and brushing purposes. In this particular type of cleaner, ball bearings are fitted throughout.

### A Floor Polisher

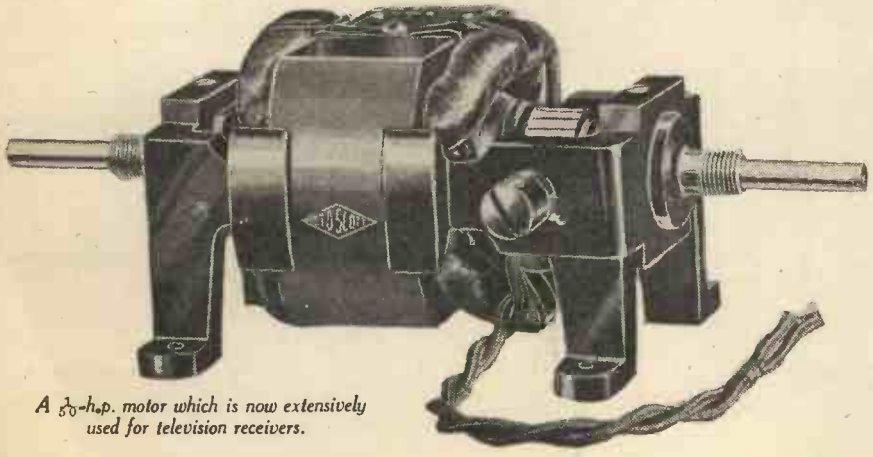
The electric floor polisher, which is similar in constructional features to the cleaner, is used mostly for floors, linoleum and staircases. It consists of a motor mounted vertically and geared to one or more brushes of horse hair or other suitable material. When two brushes are employed, they revolve in opposite directions, as illustrated. In this type of polisher two sets of brushes, mounted on a circular plate, are supplied, one set for spreading the wax and the other for polishing.

The switch mechanism is usually controlled by a movement of the pole or handle, and operates automatically on the motor casing which embodies a switch.

### An Electric Fan

There are two types of electric fan for domestic use, namely, the exhaust or ventilating fan and the table fan. The former is used mainly for large kitchens, whilst the table fan is the popular type for use in the average home. This type of fan, if placed close to a suitable air inlet, say an open window, changes the air of a room. Some of these fans have an oscillating movement, the fan turning from side to side through an angle of about 100 degrees, whilst some fans move up and down. These additional movements cause an air disturbance over a wide area and create less draught than the fan mounted on a fixed casing. In construction, the fixed model consists of a universal motor in a light cast-iron casing, with metal or moulded blades about 10 in. from tip to tip, suitably guarded, attached to the end of the motor shaft. The motor is mounted to a stand fitted with a tilting movement, so arranged that it can be operated as a table fan or a bracket fan. Fitted in the base of the stand is a regulator which provides an "off" position and two speeds. Where higher-powered fans and oscillating movements are

*(Left) A vacuum cleaner which is driven by a $\frac{1}{8}$-h.p. motor, and (right) a floor polisher which uses a similar type of motor.*



*A $\frac{1}{50}$-h.p. motor which is now extensively used for television receivers.*

# ELECTRICAL DEVICES

## motors for household work is rapidly increasing, in a number of labour-saving devices.

employed, it is usual to fit either an A.C. or a D.C. motor.

### A Hair Drier

The electric hair drier consists of a universal motor mounted in a bakelite moulded case fitted with a shockproof handle, such a handle being necessary because the hair drier may often be used whilst held in a warm, moist hand.

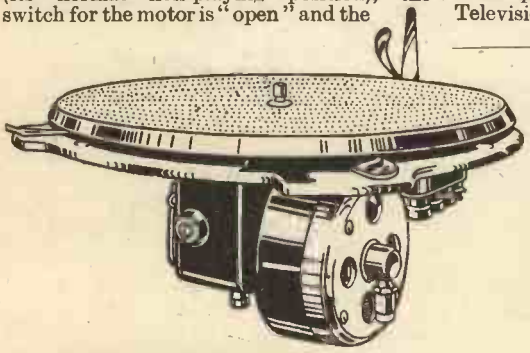
The casing contains, besides the motor, an electric heating element. The motor rotates a small fan which draws in air and expels it through a tube or nozzle (part of the casing) in which the heater element is located, thus producing a blast of warm air. The switch is fitted in the handle and controls both motor and heater separately, so that hot or cold air may be obtained as required.

### The Gramophone Motor

The universal motor supplied for rotating the turntable of the gramophone is fitted underneath a top plate and below the turntable. As the motor is out of reach and sight of the operator, it is usually of the unprotected type.

The natural high speed of the motor is mechanically controlled, and by a centrifugal system of sprung weights fitted to the motor shaft the speed is governed and maintained at about 2,000 revolutions per minute. The motor shaft engages through silent reduction gearing with a vertical shaft carrying the turntable, the resultant speed of this shaft being about 100 revolutions per minute. This speed is adjusted to the required 78 revolutions per minute by a brake pad engagement controlled by a lever projecting just outside the edge of the turntable.

In the type illustrated an automatic start and stop mechanism is fitted underneath the turntable and controlled by the movement of the pick-up arm. When the pick-up arm is resting away from the record (its normal non-playing position), the switch for the motor is "open" and the



*A very compact gramophone turntable unit driven by an electric motor.*

action of bringing the arm to the edge of the record for playing automatically closes the switch and starts the motor. When the arm has reached the playing end of the record, the mechanism automatically opens the switch and the motor stops again.

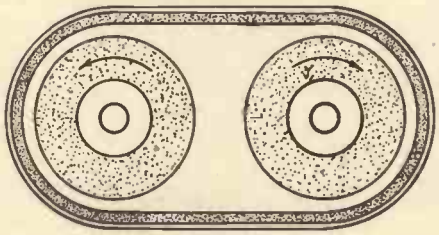
### Television Motor

In television apparatus the universal motor is used for driving the scanning disc, mirror drum, mirror screw or other form of exploring device. The normal speed for a television drive to suit the present transmission is 750 revolutions per minute, which is too slow for the natural speed of the motor. The speed is controlled by varying the voltage applied to the motor, this being effected by including a variable resistance in series with the motor. For television purposes the motor (open type) has to be designed to run with an absence of noise and mechanical vibration.

### Consumption of Apparatus

The consumption of electricity by the applications of fractional-horse-power motors outlined above is so low that they can all be safely attached to the lighting circuit if the consumer has not got a power point. In the accompanying table useful data concerning these motors is tabulated.

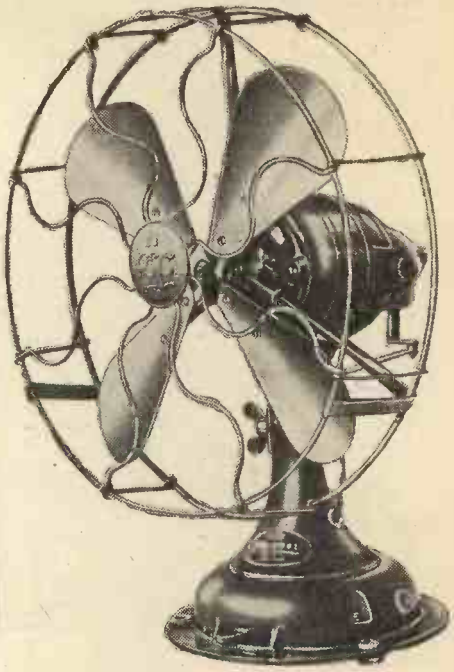
The number of hours' use for a penny is



*An underneath view of the floor polisher, showing the rotation of the brushes.*

based upon the general power charge of 1*d.* per unit.

| Type | Approx. H.P. | Watts consumed | Hours of use for a Penny |
|---|---|---|---|
| Vacuum cleaner | $\frac{1}{8}$ | 200 | 5 |
| Floor polisher | $\frac{1}{8}$ | 200 | 5 |
| Fixed fan | $\frac{1}{50}$ | 40 | 25 |
| Hair drier | $\frac{1}{50}$ | 650 | $1\frac{1}{2}$ |
| Gramophone motor | $\frac{1}{100}$ | 10 | 100 |
| Television motor | $\frac{1}{50}$ | 40 | 25 |

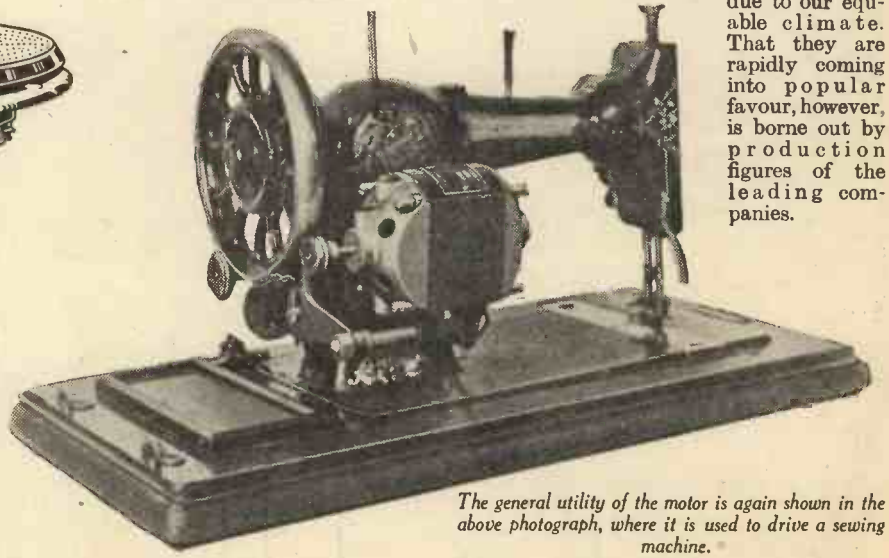


*An electric fan which employs a $\frac{1}{50}$-h.p. motor.*

It should be noted that in the case of the hair drier consuming 650 watts, 600 watts is taken by the heating element, only about 40 or 50 watts being taken by the motor.

### Refrigerators

At the foot of the column is illustrated a sewing machine adapted to work from an electric motor instead of by the infinitely more cumbersome treadle arrangement, whereby inexpert users may easily reverse the mechanism. Similarly, there are mincing machines fitted with electric motors which form a handy labour-saving device. There are also electric refrigerators which contain small motors whereby various chemicals are made to obey certain physical laws of evaporation resulting in the production of cold. It is interesting to note that by the production of heat in one part of the system the production of cold is set up in another. Whereas vacuum cleaners are now extensively used in this country, refrigerators are comparatively rare, largely due to our equable climate. That they are rapidly coming into popular favour, however, is borne out by production figures of the leading companies.

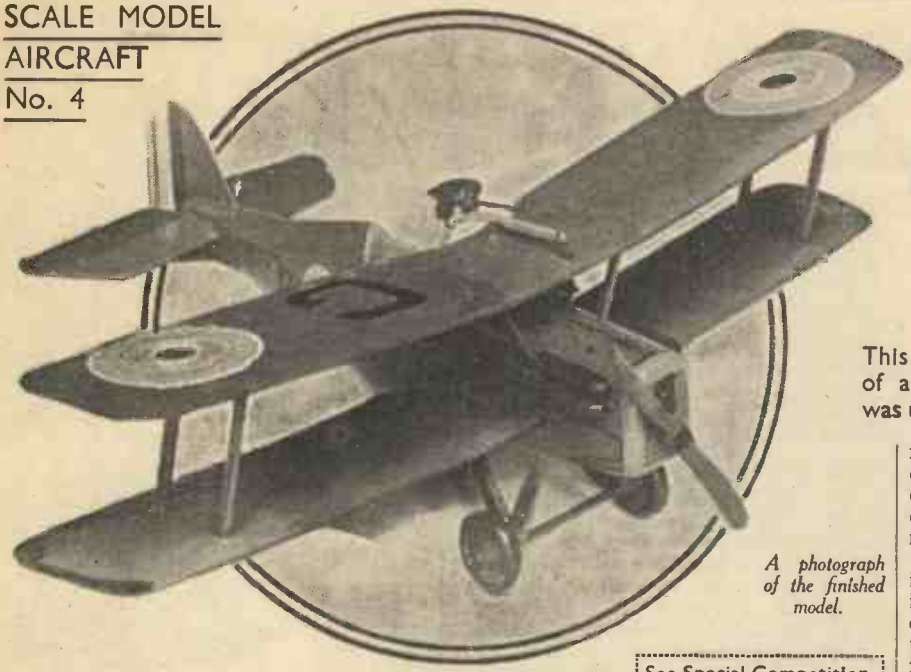


*The general utility of the motor is again shown in the above photograph, where it is used to drive a sewing machine.*

SCALE MODEL AIRCRAFT No. 4

# A SCALE-MODEL S.E.5A

This month we deal with the construction of a single-seater fighting machine that was used extensively during the Great War.



*A photograph of the finished model.*

See Special Competition on page 370.

THE S.E.5A was one of the most successful machines of the single-seater fighter class built during the war and was flown by most of the successful pilots. Ball, McCudden, Bishop, McElroy, Janes, and a host of others used it, and a model of this machine has a historical as well as a constructional interest.

If you have built the other models in this series you will have little difficulty in constructing the S.E.5A, although there are a few additional parts which are smaller than in the previous models, but which should be added to create a real likeness.

Below is given the list of parts and the sizes in inches of the pieces of wood from which they are shaped. The length column indicates the run of the grain.

**LIST OF PARTS**

| | Long. | Wide. | Thick. |
|---|---|---|---|
| Radiator | 0·75 | 0·5 | 0·125 |
| Fuselage | 4·15 | 0·5 | 0·75 |
| Valve Covers—two | 0·55 | 0·1 | 0·075 |
| Exhaust Pipes—two | 2·2 | 0·15 | 0·075 |
| Head Rest | 0·7 | 0·35 | 0·125 |
| Tail Piece and Rudder | 1·0 | 1·0 | 0·05 |
| Stabilising Fin | 0·65 | 0·25 | 0·05 |
| Tail Skid | 0·25 | 0·2 | 0·05 |
| Elevators—two | 1·25 | 0·8 | 0·05 |
| Top Wings. Outer Sections—two | 2·6 | 1·1 | 0·1 |
| Top Wings. Centre Section | 1·2 | 1·1 | 0·1 |
| Bottom Wings—two. | 1·0 | 0·1 | 0·05 |
| Outer Interplane Struts—four | 1·25 | 0·1 | 0·05 |
| Under-carriage Struts—four | 1·25 | 0·15 | 0·05 |
| Axle | 0·9 | 0·05 | 0·05 |
| Propeller | 1·8 | 0·2 | 0·1 |
| Wheels | 0·45 dia. | | 0·1 |
| Shock Absorbers | 0·1 | 0·1 dia. | |
| Vickers Gun | 0·5 | 0·1 dia. | |
| Lewis Gun, Aldis Sight | See Text. | | |

Commence by shaping the radiator, which is very similar to an old-type car radiator; in fact, car radiators were actually used. The tubes can be imitated by filing rows of slots across the face, or if more detail is required, short lengths of bare wire can be glued across from side to side. The radiator can then be fixed with two pins to the piece of wood to be used for the fuselage, where it will act as a guide for the correct shaping of the fuselage. It need not be glued in position until after the fuselage is finished. The fuselage is practically square from the nose up to the front edge of the cock-pit, and from there it is tapered on all sides to the tail unit. The head rest should be first glued as an oblong block to a small flat, filed in the top of the fuselage, and later shaped away and faired into the sides of the fuselage. The cock-pit should be gouged out to some little depth, a fairly large hole drilled in the centre making the cutting away to shape more easy.

Also drill the four holes to carry the inside interplane struts which are just inside the exhaust pipe positions. Next cut and shape the exhaust pipes and the valve covers and glue them to the fuselage. The Vickers gun is fluted with a file and has a pin inserted into the end to imitate a barrel. This is glued to the port side of the top of the fuselage. The Aldis sight is a piece of 14 S.W.G. wire soldered to two cut-off pins which is pressed into the top of the fuselage. Now cut and shape the tail unit, glue it in position, and fix the elevators; it being better to pass a pin through the fuselage to give them additional support. The hinges of the rudder and elevators can be scored or separated, and fitted with hinges and thin pins.

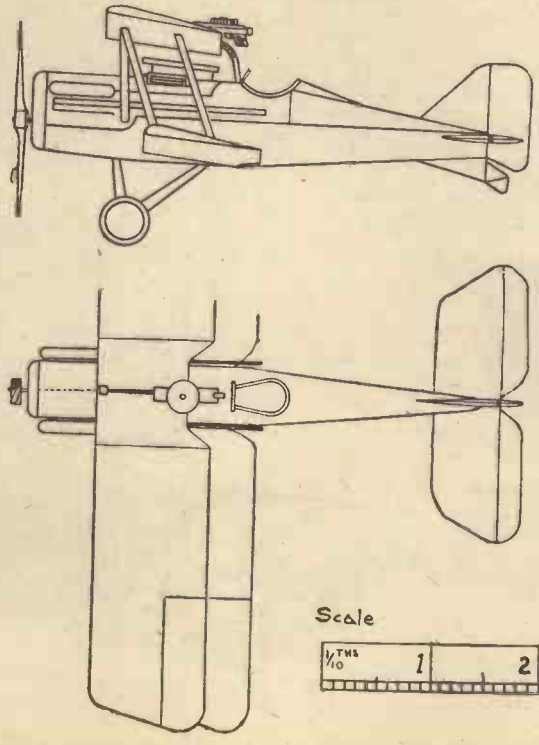
### The Top Wing

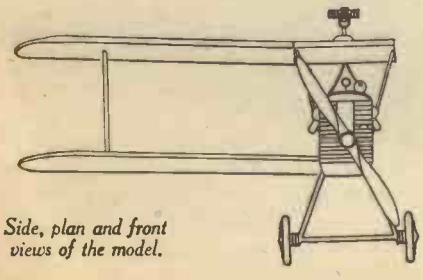
Next shape the top wing centre section and the struts, glue them into position, and allow to set hard before fitting the wings.

The upper and lower sets of wings are best mounted together, with the interplane struts glued in position between a block of wood of the correct thickness. Pins with the heads cut off are inserted into the ends of the wings, and when the wings are properly set, remove the block of wood, and glue and transfer to the correct position on the machine.

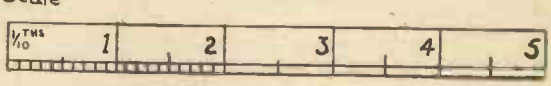
The Lewis gun mounting is a strip of 22 S.W.G. brass or aluminium 0·075 wide, formed into an arch and mounted on two small blocks of wood on the top plane with the lower end divided in two and brought down to the top of the fuselage on either side of the rear end of the Aldis sight. The Lewis gun on the machine shown in the photograph is carved from wood with a pin inserted for the barrel and a thick fibre washer glued on top for the ammunition drum.

S.E.5A's are painted a dark green-brown, with the usual identification discs on each wing tip and the sides of the fuselage, and tricolour strips on the rudder. Occasionally individuals painted their machines in different colours or carried distinguishing marks other than official, but these efforts were eventually forbidden by the authorities.





*Side, plan and front views of the model.*



# TELEVISION MADE EASY—PART III

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

This month we deal with an ingenious piece of apparatus called the Iconoscope, which may be likened to the eye, for in effect it has a retina, lens, rods and cones, together with nerves which lead to the "brain" of the device.

ALTHOUGH methods for scanning scenes to be televised at the transmitting end which avoid any form of mechanically rotating or oscillating device have been known and worked on for some years, it is only of comparatively recent date, synchronising almost entirely with high-definition television work, that these schemes have come into prominence. In one way or another they harness and control the movements of electrons either as a high velocity stream or as an ordered mass assembly, as in the case of what has been termed an "electron picture."

### Nature of Electrons

It is as well to remind readers that electrons are really extremely minute particles of negative electricity. They can be made available as a result of light stimulation on photo-electric surfaces or by rendering a filament (cathode electrode) incandescent by passing a current through it and "collecting" the electrons which escape from the surface tension and become free, in much the same way as water vapour is evaporated from the surface of the liquid. Owing to their electrically negative characteristics, and the fact that to all intents and purposes they are without inertia, they can be influenced very readily through the agency of electrostatic or electromagnetic fields produced in the orthodox manner.

Again, when required, their presence or movement can be made visible to the eye by allowing them to impinge at high velocity on screens covered with a thin layer of fluorescent material. At their point or points of impact on the screen a small or large area of fluorescence occurs, and, as we shall see later, this property is put to good service for the purpose of building up a television picture in terms of light and shade at the receiving end.

### An Early Worker

One of the first pioneers to show really demonstrable pictures using electronic scanning was von Ardenne of Germany. He was a firm advocate of what has come to be known as variable velocity modulation, whereby television pictures were scanned and later reproduced at the receiving end through the agency of an electron beam of constant intensity, but whose rate of travel in a horizontal plane was varied in accordance with light intensity. That is to say, the bright portions of a picture on a fluorescent screen would be due to a relatively slow velocity, whereby at the points of impact there was sufficient time for the fluorescence to be extremely intense and brilliant. On the other hand, at the dark sections of the picture the velocity of the electron trace would be made so high that the measure of fluorescent glow would be correspondingly reduced, and so on intermediately.

Unfortunately, the apparatus designed by von Ardenne was only suitable for the transmission of standard talking films (or still pictures such as lantern slides), whereas modern electronic devices include both films and ordinary exterior or interior scenes within the scope of the scanner. In Fig. 1 is shown a view of some of the early equipment used by von Ardenne in his experimental work with stills. An optical image of each film picture or still was focused on to the large end of the cathode-ray tube, and the light variations produced by the focused electron beam spot as it explored this picture were made to activate the electrode surface of a solitary photo-electric cell mounted, in the case of Fig. 1, in the rectangular box to the left-hand side of the amplifier. The varying voltage output from this cell and associated amplifier were fed to the transmitter in the normal manner for transference to the receiving end by radio.

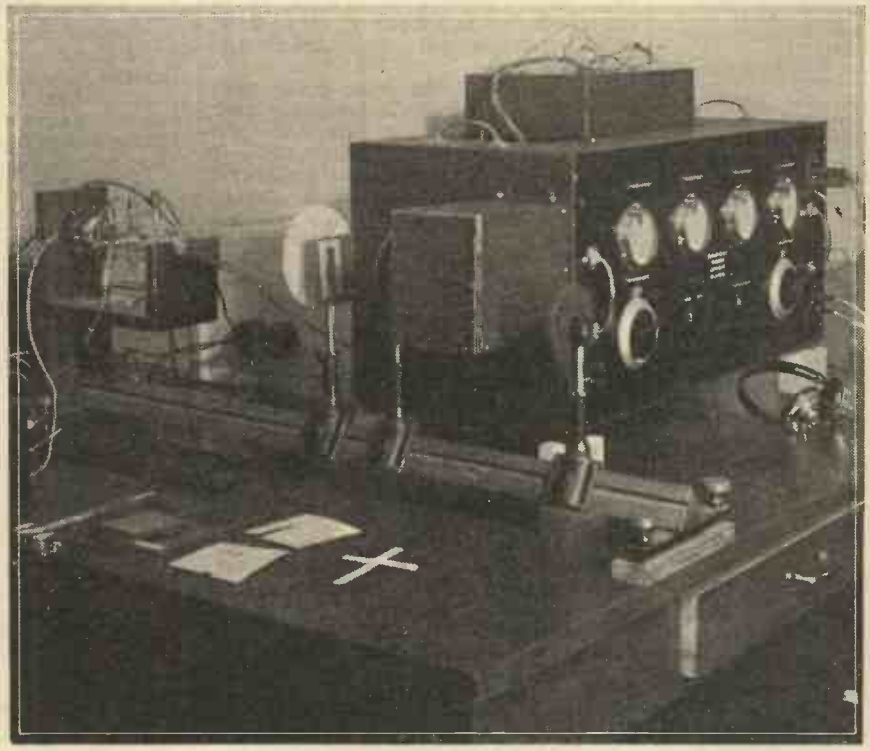


*Fig. 1.—Some of the early equipment used by von Ardenne to transmit television pictures by using a cathode-ray tube scanner.*

### Simulating the Eye

Reverting now to the electronic scanners covering a variety of animate and inanimate subjects for transmission, a particularly interesting example is the Iconoscope developed originally by Zworykin in America. This ingenious apparatus may be likened to the eye, for in effect it has a retina, lens, rods and cones, together with nerves which

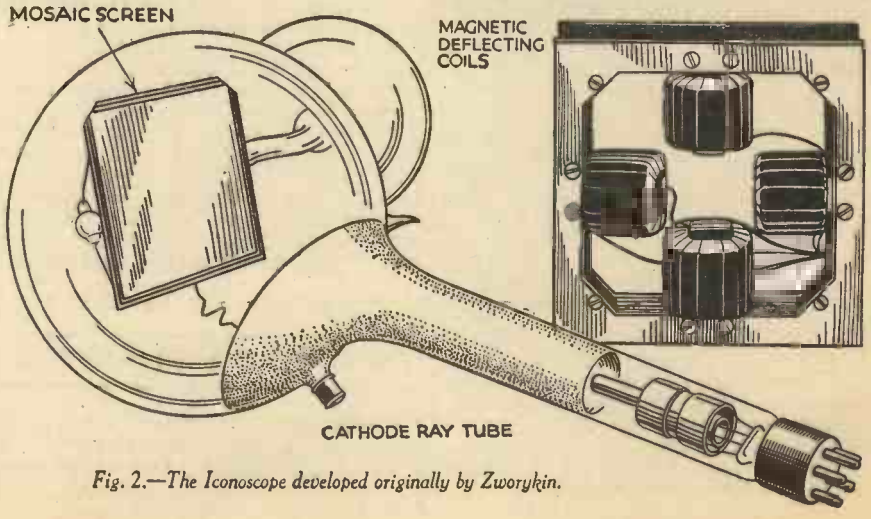



*Fig. 2.—The Iconoscope developed originally by Zworykin.*

lead to the "brain" of the device. Its shape and assembly can be gathered by a reference to the simple diagram Fig. 2. First of all there is an evacuated glass chamber in the spherical section of which is accommodated a sheet of mica, which in the original models was about 4 in. square. This is the equivalent of the eye retina, for on the face of this sheet is chemically constructed a mosaic of millions of very minute photo-electric cells said to be built up from a cæsium base. Backing this sheet of mica, which itself is some thousandths of an inch thick, is a silver deposit, so that, as a whole, the assembly is, in effect, an arrangement of an enormous number of separate and

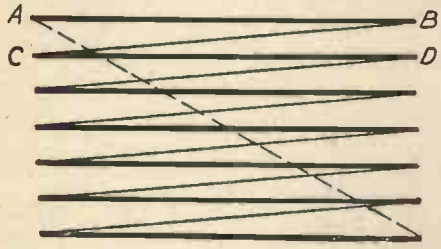



*Fig. 3.—The zig-zag line traced on the mosaic screen. Strictly speaking, the normal line traverse is inclined and the fly-back stroke horizontal.*

distinct condensers, with the added advantage that the mosaic surface is photo-electrically sensitive.

A good quality photographic lens combination focuses sharply and clearly on to this mosaic surface an optical image of the scene it is intended to transmit, whether this be from a film, an interior studio study or an effect in the open air. This light stimulation over the whole surface causes each individual but tiny photo-electric cell to acquire an electronic charge in direct proportion to the degree or amount of picture light which it receives, and this is imparted to its inherent condenser. From this "electrical memory" picture so formed must be created the television signal in an ordered line sequence of equivalent variations, and to effect this the second part of the equipment within the whole bulb assembly is brought into play.

### Cathode-ray Scanning

This is really a standard form of cathode-ray tube having an incandescent cathode from which is emitted electrons. These are formed into a stream through the agency of the normal type of focusing device and accelerated forward at high speed by applying a high-positive potential to a neighbouring circular anode having a small aperture through which the electrons are directed. This beam is directed on to the plate mosaic, and to give the beam its methodical scanning action two pairs of coils (seen to the rear of Fig. 2) are mounted in a framework and placed over the tube neck. Through these coils are passed similar types of saw-tooth currents, but their frequencies are quite different. The saw-tooth current is so named because it has a steadily increasing value with time, and after reaching a certain maximum value it drops almost instantaneously to its original low value.

### Producing the Signal

Since the beam passes right through the magnetic field produced by each pair of coils it is made to alter its direction in accordance with the strength of each field. One pair of coils causes the beam to move horizontally at a constant speed in one direction across the face and then "fly back" to the other side, repeating this action at the frequency with which the saw-tooth pulses occur, which, in actual fact, is the line repetitive frequency. In the case of a 240-line picture reproduced at twenty-five pictures per second, this frequency would be 6,000 per second. The pair of coils producing vertical deflection has passed through them a saw-tooth wave pulse at the picture repetition frequency, and it is therefore easy to see that the combined result of this dual magnetic deflection of the beam is to make it trace a path across the mosaic face in a series of zig-zag lines, somewhat as shown in exaggerated form in Fig. 3.

The passage of the beam across each individual charged condenser causes each unit to discharge itself in turn, and these resulting currents are fed to an amplifier and constitute the television signal, being at every instant proportional in its stage of conversion to the separate and distinct light values of the original scene being televised. Another factor to be noticed in connection with the wholly electrical device is that once each separate photo-electric cell condenser unit has been discharged and produced its quota of signals, it immediately comes under the optical picture influence again and commences to build up another electrical charge in proportion to the picture light to which it is exposed.

