Inside! Free Blueprint of

FLYING MODEL HAWKER HURRICANE

NEWNES

PRACTICAL MECHANICS

MAY

6D.

EDITED BY F. J. CAMM

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PRACTICAL MECHANICS

VOL. V. MAY, 1938. No. 56.

Fair Comment

By The Editor

Our Great Model Aircraft Competition

THE Blue Print given free with every copy of this issue contains full-sized working drawings for the various parts of a flying model of the Hawker Hurricane—the famous aeroplane which flew from Edinburgh to London at the astonishing speed of 407 miles an hour. It will be observed that the features of the original machine have been preserved, whilst the construction has been simplified to facilitate easy making and assembly. The lines of the original have been preserved, although it will be understood that it is not possible in wood to produce all of the fine curves, many of them of a compound character, which go to make the original attractive aeroplane that it is. The model as shown reproduces most of them, and the model makes up into a really fine and strong flying model aeroplane capable of duration flights.

It is possible for the builder to add some of the features of the full-size machine by means of solid pieces of balsa, faired off and glued into place.

A cash prize of £20 and many other prizes will be awarded in a national competition for these models to be held in July, and full details of the contest appear elsewhere in this issue. Marks will be awarded primarily for the flying qualities of the model, but additional marks will be awarded for refinements added by the competitors themselves to add a greater degree of realism.

It is a model which everyone can build, even though a model aeroplane has not been attempted before. It is necessary for intending competitors to let me know whether they propose to enter the competition so that arrangements can be made. Last year, it will be remembered, we offered a large cash prize for a national model aeroplane competition for petrol models. This year, I am giving rubber driven model builders a chance. There is not only the satisfaction of building a flying model of a famous modern aeroplane, but also the incentive to win one of the many prizes. The free full size blue print will help you to success, for it may be used as a template for cutting off the various pieces. I am expecting a large entry for this competition, and only those who notify me that they propose to enter will be permitted to compete. Such notification must reach me as stated in the rules not later than May 31st.

Our Splendid Book Offer

THIS issue also contains an announcement of a new book which I have produced especially for readers of this paper. It cannot be obtained through the normal book selling channels as it is intended only for regular readers. It is not for me to praise my own work, but I am satisfied that this book will be found a valuable work of reference by every one of my readers. I am in a prime position to know their requirements, for I handle some thousands of queries from them every year, and have for many years contemplated the compilation of a volume which will answer those queries and supply readers with a ready source of rapid reference on the thousand and one little problems which crop up in the course of their work and their hobbies. Much of the information I compiled with the purpose of answering readers' letters.

It is here presented in PRACTICAL MECHANIC'S HANDBOOK, and I hope that every reader will avail himself of the opportunity of obtaining a copy of this volume on the exceptional presentation terms announced elsewhere.

The book contains facts, figures, and formulae; tables; sections on lathe work; drawing; mechanics; grinding and polishing; plating; timber; mensuration; hardening and tempering steel; pattern making; how to obtain a patent; data for engineers, mechanics; fitters; brazing and welding; glues; soldering; silver soldering; and a vast amount of other facts which you will want. The book is a memory aid and a work of reference, a work which you can consult and one which you can read. It covers the ground of several handbooks at once, and is in many ways a complete technical library on the subjects of which it treats. Will you turn to the appropriate page and comply with the simple conditions to-day? For the small sum of 2/- and two coupons cut from consecutive issues, the volume is yours. In the ordinary way this volume would cost at least 7/6.

Ideas

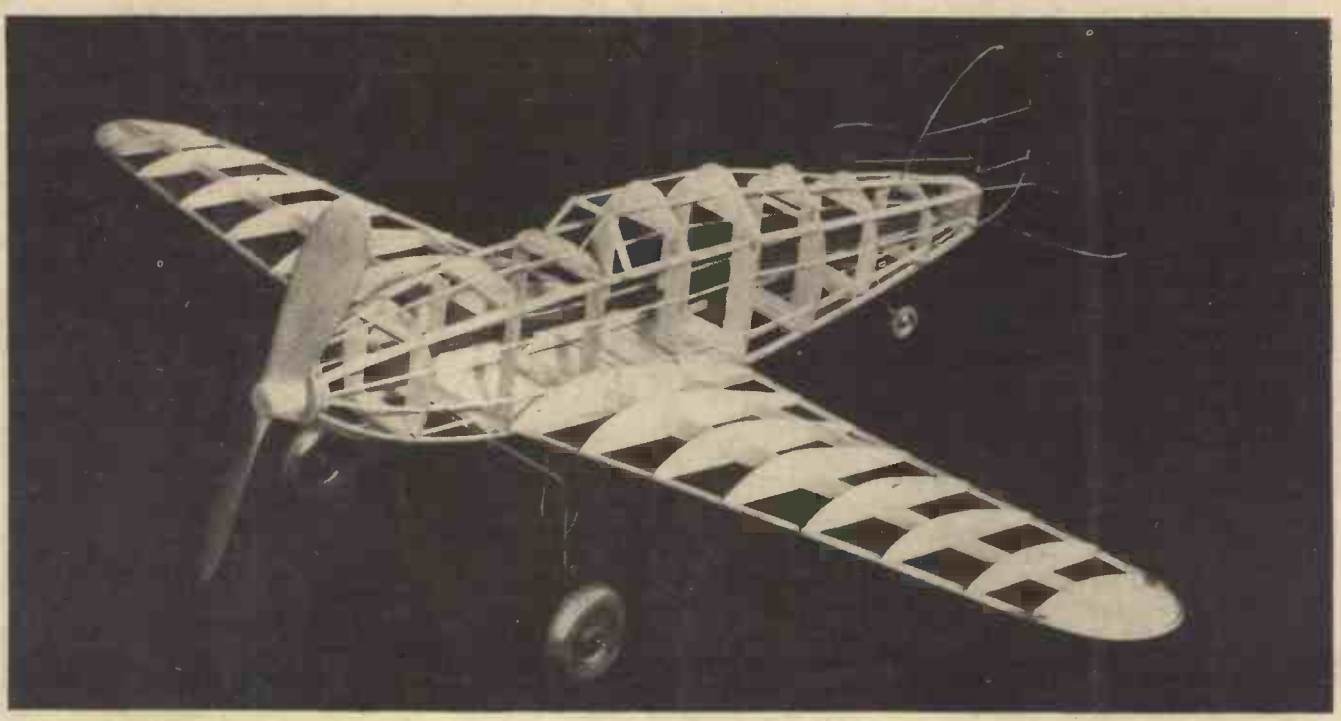
A FEW months ago I asked for suggestions from readers as to articles they would like to see in this journal and many hundreds of readers have responded to that request. Some of the suggestions I shall adopt, but many of them are impracticable on several grounds. Firstly, they ask for articles which are of purely personal interest. For example, a reader has an old motor cycle engine and he wishes to use it to drive a piece of special machinery. Such an article would only interest him. Other suggestions are for articles which are not within the ambit of PRACTICAL MECHANICS. For example, one reader desired articles dealing with making cigarettes at home. There again, I had to decline the suggestion.

Articles must have a general appeal, and be likely to interest a large number of other readers. Where the request is special and individual it would not be fair to other readers to devote space to it.

GREAT NATIONAL MODEL AIRCRAFT COMPETITION!

Build this Flying Model of the Hawker Hurricane

FIRST PRIZE: £20 cash and many other Special Awards



The Structure of the Completed Hawker Hurricane

THE free blueprint which you find in this issue is a full-size diagram of a flying model of the Hawker Hurricane. It may be used as a template for cutting the various pieces of wood which when assembled make up into the attractive looking model which you see in the photograph.

The model is the basis of a competition similar to that which I inaugurated last year in connection with the Petrel Model Monoplane driven by a small two-stroke petrol engine.

I received many requests during the run of that competition from those who wished us to run a competition on somewhat similar lines, but for rubber-driven models. Their chance has now arrived, and the conditions of this contest are here given.

I have preserved the main lines and features of the full-size machine, whilst simplifying the construction for model builders. The pictures show the degree of realism which it is possible to obtain if the parts are correctly assembled and fitted. Whilst the main object of the competition is for duration, I am aware that the possibility of a tie would necessitate a sub-division of the prize money, and accordingly extra marks will be awarded to those competitors who add refinements which make the model even more like its prototype.