### Another Device

Another important electronic scanning device works on rather a different principle, employing for this purpose an image dissector tube. This is simply an evacuated cylindrical glass tube in which at one end is a circular cathode surface covered with a uniform layer of an extremely sensitive photo-electric material. Using the normal form of photographic lens, an optical image of the scene to be televised, whatever its nature or type, is focused on to this surface. This has the effect of producing immediately a form of electronic discharge, the cross-section of each minute portion of which corresponds exactly in intensity to the picture light which is incident upon it, and which, of course, originated the discharge. Such an *en masse* discharge of electrons from the cathode surface is called an electron image, and under the influence of an accelerating positive potential this electron image is drawn forward bodily.

No matter how carefully the tube and cathode surface is constructed, once the electron image has left this surface it fails to keep its original formation unless steps are taken to retain the electron focus. This is brought about by surrounding the tube with a solenoidal coil through which is passed a steady current. This creates a uniform magnetic field, and by a careful adjustment of the coil constants and current value it is possible to ensure that the electron image, after it has moved forward to a position XY in Fig. 4, is exactly in focus. If this was not so, the picture that would be seen at this point, assuming that a fluorescent screen rendered it visible, would be blurred and, if badly maltreated, electrically quite unintelligible.

### A Dual Scanning Movement

In the plane XY is what is termed an anode target, that is a surface in which is a small aperture whose size is governed by the electron image area emitted from the cathode and the degree of line dissection into which it is intended to split up the picture for conversion to a television signal. Instead of moving the aperture over the image, the image is made to move over the aperture, which, under these circumstances, is quite steady. Since the *en masse* electron image has, of course, a negative electrical characteristic, it is readily influenced by the effects of magnetic fields. As in the case of the Iconoscope, therefore, two pairs of mutually perpendicular magnetic fields are produced through the medium of four coils arranged at right angles to one another and working as two pairs.

One pair of coils produces the horizontal displacement due to a high-frequency saw-tooth current being fed through them, while the second pair is instrumental in giving the vertical movement by applying to it a low-frequency saw-tooth current. The combination of the two varying magnetic fields sweeps the electron image across the aperture so that the electrons pass through as a stream of varying density formation corresponding to the original light intensity picture, but line dissected.

This continuous but varying strength electron current constitutes the television signal, and after amplification it is passed to the radio transmitter to modulate the generated carrier wave for propagation into space as an electro-magnetic wave.

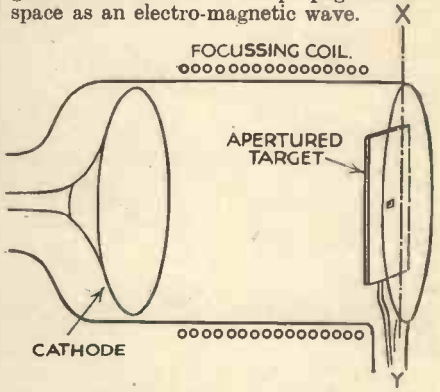



*Fig. 4.—The bare details of an image dissector tube.*

When either of these electronic scanning devices are employed for transmitting ordinary talking films, one pair of deflecting coils can be dispensed with, since the downward motion of the separate film pictures through the projector provides this. Irrespective of this, however, the scanners provide a most ingenious way of producing the necessary television signals by wholly electrical methods, and concentrated effort is being made in developing them to a high degree of efficiency.

## A NEW TELEVISION COMPANY

MESSRS. WHITELEY ELECTRICAL RADIO CO., the well-known loudspeaker manufacturers, will soon be manufacturing television receivers and component parts at their Victoria Street factory.

This side of the business will be handled by the formation of a new company under the title of the Whiteley Television Co. Ltd., with a nominal capital of £1,000.

Mr. A. H. Whiteley, head of the firm, stated that so far only experimental work confined to research has been carried out. "The new company," he said, "has been set up so that as soon as an efficient television service becomes definitely established, we shall be in a position to put receivers and components on the market. We anticipate that the first demand will be in the way of home-constructed sets."

# Machinery for "Streamlinia"

The making of *Streamlinia* is almost completed, and now readers should be able to visualise the finished model, which will be well worthy of the effort and work that has been expended on it.

*The Davis turbine—an alternative prime mover.*

THE woodwork is almost completed, the stern tube fitted, and now is the time to fit the rudder tube. It is advisable to spend a little extra care on this job, for I have noticed that this is the joint where leaks very often occur. Drill a hole in the hull as marked on the plan, and drive the tube in, until nearly flush underneath the hull. Unlike the stern tube, this rudder tube must fit tightly into the hole so that the joint is water-tight.

The hull also must be made water-tight, ready for its finishing coat of enamel, and requires three or four layers of undercoating, inside and out, to ensure this. You must remember that when *Streamlinia* sets her stern down to a 50-yd. run she is going to churn up considerable spray, and if this finds its way to any exposed wood, off comes the expensive enamel.

I find it a good idea at the end of an evening's work to give the hull a thin coat of lead paint, inside and out. This will save delay later, when the rest of the boat is completed.

### The Engine

In deciding on the machinery of *Streamlinia*, the main consideration was a really efficient plant at a moderate outlay. The hull, of course, is quite capable of carrying a flash steam set, so if any of you wish to make a "record-breaker," the hull and design of this boat are ideal. *Streamlinia* has been tested fitted with a twin engine with a 60-lb. pressure, and the result was amazing. The engine used was the G.F. Twin-Cylinder Steam Engine manufactured by Bassett-Lowke Ltd., and a special "*de luxe*" model of *Streamlinia* containing this engine will be marketed in the near future.

For the purpose of this model, the engine chosen was the Stuart "Meteor" High-speed Marine Engine. It is inexpensive and really efficient, and has the added virtue of interchangeable parts.

Some readers may be surprised that the engine is set at an angle to line up with the propeller shaft, but this does away with the need for a universal joint inside the hull, and really does not affect the working of the engine, as the displacement lubricator deals efficiently with all cylinder oiling.

### The Boiler and Lamp

The other parts of the steam set are the boiler and the lamp. The boiler is of brazed copper tube, tested to a full capacity of 60-lb. steam pressure. The methylated spirit lamp is of the new Harrison design, produced by Bassett-Lowke Ltd. It has been evolved after much research, and displaces the old sardine-tin type of lamp, which is so unreliable, as one never knows how much spirit to put in, and the result is either a short run or a dry boiler. But this new lamp has been designed to boiler capacity and is safe and efficient in all conditions. It is run on what is known as the automatic or "chick" feed principle, and does not allow more spirit to go to the burners than they can consume.

The complete set can be obtained, ready to mount in the hull, from Bassett-Lowke Ltd.

It is advisable to get acquainted with the steam set before fitting it into the hull, so take out the spirit container, draw the lamp out of the fire-box, and examine this thoroughly. Notice particularly how the wicks are put in, as later on, when new wicks have to be fitted, it is useful to know how tight to fit them. They should not be loose, as they are liable to blow out when the lamp gets hot.

Now we can proceed to give the set a "bench" test.

To fill the boiler, unscrew the safety valve, which is situated near the funnel, and with the measure and funnel supplied pour in seven measures of water. Replace the safety-valve cap and screw down tightly.

Then, being sure that the control is closed (the lever should be right down), fill the spirit container with best-quality methylated spirit. It is best to buy this from a reliable chemist, as some of the cheaper grades of spirit do not give off anything like so much heat, and so little is needed that price is not an important factor. Replace the container, being certain that the pipes are inside the lamp reservoir, pull the control lever right up, and wait for a few

## SPECIAL COMPETITION

**We offer the following prizes for the best photographs of models of *Streamlinia* built from the designs published in this series. Readers who have not yet started to build this fine speed-boat should do so without delay. Messrs. Bassett-Lowke Ltd., of Northampton, who supply the parts and the mechanism for it, have generously added £3 3s. to the prize list.**

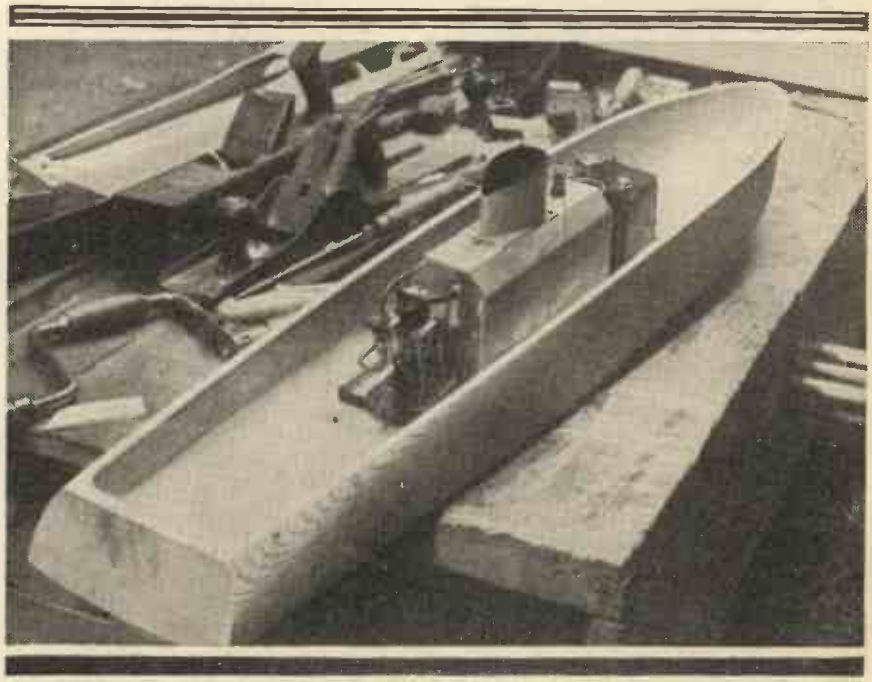
### RULES

**1. Models must be made from the designs published in these pages, and from the parts specified.**
**2. It is only necessary to send a photograph of the model, and this must bear the name and address of the sender.**
**3. The Editor's decision is final and an expressed condition of entry.**
**4. Stamps must be enclosed for return of the photographs.**
**5. All photographs must reach us not later than June 10th, 1935.**
**6. The Judges will be Mr. W. J. Bassett-Lowke and Mr. F. J. Camm.**
**7. Prizes will be awarded for the best-finished model.**

### PRIZES

**First Prize : £3 3 0**
**Second Prize : £2 2 0**
**Third Prize : £1 1 0**

**100 Consolation Prizes of Books to be selected by the winners.**



*Showing the plant placed in the hull of "Streamlinia" in the correct position.*

*The hull ready for fitting in the steam plant with false floor and stern tube.*

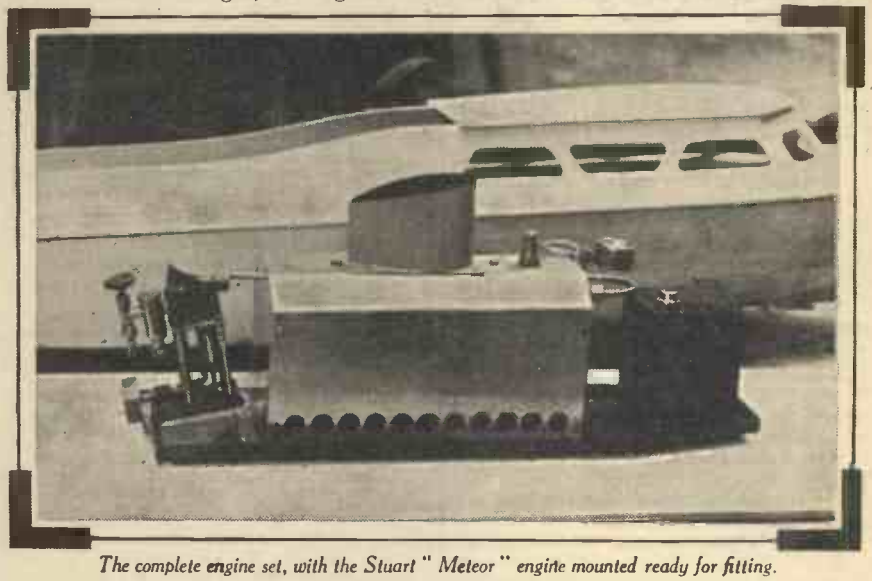
minutes to allow the wicks to saturate, then light these with the igniter supplied.

### Oil the Parts well

While steam is being generated, see that the engine is well oiled (use Rocket Machine Oil for all working parts) and fill up the displacement lubricator situated between the throttle control and cylinder with Rocket Cylinder Oil. Keep a close watch on the pressure gauge, and when it registers between 30–40 lb. open the throttle and revolve the flywheel a few times. This will free the engine of condensation. Let the plant run steadily for a few moments when the pressure has reached 55. It is useful to test the best throttle position. Remember that an engine which is racing is not always doing its best, and this bench test is interesting because each part can be seen doing its work, and you can easily make any necessary adjustments.

After this you can proceed to fit the plant into the hull. Fit the false floor in and set the plant in its correct position. Now we resort to the testing tank or bath. Put the hull in the water, and be sure that it floats at the correct water level. This is most important, as the steam plant must incline slightly aft to ensure the flow of the spirit. The tray should be about ¼ in. lower aft than forward. This can be ascertained with a spirit level, or, more simply, by pouring a drop of water into the tray, afterwards carefully drying it out.

Take the hull out of the water and screw the plant down with the screws provided, seeing that the shaft coupling is quite free and revolves easily. The exhaust pipe is next fitted. This is quite a simple job. It is put out at the stern, as the boiler does not need a forced draught, and it gives the boat a better appearance, besides forcing any engine priming right clear of the boat. Next fit on the propeller. This we found a difficult part to choose. Most model enthusiasts fit a two blade, and propellers of this type were tried with the usual varying results, but eventually we chose a 2-in. three-blade "Remod." This is a beautifully balanced job and does not require any resetting, and gives the most consistent performances over a number of speeds.



*The complete engine set, with the Stuart "Meteor" engine mounted ready for fitting.*

### Testing out

Now comes the great moment—a test on open water. Choose if possible a calm day, as with an open hull a high wind is likely to blow out the lamp. Give the boat several good runs and make notes of her performance, such as time of raising steam, and running time after steam up. Note especially how much water is left in the boiler when the spirit container is dry, as this will need deducting from the next filling.

Further experiments have been carried out, using the Davis Steam Turbine, which gave good results. The Impulse Multi-Velocity Turbine consists of rotor, casing and nozzle. The rotor used for this boat is 2 in. in diameter and requires from 60 to 80 lb. pressure to drive a metre-size boat. It can be obtained, complete with friction reduction gear, jet and union, from Bassett-Lowke Ltd. This prime mover can be fitted to the boiler, and the only alteration necessary is a longer propeller shaft, which can be supplied to order.

---

MORE than 100,000 people have already seen the photographic exhibition, "Flying Over the Empire," which has been arranged by Imperial Airways, and the interest of which has been enhanced by a remarkable collection of infra-red photographs taken by a *Times* photographer during an air voyage over the Empire routes and lent for exhibition by the proprietors of that paper. After an inaugural display in London last July—the opening ceremony being performed by the Under-Secretary of State for Air—this pictorial air pageant went on tour throughout the country, being shown in most of the important provincial cities. Actually, three of these exhibitions are now touring in the British Isles, while one has gone out to Australia, and another is being staged in Canada with the support of the Canadian National Council of Education. At Ottawa the exhibition was arranged in the main hall of the National Museum, nearly 1,000 people attending the opening ceremony. The Exhibition has also visited Montreal, so as to coincide with the annual conference on flying which was held there.

## A PAGEANT IN PICTURES

### What it Means

In the minds of spectators, as they move from picture to picture in the wonderful collections that have been assembled, comes a realisation of what it means to operate—as Imperial Airways and their associated companies are now doing—regular services by air over a total distance of approximately 20,000 miles. One sees a great 4-engined air-liner leaving the London airport on the first stages of an air journey across the Empire. Paris appears below. Europe is left behind. You see a big flying-boat winging its way above the Mediterranean, with all those coastal and island beauties which are viewed to such advantage from the air. Then comes Egypt, with its pyramids and golden sands. On you fly, in fancy, over the desert to Baghdad, with the gold-covered minarets of the El-Khadimain mosque gleaming in the brilliant sun. After which you catch a fascinating glimpse of that marvellous Arch of Ctesiphen, relic of the Palace of the Parthian Kings. On, devouring distance, above the Persian Gulf with its Sheikhs, pearl-fishers and camels—on to Gwadar, Karachi, and further eastward along the great route which now carries mails for nearly 13,000 miles from London to Brisbane in Australia.

### Over Africa

Particularly fascinating are one's pictorial impressions of a flight over Africa. The desert lies beneath. You approach the big-game lands, looking down on elephants and other animals of the wild from a bird's-eye point of view. Hills, mountains and rolling plains alternate with forests, lakes and rivers. It is the pageant of a mighty Continent that passes before your eyes. In addition to this pageant in pictures of the great trunk air-lines, one is shown photographs of the saloons and control-cabins of modern air-liners; of the engines which drive them so smoothly along the highways of the sky; and of the airports, wireless and meteorological equipment which now enable our British air-liners to fly with an all-the-year round reliability of just on 100 per-cent.

# HOUSEHOLD PLUMBING HINTS

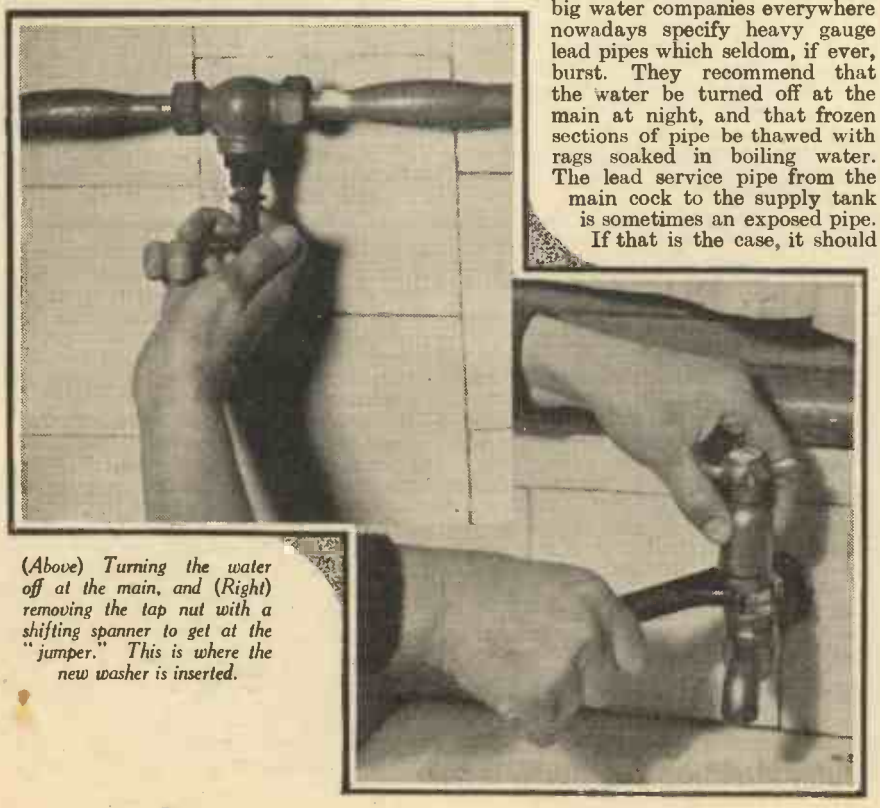
## Home Service for Sinks, Bath, Pipes and Traps

HOME plumbing seldom attracts the amateur mechanic as does wireless-set construction or model making, and yet what more useful "handyman" than one who can repair and "service" household sinks, bath, pipes and traps? The tools required are to be found in most domestic tool-boxes. The additions are a rubber force cup (1*s.*); a length of drain cane (6*d.*); a coiled wire trap cleaner (9*d.*); tow; tallow; and washers. The possession of a shifting spanner, pipe wrench, and gas pliers is assumed.

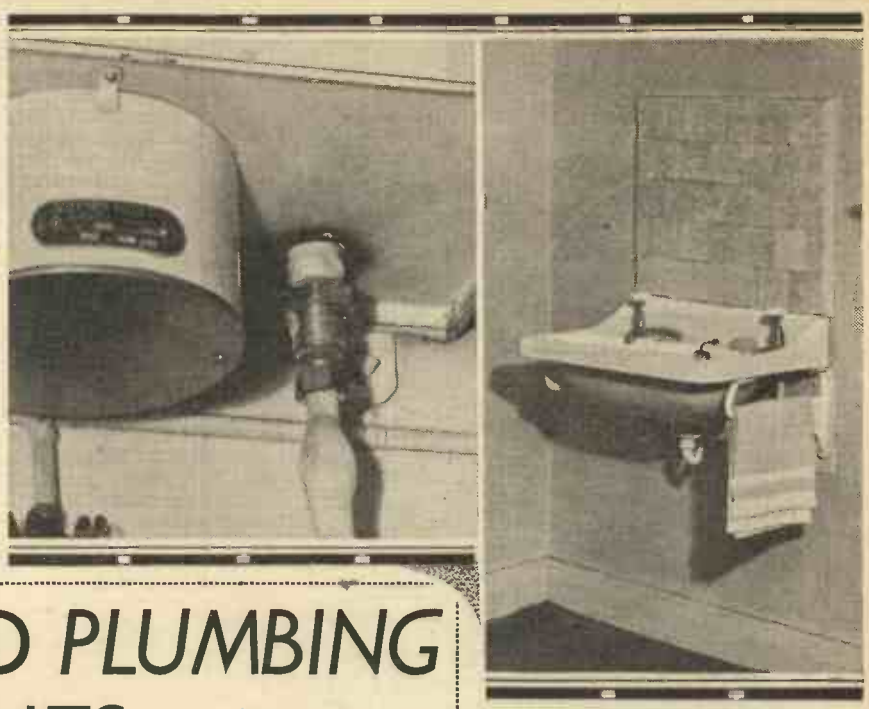
### Re-washering Taps

In addition to the fact that few noises are more irritating, wastage due to leaking taps is liable to be detected by an inspector of your water company, with an accompanying fine. Choose a time of day for your repair when turning-off the water at the main will not be a source of family complaint.

Taps leak because the "washer" is worn out. New washers in leather or rubber cost 1*d.*, and fixing a new one is easy. First find the main stop tap on the house supply and turn it off. Open the tap you are going to re-washer, and when the water has ceased to flow—and not before—use your wrench and undo the body of the tap. Don't make a mistake and loosen the tap itself off the supply pipe. It is the big nut below the tap spindle which must be unscrewed. The tap will now be in half and you must get at the "jumper." This may be in the top half of the tap or may be resting on the seat in the body. Remove it with your fingers and loosen the tiny nut which holds the washer on its stem. Replace with a new washer and tighten the little nut. After putting the tap together again, turn on at the main cock. The tap should turn off easily without effort and without dripping. In frosty weather taps and pipes will freeze, but the big water companies everywhere nowadays specify heavy gauge lead pipes which seldom, if ever, burst. They recommend that the water be turned off at the main at night, and that frozen sections of pipe be thawed with rags soaked in boiling water. The lead service pipe from the main cock to the supply tank is sometimes an exposed pipe. If that is the case, it should be wrapped spirally with strip felt and tightly bound with string.



*(Above) Turning the water off at the main, and (Right) removing the tap nut with a shifting spanner to get at the "jumper." This is where the new washer is inserted.*



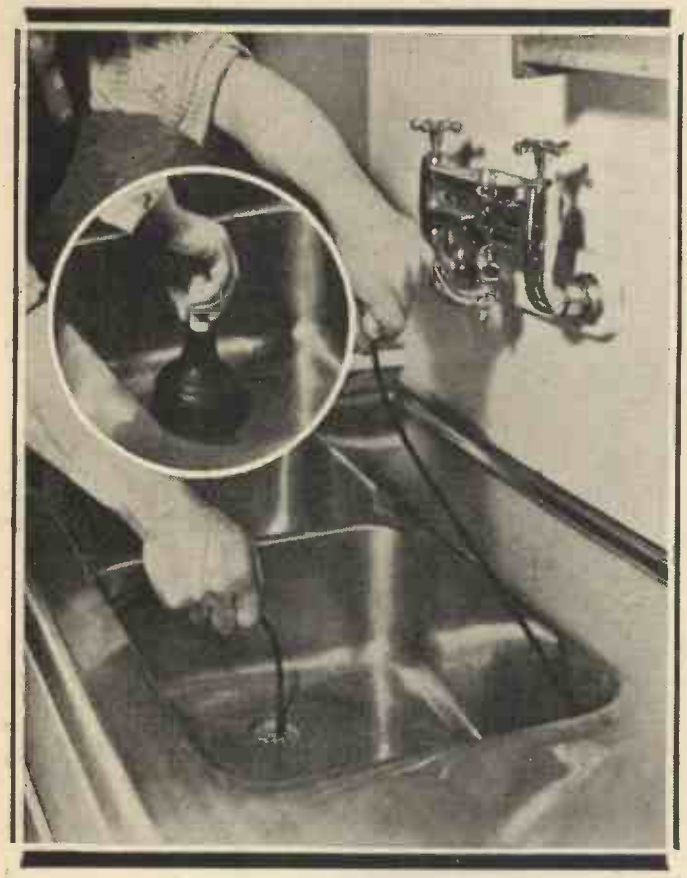
*On the left is shown the method of connecting the pipe to supply water for the basin shown above. An amateur fitted this basin in a week-end at a total cost of £5 18s.*

### A Blocked Sink

One of the household appliances most likely to become stopped up is the sink. There are three causes of stoppage: (1) solid matter in the lead trap under the sink; (2) some solid such as congealed fat which has passed through the trap but has jammed in the lead waste pipe; (3) outside gully, or syphon trap, blocked with vegetable refuse, soap and fat.

First use the rubber force cup. If the sink is not empty, bale it dry, fill it with hot water and work the cup vigorously. If the stoppage will not pass away in five minutes, it is not likely to yield to these methods, and the trap must be opened. In the bottom of the bend is a brass plug which you must now unscrew with the pliers, but have a bucket ready before unscrewing the plug. Turn on the hot tap and you will probably find the obstruction will come away, especially if you work the force cup, or use a long thin wire or coiled wire drain cleaner through the hole. The waste pipe is now probably free, and you should replace the plug and fill the sink with hot water. If it does not flow away easily when you remove the stopper, the lead waste pipe is blocked on the outlet side of the trap.

This is where the cane comes in. Now find the outlet of the pipe. This generally discharges into what is called a "gully," which you will find probably at the back of the house—generally in a yard or area. Pass the cane up the pipe a foot at a time and suddenly jerk it back, passing it up a little further each time. You need not be afraid of hurting the pipe. This is always of heavy gauge lead, which is used because it can be run with easy bends and, since it does not corrode, lasts indefinitely. The jerking of the cane and the hot water now filtering down to the obstruction will break it up. A stoppage which cannot be cured may possibly be due to a rag getting down the sink waste. A corkscrew



*Showing two methods of clearing a blocked sink—first by means of a length of cane, and (inset) by means of a force cup.*

drain cleaner and professional help will be necessary. But let it be a lesson to use a sink basket to receive plate scrapings and to fish for dish swabs before removing the stopper.

### Clearing a Stopped Gully

There is still the possibility of a stopped gully or syphon trap. This will be diagnosed immediately by the fact that the gully will be overflowing and will not pass away the drainage from the sink. The fat which may accumulate in a gully has an obnoxious smell, therefore it is advisable to pour half a cup of carbolic into the trap and get ready for dirty bailing. An empty cocoa or golden syrup tin small enough to go into the trap should be used. You will find it handier to convert the tin into a ladle by screwing a long wooden handle to it through holes punched in the side of the tin. A quart or two of water will have to be removed before getting to the fat, of which it is possible two or three pounds may have to be collected. Flush down with boiling soda water; pass the drain cane through the upper, or *outlet* hole from the gully, and your drain will be cleared.

A "spring cleaning" of your waste pipes and drains in the way described should be an annual duty for the "Plumbing Department." Baths and basins when stopped will yield to the same treatment.

### Fitted Basins for Bedrooms

There is no easier way of bringing an old house up to date than by installing fitted basins in the bedrooms. You have no need to delay on the ground of expense, because half the cost is plumber's work, part of which you will save if you do the job yourself.

The basin illustrated was fitted by an amateur plumber who realised that he would be able to do all the work himself except the "wipe" joints at the unions. The lengths of lead pipe required were carefully measured, and these measurements given to a plumber, who cut the pipes to stated lengths and "wiped on" for the connections after the pipes had been installed in position.

The materials used in the job illustrated were as follows:—

| | £ | s. | d. |
|---|---|---|---|
| Earthenware basin, 25 × 18 in., complete with chromium-plated fittings and enamelled towel rail brackets | 2 | 15 | 0 |
| Tiles for back, or opalite, or plate mirror | 0 | 15 | 0 |
| 25 ft. of ½-in. lead service pipe for hot and cold supply weighing 6 lb. per yard | 0 | 12 | 6 |
| 3 ft. of 1-in. (6 lb. per yard) lead pipe for "puff" | 0 | 1 | 6 |
| 12 ft. of 1¼-in. lead waste pipe, 14 lb. per yard | 0 | 14 | 0 |
| Plumber's charges for wiping six joints | 0 | 15 | 0 |
| Cement, screw, saddles, etc. | 0 | 5 | 0 |
| | £5 | 18 | 0 |

This means that your basin would cost you 1*s.* a week spread over a period of just over two years.