This can easily be done by means of balsa fairings, stringers, and other fittings. It is important to remember, however, that the main design must not be changed. You must not increase the span nor the length. You must not fit gears. In other words the basis of the model must essentially be that shown on the blueprint, and the judges will measure up the model and inspect its construction before the model is flown.

If a reader elects to use silk or paper for the covering he would not be debarred from doing so, or if he wishes to use a particular style of wheel or a different type of airscrew that would not debar him from entering. He must not use a different style of wing construction, nor a different fuselage, nor a different tail. The model must essentially be a flying model of the Hawker Hurricane and strictly to the dimensions given. The reader may decide that down thrust as provided by the inclination of the nose-block is unnecessary. He may be permitted to dispense with this if he so desires without risk of disqualification.

The Fuselage

The following hints on construction will be of use to readers. The first part to build is the fuselage, since all of the parts are fitted to this. The first thing to do is to bind together the two top longerons, and the two bottom longerons, *side by side*, and to bend them in a jet of steam from the spout of a kettle, until they take the form shown in the side elevation. Then cut off pieces of $\frac{1}{8}$ in. square balsa to butt behind the various bulkheads. I have not shown these in the blueprint, since there is bound to be small inaccuracies in the bending, and they would have to be cut to fit. Similarly, many of the other pieces will have to be fitted and shaped so that the curves of the model are maintained. The bulkheads, for example, as shown, are on the large side, and need to be glass-papered off to give a fair line in side and plan view. It will be noticed that the bulkheads against which the two half wings abut are parallel (see the photographs), and the dihedral angle to the wings is imparted

The Two Half Wings, the Airscrew and Boxblock Assembly

by means of ⅛ inch balsa packing pieces to the end ribs, such balsa packing pieces being glasspapered down to a wedge section. These packing pieces will also need to be shaped so that they fit closely to the fuselage; although shown curved in the blueprint it is not possible to give this curve accurately as it will vary with each model. *The aim should be to make that part of the fuselage flat-sided.* Wherever it is necessary to cut slots in the bulkheads to admit the longerons they should be afterwards packed with a thin piece of balsa and faired off with glasspaper. Thin strips of 1/16 in. spruce are cut and butted between the bulkheads to act as stringers and to provide a support for the fabric or paper covering. The fuselage underneath the wing is absolutely flat. The bulkheads should be cut by tracing off with carbon paper direct on to the three-ply and fretting out in the ordinary way. In assembling the various bulkheads on to the longerons rubber bands should be passed over to hold the structure into position until the glue is dry. The best method to adopt is to assemble the longerons as two sides, held together by means of the ⅛ in. balsa distance pieces, and then to notch the bulkheads (the notches should not be cut until you are ready to assemble them on to the longerons; their positions on the blueprint gives their approximate position) and slide these on to the two sides having first marked their positions. The bulkheads are glued, of course, to the balsa distance pieces.

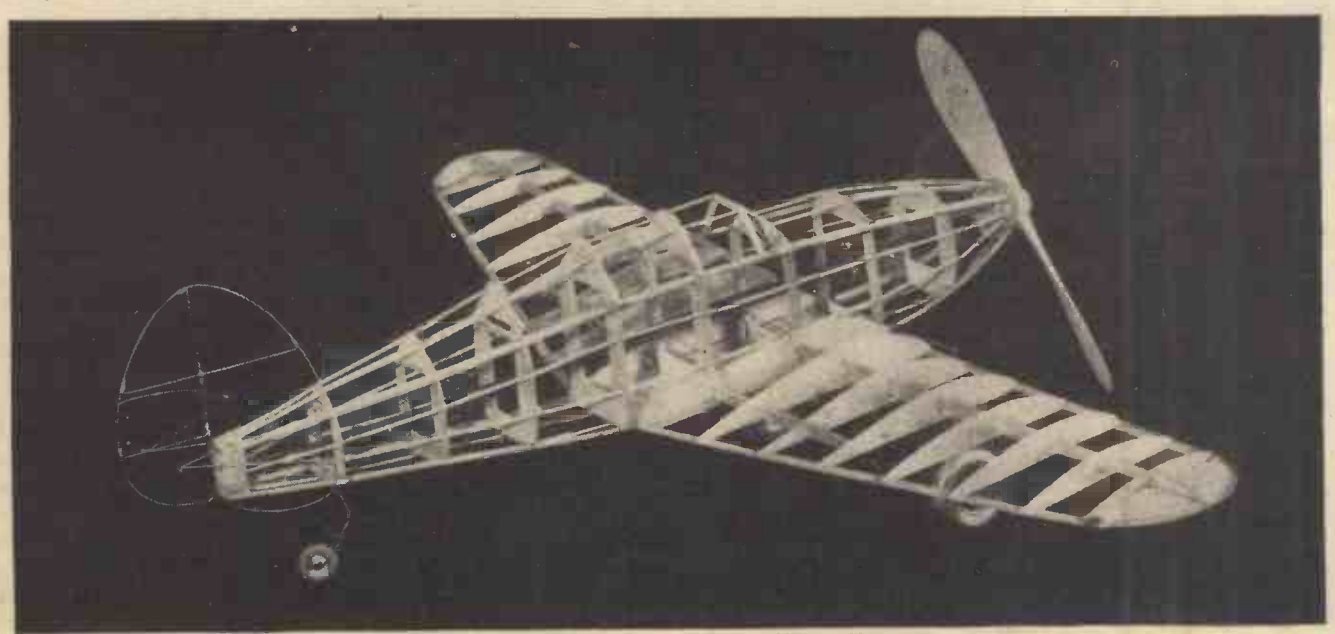
The four longerons are let into a balsa tail block which carries the rear rubber hook. The rear chassis is fixed to the bulkhead as shown, or the two limbs of the rear chassis can be fixed to the top and bottom longerons, whichever method is most convenient. The method of attaching the rear hook is obvious from the blueprint.

When all of the various pieces of the fuselage are assembled and the glue is thoroughly set, carefully glasspaper all of the bulkheads so that a smooth outline is obtained and round off the longerons to give a smooth finish. There are no sharp edges on the model. The floor of the fuselage immediately beneath the wings should be covered with 1/32 in. balsa to prevent the fuselage from bending in and also to take the landing strains. The inside of the nose of the model should also be covered with very thin three-ply or sheet balsa additionally to strengthen the nose.

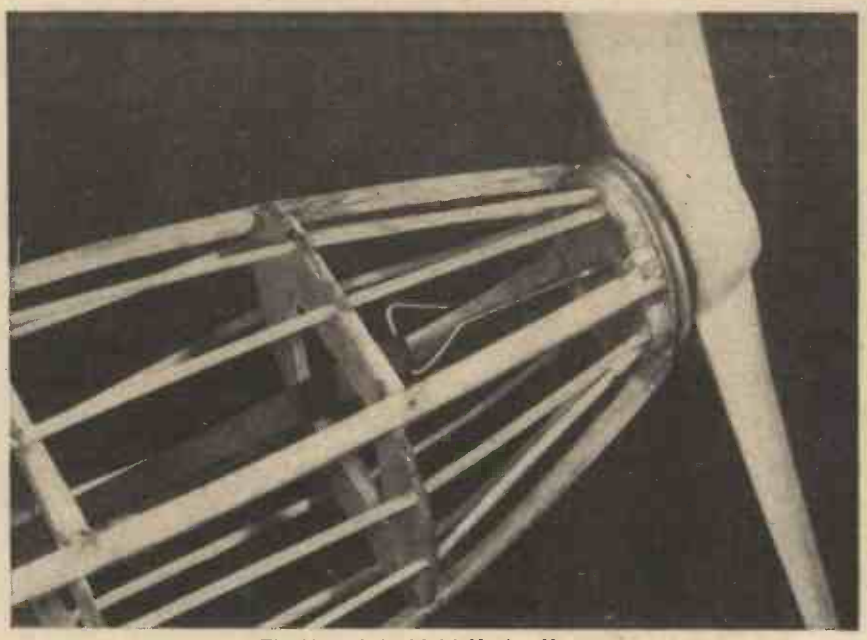
Before covering the fuselage either with paper or silk lay straight edges along the bulkheads to make sure that none of them are standing "proud." Careful glasspapering will give the fuselage its final form. If necessary pack the bulkheads with pieces of balsa to correct the curve.

The Tail and Rudder

The tail is drawn full size on the blueprint and is constructed from 20 gauge piano wire. It will be appreciated that the tail and rudder are assembled as one unit, and should be fastened to the fuselage—to the stern post by wire and soldering and to the longerons in a similar manner—before the fuselage, tail and rudder are covered. It is most important to mount the tail so that it is parallel to the neutral axis of the fuselage. In other words, it must be parallel to the bottom edge of the mainplane. A slight negative angle should be



Another Uncovered View of the Completed Hawker Hurricane



The Nose of the Model Hawker Hurricane

given to the tail flaps. An extension of the front edge of the rudder pushes down into the rear bulkhead, and the bottom end of the rudder is bound to the tailpost. It is very necessary to keep the tail and rudder flat; piano wire tends to curl, and it should be carefully straightened with pliers.

The Chassis

The chassis is of the sprung type, and the top front member passes through a piece of aluminium tubing lashed to the bottom longerons. The rear member has a coil formed in it at each side and is formed from one piece of wire soldered to the vertical limbs of the front chassis member. Thus, should the model strike an obstruction during landing the nose block can tilt and the chassis can spring back. The simple character of the chassis is shown on the blueprint and in the photograph. It is, of course, completely assembled before fixing to the fuselage.

The Mainplanes

A full size half-plan of one of the wings is given, and this should be traced off in *reverse* before commencing construction. The blue-print and tracing should be used as templates for erecting the wings and cutting off the various spars. It will be noted that the ribs are given full size, and they should be cut out in pairs by pinning pieces of three-ply or balsa together. Do not remove these pins until the ribs have been finally sandpapered to form. Cut the slots in the ribs to fit over the main spars so that the ribs fit tightly.

Lay the leading edge and trailing edge, and the main spar and the half main spar in their correct places on the drawing. Next, cut off the flat balsa ribs which are glued between the leading and trailing edges, the spars, of course, being glued on top of them. Pins are not used. Glue on the main spar and half main spar, and then slide the ribs over, gluing them into place. Small pins should be tacked round the outside of the wing to keep it down to the bench and to keep the parts in correct position until the glue has set, when the wing may be lifted and a piece of bent cane bound and let into the leading and trailing edges to form the wing tips. This cane wing tip is packed with a piece of 1/16th in. balsa, strengthened by means of a piece of balsa aligned to the main spar, and butting on to the end rib as shown in the photograph. When covering the wings cover the bottom flat surfaces first, and then the top surfaces, stretching the paper or silk from end to end first. The wing roots have piano wire hooks connected to them so that elastic bands can pull

LIST OF COMPONENTS
FOR THE MODEL
HAWKER HURRICANE

4 lengths of Silver Spruce 22 in. long.

3 lengths of Silver Spruce 13 in. × $\frac{3}{8}$ in. × $\frac{3}{16}$ in.

4 lengths of Silver Spruce $\frac{3}{16}$ in. × $\frac{1}{8}$ in.

6 ft. 6 in. of Spruce or balsa ribbing $\frac{1}{4}$ in. × $\frac{1}{8}$ in.

12 in. $\frac{3}{32}$ in. round cane.

4 ft. 6 in. of $\frac{1}{16}$ in. three-ply for ribs $\frac{3}{4}$ in. in width (maximum chord of wing 6$\frac{3}{4}$ in.).

2 ft. 6 in. of $\frac{1}{8}$ in. Balsa $\frac{3}{4}$ in. wide for ribs.

4 small brass hooks for wing fasteners.

1 piece of Spruce $\frac{1}{4}$ in. × 1$\frac{1}{2}$ in. × $\frac{7}{8}$ in. for sternpost.

$\frac{1}{8}$ in. Balsa Bulkheads :
1 piece 2 in. × 1$\frac{1}{4}$ in.
1 piece 2$\frac{1}{2}$ in. × 1$\frac{3}{4}$ in.
1 piece 3 in. × 2 in.
1 piece 3$\frac{1}{4}$ in. × 2$\frac{1}{2}$ in.

$\frac{3}{32}$-in. three-ply Bulkheads :
1 piece 3$\frac{1}{2}$ in. × 3 in.
1 piece 3$\frac{1}{2}$ in. × 3 in.
1 piece 4 in. × 3 in.
1 piece 3$\frac{1}{2}$ in. × 2$\frac{1}{2}$ in.

Nosepiece :
1 piece $\frac{1}{4}$ in. three-ply 2$\frac{3}{4}$ in. square.
1 piece $\frac{1}{8}$ in. three-ply 1$\frac{1}{2}$ in. square.

Eight 2 ft. stringers for fuselage $\frac{3}{32}$ in. square.

12 lengths Balsa 21 in. long.

4 yds. 22 gauge wire for tail, rudder and rear chassis.

6 in. of $\frac{1}{8}$-in. Duralumin tubing.

2 yds. 18 gauge wire for chassis and propeller shaft.

6 yds. $\frac{1}{4}$-in. strip elastic.

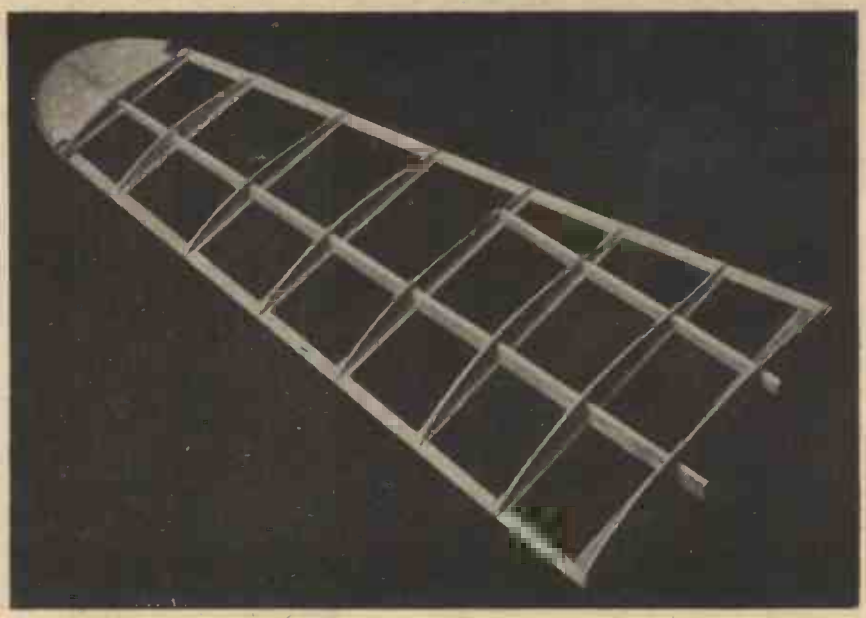
1 pair 2-in. disc wheels.

One 1-in. disc wheel.