*The lead trap which is fitted to all sinks, basins and baths provides a means of catching solid matter which would otherwise pass into the waste pipe.*

## NEW ART LABORATORIES

THE opening of the Courtauld Institute in London has provided English art galleries and dealers with the services of a specialised art laboratory similar to those existing at the Louvre in Paris, in Berlin, and in America at Harvard. Expert advice on the renovation and cleaning of old paintings is part of the work of such laboratories. But to-day, when the genuine old master fetches prices which are sometimes fabulous, the more interesting branch of their activities is concerned with identifying the genuine from the spurious, or even the obvious forgery.

The sign manual of an artist is the character of his brush strokes. Under the microscope the brushwork of an artistis as clearly distinguishable as a style of handwriting. One artist might have worked with a bold sweeping stroke, another with slight meticulous touches. Forgers aware of this sometimes make electrotype photographs of portions of a genuine work, and then use the electrotypes as stamps to impress exact facsimiles of brushwork on the soft wet paint of their forgery.

### Imitation and Genuine

Cracks are usually regarded as the hallmark of age. Though the forger can scratch in artificial cracks, the microscope distinguishes clearly between the imitation and the genuine fissures of age.

A forgery may pass all the preliminary tests of the microscope, but it cannot evade the sheer chemistry of oils and paints. To the expert the oil used in binding a paint tells its own age. The refraction of light by oil increases gradually with age long after it has set, and can be measured with such accuracy that by itself it often dates a painting to within a century.

### Paints

Paints date themselves. Thus a rare deposit of azurite blue discovered in 1450 was worked out about 1650, and disappeared from artists' palettes from that year. Prussian blue was first made by chemists about 1720, and became popular with artists some thirty years later. It is an easily identified chemical. No picture using Prussian blue amongst its colours and purporting execution before the middle of the eighteenth century can be genuine.

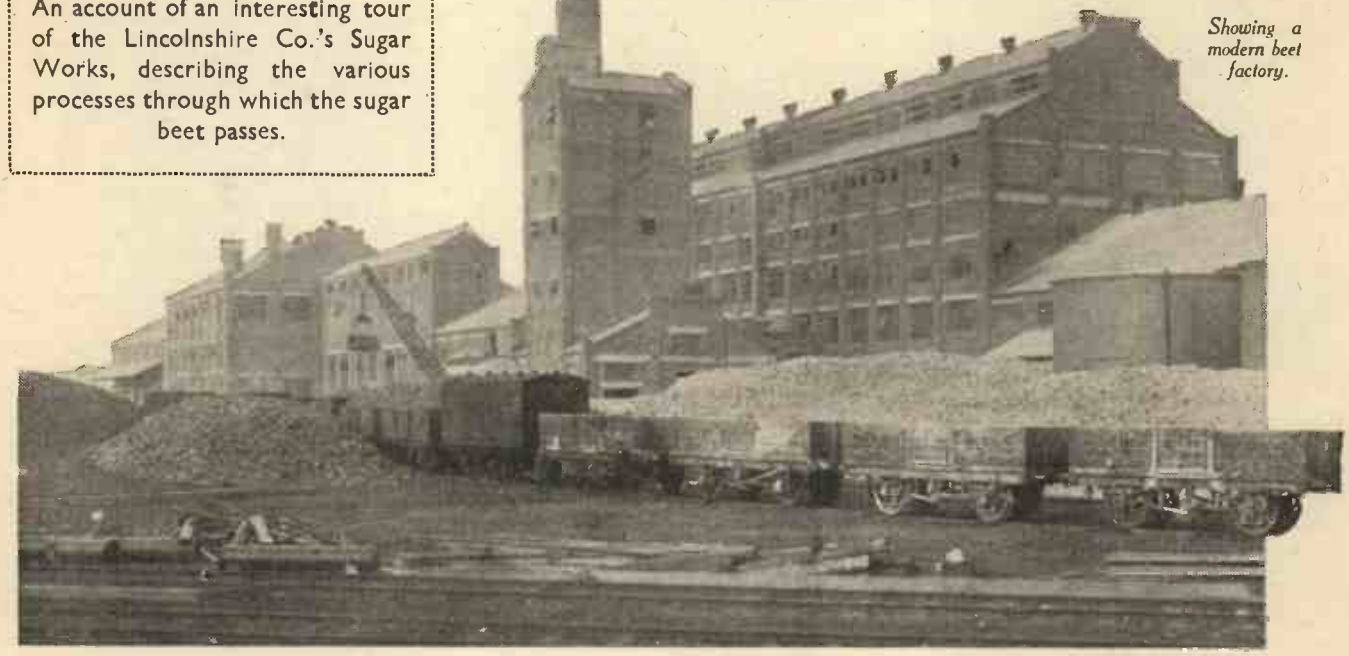
For such chemical and optical tests the minutest portions of the picture are removed in the hollow of a hypodermic needle and then examined under a microscope by the methods of microchemistry.

X-rays have a certain limited use. They show up retouchings and over-paintings. By this means a famous Dutch picture of a man drinking, "The Toper," was shown to have started life as a simple portrait of a Dutch gentleman. A later artist had added the detail of a raised wineglass. X-rays showed the over-painting. External evidence provided by an etching from the original before its bibulous character was conferred upon it showed that the X-rays had detected the original intention of the painter.

# THE ROMANCE OF SUGAR

By GEORGE LONG

An account of an interesting tour of the Lincolnshire Co.'s Sugar Works, describing the various processes through which the sugar beet passes.



*Showing a modern beet factory.*

SUGAR is not only a valuable food in itself, but is also the raw material of a host of important industries, so that its manufacture is a matter of great economic importance.

We obtained some idea of its value during the war, when it was exceedingly scarce, and was consequently severely rationed, the *wholesale* price rising to 160*s.* per cwt., that is 1*s.* 5½*d.* per lb.

There is perhaps no foodstuff in general use the manufacture of which demands so much technical and scientific skill and mechanical ingenuity.

Sugar is found in nature as a constituent of the sap of several varieties of tropical palm trees, the sugar-maple tree, the sugar cane and the sugar beet; but for all practical purposes we need only consider the last two, as almost the whole of the world's sugar supplies are made from one or other of these.

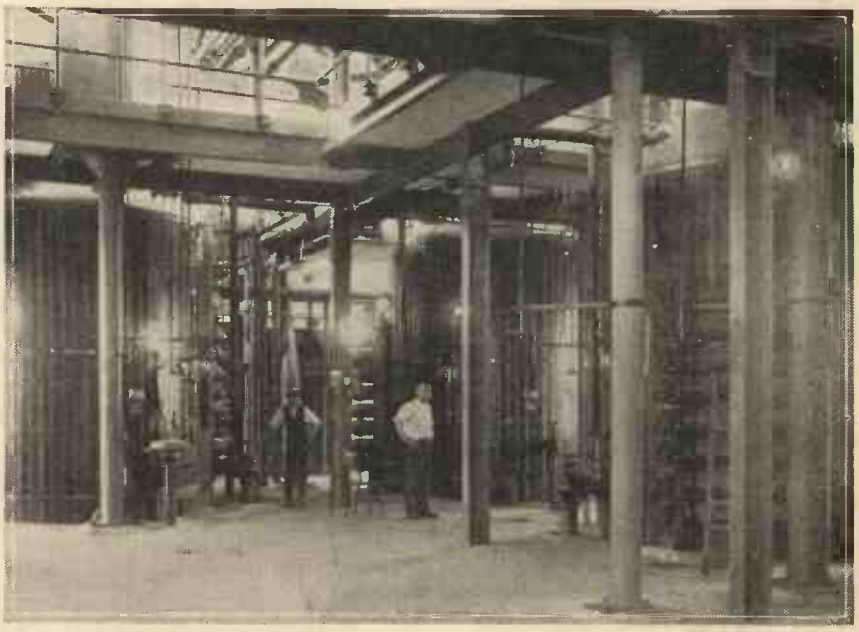
The writer has visited cane sugar factories in the West Indies, and beet sugar factories at home, and can consequently describe the process of manufacture from either raw material, which in the main is the same for both, only differing in detail. We will commence with a brief summary of the process of sugar making from the cane. The canes are harvested in the fields, removing the green leaves and loading the rods, which in the West Indies are from 10 to 20 ft. long, but in Madeira from 6 to 10 ft. only, owing to the cooler climate.

### Sugar making from the Cane

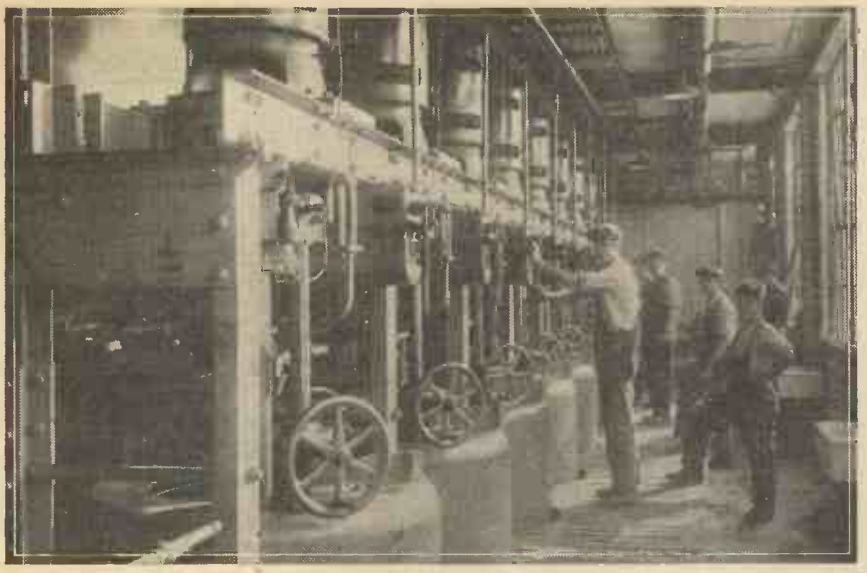
At the factory they are passed through a grinding mill, which crushes the cane flat and drives out the juice. The larger particles of foreign matter are removed by straining, and the result is an almost opaque turbid liquor containing much fine solid matter in suspension, and also soluble substances which can only be separated by precipitation. The liquid is placed in a large tank, and quicklime is stirred in. It is made into a lime cream before addition to the juice, and then carbon-dioxide ($CO_2$) is added. Sometimes sulphur dioxide ($SO_2$) is used instead; it has a very powerful bleaching effect, but modern English food regulations are very severe on residual $SO_2$, so that its use demands caution.

After a time the liquid separates by settlement, leaving an almost clear juice on top and a much thicker solution below, which requires careful filtration. The unfiltered juice is next passed through a juice filter press (which will be fully described later) and the result is a bright sugar solution, free from all foreign matter, but still of a brownish or yellowish colour. If we separate out the dry crystals at this point in the process (as some factories do abroad) the result is a raw sugar, of a dark colour.

The next process demands a high degree of technical skill, as by it the brownish, dark, unappetising sugar is decolourised and made a beautiful white, while the flavour is much improved also. The juice is mixed with finely-powdered charcoal in a closed pressure vessel by means of electrically-driven paddles, and is then forced by steam or air pressure through the refining filter. This consists of wood or metal plates, usually about 2 to 3 ft. square, which are covered with filter cloths. The carbon particles are imbedded in the mesh of the cloths, so that the juice passes through a layer of it before the process is complete.



*Showing the huge evaporating pans in which the sugar solution is evaporated.*



*A set of centrifugal separators in which the sugar is crystallised out.*

### Concentrating the Sugar Solution

We now have a perfectly refined sugar in solution, and this has to be concentrated. Here the refiner takes advantage of the old scientific principle of our school days, that the temperature at which a liquid boils varies with the pressure. The sugar solution is evaporated in closed vessels, heated by steam coils, and kept in a partial vacuum by means of an air pump. By this means it is possible to concentrate the syrup at a temperature far below that of boiling water, and this helps to produce the splendid white colour which is such a feature of British refined sugars that some countries cannot compete with it, and send their own raw sugars here to be refined. The concentrated syrup is then placed in centrifugals to separate out the crystals. A circular drum or basket of fine wire mesh is placed inside a larger drum, and is filled with the concentrated syrup. The basket is then rotated at a speed of from 800 to 1,200 revolutions per minute, so that the liquid portion is thrown out through the mesh, leaving the crystals behind. The liquid consists of syrupy non-crystallising solution called molasses, from which come various grades of treacle, and in the West Indies rum is made from it.

The above is a bare outline of the process of sugar manufacture, which is the same for both cane and beet sugar from the point where the juice has been expressed. Sugar made from beet or cane is identical in composition, being derived from the natural sugar present in the sap of each.

### The Beet Sugar Process

This process commences with the arrival by rail of the beetroots. They are shot from the trucks into bins, under which is a covered water channel. When the beets are to be used they are dropped into this stream, which removes dirt and conveys them to the slicing machine. This is fitted with from eight to twelve pairs of knives fixed on revolving discs which spin at a speed of from 100 to 150 revolutions a minute. The usual plan is for the slicing machine to be in the centre of a battery of diffusers, which are arranged in a circle around it and are fed in turn from the slicer by means of a long hopper. This process is a wonderful example of practically automatic machinery; as one diffuser is being filled with fresh slices of beet, another is evacuating the exhausted roots, which are shot into a conveyor to be made into cattle food. The diffusers are upright cylindrical vessels, three-quarters of which is sunk below the level of the floor. Each is lined with perforated metal, which retains the pulp but allows the sugar juice to pass through. Hot water is fed through each diffuser in turn, until all the sugar is extracted. As the sugar in each diffuser reaches full strength, it is drawn off and pumped into the main tank. It is a fascinating study to observe this clever machinery in full operation; each diffuser in turn is filled with beet, exhausted of sugar, emptied of waste beet, and starts again, and so around the circle throughout the day! There are about ten washings to each diffuser.

When sugar was dear years ago the diffusion method was also used with cane sugar, the bagasse, or crushed cane, being washed out with water to extract the sugar still remaining, but on my last visit I found this method had been abandoned, as with raw sugar worth only 4*s*. 6*d*. a cwt. or ¼*d*. a lb. in the Indies, it would not pay to extract any more, especially as fresh canes cost only 12*s*. 6*d*. a ton delivered to the works by the unlucky grower.

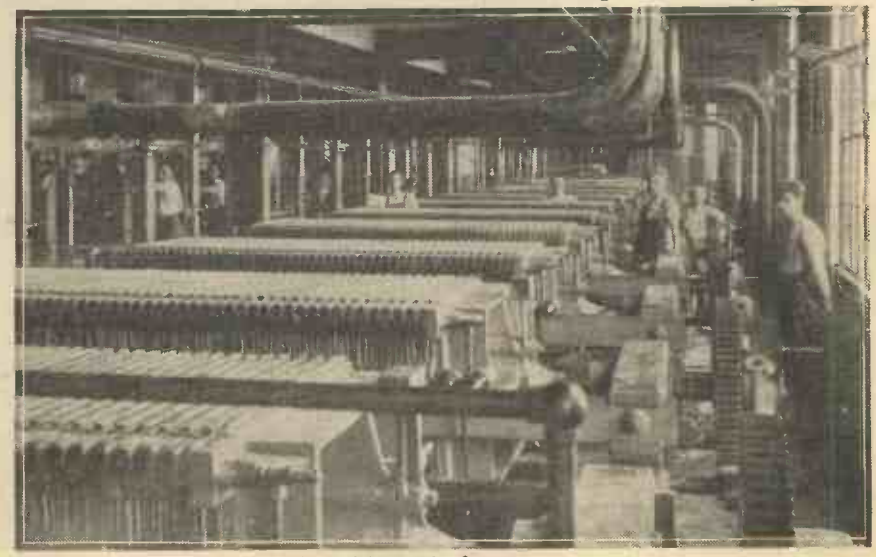
The cane process, like the beet, is continuous. The canes are fed into a travelling band or runway, which carries them through the crushing mills, which consist of a series of grooved rollers, so placed that the lines joining their centres form an equilateral triangle. The crushing mills smash the cane flat and squeeze out the juice, and the bagasse or waste cane fires the boilers of the works—no other fuel being used.

*Unloading beet at Lincolnshire Sugar Co.'s works.*

### The Filter Presses

The filter presses consist of square plates of wood or aluminium, held in racks, through which first the juice, and afterwards the sugar solution, are forced by steam or air pressure. In the first, or juice filtration, special filtering earths are used; the British product is mined in North Ireland and is called diatomite, while its rival kieselguhr comes from Germany. These earths look like fine sand, but under the microscope are found to consist of lovely little sea-shells. As with the carbon in the refining process, the diatomite is mixed with the juice, and so spreads over the filter cloths and holds back all the impurities, while the clean juice passes through.

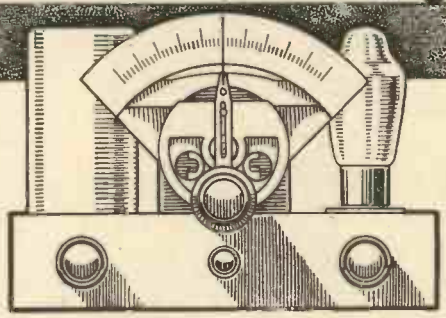
The photographs were taken at the Lincolnshire Sugar Co.'s factory.



*A set of filter and refining presses.*

The PRACTICAL MECHANICS

# WIRELESS EXPERIMENTER



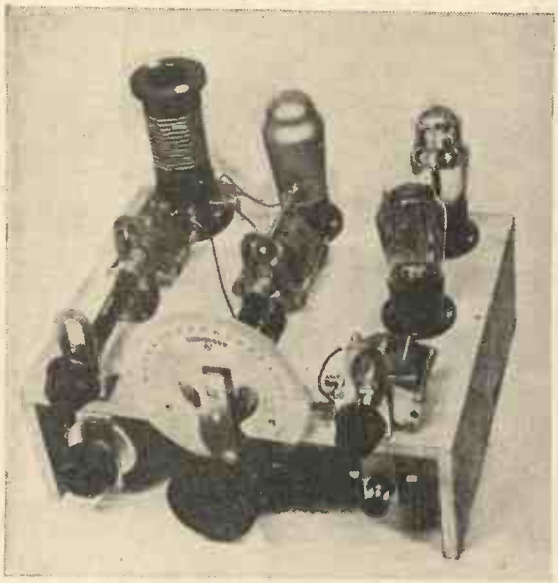
## THE WORLD-SPAN ALL WAVE THREE

*Full constructional and operating details of a three-valve receiver designed for use on short, medium and long waves.*

THE illustrations accompanying this article show that the receiver follows very closely the design of a short-wave receiver, and, in fact, the apparatus has been designed to cover this wave-band primarily, but may be adapted for use on the normal broadcast bands by the use of suitable coils. Therefore, when a set of coils has been obtained, the receiver will cover all waves from about 13 to 2,000 metres. After some experiment it was decided that the best all-round effects could be obtained without the complication of an H.F. stage, and consequently the circuit follows the well-tried detector and two L.F. arrangement which has proved so popular amongst amateurs for the past few years.

### The Circuit

The detector stage is carefully designed, and unnecessary frills and trimmings have been avoided. The grid leak is joined to the negative side of the L.T. supply, although in actual use this could be changed round to the positive supply if it is found that increased sensitivity is required. Coupling between first and second valves is of the resistance-capacity type and the values chosen provide good amplification with good quality. Between first L.F. and output stages an L.F. transformer is employed, and the ratio has been so chosen to provide good step-up without risk of instability. It will be seen that this stage is decoupled, thus reducing the risk of instability, and with this transformer a slight fillip is given to the lower frequencies. Decoupling ensures that the circuit will be quite stable, even if operated from an inefficient mains unit, and thus battery troubles may be avoided by using this type of supply.

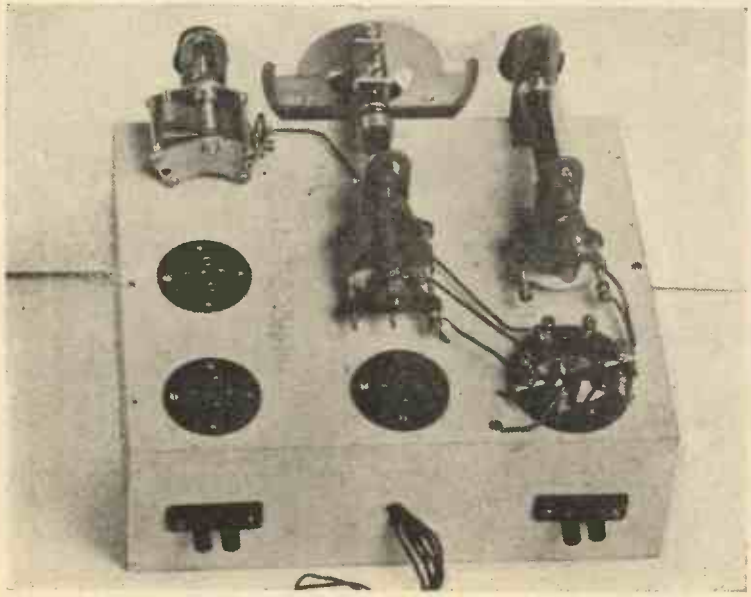


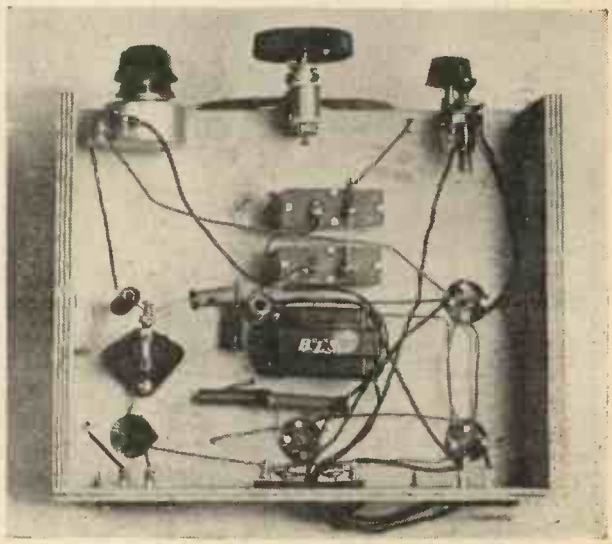
### Construction

The wiring diagram and illustrations will enable the receiver to be made up almost without the necessity of careful explanation. For those to whom receiver construction is new, however, the following notes will no doubt prove of value. The chassis must be drilled first for the valveholders and the small terminal strips. To clear the valve pins a 1-in. diameter hole will suffice, but when screwing the holders on to the chassis take care that the top of the metal sockets does not come into contact with the metallised surface of the chassis. A ⅛-in. drill will enable the socket strips to be neatly mounted, and finally all the components should be attached to the chassis. The actual wiring will be found simple, although some constructors prefer to mount the components one by one, placing the wires to each component as it is placed in its position, and working through the theoretical circuit. One word of warning is necessary regarding the mounting of the small component brackets. That which holds the series aerial condenser must not come into contact with the metallised surface, and therefore this should be cleanly scraped away with a knife, whilst the other brackets must make good contact with the chassis. Owing to the fact that the chassis only has the upper surface coated, the brackets on the under-side automatically become insulated as they are attached to the plain wood. Take care, therefore, to use fairly short screws for mounting these, in order that the screw will not penetrate through to the metal surface.

### Wiring

Complete the wiring with fairly substantial wire, making good sound soldered joints if possible in order to





*Three photographs of the receiver showing the neat and compact layout of the components.*

avoid difficulties due to corrosion or looseness at some later date. When wiring is completed connect up the batteries, the H.T. positive lead being plugged in to the 120-volt socket of the H.T. battery and the H.T. — lead into the socket on the battery similarly marked. The G.B. positive lead should be inserted into the positive socket at the end of the bias battery and G.B. — 1 should be inserted in the 1½ (or 1·5) volt socket, with G.B. — 2 into the 4·5-volt socket. To keep down the total H.T. consumption the bias applied to the last valve (that is, G.B. — 2) may be increased up to 7·5 volts, at which figure the total anode current consumption will be found to be approximately 6mA.

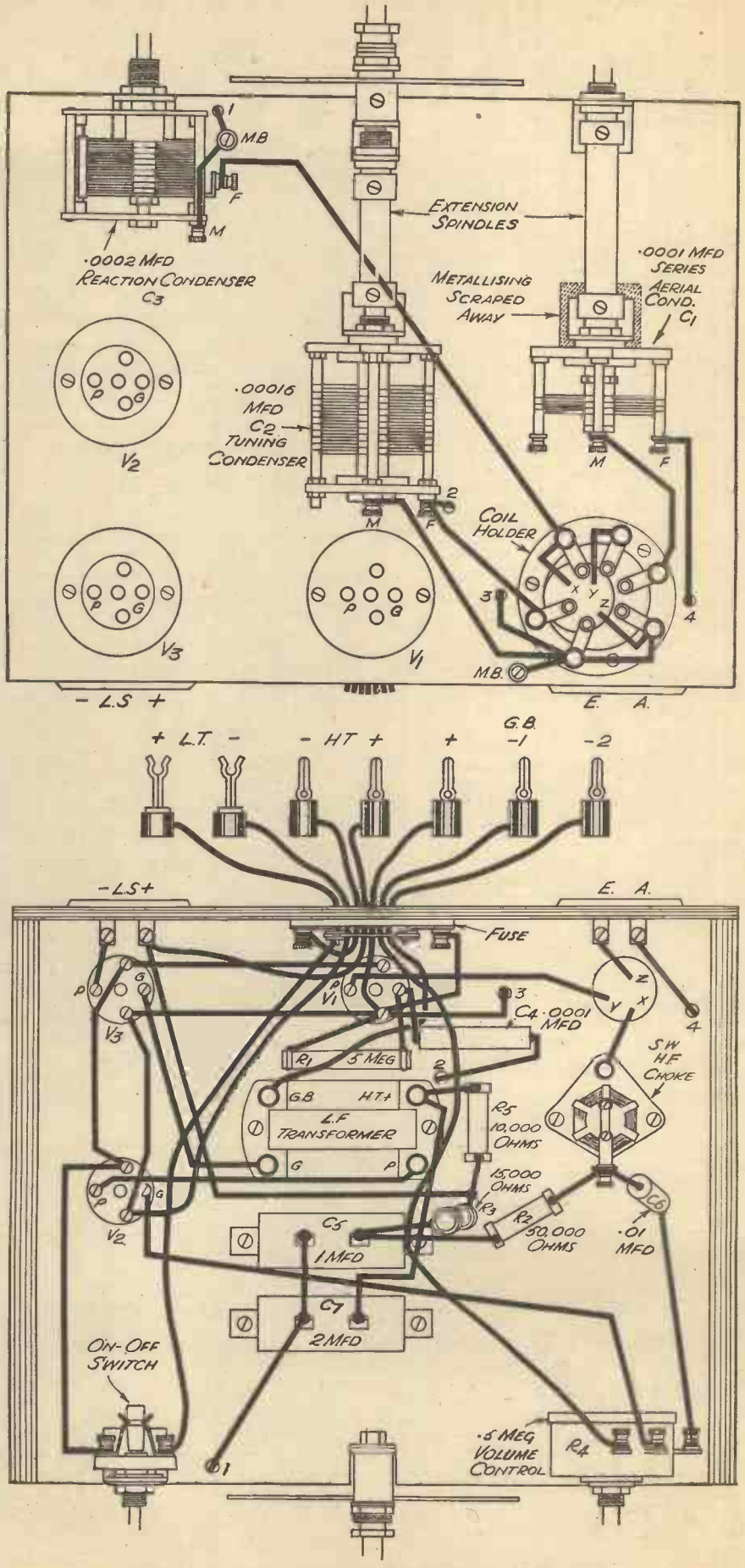
**Adjusting the Receiver**

The aerial and earth leads should now be connected, and the loudspeaker joined to the appropriate terminals, and the switch set to the "On" position. Naturally a coil will be inserted into the coil holder, and this should be of the type designed to cover the waveband upon which it is desired to listen. In order to simplify adjustment when first working on the short waves the coil 6R will prove most useful, and the reaction control should be slowly turned until a breathing sound is heard. Turning the tuning control will now enable various stations to be picked up, but if the reaction adjustment is carried too far the only sound which will be heard when tuned

(*Continued on page* 368.)

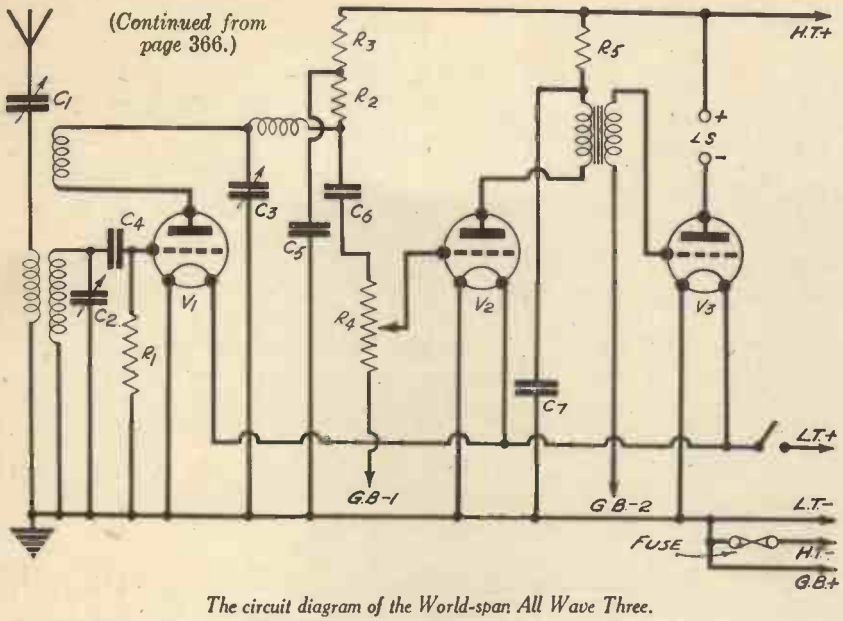
**LIST OF COMPONENTS FOR THE WORLD-SPAN ALL WAVE THREE**

Two Coils, Type S.P.C. and S.P.D. with Base S.P.B., (B.T.S.).
One ·00016-mfd. Tuning Condenser, C2, Scientific (Eddystone) with 933W Drive.
One Aerial Condenser, ·0001 mfd., C1 (Eddystone).
One ·0002 Reaction Condenser, C3 (Eddystone).
Two extension spindles, 3 in., No. 943 (Eddystone).
One 1-mfd. Fixed Condenser, C5 (T.M.C.).
One ·0001-mfd. Tubular Condenser, C4 (T.M.C.).
One 2-mfd. Fixed Condenser, C7 (T.M.C.).
One ·01 Tubular Condenser, C6 (T.M.C.).
One 5-meg. Fixed Resistance, R1 (Amplion).
One 50,000 ohms Resistance, R2 (Amplion).
One 15,000 ohms Resistance, R3 (Amplion).
One 10,000 ohms Resistance, R5 (Amplion).
One Transformer (B.T.S.).
One microfuse, 100 mA.
One On-off Switch (Ward and Goldstone)
One H.F. Choke, Type R4/406 (Ward and Goldstone).
One 500,000 ohms potentiometer, R4 (B.T.S.).
Three Valveholders, 4-pin Airsprung (Clix).
Six 2-in. Component Brackets (B.T.S.).
Two Terminal Strips, A.E. and L.S. (Belling Lee).
Five Wander Plugs, H.T. +, H.T. —, G.B. +, G.B. — 1, G.B. — 2 (Belling Lee).
Two Spades, L.T. + and L.T. — (Belling Lee).
One Metaplex Chassis, 10 × 8 × 3 in. (Peto Scott).
Three Valves, D210, L210, P220 (Hivac).
Batteries, 120-volt H.T., 9-volt G.B. and 2-volt accumulator.
Speaker, Amplion "Dragon."




*An above and underneath chassis view of the World-span All Wave Three.*

(Continued from page 366.)




*The circuit diagram of the World-span All Wave Three.*

to a station will be a loud whistle. Therefore, as soon as such a sound is heard, slacken off the reaction control and slightly readjust the tuning control. If the reaction is turned back too far the station may be lost, and thus it becomes rather necessary to carry out these two adjustments very carefully. Continuous wave Morse signals will be heard when the receiver is oscillating, but speech and music will only be resolved clearly when just off the oscillation point. If it is found that in certain positions the reaction control has no effect, the series aerial condenser should be adjusted, and thus it becomes necessary to find a position with this condenser where reaction can be obtained throughout the tuning range.

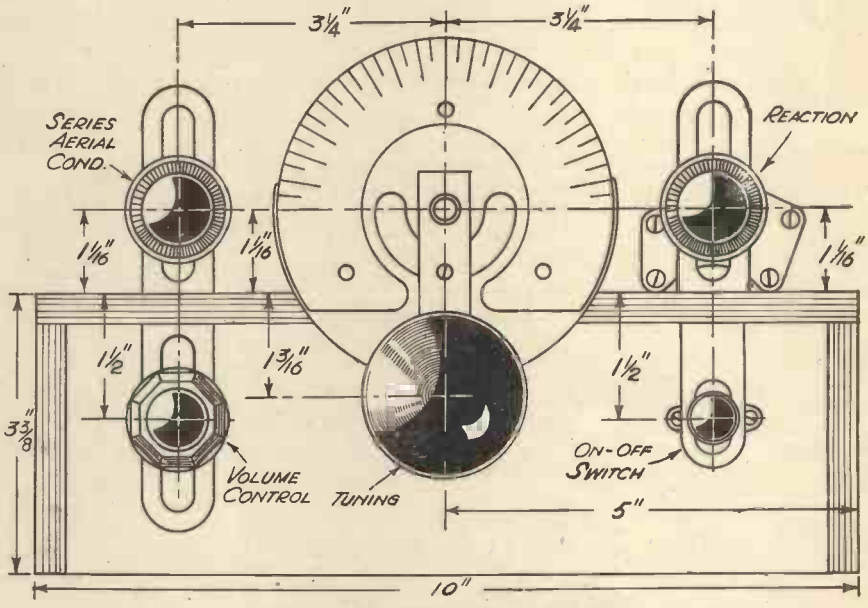
**Volume Control**

When using headphones it may become necessary to reduce the volume slightly, and for this purpose a volume control is fitted to the receiver. On most short-wave stations this control will not be used and should be set to its maximum position, but on the broadcast band it may be found very valuable in enabling searching to be carried out by means of the headphones.

This control is of the type which provides a very smooth variation in volume and does not introduce distortion. Therefore, when the receiver is used close to a powerful broadcast station, and it is found that signals are too loud, it may be used for reducing the volume without introducing any ill effects.

**Aerial and Earth**

When using the receiver for the short waves the design and efficiency of the aerial and earth system should receive careful attention. The customary 100-ft. aerial will not be productive of the best results, and, in general, a short vertical type of aerial will be found to offer much better results. If, therefore, you have at present erected one of the large types of aerial, simply disconnect the lead-in, and use this as the aerial, when, no doubt, you will find that it is capable of bringing in all the stations you require. Care should be paid to the insulation and the wire should be kept at least 18 in. from the wall or other earthed bodies. The earth itself should preferably be of the buried metal type, with a good stout wire joined to it, and some system of keeping the earth moist should be adopted. If this type of earth cannot be used, a good sound connection to a main water pipe may be used.




*The layout showing the position of the knobs.*

## A NEW WIRELESS APPROACH BEACON

SPEKE Aerodrome, Liverpool, is to be fitted with the latest type of wireless approach beacon to assist aeroplane pilots entering the airport in bad weather. The installation of the beacon equipment will be carried out by the Marconi Company, to the order of the Liverpool Corporation.

The main approach beacon is of the aural type, and will operate on a medium wavelength, so that any aircraft fitted with a normal type of aircraft-receiving apparatus will be able to use its service. In addition to the main beacon, there will be two "marker" beacons which will indicate to the pilot when flying along the correct line of approach, first, when he is at a distance of three miles from the aerodrome, and, second, when he passes over the boundary of the aerodrome.

**How the System works**

The approach beacon constitutes a method of indicating by wireless the best route into the aerodrome, providing a sort of invisible causeway that can be followed by the pilot even when the signs and landmarks that he normally uses are invisible through fog, heavy rain or low cloud.

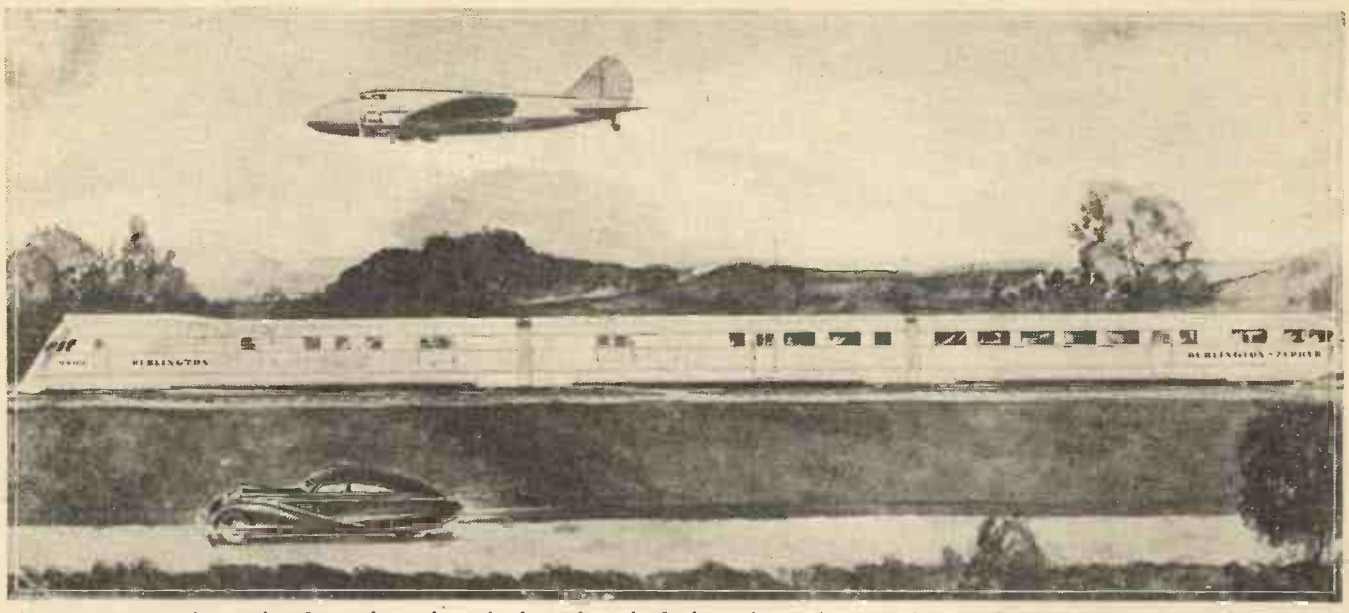
This is done by arranging the transmitter to send out a series of distinctive signals directed alternately to each side of the course. At Speke the beacon will transmit a series of Morse dots to one side, and a series of dashes to the other. The transmitter will be timed so that the dots on the one side occur exactly during the silence periods between the dashes on the other side. In this way an aeroplane flying on the correct course will receive the dot and the dash at equal strength, and, owing to the timed alternate transmission it will sound as one continuous signal.

If the aeroplane were to deviate to right or to left from this course, either the dots or the dashes would be received at greater strength. This provides an indication to the pilot that he is off course, and also to which side he has deviated.

The approach beacon at Speke is not intended to have a long range, as direction-finding facilities of this kind are available, but it is specifically for the purpose of bringing aircraft straight into the airport on the best course. The purpose of the first marker beacon at three miles from the aerodrome on this course is to warn the pilot that it is time to begin losing height, while the second informs him that he has passed the boundary of the aerodrome and is actually over the landing field. These marker beacons will be audible to the pilot without re-tuning his receiver as he passes over them, and each marker will have its own distinctive and easily recognisable signal.

**The Equipment**

The main beacon transmitter at Speke will be a compact apparatus contained in a metal-screened cabinet and operated direct from the local electric supply. Its aerial system will be low and unobtrusive, not exceeding a height of 20 ft.



*A composite picture indicating the influence of aircraft on other forms of travel. Little was known about streamlining until aircraft engineers investigated airflow by means of wind-tunnel tests.*

# MODEL AERO TOPICS

By F. J. CAMM

### Designs for Petrol-driven Models

SINCE the publication of my handbook, "Power-Driven Model Aircraft," I have been inundated with requests for working drawings of a model into which either the Atom Minor, the Hallam, the Grayspec, or the Brown Junior motors could be installed. Readers will have gathered from previous issues that I have made these various engines, and that they all work extremely well, being easy to start and developing sufficient power to fly a model weighing up to 5 lb. Several designs for models are given in the book to which I have referred, and I am now at work on a design which will be published in these pages. I have decided that all points of view would best be served by making this of the Pusher type, with the engine and propeller arranged between the mainplane and tail. Most of the experiments conducted by others in this interesting field indicate that in the early stages the model frequently crashes, necessitating several repairs and long delays before the model is a satisfactory flier.

It is a fact that for some reason or other Canard or Pusher models are more satisfactory in every way than tractor machines. Such may look more orthodox, but they do not remain intact very long. A model which is a satisfactory flier and continues to be so without frequent breakages has much to recommend it; a model which does not require tricky adjustment has more to recommend it; one, which, when it does crash, does not wreck its engine, has even more to recommend it.

These desirable features are found to exist in the type of model to which I have referred, and I would urge my readers not to risk wrecking their miniature petrol engines (they are fairly expensive to replace) by endeavouring to ape full-size machines. Such a model will not remain intact long enough for you to admire its appearance.

### Loading

I have decided that the wing span should not exceed 6 ft., and by employing an aspect ratio of 6 to 1 this gives the chord as 12 in. Employing a loading of, say, 6 oz. to the square foot, this brings the total weight of the model to 3 lb. Now I have found that this weight can easily be adhered to. If you employ a heavier loading, the speed of take off and the landing speed will be fairly high. With a loading of 6 oz. to the square foot and using a moderate wing section, the speed can be kept to less than 20 miles an hour. I am aware that some petrol-driven models have weighed as much as 6 lb., but I am certain that this weight involves many structural problems. The higher landing speed when heavier loadings are used means a stronger chassis, which means a stronger fuselage, and so you find the problem travelling in a vicious circle. A total weight of 3 lb is a convenient figure to work to. It does not call for specially light construction, and enables a reasonable amount of metal fittings and substantial attachments. I do not propose to make use of thread binding, or Balsa wood; I prefer to use silver spruce and birch, duralumin tube, metal straps, and sockets, in order to provide a rigid and workmanlike job. I saw one model last year with the engine precariously mounted in a tractor model on a bent piece of $\frac{1}{2}$-in. × $\frac{3}{16}$-in. iron by means of two bolts. Apart from the fact that the piece of iron was heavy, it caused the thrust line to alter every time the model landed. Endeavours to correct this caused the front of the fuselage to break off.

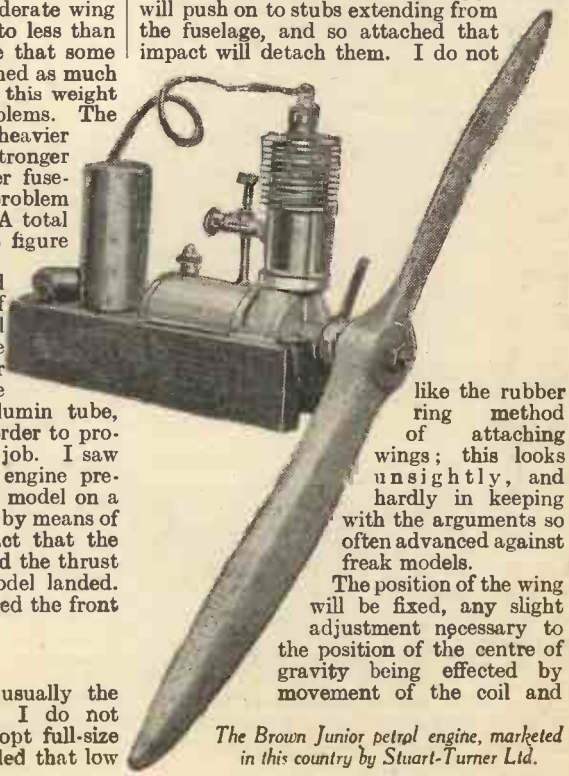
### The Chassis

I find that the chassis is usually the weakest part of such designs. I do not think there is any need to adopt full-size practice in the chassis. Provided that low pressure air tyres are used, there is no need to adopt any other form of shock absorber. Such tyres will take the load of landing without wrecking the chassis. Chassis which are flexible can be mixed blessings in that they enable the wing tips to come into contact with the ground and cause damage which would otherwise not occur. Several suitable wheels are now on the market, and I hope also to give instructions for making a pair from rubber balls. For the chassis members I propose to use duralumin and steel tube, and to make it of the divided axle type. Instead of a rear skid I intend also to use a rear wheel of small diameter to shorten the take-off.

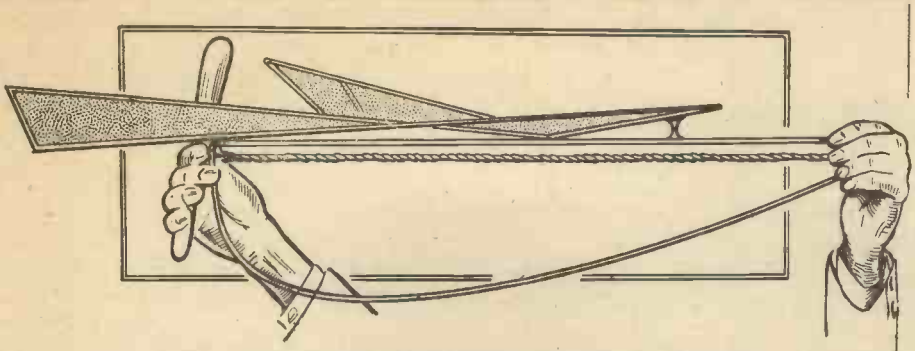
### Wings

I propose to make the wings in two sections, each of the mono-spar type, which will push on to stubs extending from the fuselage, and so attached that impact will detach them. I do not like the rubber ring method of attaching wings; this looks unsightly, and hardly in keeping with the arguments so often advanced against freak models.

The position of the wing will be fixed, any slight adjustment necessary to the position of the centre of gravity being effected by movement of the coil and



*The Brown Junior petrol engine, marketed in this country by Stuart-Turner Ltd.*



*The correct method of launching a model pterodactyl monoplane. The sketch shows the positive angle of incidence at the centre section, and the negative wing tip.*

battery. Thus, once the correct position of the C.G. has been found the model will remain in flying trim. The rubber band method is unsatisfactory from many other points of view. I have seen models crash to earth due to the wing lifting off the fuselage when a gust of wind has struck the undersurface of it. The stub method of attachment ensures that the wing remains rigidly fixed. An adjustable tail elevator will, of course, be provided.

### Controls

The engine controls will be brought out to small levers and will consist of advance and retard lever, air control, jet control, ignition switch, and a two-pin plug and socket, so that the engine can be run up from an accumulator switched over to the dry cell in the fuselage. I have found that the Brown Junior once warm will start off 1½ volts, and from cold on a 4-volt dry cell. For those readers who elect to use an engine which requires a higher voltage or an accumulator, the two-pin plug will, of course, come in useful. Ignition is, of course, by means of a fixed coil. My experiments with trembler coils have reminded me of my first motor cycle, which used this form of ignition. There is incessant trouble with the contacts and the trembler blade, and for model aircraft purposes I do not recommend it.

### The Airscrew

I have tried both wood and electron airscrews, and find that the latter, although slightly heavier, are better, since they provide just that extra bit of momentum which makes starting easy. The airscrew diameter is 13 in., and the pitch 9 in. The efficiency is thus not too high, but adequate for the load. These small engines do not run really satisfactory at low speeds, and it is not easy to make a model airscrew which is efficient or rather highly efficient at 3,000 revolutions per minute. The diameter and pitch to which I have referred and which, of course, are largely decided by the flying speed and the loading seem to provide a happy compromise between the opposing technical factors. Airscrews in electron are available from a number of sources, so that the reader will be saved the trouble of sending a wooden pattern to the foundry. My experiments with geared airscrews do not lead me to recommend this form of drive.

### The Fuselage

As can be gathered from the foregoing remarks, the fuselage will be short, just sufficiently long, as a matter of fact, to accommodate the engine, tank, coil, and battery and chassis. The tail will be carried on booms, so that the model can easily be dismantled and packed into a reasonably small space. Portability, I realise, is an important point, not only so that it may easily be transported, but also so that it may be stored.

### Full-size Blue Prints

It is not possible to give a series of full-size rib sections in this journal, so it is proposed to issue full-size blue prints of the complete model for a nominal sum. These diagrams will, of course, be reproduced in these pages, but it is thought that readers who intend to build the model would prefer to work from a full-size diagram. These blue prints may be used for marking off the material whilst the rib sections can be pasted on to the millimeter three-ply and fretted or cut with scissors to correct shape.

**SPECIAL COMPETITION**

**For the best model of an S.E.5A aeroplane made from a set of "Welcom" aeroplane parts (see paragraph on this page) we will award the following prizes :—**

**First Prize : £1 10 0.**
**Second Prize : £1 0 0.**
**Third Prize : 10s.**
**Fifty Consolation Prizes of books.**

**The following rules must be complied with :—**

**Rule 1. Every model must have the name and full address of the competitor written in ink on the underside of the fuselage.**
**Rule 2. Models must be made from "Welcom" parts.**
**Rule 3. Latest date for receipt of entries is May 26th, 1935.**
**Rule 4. Stamps for the return of the model must be enclosed.**
**Rule 5. The Judge's decision is final and an expressed condition of entry. The Judges will be the Editor of "Practical Mechanics" and Mr. Williams, of Williams, Ellis & Company, makers of "Welcom" parts for the S.E.5A.**
**Rule 6. Models must be sent securely packed and in a box suitable for their return, and addressed to The Editor, "Practical Mechanics," 8-11 Southampton Street, Strand, W.C.2.**



### Miniature Plugs

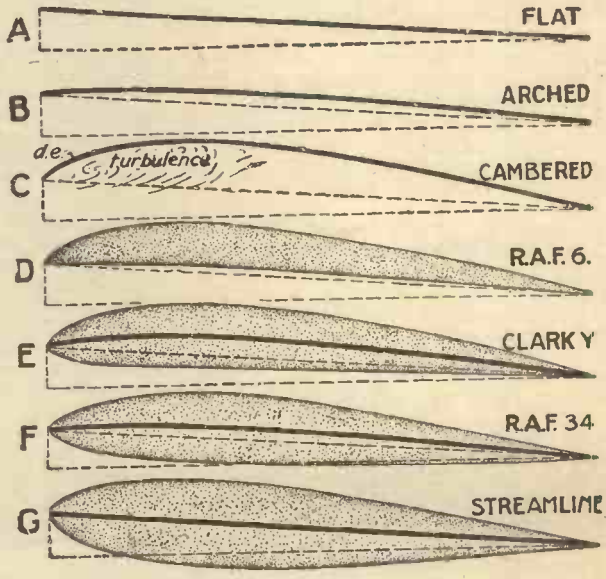
The Brown Junior miniature petrol engine makes use of a plug which is proportional to the size of the engine, and it is about half the size of the miniature plug normally supplied. I suggest that all makers of model petrol engines should modify their designs to suit.

### "Welcom" Constructional Sets

Many readers are interested in miniature scale models of famous aeroplanes. I should like to draw their attention, therefore, to the "Welcom" Constructional Sets supplied by Williams, Ellis & Co. Ltd., Kelvin House, 82 Farringdon Street, E.C.4. These realistic models may be assembled from the parts which are supplied complete with all the necessary materials for the low price of 1s. per set. The models are designed to a uniform scale of 1/48th full-size, and sets are available for the Comper Swift, the D.H.60, the Puss Moth, the Percival Gull, the Auto Giro, the Sopwith Camel, the S.E. 5A, the Bristol Fighter, the famous Hawker Hart, and the D.H. Comet. The materials are partially finished, but need a minimum of attention in order to bring them to the finished form. All machine work has been done. The partly finished unit leaves just sufficient handwork to maintain the interest and to provide room for individual touches.

The reader's attention is drawn to the centre column of this page in which appear details of a competition for the best model of the S.E.5A made from "Welcom" Constructional Kits.

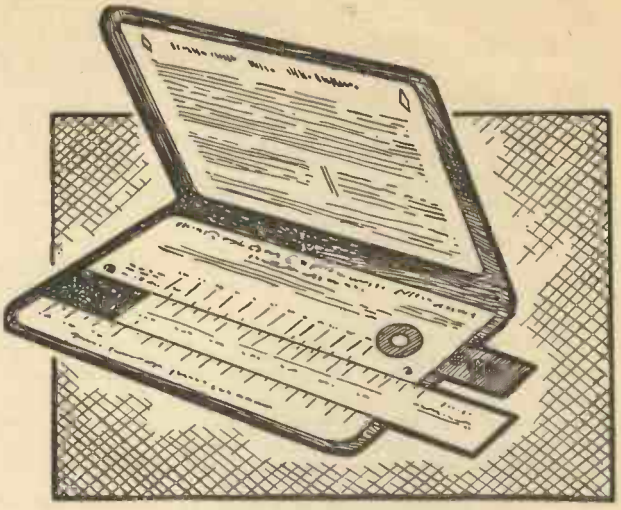
If any readers have completed the models described in my handbook on Power Driven Model Aircraft, I shall be glad if they would send me a photograph and a brief description for publication, and to pay for all such photographs which are published. I know that several of the petrol engines described in my book have been built and are successfully running, and for the guidance of other readers I should like to publish photographs of models with the engines installed. At the same time, I should be interested to receive photographs of what I may term free-lance models made and designed by readers themselves. I am, of course, referring to power driven models operated by compressed air, steam or petrol. If desired, such photographs will be returned provided that a stamped addressed envelope is enclosed.




*Showing various wing sections.*

# AN A.B.C. OF PHOTOGRAPHY

## THE FIRST ARTICLE OF A SERIES



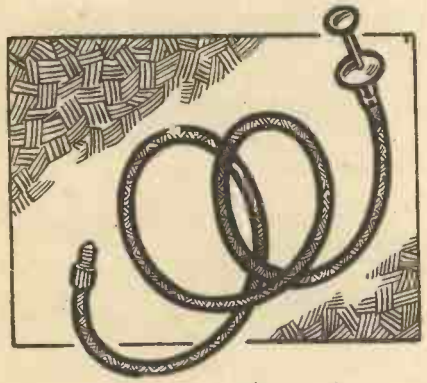
*A well-known exposure meter of the actinometer type.*

**Abrasion Marks**

BLACK lines or markings on a printing paper caused by friction or pressure. Only occur on certain types of paper.

**Accelerator**

A chemical included in a developer in order to hasten the process of development. The commonest accelerator is carbonate of soda.



*An actinous release.*

**Achromatic**

The term applied to a lens which has the chemical and visual foci coinciding.

**Acid Sulphite of Soda**—See Sodium Bisulphite.

**Actinometer**

A device which measures or gauges the strength of light, or, in other words, a device for measuring actinic strength. It generally consists of a piece of sensitised paper, and is exposed to the light until it assumes the tint of the surround. The time taken for this to occur is known as the actinometer time, and any exposure or stop is ascertained from a table supplied with the device. Another term for exposure meter (which see).

**Anhydrous**

The term applied to chemicals which have had all moisture driven off. When compounding a formula the ordinary type of chemical is referred to unless otherwise stated. If an anhydrous chemical is employed the amount used will be different from that given in the formula, and the variation will depend upon the particular chemical. For instance, in the case of sodium sulphite one-half of the specified amount should be used in the case of anhydrous, but with sodium carbonate the amount required is ascertained by multiplying the quantity given in the formula by five and dividing by fourteen.

**Alum**

Fine white crystalline substance. Unless otherwise stated in formula, potash alum is referred to. It must be chemically pure. Dissolves best in hot water. Chrome alum is purple in colour. Both types are used for hardening, the latter crystal exercising a slightly more hardening effect than potash alum. Keeps indefinitely in a dry place.

**Amidol**

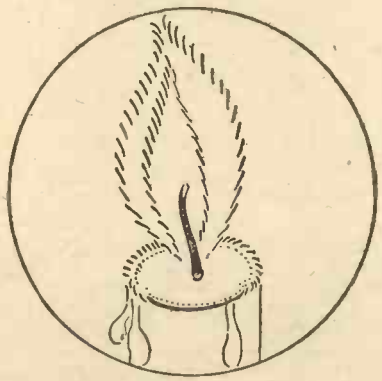
Abbreviated form of diamidophenol. Fine grey powder dissolving readily in cold water. Keeping property of the chemical good, provided it is kept in well-stoppered bottle. As a solution will not keep many days. When fresh the solution is practically clear, but gradually darkens. Should not be used when darker than vinegar colour.

**Ammonia**

Clear, colourless liquid. Must be kept well-stoppered. Keeps indefinitely in a well-stoppered bottle.

**Ammonium Bromide**

Coarse white powder, dissolving in cold water. Keeps well in powder or liquid form. Keep bottle well corked.



*Chromatic aberration is shown by coloured fringes round the candle flame.*

**Ammonium Carbonate**

Lumpy, waxish crystals. Should not be covered with powder, but may be used if powder is first rinsed off. Does not keep well in either powder or liquid form.

**Ammonium Sulphocyanide**

Crystalline substance which rapidly absorbs moisture and must therefore be kept well corked. Keeps indefinitely in solution.

**Anastigmat**

The term applied to a lens which has been corrected to enable vertical and horizontal lines to be brought to the same focus.

**Actinous Release**

A device for operating the shutter through the medium of a length of wire cable. It is passed through a small diameter tube, and pressure on a plunger at one end operates a finger at the other and so operates the shutter.

**Astigmatism**

The defect in a lens which gives different focal points for vertical and horizontal lines. A form of curvature resulting from the use of an astigmatic lens.

**Backed Plate**

One which is coated on the back with an opaque substance to prevent reflection and halation. The material usually dissolves away when the plate is developed.

**Bellows**

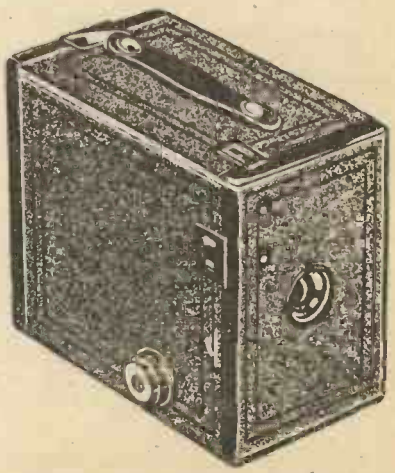
A pleated leather cone forming the connection between lens and plate or film. The lens mount is fixed to the front of the bellows and the camera is thus able to close into a small compass.