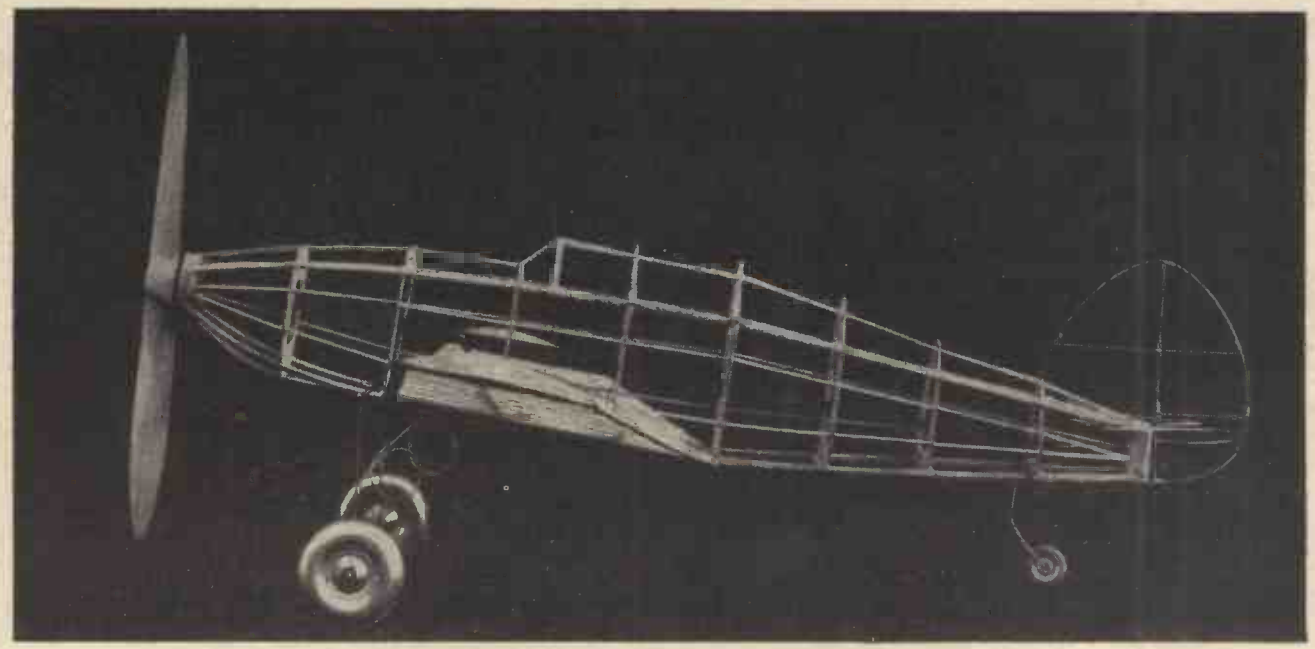
6 ft. Jap Tissue 8 in. wide.

Dope, glue, pins, thread, etc.

One 10-in. airscrew.

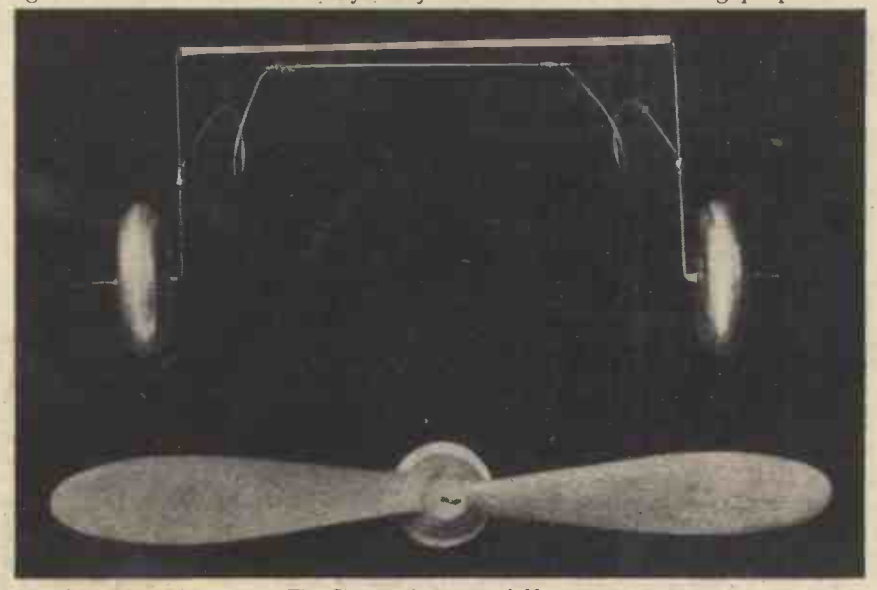


One of the Mainplanes



Side View of The Flying Model Hawker Hurricane

the two wings into the fuselage, and yet allow them to knock off in the event of a crash. These wing roots slide into sockets on the two bulkheads. These sockets consist of two pieces of 1/16th in. three-ply glued to the bulkheads and which are set to the correct dihedral angle. For additional security they should be pinned. The wing roots slide into them; or tinplate sockets can be used.



The Chassis, Airscrew and Nosepiece

Flying the Model

Glide the model before attempting to fly it under power.

In view of the fact that the wing has a fixed position and cannot be adjusted along the fuselage, it may be necessary to load either the tail end of the model or the nose for trimming purposes. It will be necessary to make a long button-hook style of tool so that the elastic can be placed on the rear hook. It might be convenient to cut a small part of the covering away from the rear end of the fuselage at the bottom to facilitate this operation, or a small balsa trap-door may be fitted. Whatever small loading is necessary to trim the model it should be placed ***inside*** the fuselage. About eight strands of $\frac{1}{4}$ in. elastic will be necessary to fly the model, and when the model has been made to glide on an even keel, wind the airscrew about 100 turns and if necessary, retrim the model, not forgetting to bend the rudder to the right or the left to correct any banking tendencies due to airscrew torque. The elastic should, of course, be lubricated. The loose nose block which is passed over the airscrew shaft before the hook is bent, should contain a brass bushing to suit the 18 gauge spindle. These bushings are obtainable from advertisers, as are complete kits of parts made to my specification.

I shall be glad to answer any questions which readers care to put to me should any difficulty arise in the construction.

Further Details of this Fine Flying Model of the Hawker Hurricane will be given next month. Enter for our £20 prize now!

RULES

1. Only models built according to the designs, and specifications here given are eligible.
2. The judges reserve the right to refuse an entry without assigning a reason. Their decision is final and legally binding.
3. Professional model-makers, those engaged in the making of models for profit, or as a livelihood, are excluded from this competition.
4. Models must be the unaided work of the competitor, but they are allowed to purchase the usual finished parts—airscrew, ribs, wheels, engine, etc.
5. Each competitor may enter only one model.
6. Any variation in the design may entail disqualification, within the discretion of the judges.
7. Those competitors who will be unable to attend to fly the models themselves may appoint a delegate, approved by the judges, to do so.
8. The competition will be for duration, extra marks being awarded for take-off, stability, and landing.
9. The first prize is £20, and other prizes will be awarded for workmanship and finish.
10. The competition will be held at a venue to be announced later.
11. Each competitor may be allowed three flights if time permits.
12. Each model must have the name, address, and number assigned to each competitor clearly marked in block letters on the fuselage, wing or tailplane.
13. The order of starting will be according to the competitors numbers.
14. Competitors may not be permitted to make any major change to the model during the competition, within the discretion of the judges.
15. Notification of intention to compete must be sent on a postcard, so that a register of competitors can be compiled. Address postcards to The Editor, Practical Mechanics, George Newnes, Ltd., Tower House, Southampton St., Strand, London, W.C.2, to reach us not later than May 31st, 1938.
16. The Editor reserves the right to refuse an entry without assigning a reason.

THE MONTH IN SCIENCE AND

A new "Electron Bombardment" furnace, permitting scientists to heat metals up to temperatures of about 4,500 degrees Fahrenheit, almost half the temperature of the sun, has been perfected by Dr. Ralph R. Hultgren, Harvard metallurgist, who is shown here placing a vacuum cover over the furnace.

Grass from Paper

AFTER costly experiments, a new method of lawn growing, destined to cause a sensation in the horticultural world, has been successfully developed. Sheets of paper made from vegetable matter and impregnated with grass seed, are laid on the plot, a layer of fine earth is sifted over and carefully watered, and within a week a lawn, minus bare patches, is growing. The paper is made in sheets three feet by two feet and sells at about 5d. a sheet.

Sun Rays Produce Gas

MR. OTTO H. MOHR, of Concord, California, has invented a machine which utilises the rays of the sun in producing gas. Water is placed in a tank which is stood in the sun and allowed to vaporise. When the water reaches a given temperature, it is passed into another chamber filled with an acid to make the vapour more conductive. An electric current is then used to break it into oxygen and hydrogen gas, the gas being stored in tanks for cooking, heating and other purposes.

An Active Scientist

THE Polish scientist, Professor Odo Bujwid has recently celebrated his 80th birthday in Cracow. The Professor has lead an extremely active life in the cause of humanity, particularly in the field of bacteriological science. After a visit to Pasteur in Paris he was, in fact, the first to introduce inoculation against hydrophobia outside France. In 1886 he founded the Bacteriological Institute of Warsaw University and in 1893 he received the Chair of Hygiene at Cracow University. He has more than 250 scientific works to his credit and has been honoured by many States.

Shock Absorbers for Electric Bulbs

SHOCK absorbers on cars are now general practice, not only because they increase the pleasure of driving, but also because they increase the life of the components of the car. At the recent Leipzig Spring Fair, an electric bulb was shown with shock dampers. The principle is not one of springing, but at a point in the bulb a bead is smelted in to restrict vibrations of the filament which frequently lead to failure of a lamp. The glass bead has the effect of creating a mechanical element which oscillates as a unit with no tension, or at any rate very little tension on the filament proper. On larger bulbs, even the oscillation of the filament unit as a whole is restricted by a second bead in the middle.

An Automatic Recorder

A MUSICIAN usually discovers his best melodies when improvising on the piano. If, however, he is obliged to stop playing in order to write the score, he is liable to lose the trend of his thoughts. Many a delightful air has "vanished away into silence" because it was lost at the critical moment. This inconvenience, which sometimes almost borders on tragedy, has at last been eliminated in a most effective manner. An apparatus has been placed on the market which automatically records all the music played on the piano without disturbing or causing the musician to forget his theme.

The Easco Callboy

ALTHOUGH inter-communication telephones are extremely useful in an office, the staff must cease work to use them. A device has been placed on the market known as the Callboy, which is a modern and efficient means of giving instructions to staff and receiving their reply without either party moving from their chair. The instrument is sufficiently sensitive to pick up any speech within 8 or 10 yards of the special microphone-speaker used. It comprises a master control unit, and from one to six microphone-speakers installed in the rooms with which it is desired to communicate. Addressing the Callboy from a distance in a conversational voice will cause one or more of the microphone-speakers, at will, to reproduce the voice and the person thus addressed answers the caller without approaching the mike installed in the room. The person called can reply to you, but he cannot call you, unless you desire it, as all control is in the master unit. The equipment will operate from D.C. or A.C. supply mains 200 and 250 volts.

10-ton Stratosphere Plane

AN all-metal aeroplane weighing 10 tons for flying to the stratosphere has been designed by a Belgian, M. Renard. The plane is claimed to be air-proof and waterproof, thus enabling it to land in the sea. A crew of three, and twenty passengers can be carried to a height of 19,500 ft. When completed the plane will be powered by three 950-h.p. engines, have a cruising speed of 220 m.p.h. at 15,000 ft., and a ceiling of 28,000 ft.

The Easco Callboy master unit with a microphone speaker in the foreground.

A "Disc-rotor" plane

A REVOLUTIONARY type of plane has been invented by Mr. J. S. Caldwell, known as the "disc-rotor." The rotor, which is a web-like arrangement on top of the plane, aids in lifting the machine from the ground. It is claimed by the inventor that this machine, when mass-produced, will retail at less than most cars. Its safety factors in taking off and landing almost vertically, like an autogiro, add to its desirability for the layman. The plane is powered by a 7-cylinder motor, and combines the best features of the autogiro and aeroplane. A flat disc-rotor, which is locked in place in flight, to permit high speeds, supports the plane. When landing, the disc becomes movable and operates on the autogiro principle. It is stated that the plane cannot tail-spin or nose-dive.

Telephone Cable Works

AN entirely new factory and laboratory dealing with all types of telephone cables has been built at Eastleigh, Hampshire. This factory is equipped with Pirelli-General continuous lead extruding machines, and will greatly facilitate the

THE WORLD OF INVENTION

execution of emergency orders. A recent example is the submarine cable between Portsmouth and Gosport for the British Post Office which was manufactured and installed within seven days.

"Everything Electrical"

IN the wide field of electrical accessories, many developments have been undertaken to meet changing conditions and new demands, both in domestic and industrial applications. New lines have been introduced, existing designs improved, and standard ranges extended to meet present-day requirements. New types of fractional h.p. motors, fans, ironclad switchgear and bells, mine telephones, and spotlight torches are items taken at random from the ever increasing range of "everything electrical."

Cylinder-shaped 'plane

ALMOST a perfect cylinder in design, a new air-liner capable of carrying 47 persons and tons of mail and freight at 240 m.p.h., is nearing completion in the Douglas aircraft works at Santa Monica, California. The combined genius of leading designers and craftsmen of American aviation are represented by the plane. £100,000 has been pooled by them to build the machine, but it will cost another £200,000 before it has passed its tests. It will have four engines, generating 6,000 h.p., along its single low wing.

Best Cycle Improvement

THE Silver Plaque given by the C.T.C. for the best improvement in cycle construction or design, etc., for 1937 has been awarded to Bayliss, Wiley & Co., Ltd., for their free-wheel hub, more popularly known as the Perry. The hub, which has been fully described in our companion journal *The Cyclist*, contains a free-wheel device as part of its ordinary mechanism. It is a clever piece of engineering, and is so designed that the whole of the inside can be lifted out without disturbing the balls or pawls. Every revolving part runs in well-made ball-bearings.

A Waterless Gasholder

ON page 312 of the March issue of *PRACTICAL MECHANICS* we described the gasholder at the Ford Works in America with a capacity of 22,000,000 cu. ft. as the biggest in the world. Dry Gasholders, Ltd., point out that the actual capacity of this gasholder is only 10,000,000 cu. ft., and that the largest waterless gasholder in the world is the Klonne waterless gasholder of 21,000,000 cu. ft. capacity at Gelsenkirchen, Germany. We are obliged to this firm for the correction.

An Interesting Model

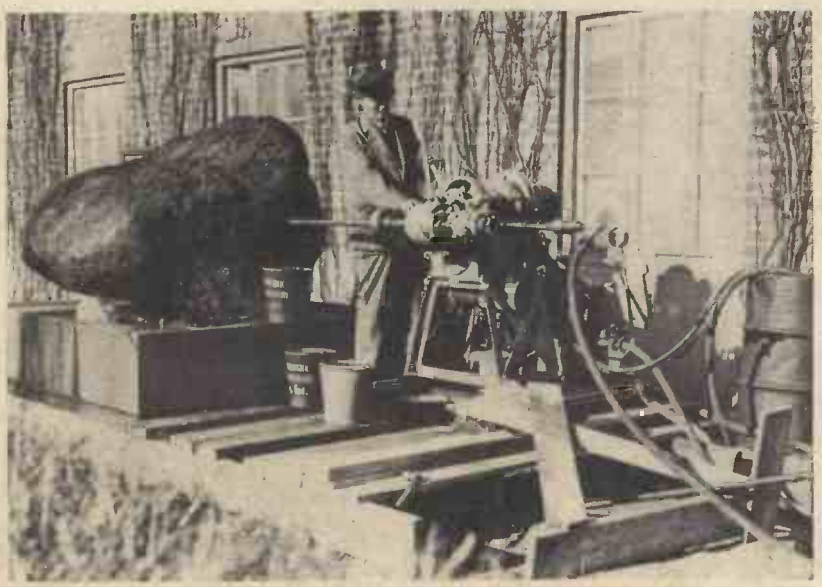
THE Port of London Authority have recently taken delivery of a mechanically operated model of a section of the Thames and the docks system of the Port of London. Built on a horizontal plane, the model depicts the River Thames from Tower Bridge to Barking Reach and includes the five large dock systems—London and St. Katherine, India and Millwall, Surrey Commercial, Royal Victoria and Albert and King George V Docks as well as the jetty and passenger landing stage at Tilbury. The area involved comprises 14 miles of the river while the docks cover a total area of 4,247 acres, of which 722 are water area. About one-third of the model is visible at a time, the whole consisting of 13 hinged sections constructed on an endless band which is rotated by an electric motor. The

The inventor shown in the cockpit of his "Disc-rotor," a revolutionary type of plane.

mechanism embodies principles of construction which have not hitherto been used for model work.

Plastic Lenses

FOR the first time in history, Combined Optical Industries, Ltd., have succeeded in making lenses from a material other than glass. Thus the public will now be able to buy, at prices not exceeding those at present ruling for the "best form" glass lenses, spectacle lenses that are technically superior to glass, practically unbreakable, and light to wear. The new plastic lenses ("Plasta") are designed to "best form" curves to correct oblique astigmatism and, in powers where spherical aberration is prominent, the surfaces are made aspheric. They can be produced in any quantity without the slightest variation from prescription and they have a surface finish equal to the finest glass polish. Their actinic value is much higher than that of glass, they will not warp or distort, and fitting to a frame can be done without risk of breakage.



The meteorite which Nordenskjoeld, the famous Swedish explorer, brought along from his expedition to Greenland, is now being researched in Stockholm. The first surprising result was that the meteorite consisted of pure iron and boring work is proving difficult.