**Bicarbonate of Soda**—See Sodium Bicarbonate.

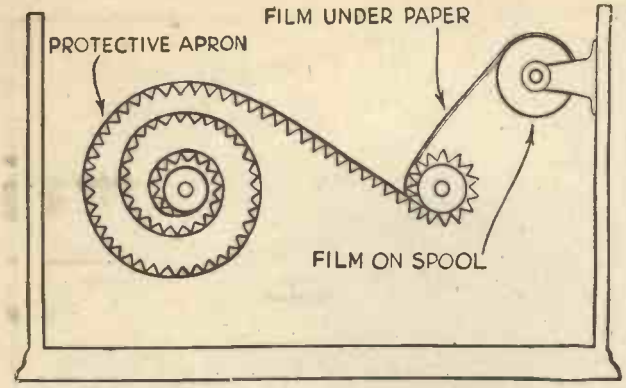
**Blue Vitriol**—See Copper Sulphate.

**Box Camera**

A camera in the form of a box, that is, with the whole structure rigid, and the lens and plate or film-holder fixed in relation to one another. Usually no focusing is possible with this type of camera, and it is therefore one of the cheapest types of camera.



*A good example of a box-type of camera. No focusing adjustments are possible with this type of camera.*




*The daylight loader for developing films. As may be seen, the film is wound off from the spool into a special light-proof apron, which is then removed and placed in a cylindrical metal can into which developing and fixing chemicals are placed. The whole operation may be carried out in daylight.*

**Bromide of Ammonium.** See Ammonium Bromide.

**Bromide of Potash.** See Potassium Bromide.

**Carbonate of Ammonia**—See Ammonium Carbonate.

**Carbonate of Potash**—See Potassium Carbonate.

**Carbonate of Soda**—See Sodium Carbonate.

**Caustic Potash**—See Potassium Hydrate.

**Chromatic Aberration**

Distortion caused by the uneven refraction of an object due to differences in colour.

**Chrome Alum**—See Alum.

**Citric Acid**

Powder or crystalline substance. Keeps indefinitely without any precautions.

**Convertible Lens**

One in which the various components may be used separately or in different focal lengths.

**Copper Sulphate**

Blue crystals which keep indefinitely, but in solution turn cloudy with time. May be dissolved in hot water to speed the preparation of solution.

**Covering Power**

The extent to which a lens is capable of giving a sharp or well-defined image.

**Curvature of Field**

The term applied to a lens where the centre is sharply defined but the edges are out of focus.

**Dark Room**

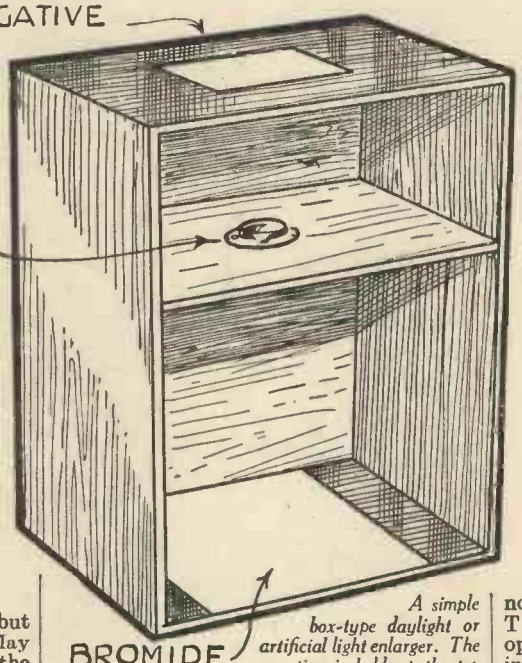
The term applied to the room in which developing, camera loading, etc., is carried out. Any room may be converted to a dark room by simply pulling down the blinds and in any other way cutting out all extraneous light, but the term is strictly applied to a room correctly fitted out for the purpose of photographic operation. Thus a special lamp is fitted capable of shedding either a red or an orange light, and various dishes and sinks are provided in the interests of chemical cleanliness. For certain factorial operations a luminous clock should be installed, capable of showing seconds clearly.

**Daylight Paper**

A printing paper coated with a slow emulsion requiring lengthy exposure to daylight in order to produce an image. The image becomes visible as exposure proceeds, and only fixing is required. An acid bath should not be used. The normal colour is a warm brown.

**Daylight Tank**

An ingenious device to enable development to be carried out in daylight. The plate tank has to be loaded in a dark room, but the process of pouring in the developer, etc., may be carried out in daylight owing to a special light-trapped opening. A roll-film tank is provided with a long apron and a special box in which the film and the apron are interwound. The apron may then be removed and inserted in the developing tank, no dark room being necessary at any part of the proceedings. The tank for film packs operates in the same manner as the plate tank, a dark room being necessary for the preliminary loading process.




*A simple box-type daylight or artificial light enlarger. The negative is held at the top and exposure controlled by the small shutter. Only one size of enlargement is obtainable.*

**Definition**

The clearness or sharpness of an image.

**Depth of Focus**

The distance over which an image will photograph sharply. In a very large aperture (that is, one which has the stop almost of the same diameter as the actual lens) the depth of focus will extend only for a few feet. Thus, if the camera is focused to 10 ft. it will be found that objects from, say, 8 ft. to 12 ft. will be sharply defined, whilst everything nearer or farther away than these limits will appear "fuzzy" or out of focus. When the lens is stopped down (that is, smaller stop used) the depth of focus will increase, even though the focusing point is not altered. It follows from this, therefore, that when taking a photograph of an extensive view, where both near and distant objects are required to be sharp, a small stop should be employed. On the other hand, when taking a portrait of a person in the open air, a large stop should be used in order that the background may be out of focus and thus enable the attention to be concentrated on the portrait.

**Desensitiser**

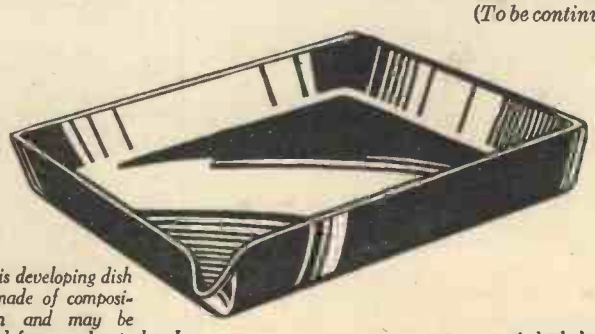
A preparation containing pynakryptol, which has the property of staining the negative in such a way that the operations of developing and fixing may be carried out in ordinary light. The preliminary staining is, of course, carried out in the dark room.

**Desiccated**—The same as Anhydrous (which see).

**Developer**

A chemical agent for acting upon the silver salts which form the principal part of the sensitive emulsion. When this salt receives direct rays of light a certain action takes place, and when a developing chemical comes into contact with it a deposit is left upon the emulsion. The process of fixing is then carried out, whereupon the deposit so left is made permanent, whilst all salts which received no light are removed. The deposit is opaque, and according to the degree of light which struck it the thickness of the deposit will vary on the finished negative, thus producing the lights and shades of the original object.

*(To be continued.)*

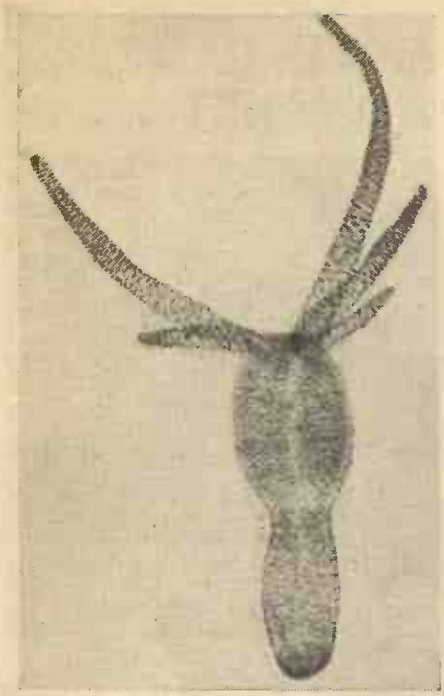


*This developing dish is made of composition and may be used for any chemicals. It is light and unbreakable.*

*A daylight tank for the development of a roll film in the strip.*

# LIVING FOR

Despite the application of scientific discoveries to the art of
70 years. In this article is discussed methods of prolonging



*The Hydra, which is a monster in miniature. Although barely an inch in length, it is provided with tentacles with which it entraps unwary living creatures that come within its reach. The Hydra usually secures itself to a leaf or plant stem below the surface of the water.*

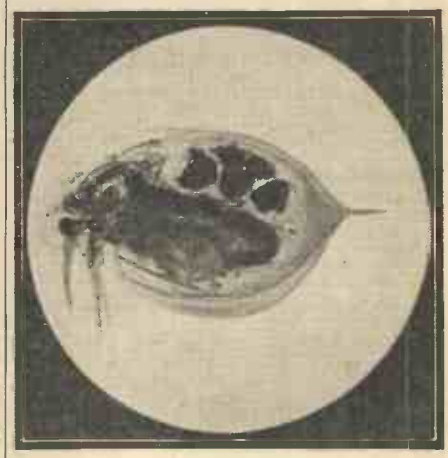
MAN'S allotted span of life is traditionally seventy years. Many succeed in living considerably beyond this limit. A few stretch out their lives to 100 years or more. On the other hand, a large number of individuals fail to attain anything like their seventieth birthday. Despite, therefore, the present increase in the expectation of life, an increase which is, for the most part, a direct result of the application of scientific discoveries to the art of living, the average stretch of human life still remains fairly constant at seventy years.

The phenomenon of death, on the material side at any rate, occurs as a result of the disorganisation of the bodily tissues through general wear and tear, through organic disease or in consequence of accidental destruction. The heart, for instance, can fail owing to senility or gradual wearing out, or owing to acute disease. Again, a bullet passing through the heart would permanently disorganise its functioning. In such an instance, the heart would have been subjected to "accidental" destruction.

Despite various statements to the contrary, there seems to be little doubt of the fact that the bodies of human beings or, indeed, of any other living creatures, were not designed for perpetual functioning. Sooner or later the animal body, due to the above-mentioned factors, becomes unable to carry on its functions. Death, therefore, results, and subsequently, unless elaborate and usually not very satisfactory counteracting measures are taken, the body gradually loses its features and form and subsides away in that long sequence of complex chemical, physical and bacterial changes to which the name "corruption" is given. Life, therefore, as we know it with our material senses cannot go on for ever. Perhaps some day the average life-span may be pushed up to 100 years or even a decade or two beyond that limit. Such prolongation of life, however, would be due to our better knowledge and more careful treatment of the human organism and not to any radical change in the life-balance of the body.

### Prolonging Life

Considerations such as the above, upon which most individuals will be agreed, however, do not preclude the dim possibility of life being lived in snatches. Suppose, for instance, that a man were able to spread out his seventy years of life throughout the centuries, living ten years in one century, six years in the next, a couple of years in the third century, and so on, his "life" could be prolonged for a very great length of time. An individual capable of living his life in jerks, as it were, would be able to gather glimpses of contemporary civilisation down the centuries. True it is that he would not have to form any deep social or individual attachments owing to the comparative shortness of his "snatches" of life. Nevertheless, our imaginary individual would prove a most valuable member of the community from an historical point of view. A man in our own days, for instance, who remembered clearly the ancient civilisation of Greece, who had been present on the battlefield of Hastings and who, five centuries later, had conversed with Shakespeare in his Stratford-on-Avon home, would be in a position to throw much light upon many doubtful historical matters. Sound recording and photography can now do much in the way of handing down records to posterity, but an individual eye-witness accompanying such records would render the evidence of history complete.



*The water flea.*

The notion of living one's life in snatches is not so fantastic as that of living continually for an indefinite period. The latter dream of humanity has no scientific evidence on which to base itself. The "interrupted" method of living, however, possesses at least a number of practical observations upon which its technique might possibly be reared. Suspended animation is, of course, a well-known phenomenon. It can be entered into voluntarily by certain individuals, notably Indian fakirs and Hindu yogis, and, in many instances, it forms the accompaniment of mystical religious experience. Such suspended animation, however, is but relatively brief. A few hours, days or, at the most, weeks is the time limit of this cessation of bodily functions, and the suspension of activity is originated mentally rather than physically. The "interrupted" life, therefore, cannot be based upon such experiences.

### The Effect of Heat

Our bodies, being composed of matter in its various combinations, consist, like all

*The petals of flowers frozen in liquid air become so brittle that they can be powdered up with a hammer like thin pieces of glass.*

# 200,000 YEARS!

living, the average span of human life remains at roughly the span of life to the amazing figure given in the title

other material objects, of vast assemblages of particles called atoms, all of which are in a state of rapid motion and vibration. It is the motion of these constituent particles which constitutes the root cause and directing force of the various changes which are continually undergone in the bodily tissues. These motions are all very complex in nature, and we do not understand them properly. There is one thing, however, which we do know about them, and that is the fact that they are influenced directly by heat. Adding heat to a body or a system increases the motions of its particles. If you throw a man into a furnace, heat will be added to his body. The motions of his particles will be given such an enormous increase of energy that they will fail to keep within their prescribed bounds. The bodily particles of such an individual

*Ceratia. Other minute aquatic organisms which have been frozen and afterwards returned to life.*

will rush here and there in mad confusion, forming new chemical compounds and completely disorganising and disrupting the body. The man will burn and he will no longer live.

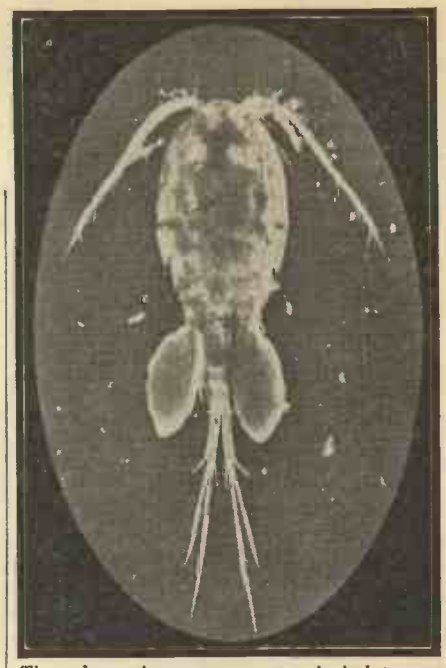
When a body or system is cooled down, the motions of its constituent particles are progressively retarded until the temperature of absolute zero (— 273° C.) is reached, at which temperature the particles are motionless. It is impossible to attain or even to imagine a temperature lower than absolute zero, because at this temperature a body contains no heat at all. If, now, a man in good health could be cooled down to absolute zero or to a temperature very near that point, the minute particles of his body would have their motions arrested. The body, therefore, would no longer be able to function. The man would no longer live in the active sense of the term. On the other hand, the body could not disorganise or decay, because even such retrograde processes require a ceaseless activity of its constituent particles. In such circumstances, therefore, the body would be "held." It would remain indefinitely undead, un-alive. Careful thawing of the body would, owing to the addition of heat, restore the motions to the particles and thus, under favourable circumstances, the body would again return to life.

### Why it is Impossible

One big snag stands out prominently in the above scheme. Under any known conditions it would be impossible to cool down a man's body quickly enough for the motions of its particles to be arrested instantly. If the cooling process took place slowly, even if it occupied merely a few seconds of time, the different rates of freezing would destroy the balances between the various organs and tissues in the body and death, instead of frozen animation, would result. The entire possibility of the scheme is dependent upon the motions of the body's constituent particles being instantly "held," and this could only be effected by instantaneous cooling down to absolute zero, a process which, at the present time, is totally impossible.

Within recent years experiments upon the prolongation of life by freezing have been carried on in many laboratories. For years it has been known that fish may be frozen hard in ice, so hard that they may be snapped in two with the fingers, yet, after slow thawing, they return to life and are apparently none the worse for their experiences. In the Polar regions this freezing process must be fairly common, and the marine inhabitants of those localities must survive frequent periodical refrigeration.

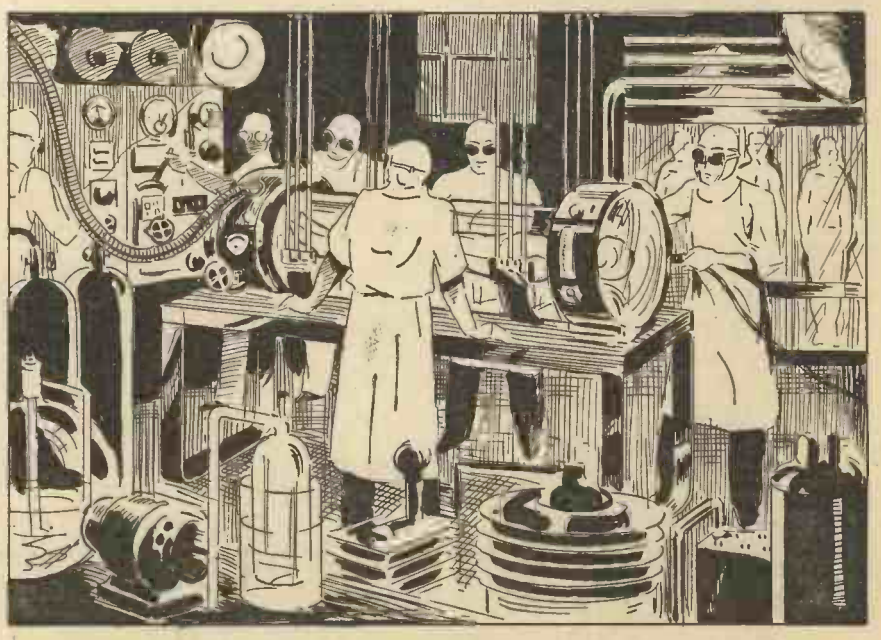
Liquid air is well known in laboratories as an extremely powerful refrigerant. Flowers dipped in liquid air, which has a temperature of about 190° below the freezing point of water, immediately become as rigid and as brittle as glass. This temperature, however, low as it is, is a high one compared with the temperature of liquid helium. Liquid helium has a temperature of — 268° C.—268 degrees below the temperature of ice, and only 5 degrees above absolute zero. Into liquid



*The cyclops. A minute water animal which is sometimes found in drinking water. This is the female of the species, and she carries two egg-cases full of eggs on each side of her.*

helium various small and soft-bodied aquatic creatures have been placed and allowed to remain therein for periods ranging from a few minutes to several days. In all such instances, immediate freezing of the living tissues has taken place, the motions of the particles of the animal organisms have been instantaneously arrested. A condition of life-suspension has, therefore, ensued. After the elapse of these varying times, the creatures have been removed from the bath of liquid helium and very slowly thawed. In nearly every instance, life has returned after normal temperatures have been reached, thus proving that it is possible to cool down a living creature to such a degree

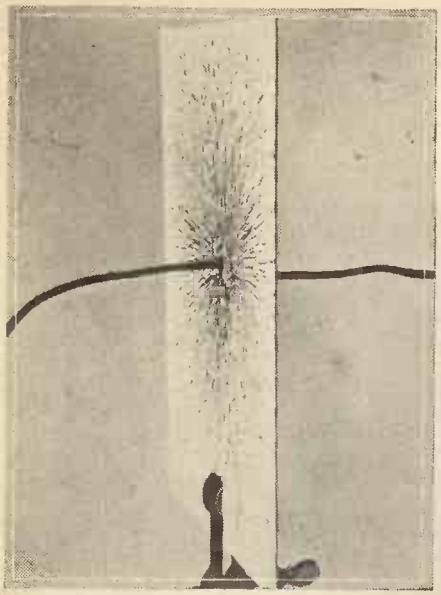
(*Continued on page* 388)



*Our artist's impression of the "subject" about to be frozen. Around can be seen vacuum bottles and large steel control gauges with taps. In the far background are "containers" having within them at constant absolute zero, the bodies of other individuals in a state of refrigeration.*

# FACTS ABOUT AURA

An interesting article dealing with the "Human Haze" surrounding the living body, and how it may be seen.



*An electrical aura. The field of influence surrounding a wire carrying a current disclosed by means of iron filings.*

NO scientific subject has proved of greater fascination to many minds than that of the human aura. Around every living body there exists from the moment of birth, nay, from a time even before birth, to the instant of death a peculiar haze or "aura," as it has now come to be termed, which, under certain conditions, can be made visible. This human haze is a product of the living body. It persists throughout life, in health and in sickness, varying in intensity and in physical form according to the varying conditions and state of the body. So inseparably connected is this ethereal and tenuous haze with the living body that it is often referred to as the "human atmosphere."

There are not many people who have seen the human atmosphere. There are, in fact, individuals to whom, apparently, the human haze can never be revealed, on account of the insensitivity of their eyes to the rays which proceed from it. Despite this fact, however, it would seem that at least 60 per cent. of the persons who endeavour to see the human aura are successful in doing so; not, perhaps, on their first attempts, but, more commonly, after three or four painstaking endeavours to witness the phenomenon.

A few people claim to be able to perceive the aura surrounding the human body with the naked eye alone. Many people gifted with second sight seem to possess this faculty. Clairvoyants and individuals possessing spiritualistic tendencies and powers claim to be able to distinguish the human aura either at will or after they have voluntarily attained certain trance-states of the mind. It is not at all certain, however, whether the "aura" which such individuals claim to be able to see is identical with the aura of the scientific investigator. The aura of the scientist is definitely a material phenomenon. It can be witnessed, measured and even minutely examined at will by the scientific investigator working under the right conditions. No hypnotic or trance-like conditions on the part of the investigator enter into the question. The human aura is a perfectly material and natural phenomenon. It is as natural an accompaniment of the human organism as is the breath. Owing to its nature, however, it is an evasive entity and, usually, it is only seen under very rigidly defined physical conditions.

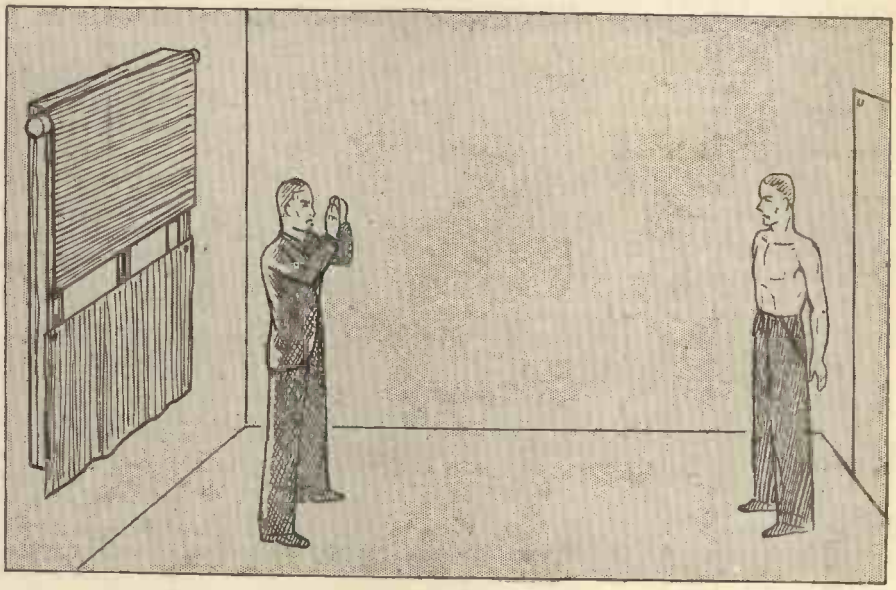
### A Thin Luminous Haze

Science in general has, as yet, given surprisingly little attention to the matter of the human aura. Some years ago a medical man—W. J. Kilner by name—who was living in retirement at Southampton, wrote a volume on the subject of the aura. In his book Kilner embodied the results of many years of patient investigation. Unfortunately, the book was allowed to go out of print, Kilner died and few scientific workers attempted to repeat and advance his experiments.

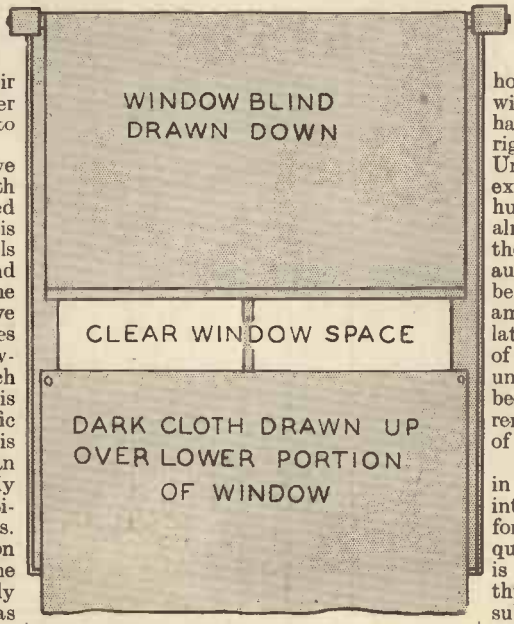
The human aura, as we have already explained, consists of a thin luminous haze which surrounds the body. It is completely hidden by clothing. Hence, for the purpose of experiments, the "subject" must divest himself of his clothing if his aura is to be seen in its entirety. Usually, however, for the purpose of preliminary experiments, a subject who has stripped to the waist or even to the chest will suffice to reveal the presence of this mysterious bodily haze.

Buried among historical observations and facts are to be found records of individuals around whose bodies has been witnessed luminous mists. The halo surrounding the head of the saint is traditional and may, without much doubt, have a basis of actual fact. In modern times the halo around the human head has come to be regarded purely as a symbol of sanctity. Records of holy persons who in life actually went about with their heads surrounded by a luminous haze are supposed to exist. One has no right to assume that such records are false. Under certain conditions it has been experimentally demonstrated that the human aura can shine forth so as to become almost visible in daylight. May it not be, therefore, that a life associated with austerity and mystical contemplation can be accompanied at times by so great an amplification of the bodily aura that the latter becomes visible about those areas of the body—chiefly the head—which are unclothed? Mysticism and sanctity have been proved to be productive of far more remarkable phenomena than the generation of outwardly visible auras.

Be that as it may, however, the matter in which the present reader will mainly be interested is that of seeing the human aura for himself. That the aura can be seen under quite simple experimental conditions there is no doubt. Nevertheless, the reader who thinks of taking up experiments in this subject is warned that such experiments may possibly lead to disappointments. In a word, the amateur aura investigator, after obtaining the necessary materials, may find



*A sketch of a room, outlining conditions under which the human aura is best viewed.*

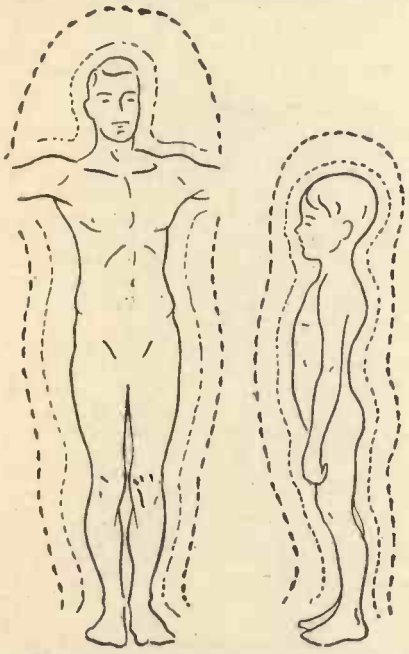



*Obtaining the correct lighting conditions for viewing the aura. The window of the room should be darkened in the manner shown.*

that he is unable to hit upon the precise experimental conditions for the success of his experiments. He may even find that he is one of those individuals whose eyes appear to be totally insensitive to the aura's rays.

### Experiments

In order to make experiments in the viewing of the aura, a certain dyestuff is



*(Left.) The aura of a healthy man, and (right) a side view of a boy's aura.*

required. This dye is known as *dicyanine*. Unfortunately, it is a very expensive dyestuff. Just after the war the dye was being produced in minute quantities at a cost of £6 per gm. It can now be had at a very much reduced price through any wholesale house of manufacturing chemists or laboratory suppliers. Dicyanine is made by the firm of Meister, Lucius und Brüning, of Hoechst, Germany. It is also manufactured in the laboratories of the American Kodak Company at Rochester, N.Y., U.S.A.

Experimenters who contemplate obtaining a small quantity of dicyanine should be careful not to confuse this dye with "Dicyanine A," which is not the same as dicyanine and which is not suitable for the purpose.

In order to witness the human aura, the investigator first of all "sensitises" his eyes by looking through a liquid light-filter or screen composed of dicyanine dissolved in pure alcohol. Immediately afterwards, the experimenter gazes through another dicyanine screen at the "subject," who stands partially or totally unclothed against a suitable background. Completely surrounding the body of the subject, or, at least around that portion of the body which is unclothed, is then seen a faint, hazy, cloud-like aura, usually of a greyish hue, but varying frequently in colour, which follows roughly the outlines of the body and extends to about a foot or so away from the body.

The aura can often be separated into three distinct portions. Nearest to the body there may sometimes be seen a narrow and almost transparent band following the bodily outlines. This Dr. Kilner termed the *Etheric Double*, on account of its being the exact shape of the body. Next to the etheric double comes the *Inner Aura*, the strongest and plainest of the three auras, and, after this, the *Outer Aura*, which is the most distant from the body and which fades away imperceptibly into space. These three portions of the human aura blend together very finely, making it often difficult to distinguish their lines of demarcation.