Detecting Fog at Sea

TESTS are at present being carried out on the liner *New York* with a new type of apparatus for detecting fog at sea. It consists of two giant "earphones" each over 3 ft. in diameter, which are constructed similarly to the human ear, and fog is detected by listening to the various sound waves, inaudible to the human ear.

A Novel Telephone

A GROUP of Soviet telephone engineers has designed a telephone apparatus with a special device for recording a message in the event of the telephone subscriber being out when a call is made. The device is attached to the ordinary telephone apparatus. If the receiver is not lifted when the telephone bell has rung a given number of times, the caller is automatically connected with the special device, which records on to a film any message he wants to leave. On returning home, the subscriber is able to receive the message by turning on the record. An experimental model of this apparatus is now being made and will be tried out in Leningrad.

A Record Flight

A NEW record for the England-New Zealand flight has been set up by Flying Officer A. E. Clouston and Mr. Victor Ricketts. They accomplished the journey in 4 days 8 hours 7 minutes, thus beating Miss Jean Batten's record of 11 days 1 hour 25 minutes by 6 days 17 hours 18 minutes. A record crossing of the Tasman Sea of 7 hours 19 minutes was also made by the fliers. The machine used was the four-year-old De Havilland Comet flown by Scott and the late Campbell Black on their record breaking flight to Australia in the England-Australia air race in October, 1934.

Improved Electric Clock

SIEMENS-SCHUCKERT (G.B.), LTD., have recently produced a synchronous electric clock movement which is fitted with a reserve spring. If the current should fail, this spring comes into operation and drives the clock. It is wound automatically by the electric motor which drives the clock, and is prevented from being overwound by a friction clutch, which also, in the event of current failure, effects the changeover from the electric movement to the spring. When the supply is resumed the reverse action takes place and the drive is once more transferred from the spring to the electric motor. The spring will run the clock from 5 to 6 hours. The clock is priced at about two guineas.

A "Turntable" Aerodrome

IT is proposed to build a "turntable" aerodrome over Paris from plans devised by Monsieur Basdevant. It will be erected on buildings high above the French metropolis. In this way the landing track could be revolved to the direction required according to the wind, so that planes would always be able to land or "take-off" over Paris into the wind.

Power from Insects

A SCIENTIST has announced that he has succeeded in capturing power radiated by insects. The power is on an ultra-ultra-short wavelength, and can operate a special meter. The meter readings vary as the insects are annoyed or teased, and no doubt attempts will shortly be made to convey "thoughts" to them by means of radio signals.

Automatic Store

IN a store at Memphis, Tennessee, a customer selects her goods automatically. On entering the store she is given an individual key and selects goods by turning her key in a slot beside each article. On arrival at the end of the store the key is surrendered to a cashier who places the key in another slot and this brings all the selected goods on a conveyor belt for charging purposes. Communication between the assistants who replace the goods and the cashier is maintained by an intercommunication system.

Listening In

TO enable the police authorities to hear the conversations of the inmates, microphones have been fitted in a number of cells in the prison at Greenwich, Conn., U.S.A. It is thought that this arrangement will enable confessions to be obtained and other valuable disclosures to be conveyed to the authorities, unknown to the convicts. It is doubtful whether any information will be obtained by this means, as they make no secret of their intentions.

Television at Sea—

IN conjunction with the Cunard-White Star Line, the Marconiphone Company recently carried out tests at sea on the Britannic, as a result of which good picture reception from Alexandra Palace was found possible almost as far away as the coast of France. Good picture reception was obtained off the Nore Lightship and 30 miles south of Hastings—where the measured field strength was 100 micro-volts.

—And by Wire

FURTHER experiments in Germany have shown that the radiation of television along existing wires may lead to some important developments. The frequencies dealt with are being improved upon, and apart from the linking of stations, there is the possibility of providing domestic television over the existing telephone wire system.

A doctor landing from an autogiro by means of a rope.

One-Bladed Airscrews

EXPERIMENTS with full-size aeroplanes as well as models have shown that airscrews having only one blade and a counterbalanced weight at the boss are more efficient than two-bladed screws. There is less slip no doubt due to the lack of interference which is normally caused by the second blade. Several full-size machines are now flying with one-bladed airscrews and successful models have been made.

Sorting Rice

SORTING rice, grain by grain, may sound an impossible task, but it is a simple job for a machine invented by Mr. W. R. Horsfield. The machine which cost £4,000, took three years to make and consists of 10 units each the size of a portable gramophone. It is used to eliminate discoloured grains. A single stream of grain, endways-on but not quite touching, is passed through the machine, and is viewed from above by lenses and a photo-electric cell. Grains white enough to pass are collected in sacks, whilst brown ones are held back for cleaning. Rice cleaned by the machine appreciates several shillings per cwt., and the output is as much as ten tons a week.

Wonder Clock

A WONDER clock is being constructed for use at the Royal Observatory, Greenwich, in connection with national time services. The clock will lose only a fraction of a second a year. Such high accuracy is necessary in radio telegraphy and broadcasting stations, and in astronomical observations.

Battery Locomotives

THE London Transport have ordered nine battery locomotives for use on new works and track maintenance. These are the only locomotives of their type and are probably the only battery locomotives in the world. They are to be used on extension works, maintenance and cable-laying on the Underground system, and will haul trucks carrying material and equipment, travelling at a speed of three miles an hour. The locomotives are designed to work with any main line type of stock.

Adapting the Autogiro

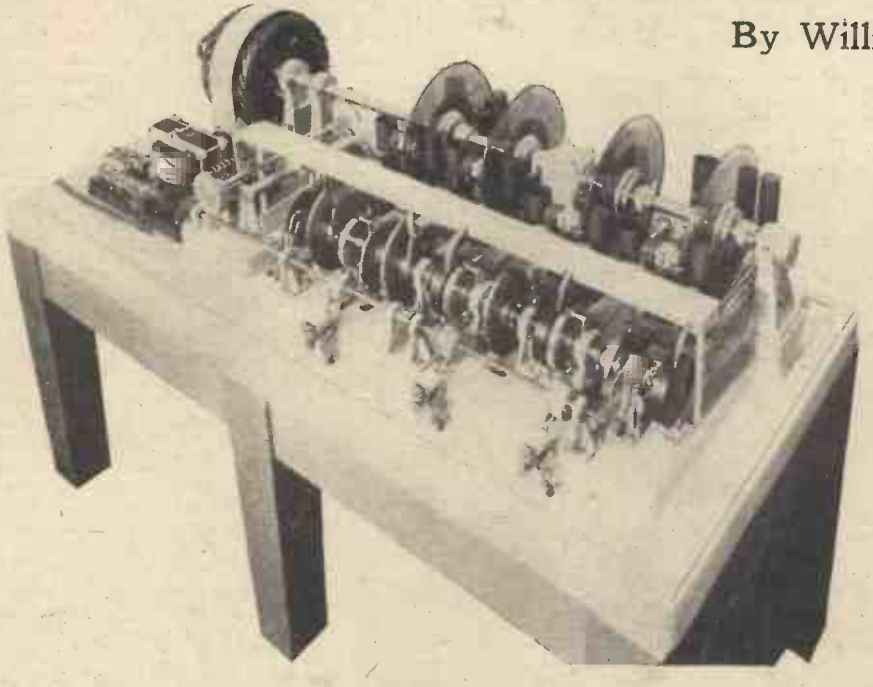
UNDER the direction of M. Denois, director of the French parachute school at Flers, a scheme has been prepared for the landing of medical supplies and surgeons in a confined space. The surgeon arrives by autogiro and owing to the possibility of injuries if he attempt a landing by parachute, the autogiro hovers as near the ground as possible and the surgeon climbs out of the cockpit and lowers himself to the ground with the aid of a rope.

A view of one of the new battery locomotives at the Ealing (London) depot.

THE G.P.O. SPEAKING CLOCK

By William G. Pike

A Brief Description of TIM the G.P.O. Clock which has Answered over 20,000,000 Calls Since its Installation just over a Year Ago



The disc and cam apparatus of the speaking clock.

TALKING CLOCKS are not new inventions, for clocks of this nature have been in use for a considerable time in Europe, Asia and elsewhere. There is nothing, however, quite like TIM, the wonder instrument of the Post Office. The sounds which come from this clock are recorded on glass discs, reproduction is remarkably clear, and the discs are practically everlasting.

Eighteen months' severe testing in the Post Office research station has resulted in the clock giving an extremely accurate performance. It is only possible, at present, to hear this clock in the London district, but it is hoped to extend the service to other large towns in the near future.

Proof of the popularity of this clock is shown by the fact that over 20,000,000 calls have been made since its installation a little more than a year ago. The public's appreciation of accurate time is evident, for 37,000 people asked the time between 8 a.m. and zero hour on the last Armistice Day.

Glass Discs

The main part of this ingenious clock consists of four circular glass discs like gramophone records. On each disc are photographed the various numbers and phrases as spoken into a special microphone by Miss J. Cain, who is now known as "the girl with the golden voice." The sound tracks, similar to those on the edge of a talkie film, are arranged in a series of concentric circles.

Upon dialling the letters TIM a subscriber is connected with the clock and hears a voice repeating the time. The announcement is phrased as follows: "At the third stroke it will be ten, twenty-five and thirty seconds precisely" (or whatever time it is) followed by pip . . . pip . . . pip. The period of listening lasts from 1½ minutes to 3 minutes, after which the call is automatically cut off.

Of the four discs, two share the minutes, each having thirty sound tracks. The other two discs are used for the hours and seconds. The hour disc has twelve tracks, and the seconds disc six tracks. The various words of the sentence are also recorded on the various discs, so that when an announcement is made all the discs come into use.

Speech Production

The reproduction of speech from the sound tracks is produced by focusing a ray of light on the discs and letting the light fall on to a photo-electric cell mounted on the opposite side. The electric current from the photo-cells is amplified, the volume of sound being such that two hundred people may listen at the same time.

The light rays are obtained from small electric lamps and a number of lenses. Each disc has its own lamp and set of lenses usually referred to as the "scanners." The "scanners" are mounted on carriers which move in and out of the discs in order that the ray falls on the appropriate track. Movement of the "scanners" is governed by cams mounted on the carrier shaft. The cams work in conjunction with three ratchet wheels, one each for the hours, the minutes and the seconds, the ratchet mechanism being operated by trip magnets.

A close-up of part of the mechanism.

Extreme Accuracy

A very accurately controlled electric motor drives both the discs and the scanners. Extreme accuracy is ensured, for the motor speed is governed by a master clock having a free pendulum, beating seconds. Attached to the bottom of the pendulum is a slide having a number of transparent areas. Placed in front of the slide is an electric lamp, a series of lenses and a narrow vertical slit, and behind the slide is a photo-cell.

The current produced by the light falling on the photo-cell is amplified and used to give impulse to the pendulum. As long as the pendulum vibration is constant, no impulse is given, but as soon as the vibration decreases current from the photo-cell is used to increase the vibration to normal.

In order that the error between the third pip and true time shall not be more than 0.1 second, the master clock is connected by relays to Greenwich Observatory, and synchronisation takes place every hour. Should the clock be out of step with Greenwich time, one of a number of relays is operated, causing the current in the coil of a magnet—which is placed beneath an armature fixed to the pendulum rod—to vary. By varying the force the rate of the pendulum can be advanced or retarded and brought into step.

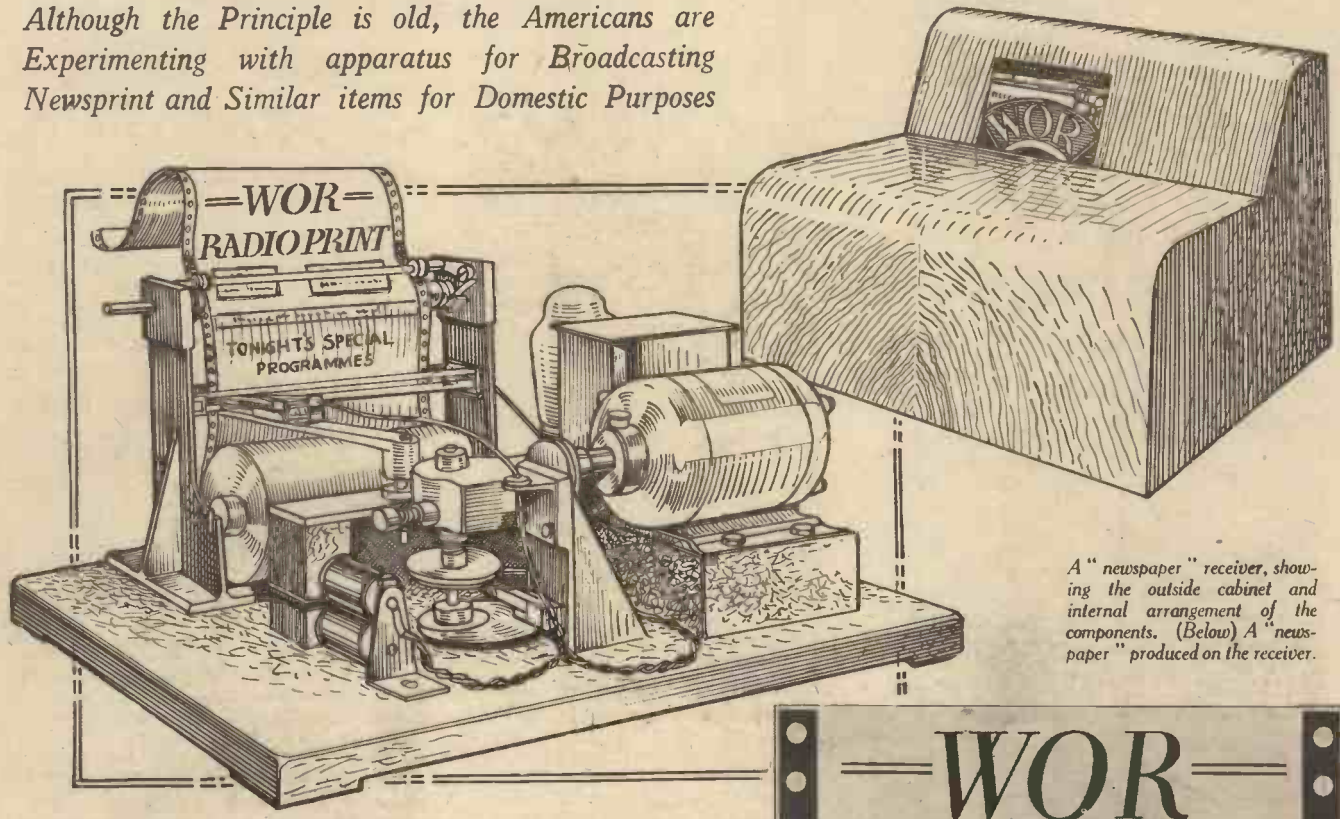
Two Clocks

Actually there are two clocks installed at the Exchange. Erected side by side, both are running continuously. Should the first clock break down or have an error in excess of a tenth of a second from G.M.T. at any hour, the second clock automatically comes into action.

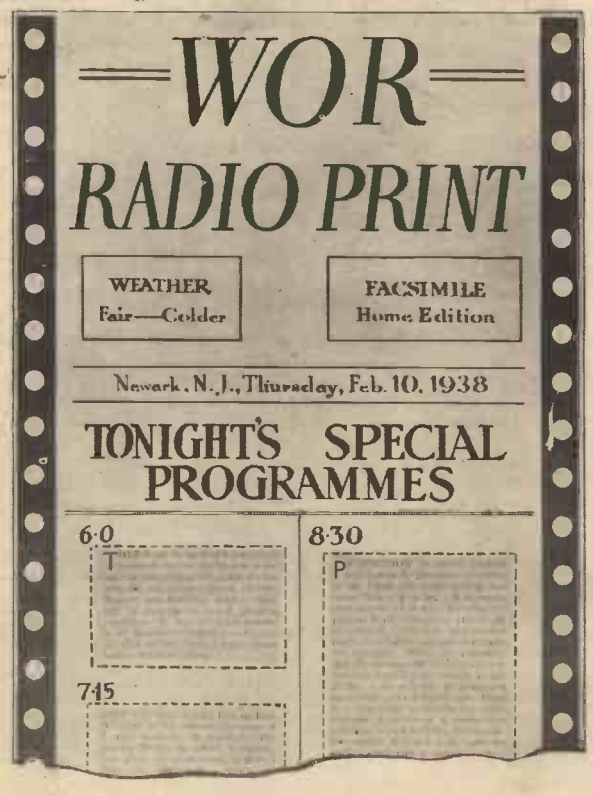
The Post Office have spared no energy to make this service the most accurate possible, and they have been rewarded. TIM has already netted the sum of £85,000.