The action of the dyestuff, dicyanine, upon the retina of the eye is not known. In some peculiar manner it appears to confer a temporary sensitivity upon the light-receiving elements of the retina. It has been suggested, on the contrary, that dicyanine works in an opposite manner, that is to say, by actually decreasing the retinal sensitivity of the eye to certain wavelengths, thereby subduing that portion of the spectrum whose wavelengths normally overpower and block out the faint rays proceeding from the aura. This supposition, however, for many reasons, is difficult to accept in its entirety.

### A Dicyanine Screen

A dicyanine screen is not easy to make. In its most perfect form it comprises two pieces of flat (preferably optically worked) glass cemented together with glass separators between them so as to form a liquid-tight cell. A good substitute for such a cell is a small flat-sided bottle. Such a bottle can be procured from any chemist's shop. It should be of small dimensions, otherwise a large quantity of the expensive dicyanine solution will be required to fill it. Such a bottle will suffice amply, provided it is tightly stoppered or corked, for the "sensitising" screen whose function is explained later. For the "viewing" screen, however, a more suitable cell is required. This must have perfectly flat sides, for it has to act as a visual screen, and thus any irregularities in its sides would give rise to much distortion. A small perfume bottle, flat sided and well stoppered, will often meet the above requirements. Better still is an "animalcule trough," which is a small glass-walled trough used for the purpose of confining small living aquatic creatures for microscopical observations and which may usually be obtained from any laboratory supplier or dealer in natural history requisites.

Dicyanine must not be dissolved in water. Its aqueous solution decomposes very rapidly, and this would result in a wastage of the valuable dye. Dicyanine is best dissolved in absolute alcohol (not rectified or methylated spirits). Unfortunately, the price of absolute alcohol in this country is, on account of excise duty, in the prohibitive region of 27*s.* per lb. A good substitute for it, however, is iso-propyl alcohol, which is not subject to duty and which costs about 4*s.* per lb. Half a pound of iso-propyl alcohol, or even less, will be amply sufficient for numerous aura experiments.

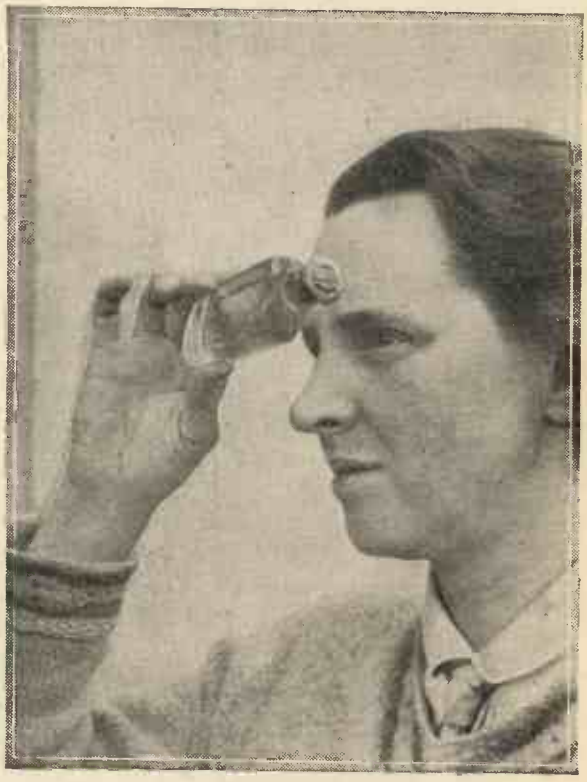
For viewing the aura, two dicyanine screens must be made up. The first is made by dissolving sufficient dicyanine in the alcohol to produce a solution of a strong blue coloration. This is poured into the flat-sided bottle or other suitable glass cell, and it constitutes the "sensitising screen." A much weaker alcoholic solution of dicyanine solution is now made up, the tint of the solution in this case being merely a pale blue. This is poured into another flat-sided bottle or liquid-holding cell, and it then comprises the "viewing screen."

The aura is best viewed in a small room having a single window fitted at the top with an ordinary opaque roller blind and having at the bottom an extra blind or curtain of black material which can be raised to any required height, thus forming a slit between itself and the upper blind through which light can enter the room. The subject of the experiments stands stripped or partially stripped opposite the window. Behind him is placed a plain background. The colour of this background is usually immaterial. Some observers have preferred a perfectly white background; others favour a greyish one. The latter is probably the best for most aura viewing purposes.

The actual lighting of the subject is of greatest importance. The light should be arranged through the slit formed by the top and bottom window blinds so that the subject's body is just clearly visible. Too strong a lighting will, by its sheer intensity, flood out and overpower the aura, making its viewing absolutely impossible. On the other hand, if the lighting is too dim, attempts to peer through the gloom at the subject will only result in optical fatigue.

### Viewing the Aura

The actual manner of viewing the aura,



*A small flat-sided bottle filled with dicyanine solution being used as a sensitising screen for the eyes.*

the above conditions having been complied with, is simple. The experimenter takes up the dark blue "sensitising" dicyanine screen, raises it in front of his eyes and looks through it at the daylight sky through the slit in the window blinds for two or three minutes. Brilliant sunshine should not be

viewed through the screen. It is unnecessary and only injures the sensitising properties of the screen.

The eyes having been sensitised in the above manner, the experimenter turns his back to the window, puts down the "sensitising" screen and takes up the "viewing" screen. He looks through this at the subject, who is standing against the plain background at the opposite side of the room. If the eye sensitisation has been successful, the aura will be seen immediately around the naked portions of the subject's body.

Since the peculiar effect on the eyes of the dicyanine screen is cumulative, repeated gazings through the sensitising screen may be necessary before the aura is first seen. Once the aura has been discerned, however, the necessity for previously looking up at the sky through the "sensitising" screen will become progressively less and less. With some individuals there will come a time when a mere glance through the "sensitising" screen beforehand will suffice to confer the necessary sensitivity upon the eyes for the perception of the aura. Such persons, also, will find, in time, that they can perceive the aura without having to look through the "viewing" screen at the subject of the experiments.

It may be as well to utter a caution here. It has been reported that, in some instances, too prolonged gazing through the dicyanine sensitising screen has proved injurious, in a temporary manner, to the eyes. If, therefore, any strain on the eyes is experienced after repeated applications of the dicyanine sensitising screen, the experiments should be terminated for the time being.

Dicyanine is not a very stable dyestuff. In water solutions it decomposes rapidly, and even in alcoholic solution its keeping qualities are not good. In the presence of light, dicyanine solutions are particularly unstable. This is probably due to the fact that the dicyanine of commerce is not a pure dyestuff, but that it is a mixture of at least three closely allied and difficultly separable blue dyes. The action of light initiates complex reactions between the component dyestuffs of commercial dicyanine. Hence the instability of the product. Do not, therefore, make up more dicyanine solution than is actually needed at the time. Once made up, the dicyanine solution should be kept in total darkness, except when it is actually in use. This precaution will slow down the decomposition of the dyestuff very considerably, and, under these conditions, the dicyanine solutions will retain their sensitising powers over a period of weeks instead of days, as would otherwise be the case.

Any scientific investigator who takes up the systematic study of the human aura has a rich field of research in front of him. Unfortunately, however, there appears to be a "personal factor" present in the matter which makes it apparently impossible for some individuals to witness the aura. This inhibiting factor may be present in as much as 40 per cent. of individuals, even when their eyes have been sensitised by prolonged gazing through freshly made dicyanine screens.

The use of the expensive dicyanine appears to be necessary to aura viewing. One or two workers have claimed that methyl blue (*not* methylene blue) possesses sensitising properties which enable the aura to be seen. Perhaps, therefore, this relatively cheap dyestuff (costing about 2*s.* per ½ oz. in purified form) may be worth a trial. It can be used in water solution, since it is perfectly stable.

### Its Nature Unknown

The precise nature of the human aura is unknown. It may be some obscure electro-optical effect consequent upon the living forces of the body. More probably, however, it is some form of heat emanation arising from the body. It would not be advisable to say that the aura cannot be photographed. Rather, it should be stated that the aura has, up to the present, not been photographed, despite many attempts at that feat.

The existence of this shadowy emanation around the body is not, after all has been said and done, very surprising. Many other things possess their own characteristic auras or fields of influence. Atoms have their own circumscribed attractive fields. The lines of force surrounding a magnet are well known. So, also, is the electromagnetic field which surrounds a wire carrying an electric current. That the living organism, therefore, should possess a ghostly emanation which is visible under certain conditions is not a very startling observation, despite the enormous interest attached to it. More likely than not, it will be discovered, in time, that every living creature possesses a characteristic aura of its own.

The present problem, however, is to elucidate more fully the exact nature of the human aura, to determine more precisely how it varies with individuals of different ages, sexes, states of health and conditions of mind. Moreover, it would be exceedingly advantageous if the dicyanine method of viewing could be done away with and if some cheaper and better means of witnessing the phenomenon could be provided in its place. For, after all, the dicyanine method of aura viewing, which, as we have seen, has about a 40 per cent. failure factor is not a very satisfactory method, and the writer of this article would advise readers to bear this fact in mind before deciding to embark upon the purchase of the expensive dicyanine for the purpose of such trials.

## ITEMS OF INTEREST

### Seen at Olympia

THE official scale model of the Cunard-White Star liner *Queen Mary* was seen by the public for the first time at the Ideal Home Exhibition.

The model, 5 tons in weight and 24 ft. in length, is a perfect model of the liner and similar in every detail to that used at Clydebank to reproduce in advance the actual launch of the vessel by the Queen last September.

Only at the Exhibition did the Cunard-White Star Company feel safe in allowing the model to be shown, for marine engineers all over the world have tried in vain to discover the secrets of the world's greatest ship.

The model, in a 26-ft. glass case, was transported to Olympia on a specially designed railway truck, from which it was removed in London and towed by road—a special precaution taken so that the glass case was never removed and nobody actually handled the model.

The model was shown on the first floor of the Empire Hall with two reproductions of Cunard-White Star liner cabins.

### Twenty-five Years of Progress

A FEATURE of supreme interest to the mechanically minded was a review of the amazing progress of invention during the King's reign. By the co-operation of the Marconiphone Company, much of the early experimental equipment of the Marchese Marconi was on view. The development of the gramophone from the early type with external horns to the handsome high fidelity autoradiograms of to-day, containing fifteen valves and more than 6,000 parts, and the advances in sound-recording was shown by the H.M.V. Company.

Fascinating exhibits illustrating progress in building and in the technical equipment of the G.P.O. was opened to inspection, and the newly-formed National League of Airmen provided a display of universal interest.

Elsewhere, a £50,000 installation of the very latest types of British canning machine showed the new industry peeling, coring, slicing, boiling and canning fruit almost as fast as you could eat it.

For garden-lovers there was all the thrill of a peaceful, sunny "world tour" through a wonderland of beauty that was a joy to the eye—the Gardens of the Nations. A Chinese "Moon" garden made for lovers, a Japanese retreat in the shadow of Fujiyama, a haunt of beauty by an Italian lake—these were but a few of the enchanting scenes from Holland, Germany, Spain, New Zealand, and many other lands reproduced for the public's delight by some of Britain's famous landscape artists.

### Model "00" Gauge Railway

FOR some time past we have included articles giving constructional details of indoor model railways of the "00" gauge, which is the most adaptable indoor size, and quite a good layout with stations, goods yards, etc., can be got into quite a small space. It was with interest that we accepted an invitation from Messrs. Hamblings, who are the specialists in this gauge, to inspect their showrooms, and we were amazed to see the wonderful range of models now available. We understand that there is an ever-growing interest in this new gauge, and a look round Messrs. Hamblings' showrooms certainly convinces one of the fascination of these small scale models. There are locomotives in perfect detail, all electrically controlled, wagons, vans, in fact, every type of rolling stock all with detail and to scale. A complete model of the Southern electric train is very attractive, and it is surprising the amount of correct detail that can be achieved and can be done by the home constructor. Messrs. Hamblings give practical help to customers both for construction of models and also the electrical circuits necessary for the control.

It is really fascinating to see a loco move back on to coaches, automatically couple, and haul them out of the station and detach again; or, again, a small tank loco doing shunting in a goods yard, picking up wagons and releasing them, all at the will of the operator without having to handle them.

We recommend interested readers to visit Hamblings at 26 Charing Cross Road, London, W.C.2. There is no obligation to purchase; just call and see these models; or they will be pleased to send full lists and a sample of the track so that you can see the size, noting that the running rail has correct bull-head section, even in this small gauge.

# Model Electric Railways No. 2

By E. W. TWINING

## An Automatic Control and Signalling System

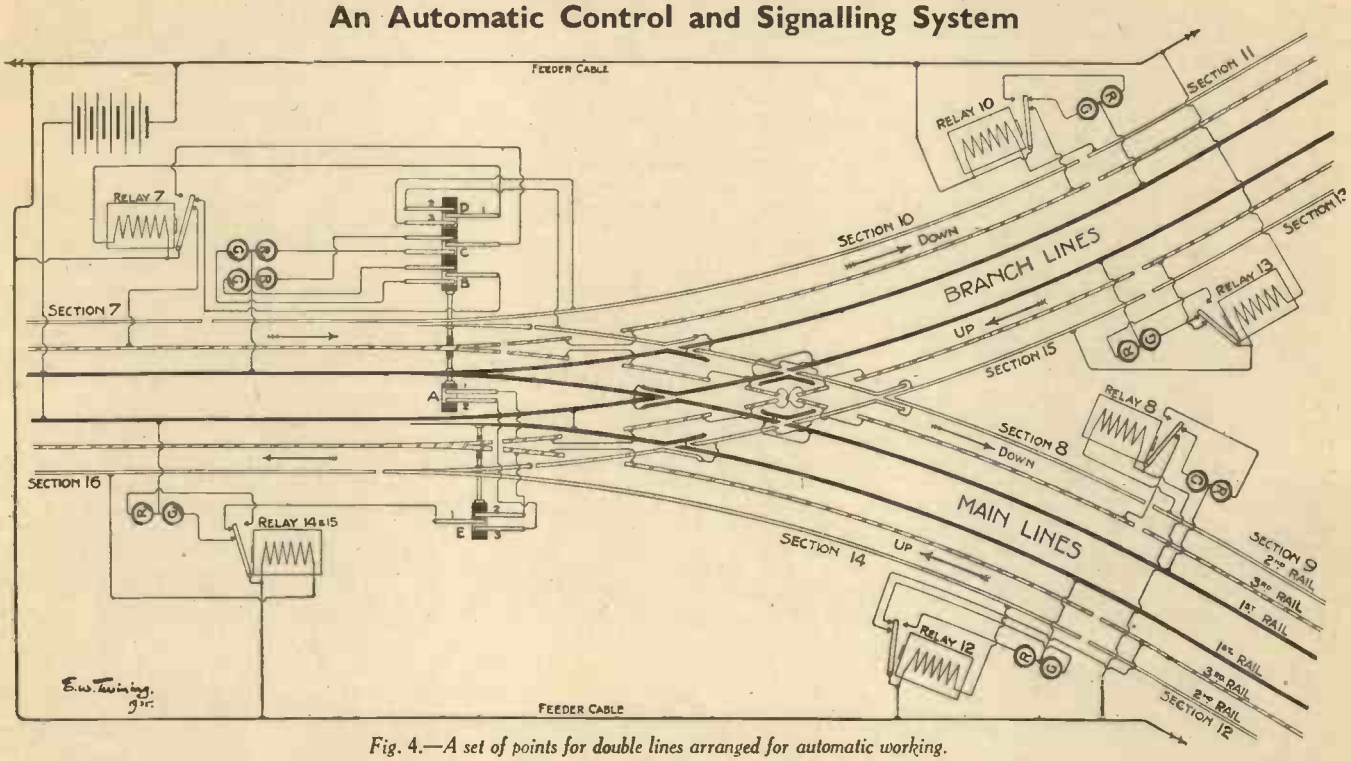



*Fig. 4.—A set of points for double lines arranged for automatic working.*

AS was stated in connection with Fig. 1, the system is precisely the same for both up and down lines in a double-track railway, but where points occur to a branch in double-track, although exactly the same relays are used, additional contacts are required. Thus, as the purpose served by these will be dependent upon the state of the tongue of the points—*i.e.*, whether open to the main lines or the branch lines—the contacts must be operated with the tongues and are so placed that they are moved by the point-operating rods or mechanism.

### Requirements for Working of Trains

Before going into the details of contacts and connections, it is necessary to consider what is called for in safeguarding trains travelling to and from main and branch lines, over the points on both up and down rails. These may be stated as follows :—

(1) The passage of a train over the points on the DOWN MAIN line must cut out current from the UP BRANCH line. Similarly, an UP BRANCH train must cause the DOWN MAIN line to be dead.

(2) The passage of an UP BRANCH train must cut out the section which includes the points and stop an UP MAIN train, or

(3) The passage of an UP MAIN train must cut out and stop an UP BRANCH train.

(4) A train on the DOWN BRANCH line in the section ahead of and which includes the points must permit a train to proceed over the points on to the DOWN MAIN line.

(5) A train standing on the DOWN BRANCH line must *not* stop an UP BRANCH train.

(6) It will be in the power of the person at the control panel to send a DOWN train either to the BRANCH line or to the MAIN line by operating the points accordingly, but the UP LINE points, which are trailing, if they are worked from the control panel, will, if they are set for an UP MAIN train, stop an UP BRANCH train, and *vice versâ*. They can, however, be made to operate automatically, being moved and set by, and for, the first train to enter either of the sections approaching the points, though this has not been provided for in the scheme.

### Diagram of Points and Circuits

The lay-out of a double set of points to main and branch lines is shown in Fig. 4. In this is included the relays controlling the block sections on either side of the points, with the additional contacts on the point rods already referred to.

With the diagram before you, consider how the conditions for safe working are complied with : it being taken for granted that the conditions are obviously necessary. They are dealt with in the order given above.

### Compliance with Conditions

(1) This is complied with, not by the actual passage of a train entering section 8 (see diagram), but by the setting over of the points for the DOWN MAIN line. The current supply to the third rail of section 15 will be interrupted by the opening of the two contact leaves A on the point rod switches. Through these leaves, the current is passed *viâ* the leaves E on the DOWN point rod switch, *viâ* the contact on relay 14–15 and from the feeder cable. Should the DOWN points be already set over the other way—*i.e.*, for an UP MAIN train on section 14—the switch A will have no effect, since the DOWN BRANCH line, third rail, section 15, will be already cut out by switch leaves E.

The second condition in (1), which provides that an UP BRANCH train shall stop a DOWN MAIN, is complied with by causing the third rail of section 7 to carry no current. This third rail is cut out by its own relay No. 7, the coil of which derives current thus : from battery through rail No. 1, through wheels and axles on section 15, through second rails of this and section 8, through switch leaves $D^2$ and $D^1$, through coil of relay 7 and *viâ* feeder to battery. Should a DOWN train be approaching on section 7 which is intended for the branch line it will not be stopped by an UP BRANCH train because the points will be set so that switch leaf $D^2$ will be inoperative and only a train on DOWN line section 10 will cause the train in section 7 to pull up.

(2) An UP BRANCH train will stop an UP MAIN train or (3) *vice versâ*, through the medium of switch leaves E, according to the position in which the points are set. If the points are as shown in Fig. 4 the current path is broken to the third rail of section 14, and flows to section 15. If trains enter sections 14 and 15 simultaneously, one of them will be stopped according to the point setting. It is possible, therefore, by setting points early,

for the operator to give the preference to whichever train he wishes, even though one train be before the other.

(4) In order to render this impossible, the point tongues of the second rails must be interrupted or insulated. It will be seen from the diagram that if they were not insulated, when a DOWN BRANCH train was stopped in section 10, or for some reason had not cleared the section, and a following train wished to pass to the DOWN MAIN—section 8—it could not proceed even when the points were set over for it, because the point tongue would put the second rail of section 10 in connection with that of section 8 and the switch leaf $D^2$ would be inoperative. Consequently, the third rails of sections 7 and 8 would remain dead through relay 7 remaining energised. With an insulated point tongue, even if a train is in section 10, the opening of the points to the DOWN MAIN line changes over switch tongues D1–3 to D1–2, which causes relay 7 to open and restore current to both the third rails.

(5) Here again the insulated point tongue leading to sections 8 and 10 is utilised to prevent this occurring. If the tongue was not insulated and the points were put over to the opposite position to that shown in Fig. 4, immediately after the passage of a DOWN BRANCH train an UP BRANCH train, on entering section 13, would be stopped because relay No. 13 would be actuated in just the same way as it would if section 15 were occupied.

(6) The automatic starting and stopping of the UP trains in sections 15 and 14 is controlled by switch leaves E according to the state of the tongue of the points.

The foregoing will doubtless provide an adequate description of the general arrangement of the rails, relays and electrical connections and it only remains to refer to the signal lamps before passing on to the design of the point-operating gear.

### Signal Lights

In the ordinary way the lamps, marked R and G in the diagrams for Red and Green respectively, are controlled direct from contacts on the relays, but at the points on the DOWN lines the lights have, of course, to be doubled, one pair for the down main and one pair for the down branch. The control of the lighting of these must be with the points and so additional switches B and C are introduced on the point-rod gear. When the points are open to a branch train the left-hand green light and the right-hand red light both glow, and *vice versâ*.

### Point Operating Gear

The point tongues are moved by solenoids—coils having sliding cores—a pair of them being inter-connected mechanically. The whole arrangement is shown in Fig. 5, including the electrical switches shown in Fig. 4. It should be made clear that the number of switch springs or leaves here shown are those required for the DOWN facing points, A, B, C and D, shown in Fig. 4. For the UP trailing points only the three leaf contacts at E, Fig. 4, will have to be fitted. The automatic locking of the tongues, after being moved, is provided for by the form of the ends of the slot in the plate connecting the cores. These slot-ends being parallel with the direction of motion securely hold the lever which actuates the point rod. Each coil of the solenoids should be wound with 4 oz. No. 22 or No. 24 enamelled wire on brass bobbins and housed in casings of soft iron plate, as shown. The base plate and brackets may be of either brass or aluminium.

The rest of the details will be obvious from the drawing; the reader is asked to remember, however, that the two point tongues must be insulated one from the other and it is therefore important that the rod inter-connecting the two tongues must have an adjusting turnbuckle made of red fibre. The rod ends will be threaded right and left hand, and must never be screwed up sufficiently to make contact.

Obviously, connections to the coils of the solenoids for working them will be taken from the control panel of the railway, where a two-way switch will be fitted. Three wires will be run, one of them common to both coils.

A scheme for the automatic operation of the points by the trains themselves is not a very complicated matter and this will be dealt with in the next article.

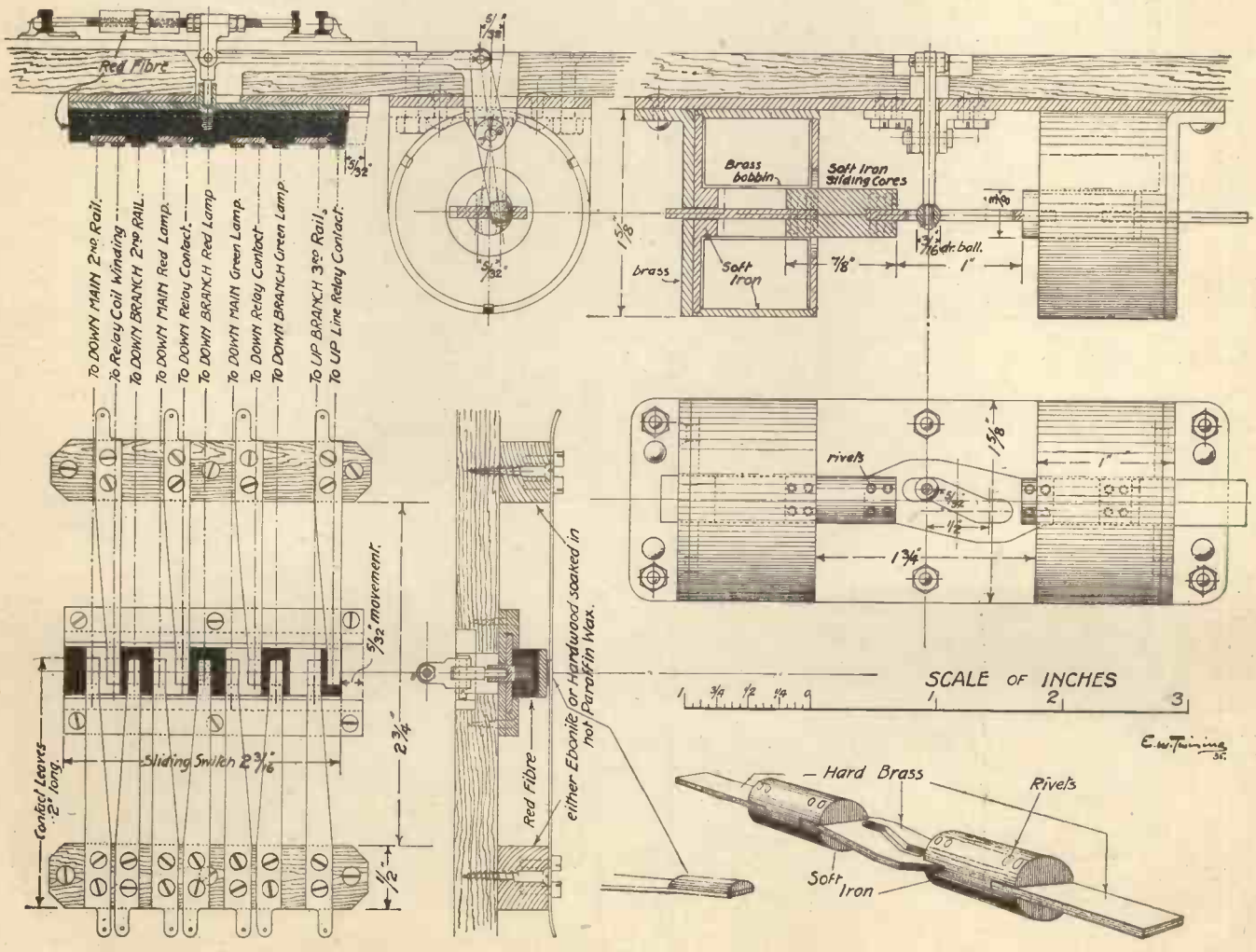



*Fig. 5.—Point operating solenoids with switches for automatic working.*

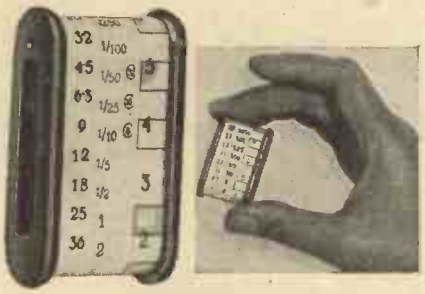
# The LATEST Novelties

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

### A Vest Pocket Exposure Meter

MEASURING only 1½ × 1 × ⅜ in., the Leudi vest pocket exposure meter shown below is one of the smallest and lightest extinction photometers made. It has no lens, needs no focussing, no reference to tables, is as effective indoors as out of doors, and can be used with plates or film of any make.

The brightness of the subject can be instantly seen by looking through the central opening of the device. A series of numbers, varying in density, is observed, and the last clearly visible number is taken as the guide. This number is then brought over the square space on the meter corresponding to the light prevailing. The correct exposure will then be found opposite the lens aperture to be used. The meter costs 5*s*. [116.]




*The Leudi vest pocket exposure meter, the size of which can be gathered from the photograph on the right. It is sold by Sands, Hunter, Ltd.*

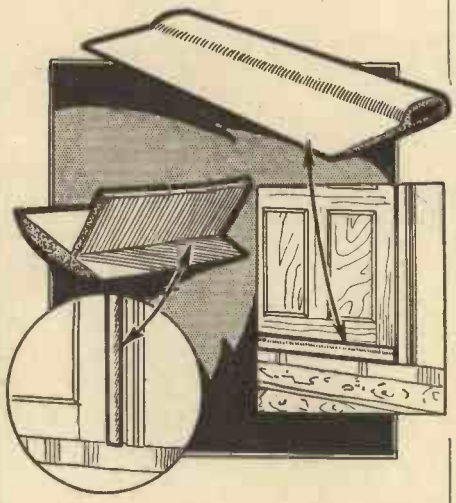
### A New Type of Suction Plug

A NEW type of bathroom or hand-basin plug is that shown below, which is held in position over the outlet by means of water pressure. When fitted into place, it is claimed that it cannot be accidentally dislodged. Obtainable with a chromium plated finish, it costs 2*s*. [117.]

### Safeguard Your Wireless Set

A FUSE plug has recently been introduced by a well-known wireless firm which is interchangeable with all standard 5-ampere, 2-pin plug sockets. It has a cartridge fuse incorporated in each pole which blows at approximately 2 amperes, thus in case of a short-circuit the fuse blows in the plug, and can be promptly replaced at a negligible cost. The combined base and plug is also obtainable provided with a milled nut and screw, which enables the plug to be fixed to the base to prevent its inadvertent withdrawal. The price of the plug base with plug top, locking nut and screw is 1*s*. 10*d*., a twin fuse plug complete with two fuses costs 1*s*. 4*d*., a 5-ampere plug base costs 6*d*., and extra fuses cost 4*d*. each. [118]

*A suction plug for the bath or hand-basin which cannot be accidentally dislodged.*



*The "cosy" draught excluder which can be fitted to the bottom of doors, French windows, etc., in a few minutes.*

### The "Cosy" Draught Excluder

DRAUGHTY doors and windows are a bugbear in most households. A simple and easy method of overcoming this difficulty is to fit the "cosy" draught excluder shown on this page. Two types are shown in the sketch, one for the bottom of doors and the other, known as "Cosy T," for double doors, French windows, the tops of rise and fall windows, motor-car floor boards, etc. As can be seen, the two sides of the "Cosy T" are of a different width, to allow for fitting to wide or narrow apertures. Both types are made of rubber reinforced with canvas, the former costing 6*d*. per foot and the latter 3½*d*. per foot. [119.]

### Arnold Stop Watches

WE have recently had the pleasure of testing a moderately priced thirty-hour stop watch, which has recently been placed on the market. Costing only 10*s*. 6*d*., it is wonderful value for money, and there is a three years' guarantee with each model. The same type of watch is also available as a wrist watch and costs 15*s*. complete with strap.

Furthermore, so that readers may judge the demand for these watches, the manufacturers, Messrs. A. Arnold & Co., are willing to let readers have them on a sale or return basis. [120.]

### The Brush Grille-type Microphone

THE Brush grille-type microphones consist of various designs of cases all constructed of monel-metal containing sound-cells arranged, as implied, in the form of a grille. Monel-metal is used for the sake of appearance and resistance to corrosion. The microphones are extremely robust, and are unaffected by sudden temperature changes. They are also extremely compact. The smallest weighs but 2 oz., and the larger models, complete with socket, weigh only 12 oz.

It is almost unbreakable, having no delicate mechanical parts, is unaffected by vibration or shock, and cannot be over-loaded. Having only two conductors (there is no field current or polarising voltage), it provides complete freedom from background noise. [121.]


*Showing the Brush grille-type microphone.*

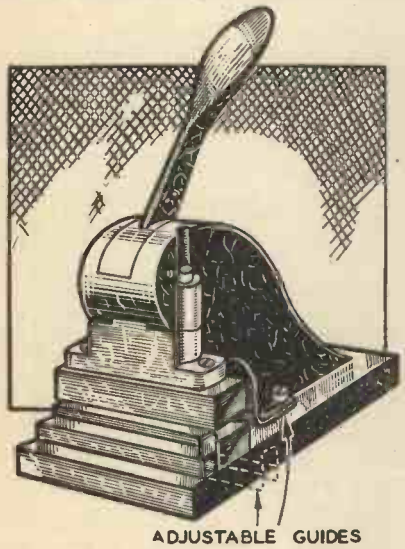
### A Popular Sculling Exerciser

THE sculling exerciser shown below has been designed to meet the demand of a good-class exerciser at a popular price. Its smooth gliding action—a good reproduction of actual sculling—tones up the muscles, reduces surplus weight and assists the building of normal healthy tissue. The standard models have steel tube frames, centrally divided for packing into a small space, a comfortable sliding seat and fibre silent rollers. The strength of pull on the rope springs may be varied by using one, two or three springs. The chassis is black enamelled, and the steel-strands, clips and pulley blocks are chromium plated. It is 5 ft. 5 in. in length, weighs 20½ lb., and may be fitted with a rocker chassis as shown, if desired. The price is 84*s*. with an enamelled chassis, 110*s*. with a chromium plated chassis, and the junior model costs 63*s*. The standard rocker chassis is 15*s*. 6*d*. extra, and the junior rocker chassis costs 10*s*. 6*d*. [122.]

*The Terry sculling exerciser.*


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

THE "Simplex" press, shown below, should certainly make its appeal to those readers who like their address embossed on their notepaper and postcards. It is fitted with patent adjustable paper guides (top and side), thus enabling the exact stamping position desired to be

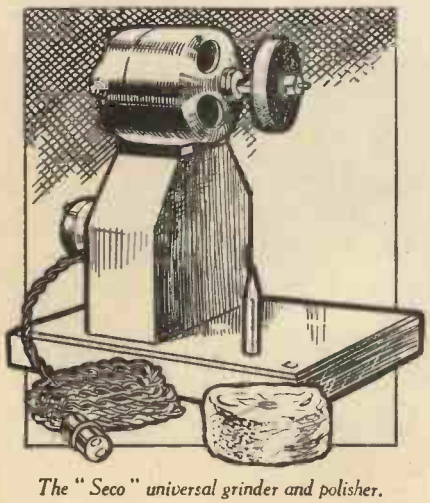



*The "Simplex" press for embossing notepaper and ordinary postcards.*

instantly obtained and maintained. The press embosses paper with the slightest touch and postcards with an easy pressure. Fitted with a 2½ in. die it enables long addresses to be properly displayed. Made in various styles the prices range from 4*s.* 11*d.* to 12*s.* 6*d.* [124.]

### A Universal Electric Grinder and Polisher

THIS universal electric grinder and polisher will prove ideal for workshop or household use, being suitable for grinding workshop tools, knives, scissors, etc., and shaping small castings. Fitted with a bristle brush it will polish cutlery, jewellery, plate and all small metal articles, and can also be used for polishing boots, shoes and leather. The outfit consists of a $\frac{1}{20}$ h.p. high-speed universal ball bearing motor (10,000 revolutions per minute), mounted on a wooden stand with a switch, flex and plug, one 2½ in. grinding wheel (½-in. bore) on a steel arbor, and one 3-in. polishing mop and taper-threaded arbot. The motor is capable of driving a 3½-in. grinding wheel, a fan blade or a watch maker's lathe, and is supplied for all standard voltages, A.C. or D.C. The price is 50*s.* complete, but a high-speed 3-ft. flexible shaft for the above with a chuck and two collets for drills (capacity 0–⅛ in.), costs 30*s.* extra. [125.]

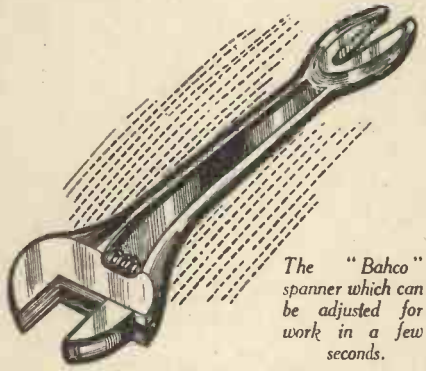


*The "Seco" universal grinder and polisher.*

*The Cooper Stewart speedometer for fitting to bicycles, which was described on page 335 of last month's issue.*

### The "Bahco" Adjustable Spanner

ADJUSTABLE in a few seconds and fitted at one end with a pipe wrench, ¼ in. to ⅝ in. diameter, the spanner shown on this page



*The "Bahco" spanner which can be adjusted for work in a few seconds.*

should prove ideal for the home mechanic. The range of the jaws of the spanner is ⅛ in. to 1$\frac{17}{32}$ in. The size of the spanner is 2½ × 8 in. overall. It costs 4*s.* 6*d.* [126.]

### A Vacuum Cleaning and Polishing Outfit

MESSRS. Brown Brothers Ltd., have recently sent us details of the "Supreme" Electric Vacuum Cleaning and Polishing Outfit which they are marketing. Three machines, which may be bought separately if desired, make up the outfit and comprise:

The first is the "Supreme" Ferret Electric Cleaner, which is a small, portable machine which dispenses with hose attachments. It is particularly suitable for cleaning the upholstery of the car, and has innumerable uses in the home. A rubber nozzle is fitted to obviate scratching the furniture. A special sprayer is included for scent, disinfectant and so forth, and a blower for removing dirt and dust from inaccessible places.

The second is the "Supreme" De Luxe Floor Model. The double suction power of this machine removes all surface and deep-trodden dirt from carpets and rugs. Fitted with a safety automatic switch, the current is switched on and off as the machine is used, thus providing a saving in power cost. The extra wide nozzle saves a great deal of time.

The third is the "Supreme" Electric Floor Polisher. The rapidly revolving brush or pad creates a lasting and beautiful


*The "Supreme" electric vacuum cleaning and polishing machine.*

surface in a few moments. Simple to use, it only needs guiding.

In addition to a co-operative local dealer advertising scheme, special hire-purchase terms are appliable to one or all of these cleaners and full details and illustrated literature are available on request. [127.]

### A Powerful Concentrated Light

THE "Localite" Arm, illustrated on this page, gives a perfect concentrated light with the maximum economy in current. It assists mental concentration and prevents headache and eyestrain. It can be placed in any position, as it is fitted with universal friction joints, and is finished with a glossy black stove enamel that is serviceable and durable. The "Localite" Arm is fitted with a "Q" screw-down base, lampshade switch, lampholder and 2 yd. of flex, with a combined wall-plug and bayonet-adapter. The lamp, complete, costs 20*s.*, but is also obtainable for 11*s.* each with only a "Q" socket and without the shade and electrical accessories. [128.]

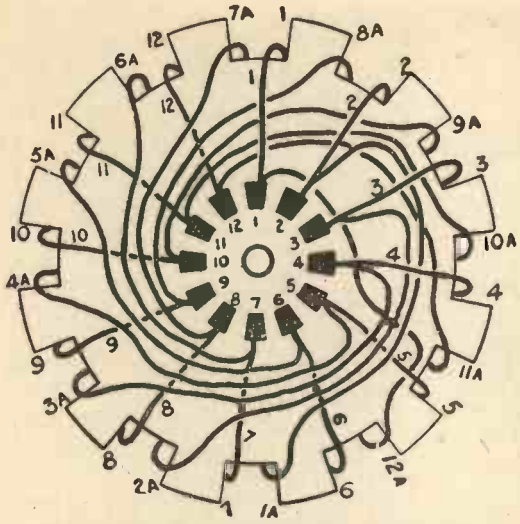
### Erratum

OWING to a printers' error, a mistake occurred in Messrs. Beck's advertisement on p. 338 of last month's issue. The price of their special parcel of chemistry apparatus, containing 1 flask, flat bottom 150 c.c., 1 beaker, spouted 100 c.c.; 3 test tubes, 4 × ⅝ in.; 1 thistle funnel 20 cm.; 3 ft. glass tubing, 1 rubber cork 2 holes: 4 in. rubber connection tubing and 1 glass stirring tube, appeared as 62*s.*, post free. This, of course, should have been 2*s.* 6*d.*, post free.


*The "Localite" arm gives a perfect concentrated light with the maximum economy in current.*

# SOME ELECTRICAL QUERIES ANSWERED

[BY THE TECHNICAL STAFF]



*Winding a 12-slot armature. Wire No. 1 is connected at the back of No. 1A, etc.*

**T. P. (Aspatria).**—Your armature and windings are not at fault, so do not try to rewind, as the results will be worse than before. It is the permanent magnets that are defective, and they must be re-energised.

**H. B. (Devon).**—If your landlord is the "Supply Company," then legally you can open the meter, but once open, the makers will not be responsible for same or its behaviour.

**B. H. (Lee).**—For a 50-watt heater suitable for your tank, you will need 12¼ yd. of No. 40 nickel chrome bare resistance wire, as supplied by Messrs. Grafton Electric Co.

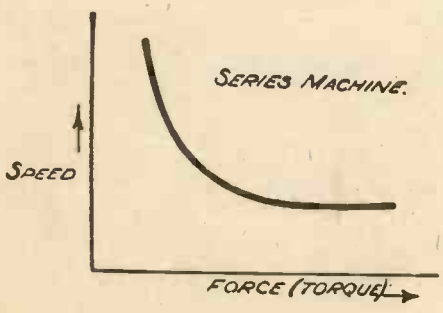
**J. B. (Ryton-on-Tyne).**—The running winding must consist of 170 turns of No. 22 D.C.C. wire spaced out on each pole, giving a total of 680 turns for the machine. The starting coils consist of 70 turns of No. 30 D.C.C. wire. If you have difficulty in getting all this wire into the slots, connect a series resistance with the starting coils.

**E. S. (Catford).**—You cannot get ⅛ h.p. from your machine if you run it continuously. Rewind the armature as for low-voltage D.C. with No. 20 D.C.C. wire, putting on as many turns as possible. The fields are wound with No. 28 D.C.C. and connected to give alternate poles.

**R. M. (Llandyssil).**—A circuit diagram has been posted to you suitable for both the experiments.

**C. S. (Holt Fleet).**—If your drawings are correct, the machine when rewound could not supply more than 200 watts.

**H. B. (Bradford).**—The following resistance will pass 8 amperes at 230 volts when using ¼-in. carbons: 54 yd. of No. 18 bare "Eureka" wire. Wind the wire into ½-in. spirals.

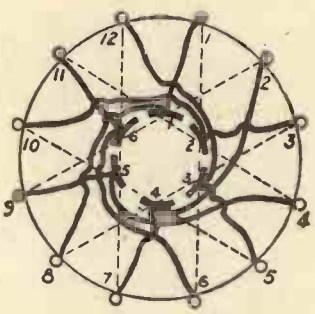


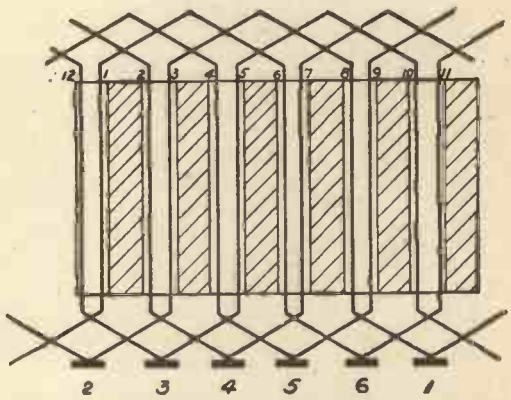

**M. C. (Galway).**—To design a choke you would have to make a complete study of alternating currents, and a single book would be of no use. The only power a choke absorbs, in theory, is due to its own resistance.

**P. P. (Hull).**—Sensitive relays are difficult to make, and are generally of the moving-coil type. Your best plan would be to adapt an old moving-coil voltmeter.

**W. A. (Wool).**—There are special sets on the market consisting of a converter and a transformer, and for serious use you are recommended to install one of these.

**F. R. (Chadwell Heath).**—You have made a mistake in making the fields solid. These, as well as the rotor, should be laminated, and made of good quality stampings.

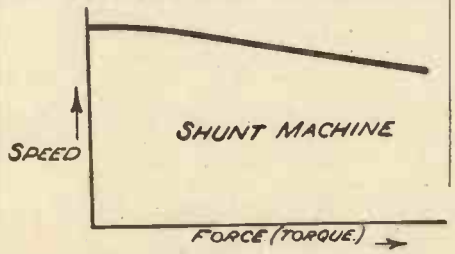




*How a wave armature is wound.*

**A. B. (Croydon).**—Both the thick and thin wire should be removed from the fields and then rewound so as to give north and south consecutive poles.

**T. S. (Northampton).**—We have done considerable work on making copper-oxide rectifiers, and if present experiments are satisfactory, we may publish an article on making a complete unit.




*(Left to right). Characteristic curves of series, shunt- and compound-wound motors.*

**C. L. (Brockley).**—The effects mentioned are quite common. You will not ruin a bulb by the method you mention, though with a heavier discharge the glass may be pierced.

**N. F. (Northampton).**—You must wind your coil with very nearly 4 oz. of No. 47 enamelled wire. This will give a resistance of 52,790 ohms. Adjust the amount to get the exact resistance you require.

**H. B. (Liverpool).**—Both methods you suggest are impracticable. You can, however, connect the fields in parallel and then put them in series with the armature.

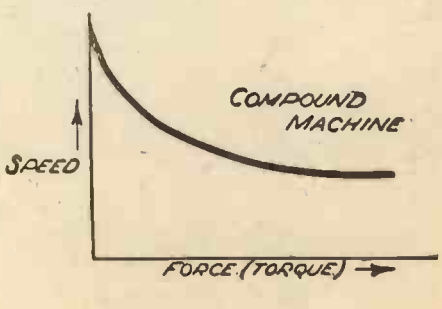
**J. A. (Smethwick).**—For full details for converting car dynamos to A.C. machines you should consult the June issue of this paper.

**H. M. (Newcastle-on-Tyne).**—From the meagre information you supply, we cannot give definite advice. Rewind the running windings with No. 34 D.C.C. wire, and the starting with No. 36.

**E. W. (Leeds).**—You have omitted to mention the depth of the furnace which we assume to be 10 in. The current taken will be 11 amperes, and must be started with a resistance in series to avoid damage.

**E. W. (Stockport).**—The dynamo is wound with the armature either in series or in shunt with the field. Consult the article in the December issue of PRACTICAL MECHANICS on the principles of small motors and dynamos.

**L. W. (Sowerby Bridge).**—Polarity may be determined with a pocket compass. The north pole of the magneto magnet is placed on the south pole of the magnetiser.



# Making a Lifting

The magnet described in this from an 8-volt accumulator circuit and will easily

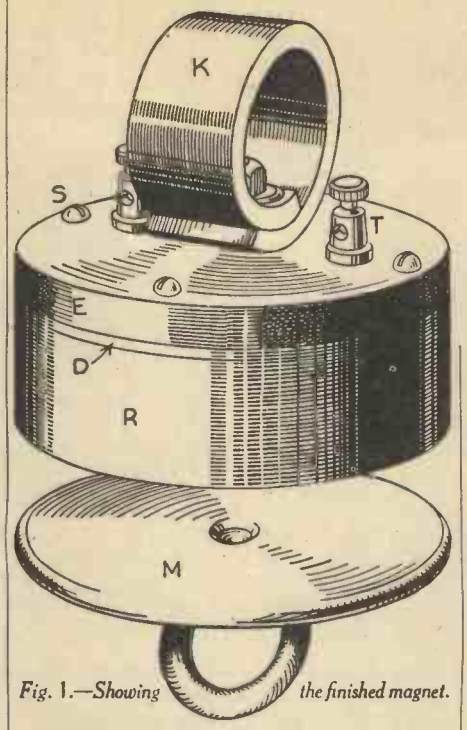



*Fig. 1.—Showing the finished magnet.*

A LIFTING magnet is an electro-magnet which is especially designed to support heavy weights by the application of a comparatively small electric current. The model described below is capable of carrying a current from an 8-volt accumulator, with no other resistance in the circuit, without undue heating up of the coil, and it is easily capable of supporting a load of 25 lb. weight, or even more. The materials used are inexpensive, and the work involved is not beyond the skill of the average amateur constructor.

Fig. 1 shows the finished article, and Fig. 2 a vertical section. The dimensions given can, of course, be varied to suit individual requirements, and are merely intended as a general guide, but every constructor knows that a great deal of trouble can be saved by working to dimensions which have been previously ascertained for him by someone who has already constructed a model. The main portions of the body of the magnet are shown separated in Fig. 6.

### The Magnet

To construct the magnet, obtain a piece of iron piping 1¾ in. internal diameter and about ¼ in. in thickness. Cut off a short length, about 1⅛ in., and file and polish the ends until they are square, flat and smooth, and the finished length is ¾ in. Of course, the appearance is improved if the outside surface of the piping is also finished off smoothly or even enamelled. This portion will afterwards be referred to as the "ring" (R) in all diagrams and descriptions.

The "core" (C) is made from a piece of ¾-in. soft iron rod, ¾ in. long, with the ends worked smooth and square. Through the centre, drill and countersink a hole to take a ¼-in. countersunk bolt (B.S.F. thread) fitted with a nut. This hole is, of course, drilled more easily on a lathe if the constructor is the fortunate possessor of such a machine. D is a disc of ⅛-in. sheet iron of the same diameter as the outside of the ring, and is also drilled in the centre to allow the bolt to pass through it. The object of this disc is not only for strength, but also to close the magnetic circuit. E is a similar disc of ebonite or other insulating material ¼ in. thick, also drilled in the centre to allow the bolt to pass through it easily. The supporting ring K is made by turning a strip of ⅛-in. sheet iron into a ring of about 1¼ in. diameter with the ends overlapping and drilled to take the bolt, as shown in Fig. 1.

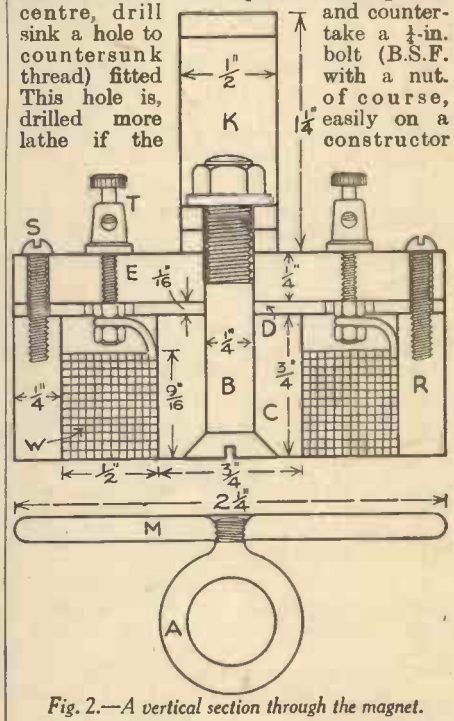



*Fig. 2.—A vertical section through the magnet.*

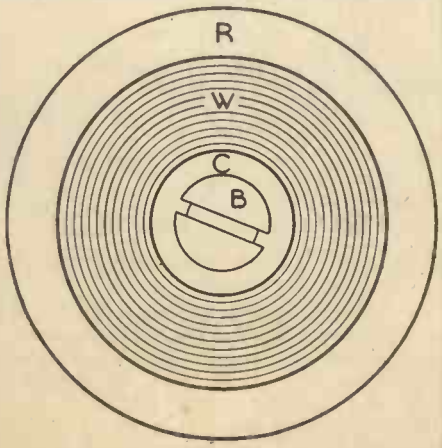



*Fig. 3.—Details of the core of the magnet.*

It is advantageous to construct from a piece of ¼-in. soft sheet iron another disc (M) of the same diameter as D and E, though this disc is not actually a portion of the magnet itself. Drill and tap it to take a stout screw eye (A). If the top of the hole is slightly countersunk, the eye is screwed a little way through, riveted and then filed down level with the disc; there is no danger of the eye pulling through under strain.

Now drill and tap, all together, the ring R and the discs D and E, so that later on

# Powerful Magnet

article will carry a current with no other resistance in lift a weight of 25 lbs.

they may be held together by four round-head 2B.A. ⅝-in. screws (S, Figs. 1 and 2). Also drill together the discs D and E to allow the legs of two terminals **T** to pass through the holes later.

### The Coil

The next job is to wind the coil. This is carried out on a "former" (Fig. 4), and this must first be constructed. The dimensions of the "former" are such that the finished coil will afterwards fit snugly into its proper position, as shown in Fig. 5, which is a "transparent" view of the ring, core, discs and bolt in position.

The centre of the "former" is a piece of ¾-in. wood dowelling ⅞ in. long, with the ends truly squared. The discs P, $P_1$ are

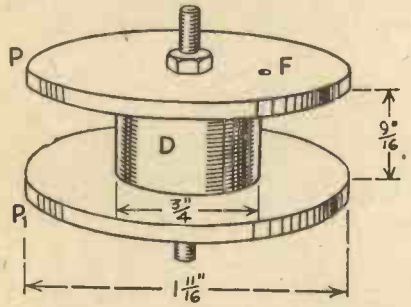



*Fig. 4.—The former for the coil with the necessary constructional details.*

made of plywood 1 11/16 in. in diameter. Drill a hole through the centre of the discs and dowelling and pass through them a piece of threaded brass rod so that the whole can be held firmly together by a nut at the top, and another at the bottom. A hole to take one end of the wire should be drilled at F at the edge of the dowelling. Wrap a piece of paper round the dowelling to facilitate the removal of the finished coil. The wire required is about 1¾ oz. of No. 28 D.C.C. copper.

To wind the coil fix the "former" on a lathe, a hand drill clamped in a vice, or on any other form of winder such as those which have been described in PRACTICAL MECHANICS. Pass one end of the wire from the inside to the outside of the "former" through F, secure it and begin to wind the rest of the wire on the "former."

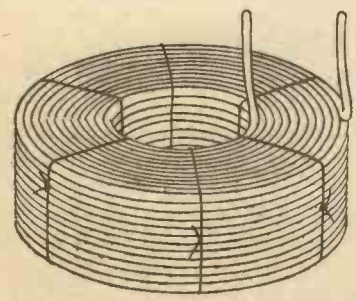


*Fig. 7.—Showing the coil wound and tied with thread after completion.*

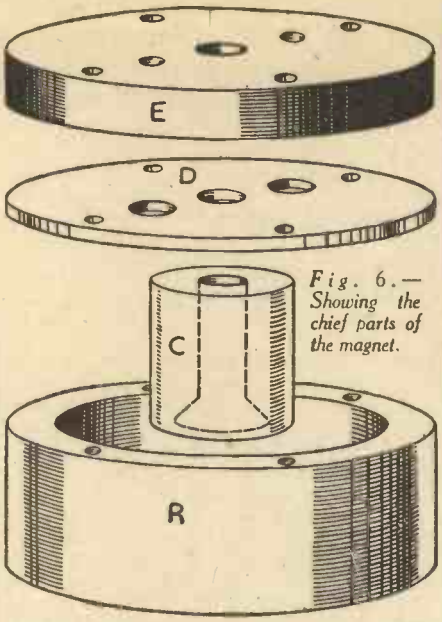



*Fig. 6.—Showing the chief parts of the magnet.*

Arrange between the paper and the first layer of wire several pieces of cotton thread to allow the coil to be tied up after completion, as shown in Fig. 7. After winding each layer of wire, apply with a brush a strong solution of shellac in methylated spirit, which, when it dries, will improve the insulation and bind the coil together. When the "former" is completely filled, allow the coil to stand as long as possible so that the shellac solution may dry off thoroughly, then tie up the threads of cotton to secure the coil. Unscrew the nuts on the "former," remove the discs, and slip the coil off.

### Assembling the Magnet

To assemble the magnet, first pass the bolt B through the core C and the discs D and E. Now place the ring K on the top of the bolt and secure the whole in position by the nut at the top of the bolt. The grip will be improved by a washer below the nut. Pass the terminals through the holes prepared for them in E and D, fasten the ends of the coil to them by small nuts and slip the coil over the core C. Now fasten the ring in position by the screws S. Set the coil back from the bottom face of the magnet about 1/100 in. and pour round it melted paraffin wax to improve the insulation and to maintain the coil in position. Remove the excess of wax, level it up, and the magnet is ready for use. Suspend the magnet by K. Connect the terminals of a 2-, 4-, 6-, or 8-volt accumulator to the terminals T of the magnet. Bring the disc M near it, when it will be strongly attracted. Hang weights on A, when the lifting power of the magnet may be ascertained.

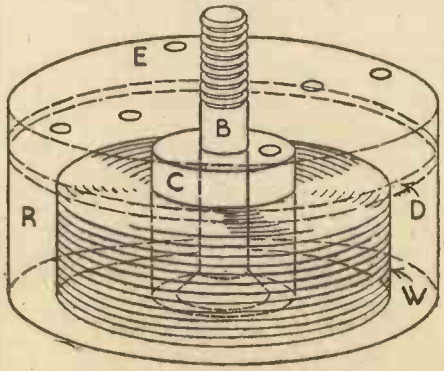



*Fig. 5.—How the coil is fitted into position.*

## LIVING FOR 200,000 YEARS

(*Continued from page 375.*)

that its animation is suspended, and afterwards to return it to normal temperatures and to a continuance of life.

If in such manner a man could be cooled down *instantaneously* to an exceedingly low temperature, it is possible that he would remain in a state of frozen animation indefinitely. An individual subjecting himself to a series of such experiences or treatments could, as before mentioned, live out his life of seventy years in snatches which would extend over an enormous number of centuries.

### Life-suspending Refrigeration

For instance, assuming that an individual subjected himself to life-suspending refrigeration for the first time at the age of nineteen or twenty years, he could, by being thawed once every 300 years and by remaining in active life for a period of twelve months during each third century, spread out his seventy years' span to about 15,000 years—that is, assuming also that the continual refrigeration and thawing did not weaken his bodily functions during the thaw intervals.

In the same way, a man, by allowing himself merely three weeks or a month "in thaw" every third century, could stretch out his seventy years of life over a period of 200,000 years, whilst by reducing his thaw periods still more, say for merely a few days at a time, his "life" would stretch out to incredible limits. Death, when it did arrive, would overtake the individual in one of his thaw intervals. It would come to him as it does to all normal livers—by senility, disease or accident. No longer, after this occurrence, would the refrigeration process be of any use. It would, of course, completely inhibit the dissolution of the body, but, death having overtaken the individual, the body would never be self-animated again.

Living out one's life by snatches is a notion concerning which little has been heard. No doubt, for the majority of persons, such a method of interrupted living would be distasteful, unsociable and even heroic. The method, however, would make its appeal to the few. Such individuals would enter nationally controlled "refrigeratories," and before entering into refrigeration they would signify in some permanent manner the date at which they wished to be thawed and returned to active life. Naturally, in view of the decided impermanence of most human institutions, individuals entering into refrigeration would find it necessary to take many things on trust. Such considerations, however, do not concern us here. The mere principle of the expansion of life by means of refrigeration periods has been outlined. Whether, from the standpoint of human psychology, the method, if it ever became possible, would be practically successful is a question which must be left to individual opinion.

## IN THE NEWS

### Giant Telescope

LAST December the 200-in. reflector mirror for the new Mount Wilson telescope was cast at the Corning Glass Works in America. Watched by experts, it is now being cooled at the rate of 1 degree drop in temperature per day. Sometime next autumn it will at last be cooled, and it is hoped perfectly annealed. In the casting of this disc, 2 ft. thick and 17 ft. in diameter, 40 tons of special glass were used. The glass was melted in a furnace at white heat (1.580° C.). White heat was maintained for fifteen days to free the melt from air bubbles. It was then picked up in 750-lb. ladles and poured into the mould. The mould has a honeycomb structure underneath to give the disc rigidity for the least weight. In casting it was kept under a gas-heated hood which had doors in the side for the entrance of the pouring ladles. When pouring was finished the gas was turned off and the disc was allowed to cool down to red heat. The hood was then lifted and the mould was traversed away to the annealing hood. Both annealing hood and mould have exactly controlled electric heating elements to regulate the cooling to the required 1 degree per day. If the disc were not so carefully cooled stresses would be set up in the interior which, if they did not cause it to explode suddenly into small fragments, would so distort and striate it that it would be useless for its optical purpose. When the disc is finally cooled and delivered to Mount Wilson, it will then have to be ground to an exact parabolic curvature and silvered over with a reflecting surface of metallic aluminium. These operations will take a further three years.

### Damming a Canyon

SOUTHERN California, in need of water and power for electricity, has dammed a subsidiary gorge of the Grand Canyon in the Rocky Mountains. Irrigation dams have been built before, as the huge Nile barrier. But this, the Boulder Dam across the Black Canyon, is something exceptional. A deep, rocky gorge has been filled by a single poured concrete monolith, 700 ft. in height, 660 ft. thick, and spanning 220 yd. in a sweeping curve. Seven million tons of concrete have been used, requiring the whole output of four cement factories for two years. Curiously, to chemists belongs the chief distinction in the work. With so large a single mass of concrete the setting heat given up by the cement could not escape from the interior fast enough. The crust sets and cools quickly, confining the heat in the inside, so that it would get overheated and seriously expand. The combination of hot expanded interior and contracted crust would crack and weaken the whole structure. Chemists overcame the difficulty partly by preparing a new type of cement with only half the setting heat of ordinary Portland cement and partly by force-cooling of the whole dam. The dam as it grows is honeycombed with steel pipes leading to headers on the dam face. Refrigerated water is pumped through this cooling system. When the job is finished and set the pipes will be filled full of liquid cement and grouted off.

The giant spillways, pipes 30 ft. in diameter, valves and tees of the power scheme, as they are too big to bring to the spot, have been riveted up on location in a specially built steel mills. The cost of the scheme is assessed at £100,000,000.

# MONEY MAKING IDEAS REVIEWED BY OUR PATENT EXPERT

### AN IMPROVED PAINT BRUSH

**"I should be pleased if you would tell me of the commercial value of the three designs I have enclosed.**

**"I should like to 'Letter Patent' the first design if possible, and I should be very pleased if you would supply me with information as to the cost of the process.**

**"This is the one I am particularly interested in, as one firm I know would market it for me.**

**"If you think it has any value I should be pleased if you can tell me the names and addresses of some of the leading paint brush manufacturers.**

**"Thanking you in anticipation of an early reply." (A. B., Bucks.)**

(1) The suggested improvement in paint brushes is thought to be novel and forms fit subject-matter for protection by Letters Patent. It is presumed that the inventor has practically tried the invention and that it will in fact do what is claimed for it. If so it should have a commercial value which, however, will depend largely on the way it is marketed. The inventor being satisfied as to the capabilities of the invention is advised to protect it by filing an Application for Patent with a Provisional Specification which will give him protection for about twelve months, during which period it should be possible to ascertain if the invention is likely to be commercially successful.

The following are brush manufacturers who might possibly be interested in the idea :—

Messrs. Ernest W. Perrett Ltd., 68 East India Dock Road, London, E.14. Messrs. Rigby Battock Ltd., Upper Clapton, London, E.5. Messrs. Hamilton & Co. (London) Ltd., 116 Clerkenwell Road, London, E.C.1. Messrs. G. B. Kent & Sons Ltd., 75 Farringdon Road, London, E.C.1.

(2) The improved funnel is apparently a removable spout for petrol tins, and is not thought to have much chance of being made a commercial success, for the reason that petrol is now being increasingly supplied to motorists by wayside pumps and the use of 2-gallon petrol tins is rapidly diminishing.

(3) The case for match-boxes to enable a cigarette to be readily lit in a wind, is ingenious, but is not thought to be particularly novel. There have been a number of Patents granted for match-box cases having the same object in view, but none is believed to have been commercially successful. The extra bulk would militate against the proposed construction, and the idea is not thought to have any large commercial value, even if it be capable of being validly protected.

### AN IMPROVED TOWEL HOLDER

**"I would appreciate your advice on the enclosed sketch of a domestic article.**

**"Apart from the novelty and efficiency of the idea—I have had one in use in my home for one and a half years—it is designed for mass production, as apart from the fixing screws there are only three parts. Could the idea be patented ?**

**"If not would a design registration allow me to have it manufactured and used commercially." (J. L., Newcastle-on-Tyne.)**

The improved towel holder is extremely ingenious and should be a great commercial success if properly marketed. It is certainly novel so far as is known from personal knowledge and forms fit subject-matter for protection both by Patent and Design registration.

The inventor is advised to protect the invention by filing an Application for Patent with a Provisional Specification, since the protection thereby afforded is very much broader than by registration of a Design. A Design registration only gives protection for the article as judged solely by the eye, and it would be easily possible by varying the shape or configuration, whilst employing the gist of the invention, to overcome the Design registration.

The inventor is advised to file a Patent Application and then approach manufacturers with a view to their taking an interest either to manufacture or market it. The Editor will be pleased to put you in touch with a reliable Patent Agent.

### AUTOMATIC WEIGHING MACHINE MECHANISMS

**"I would like your advice regarding the two drawings enclosed. The first sketch is a patented mechanism for an automatic weighing machine, and the other is the mechanism for the same type of machine, but is not patented. What I wish to know is, if I patent the number two design should I be infringing the number one design." (R. N., Leeds.)**

Without having the Patent Specification covering the automatic weighing machine before us it is a little difficult to advise, but apparently the proposed new arrangement is simply the employment of a single mechanism in place of a dual one usually employed. This being so, it is not thought that the omission of the second mechanism constitutes invention or subject-matter sufficient to support a Patent. On the presumption that the specification and claims of the original Patent have been ably drafted, there can be little doubt that the proposed arrangement would, if manufactured, sold or used, be an infringement of the original Patent. The mere act of patenting an invention does not constitute infringement of an earlier Patent, as the Applicant seems to imply. A valid Patent can be obtained for an invention and it is only when the said invention is manufactured, sold or used, that infringement would ensue.

# PRACTICAL MECHANICS Replies to Queries and Enquiries

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

## MAKING HYDROGEN PEROXIDE

**"Can you tell me how to make hydrogen peroxide? I use a large amount for various purposes and find it expensive to keep continually buying the peroxide." (R. P., South Wales.)**

Many and various are the means of producing hydrogen peroxide, none of which is of the slightest use for small scale production, which is always a costly job. The usual laboratory method is to allow a dilute acid to react with sodium peroxide, which is added a little at a time. Hydrogen peroxide is set free and remains dissolved in the water. A cheap method of buying peroxide is to obtain it in 100 per cent. concentration. This product is of a syrupy nature and extremely dangerous to handle owing to its caustic nature on the human skin, and also the explosive violence with which it liberates oxygen gas if kept in a warm place. For use, of course, this concentrate is diluted with water.

Hydrogen peroxide solution is not costly by any means, and provided that you get on to the right market, assuming that you are using the quantity you state you will be able to buy it at a ridiculously cheap figure. There can be no point in home manufacture of such a product which is produced commercially by electrolytic means at small cost.

## "INTERESTING FACTS ABOUT RAYS"

**"With reference to your article on 'Interesting Facts about Rays,' I require information regarding the aura seen by the aid of a 'dicyanin screen.'**

**"I have obtained the dicyanin solution, but the results have not been quite satisfactory.**

**"I should be glad if you will kindly inform me on the following:—**

**"(1) What is the thickness of the screen which gives best results? and is Vita glass necessary?**

**"(2) What is the action on the eye, or in what way does it render these rays visible?**

**"(3) Does dicyanin transmit ultra-violet rays? (F. H., Birmingham.)**

Yours is a common experience. Many people, even after having sensitised their eyes with dicyanin, are unable to see the human aura. So much so is this that it is considered in some quarters that such individuals are congenitally incapable of seeing the human aura. This observation, however, has never been proved and, to say the least, is doubtful.

The thickness of the dicyanin screen is quite immaterial. A vita-glass screen is *not* necessary.

The so-called sensitising action of dicyanin on the human retina is quite unexplained at the present day. Probably the peculiar blue light coming through a dicyanin screen may have a slight paralysing effect on the retina, making it less sensitive to the rays of white light.

Dicyanin transmits blue rays. But its transmission is not a "sharp" one. The dicyanine of commerce is a mixture of three dyes, and it is doubtful whether pure dicyanin has ever yet been prepared. Dicyanin's main use was formerly that of infra-red sensitiser for photographic plates. It has now, however, been superseded for this purpose by the more efficient dyes, kryptocyanine and neocyanine, discovered in 1919 and 1925 respectively. Both these dyes do not appear to confer "aura-sensitivity" on the human retina.

Truth to tell, the whole subject of the human retina is, as yet, in a very unsatisfactory state of explanation. That the aura does exist is an established fact—what it is exactly and how it is best to be seen are, as yet, unknown.

In 1920, a Dr. Frederick Kilner, then an old and retired man living in Southampton, wrote a book which he entitled "The Human Aura." This work was published by Methuens. It is now out of print, but would probably be obtainable from a firm of secondhand booksellers, as, for instance, Messrs. Foyles, of Charing Cross Road, London, W.C. 2. Kilner's "Human Aura" is still the only work on this most interesting subject.

## ELECTRICAL QUERIES

**"(1) How could I calculate the amount of wire required to make solenoids to work off (a) a car battery, and (b) the electric mains? Is it necessary to use a resistance to avoid blowing the fuse or damaging the battery?**

**"(2) I have been experimenting with an arc-lamp, using the wire from an old electric fire as resistance. I had an idea that if less wire was used there would be more current to give a bigger arc, but on cutting the wire in two I did not notice an improvement. Why is this? Would using more wire give more current at the points?**

**"(3) Would it be possible to make an electric petrol gauge by using an ordinary voltmeter, or ammeter, and utilising a coil of resistance wire to alter the reading? If so, what type of wire is needed and how much?**

**"(4) Referring to the arc-lamp again, I have used jars of water to which a little salt had been added, as resistances, and these gave a far larger arc than did the resistance wire from the fire. How is this? Do the jars cut down the voltage or the amperage of the current?" (L. R., Belfast.)**

The amount of wire on an electro-magnet depends upon the purpose for which the magnet or solenoid is designed, but the power of a magnet depends on the product of the ampere and the turns. Thus you can get the same result with one turn and 10 amperes or 1 ampere and ten turns.

If you only desire a small magnet for experimental purposes, then calculate the amount of wire by its resistance found by examining the makers' lists.

Quite a moderate arc lamp requires 5 amperes, this means that it requires a resistance of 30 ohms in series, the reason being that the arc needs 5 amperes at 60 volts, thus a resistance is needed to absorb the unwanted 150 volts. This is found by Ohm's Law to be 30 ohms. You were probably using a resistance of about 100 ohms, but you should have noted a bigger arc when removing part of the wire; a dirty contact probably caused the trouble. We cannot quote the wire needed for the petrol gauge, as it is essential to know the resistance of the voltmeter. The jars obviously had a lower resistance and let more current pass. You have a wrong conception of amps, volts, etc., and you would profit enormously by reading the two small books, "Accumulators" and "Simple Electrical Apparatus," obtainable from Messrs. Geo. Newnes Ltd., 8–11 Southampton Street, W.C.2, 1*s.* 2*d.* post free. The first chapter of "Accumulators" deals fully with the question of Ohm's Law.

**MISCELLANEOUS QUERIES**

**"Could you please inform me on the following :—**

**"(1) How is paper treated with potassium iodide for use in electro-chemical telegraphy? Are there any other chemical solutions which produce the same effect? (non-poisonous).**

**"(2) What is 'Thermit' (or 'Thermite') used for? What is its composition? Is it possible to make it?**

**"(3) What is the composition of a good hectograph and the method of working?**

**"If newspaper printing is done with aniline ink, would it be possible to take impressions of newsprint on to a hectograph?**

**"I have made a quantity of ink by placing 'lead' of a copying ink pencil into boiling water. Is this a good substitute for aniline ink for use with the hectograph?**

**"I would be very much obliged if you could let me have the above information, as I have looked through many magazines and books without finding it." (J. B. H., Telscombe Cliffs.)**

(1) Paper is treated with potassium iodide for electro-chemical use, by soaking it for a few minutes in a 10 to 25 per cent. solution of potassium iodide, and then by drying it. The exact strength of the potassium iodide solution is determined by the type of paper used (it should be best white filter paper—not ordinary blotting paper, which is too thick and which absorbs too much of the iodide solution) and, also, the precise current-intensity under which it is intended to work. Such details, therefore, can only be determined by actual trial and experiment.

Paper treated with potassium iodide solution alone will give a yellow or brown colouration when submitted to electro-chemical action. If, however, a few drops of starch solution are added to the iodide solution, the subsequent colour developed on the paper will be blue. Be sure, however, that the potassium iodide solution is perfectly neutral before you add the starch solution, otherwise a blue colouration will appear in the solution itself.

Another chemical solution which develops a colouration on paper under the influence of electro-chemical action is a 10 to 25 per cent. solution of prussiate of potash to which a few drops of nitric or hydrochloric acid have been added. Prussiate of potash is not a scheduled poison in the strict sense of the term. Nevertheless, it cannot be said to be non-poisonous. Paper wetted with this solution gives a blue or brownish colouration upon contact with the positive pole of a battery or circuit.

(2) The material known commercially as "Thermite" is a mixture in varying proportions of aluminium powder with various metallic oxides. It is used in the Goldschmidt or "Aluminothermic" process of welding. The thermite is heated either electrically or by means of some pyrophoric mixture, whereupon a very energetic reaction sets in, the aluminium combining with the oxygen of the oxide and thus liberating the free metal which effects the necessary welding.

You could make thermite mixture for yourself by mixing aluminium powder with ferric, chromium or similar metallic oxides, but you would find it necessary to heat it to a very high temperature, say bright-redness, before the "thermite reaction" commenced.

(3) A hectograph, as you know, is a gelatine pad which is used for duplicating letters and other writings by the method of transfer.

Either of the following recipes will provide a good hectograph pad, the first recipe being the simpler of the two, but wearing more rapidly :—

| | | |
|---|---|---|
| (*a*) | Gelatine | 1 oz. |
| | Glycerine | 6 oz. |
| | Sugar | 1 oz. |
| | Water | 4 oz. |
| (*b*) | Gelatine | 3½ oz. |
| | Glycerine | 3½ oz. |
| | Sugar | ½ oz. |
| | Dextrine | ½ oz. |
| | Zinc oxide | ½ oz. |
| | Water | 2½ oz. |

If gelatine cannot be obtained for making-up the above formulæ, powdered glue may be substituted.

The gelatine or glue is first soaked and thoroughly dissolved in the water, the remainder of the ingredients being added subsequently. The zinc oxide, of course, employed in the second recipe is not soluble in water. When all the ingredients have been well mixed together, the resultant liquid is poured into a flat tray and left to set. If the setting of the mixture is not satisfactory, the tray should be heated gently over a gas ring in order to drive off a little of the water.

To work this hectograph, the writing to be copied is done in aniline ink. Your method of dissolving the purple "lead" of copying-pencils in water would be effective as a substitute for an aniline ink, but it is not likely to give the best results.

A good violet ink for hectograph use is made as follows :—

| | | |
|---|---|---|
| Methyl violet crystals | 1 part | Parts by weight |
| Sugar | ½ part | |
| Methylated spirit | 1 part | |
| Glycerine | 2 parts | |
| Water | 12 parts | |

Mix the methylated spirit with the glycerine and then dissolve the methyl violet in the resultant mixture. Dissolve the sugar in the water and then mix the two solutions well together. This ink will keep indefinitely.

Characters written with this ink are transferred to the hectograph pad by allowing the paper on which they are written to make firm contact with the pad for a short time. The paper is then removed, after which copies can be taken from the pad by pressing clean white paper in contact with it.

For success to attend results, a home-made hectograph usually requires a considerable number of trials to be made before the right working conditions are obtained.

Newsprint, not being effected in ink of the above character, cannot usually be satisfactorily hectographed. A few trials, however, would inform you on this point.

### THE INDIAN ROPE TRICK

**The following is a reader's solution to the Indian rope trick published in our March issue.**

"I rule out the possibility of magic as the solution to 'The Indian Rope Trick' which you kindly invite readers to solve, and as the trick is performed in open air, I think it is safe to assume that the rope is the only part that is not genuine. The rope, of course, would have to be rigid while being ascended, and flexible while being examined, and to have these properties I suggest that it could be constructed in the following way :—

"The whole length could be cored with identical steel bushes about ½ in. long by $\frac{7}{16}$ in. outside diameter, and $\frac{5}{16}$ in. bore, the ends of which, being machined spherical (slightly) to fit each other. One end is concave and the other convex, and a ⅛-in. diameter steel cable is passed through the centres of the bushes and attached firmly to the 'top' end bush. The other end of the cable (the base end) would be provided with a tensioning arrangement which could be a nut and screw. The nut being in the form of a twist grip to represent the binding at the end of the rope.

"For realistic appearance, the rope would be braided, and this would also serve to position the bushes.

"To make the rope rigid, the steel cable would be highly tensed, which would compress and lock the bushes together in whatever position they happened to be. By slightly tensing the inner cable, the rope would be partially stiff, enabling it to be 'erected.' With the inner cable relaxed, the rope would seem quite natural when examined. These operations would, of course, have to be done surreptitiously during the 'ritual.'" (E. B., Staffs.)

### A MAINS UNIT FOR 9·5 MM. CINEMAS

In the article on page 287 of the March number of PRACTICAL MECHANICS a draughtsman's error occurred in the pictorial circuit and in the wording on the layout plan.

A "mains socket" is indicated on the plan, and this should read "mains plug." Actually the socket is connected to the mains lead. In the pictorial circuit a "mains plug" should be substituted for the "A.C. mains socket" shown; therefore constructors should substitute accordingly a suitable plug and socket, namely, the Bulgin type P.20.

### FACTS ABOUT BENZOLE

DURING the war benzole was used as a substitute for petrol when our supplies were failing. If everyone can become educated to use this nationally produced motor spirit, we shall eventually be independent of all foreign imported motor fuel. In the retorts of our gas works, coke ovens and tar distilleries, benzole is being extracted every day in ever-increasing quantities.

Every now and then we hear scare statements on "our coal reserves are failing." How untrue and exaggerated these are can be judged by the fact revealed not long ago by Sir Frank Smith, of the Department of Scientific and Industrial Research, that even at our present colossal rate of consumption there are reserves in British coal fields sufficient for nearly 500 years.

## CLASSIFIED ADVERTISEMENTS

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

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



**FREE ADVICE BUREAU**

**COUPON**

This coupon is available until May 31st, 1935, and must be attached to all letters containing queries.

PRACTICAL MECHANICS, MAY, 1935

# What the Clubs are Doing

*Club Reports for inclusion in this feature should not exceed 250 words in length, and should be received not later than the 12th of each month for inclusion in the subsequent month's issue.*

### STREATHAM COMMON MODEL RAILWAY CLUB.

WE have had two very interesting lectures this last month, one by Mr. Brightman of the West Essex Club on "Building of '00' Gauge Models in Brass and Wood," in which he described his own models—some very nice coaches, wagons and a loco; and one by Mr. Taylor (member) on "High Capacity Wagons."

We cordially invite you to our clubroom at 201 Gleneldon Mews, High Road, Streatham, S.W.16, on any Friday.

We have just made the positions of President and Vice-Presidents and they have been filled by W. B. Hart, Esq., M.I. Loco E., as President, and Messrs. J. N. Maskeleyne, A.I. Loco E. and C. H. Stephens.

The Fourth Annual Exhibition is being held on June 7th (6.30 p.m.–9.30 p.m.) and June 8th (2.30 p.m.–9.30 p.m.) at the Waterworks, 70 Conyers Road, Streatham, S.W.16, to which we invite all readers. Tickets, price 6d. each (for both days), as well as full particulars of the club, can be obtained from the Secretary, Brooke House, Rotherhill Avenue, Streatham, S.W.16.

### INSTITUTE OF SCIENTIFIC RESEARCH

ON Friday, March 29th, a visit was paid to the Distributing and Maintenance Dept. of Leeds Gas Works. After seeing the Plumbing Dept., we were shown how old gas stoves and gas fires are cleaned, mended, and renovated, and concluded this interesting visit by seeing the various parts of gas meters being mended and tested.

On Saturday, March 16th, a meeting of the Leeds Radio Section was held, and on Saturday, March 23rd, a meeting of the Leeds Physics and Chemical Section was held. On Wednesday, April 24th, we paid a visit to Kirkstall Power Station, Leeds.

We are now conducting a "more members" campaign, and are also endeavouring to form new branches. We shall therefore be pleased to hear from anyone who would be willing to form a branch, and also from any prospective member.

Readers in Leeds should communicate with F. Underwood, 11 Sandhurst Grove, Leeds 8; readers in Canterbury with J. H. Potts, 16 Whitstable Road, Canterbury; and all other interested readers with D. W. F. Mayer, 20 Hollin Park Road, Leeds 8.

## MAKING A THERMOPILE

(*Continued from page* 351.)

produced when a finger is placed on the junctions. A case for the instrument is made from ⅜-in. plywood in the form of a long box about 4 in. by 1 in. square. A group of elements are mounted in one end so that they are flush with the opening, and terminals are fixed to the box. The securing of the unit in the box is most easily done by using the assembling bolts, which should be made a little longer for the purpose. The box should be made with the lid left off and secured to the stand. The element is now mounted by passing the bolts through holes in the wood, and the lid is then fixed in place. A hinged lid, also of wood, is fixed to the element end of the box so that it can be closed down to shut off unwanted radiations, and also to protect the instrument when not in use. A similar lid can be fitted to the other end. The reason for making the long box is to protect the cooled junction from draughts and keep the temperature constant when in use. A stand can be made from a base of hard wood about 3 in. square to the centre of which a round upright is fixed, and the box is mounted on the top of this (see Fig. 5).

To the reader who has had little experience with thermopiles and thermo-electricity the above may still leave him in the dark, but the article is intended for those who have experimented slightly and understand the principles.



# FREE SERVICE FOR READERS

**READERS requiring information concerning goods or services advertised in *PRACTICAL MECHANICS* should give names of Advertisers from whom particulars are desired. Any number of names may be included, and we will obtain for you catalogues, lists, and any other information you may be wanting. THERE IS NO CHARGE FOR THIS SERVICE.**

**Readers desiring particulars from a number of Advertisers will, by this method, save time and postage. Half-penny stamp only is required if your envelope is left unsealed. If any Advertiser stipulates that stamps or postal orders are necessary before samples or catalogues are sent, please enclose the necessary amount with your instructions. You are cordially invited to make full use of this Service.**

*Post this to*

**ADVERT. SERVICE DEPT.,**

**PRACTICAL MECHANICS,**

**8-11 SOUTHAMPTON STREET STRAND, W.C.2**

*Please obtain and send to me particulars from the Advertisers in your May issue whose names I give on list attached.*

| Advertiser | Page No. | Information Required. |
|---|---|---|
| | | |

*Attach sheet of paper, with particulars, and your name and address (written in* **BLOCK** *letters), with date, to this announcement.*


All applications respecting Advertising in this Publication should be addressed to the ADVERTISEMENT MANAGER, GEORGE NEWNES Ltd., 8–11 Southampton Street, Strand, London, W.C.2. Telephone: Temple Bar 7760.

# MAKE BIG MONEY

## *Or Save Money*

WITH THE NEW

# ADANA

HIGH-SPEED AUTOMATIC

# PRINTING MACHINE


**CASH OR EASY TERMS**

## YOU CAN MAKE £££'s

### *IN YOUR OWN HOME*

The enormous profits which can be made with the new "ADANA" Machine are forcibly demonstrated by the following examples :—

**1,000 VISITING CARDS**

| | |
|---|---|
| Sold for ... ... ... | 10/6 |
| *Cards cost* ... ... ... | 3/3 |
| **PROFIT ... ...** | **7/3** |

**1,000 CONCERT TICKETS**

| | |
|---|---|
| Sold for ... ... ... | 15/6 |
| *Cards cost* ... ... ... | 4/9 |
| **PROFIT ... ... ...** | **10/9** |

**1,000 BILLHEADS**

| | |
|---|---|
| Sold for ... ... ... | 12/9 |
| *Paper costs* ... ... | 3/– |
| **PROFIT ... ... ...** | **9/9** |

**1,000 LETTER HEADINGS**

| | |
|---|---|
| Sold for ... ... ... | 12/6 |
| *Paper costs* ... ... ... | 3/– |
| **PROFIT ... ... ...** | **9/6** |

**FREE** WITH EVERY MACHINE

**100-PAGE BOOK**

"85 Ways of Making Money with a Printing Machine"

¶ A Real Automatic Machine in every detail. Accurate Metal Diecastings (having a tensile strength of over 20 tons) from costly moulds have made it possible to market this fine piece of machinery at this remarkably low-price. Nothing has been spared to produce a smooth-running, high-class, fast Printing Machine. The result is wonderful. No words can explain what fine adjustments can easily be made to produce a perfect print, and which, once set, is permanently maintained throughout the job, as the impression is entirely mechanical.

## 1,000 COPIES PER HOUR

A thousand copies per hour are easily obtainable. Any size of paper, card, or made-up cartons, etc., can be printed. It is, therefore, possible to do an unlimited number of jobs that are in everyday use. The inking mechanism is all that can be desired. Standard printers' type and blocks of all descriptions can be used, as well as line, colour, register and half-tone work. Adjustable lay gauge is provided to do away with the necessity of gauge pins.

**MONEY-MAKING POSSIBILITIES WITH THIS MACHINE ARE GREATER THAN EVER**

*Write at once for full illustrated Particulars and Samples of Work*

## D. A. ADANA

**(Dept. P.M.13),**
**17/18, Church St., TWICKENHAM**

**London Depot :**
**1, Ludgate House, Fleet Street, E.C.4**

**Manchester : 60, Oldham Street**

## *You Can Print*

### EVERYDAY NEEDS

- Private Noteheadings
- Visiting Cards
- Business Cards
- Gummed Labels
- Showcards
- Greeting Cards
- Small Wrappers
- Price Tickets
- Entertainment Cards
- Sports Scoring Cards
- Card Games Scoring Cards
- Small Programmes
- Tag Labels
- Commercial Noteheadings
- Billheads
- Sports Printing
- Competition Cards
- Correspondence Cards
- Christmas Cards
- Wreath Cards
- Mourning Notices
- Advertising Blotters
- Wedding Cake Cards
- Wedding Invitations
- Hairdressers' Cards
- Scented Cards
- Admission Tickets
- Window Tickets
- Dance Invitations
- Calendars, etc

### OFFICE PRINTING

- Commercial Noteheadings
- Business Cards
- Overprinting Circulars
- Card Index Slips
- Urging Notes
- Instruction Chits
- Price Tickets
- Overprinting Cheques
- Stationery Samples
- Proofing of Blocks
- Advertising Tickets
- Advertising Blotters
- Overprinting Ledger Cards
- Commercial Envelopes
- Motto Desk Pads
- Letter Reference Slips
- Account Remittance Slips
- Cash Receipts
- Exhibition Cards
- Travellers' Cards
- Address Slips for Envelopes
- Book Indices, etc., etc.

### HOTEL PRINTING

- Menus and Wine Lists
- Writing Room Stationery
- Tariff Cards
- Porters' Labels
- Room Notices
- Suit Case Labels
- Greeting Cards
- Entertainment Cards
- Card Games Scoring Pads
- Dance Cards
- Forthcoming Attractions
- Small Programmes
- Dance Invitations
- Reservation Cards
- Receipt Slips
- Guests' Name Tickets
- Tag Labels
- Cloakroom Tickets
- Waiters' Pads
- Billheads, etc., etc.

### FACTORY AND SHOP

- Works Instructions
- Overprinting Carded Goods
- Overprinting Cartons
- Chemists' Labels
- Instructions for Games
- Parcel Labels
- Small Wrappers
- Cloth Name Tapes
- Printing Cloth Samples
- Printing Bags
- Billheads and Statements
- Overprinting Drawings
- Printing Wrapping Seals
- Wrappers' Number Tickets
- Bonus Stamps
- Photographers' Imprints
- Titles on Negatives
- Snapshot Wallets
- Wage Envelopes
- Jewellers' Envelopes
- Seed Envelopes
- Hairdressers' Cards
- Window Tickets
- Interior Forms
- Boot Repairers' Tags
- Stores Labels, etc., etc

### PRINTING FOR THE CHURCH

- Special Hymn Sheets
- Collection Box Labels
- Church Announcements
- Notices of Meetings
- Bazaar Tickets
- Greeting Cards
- Concert Admission Cards
- Small Programmes
- Pew Seat Cards
- Mourning Notices
- Wreath Cards
- Duplex Envelopes
- Wedding Hymn Sheets
- Admission Tickets
- Funeral Service Sheets
- Calendars, etc., etc.

**ALSO CLUB FOOTBALL AND RACING PRINTING**

Published by GEORGE NEWNES LIMITED, 8–11 Southampton Street, Strand, London, W.C.2, and Printed in Great Britain by THE WHITEFRIARS PRESS LTD., London and Tonbridge. Sole Agents for Australia and New Zealand—Gordon & Gotch Ltd. Sole Agents for South Africa—Central News Agency Ltd.