Radio Newspapers

Although the Principle is old, the Americans are Experimenting with apparatus for Broadcasting Newsprint and Similar items for Domestic Purposes



A "newspaper" receiver, showing the outside cabinet and internal arrangement of the components. (Below) A "newspaper" produced on the receiver.



CRITICS of television often put forward the claim that a printed picture or news would be of much greater value. They mention, for instance, the case of the business man who comes down to breakfast, without much time to spare, but who is keenly interested in the latest stock prices or other news. They say that a printed news-sheet containing such material, broadcast about breakfast-time, would furnish him with the details he requires for use on the journey to the office or at his leisure. The television broadcast, on the other hand, demands the entire attention of the "listener" and if he is unable to spare the time when the broadcast takes place the transmission has to be lost. Each item does, however, fill a definite place in one's life, and it is unfair to make comparisons between them. About ten years ago the B.B.C. realised the value of a news-service which would provide listeners with printed details and transmissions were carried out for some time from the Daventry station. The receiving device which was then on sale was known as a Fultograph, and briefly the system consisted of a metal cylinder round which a piece of paper was placed. A needle was brought into contact with the paper and the cylinder slowly revolved and the passage of a current from the needle to the cylinder brought about a chemical change in a solution with which the paper was saturated, and this produced a picture or print in a blue tone.

Modern Systems

There were certain drawbacks to the system, although at the time its importance for police broadcasts of wanted people, finger-prints, etc., was fully realised. The illustration at the foot of page 428 shows an American news-sheet receiver in use at a listener's home, and this is a product of the well-known Radio Corporation of America. To cover all forms of material the system is known as "Faesimile," and it will be seen that a sheet of paper is gradually fed out of the machine and carries late news as well as illustrations. Unlike the original system used in this country, the reproduction is in black and white and is almost indistinguishable from standard news-print. This is accomplished by using a stylus which travels over the paper and between which a sheet of carbon is interposed. In another system being used in U.S.A. rolls of sensitised paper are employed and it is claimed that this is stated to be more attractive than orthodox black and white. In this system the paper is fed on the same system as with standard cinematograph film, the sides of the roll being perforated and a rotating drum with toothed edges providing the driving power. The illustration at the top of this page shows the roll as it comes out of the machine, together with the associated equipment The illustration at the side shows the appearance of the finished instrument, the roll being ejected from the small cut-out or escutcheon in the upper part of the cabinet. This particular instrument produces the news-sheet seen on the right.

Time-Operated

In all the systems now in use in America, time-operated switches are employed to bring the apparatus into use. In this country the original system had a synchronising mechanism which was brought into action by a special tuning note, but the operator had to start up the apparatus before the transmission commenced. To avoid interference with existing radio

(*Continued on page* 428)

New Materials for Old

Cement, Steel and Glass Replace Bricks and Mortar

A modern cement works. In the foreground are the slurry thickeners, storage silos are at the back. The two long low buildings on the right house the rotary kilns.

CEMENT will always rank amongst the greatest gifts of science to civilisation, though its discovery is now more than a hundred years old. From cement bonded with steel has sprung greater and more ambitious structures than ever mankind has aspired to in the greatest building ages of the past. Steel is the backbone of these structures, and Bessemer's discovery of a process for making bulk steel first allowed the architect to plan outside the limitations of bricks and mortar. Always, too, ever since glass was first made, mankind has striven to use it to lighten the inside of buildings. But to-day the architect can actually build with glass, for the most recent of the glass maker's achievements is the production of bricks moulded from glass.

Cement

Both the Greeks and the Romans used a hard setting mortar similar to cement in qualities. The dome of the Pantheon in Rome was actually made entirely from a lime concrete. It stands to this day. But in some extraordinary way, all knowledge of the art of cement making disappeared with the fall of the Roman Empire. For nearly 2,000 years, if it was made at all, it was only by accident.

In 1756 the engineer Smeaton was commissioned to build a lighthouse of stone on the dangerous Eddystone reef off the Devon coast. For this enterprise he required a cement which would set under water. In his search he discovered that lime makers who used rather poor quality limestone which was contaminated with clay produced, quite by chance, the water-setting material he required. Though his lighthouse stands to this day his discovery seems to have languished.

Fifty years later a French chemist Vicat came a step nearer modern methods. By burning a paste of chalk and clay together he, too, produced cement. Probably his discovery was lost in the turgid upheaval of the French Revolution, for the honour of first manufacturing cement does not belong to France.

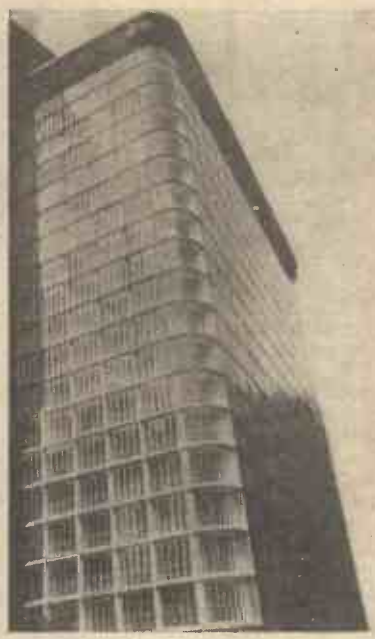
The secret of cement, however, was so obvious that from 1800 onwards many inventors and manufacturers were producing something very like modern cement by burning together clay and chalk or limestone. But by one of those tricks of chance which always cloak great discoveries, they were carefully picking out and throwing away the very portion of the burnt material which would have given them Portland cement. From their kilns came two types of material, the one they kept was a soft limey material. The material thrown away was a hard clinker.

In 1824, Joseph Aspidin, a lime burner, of Leeds, found that if the clinker were ground like flour between mill-stones it gave a material which set when mixed with water. The hardness of his cement was far greater than that of any other then known. Because it looked very much like Portland stone, he named it "Portland" cement. Though cement manufacture has vastly improved on Aspidin's methods and has grown into an industry measuring production in millions of tons, cement is still known by the name Aspidin gave it, and his discovery that to make cement, chalk and clay must be ground intimately together and burnt to a hard clinker and ground again to a fine flour, is still fundamentally the basis of cement manufacture.

Clay and Chalk

Cement is essentially a compound of lime with silica and alumina. The lime comes from chalk or limestone. Alumina and silica are provided by clay, one of the commonest materials of the earth's crust. At white heat, lime and clay fuse together and form cement clinker. The new compound is capable of taking up water to form a hard setting compound whose strength lies in the interlock of new crystalline forms keying the whole mass together. Plaster of paris, which is the sulphate of lime, sets in just this way. But to get cement to take up water it must be ground up to the finest of fine powders, just as Aspidin discovered.

Wherever chalk and clay occur together, the raw materials of cement manufacture are at hand. The fortuitous co-existence of Kent chalk and river clay round the basin of the Medway gave Britain a flying start as monopolists of cement manufacture. In fact, it took other countries nearly fifty years to find out that there was no real secret or special property about British clays for cement making.



A wall of glass bricks for the crystal skyscrapers of to-morrow.

400-Foot Furnaces

Up the River Medway can still be seen the old-fashioned type of stone cement burning kiln into which a mixture of chalk, clay and coal was charged, burnt off, cooled and withdrawn. To-day cement manufacture has moved nearer the Thames itself to Tilbury and Purfleet where cheap water-borne coal feeds the maws of the great modern cement furnaces.

From the chalk pits chalk is brought by bucket conveyer or pumped in the form of a slurry. It is mixed under the most careful analytical control with clay which at some works is dredged and pumped up from the river bottom. In huge settling tanks the slurry is thickened to eliminate water and pumped as a paste to the top of the cement kiln.

The modern cement kiln is a vast tube, sometimes 400 ft. long by 15 ft. in diameter.

firebrick-lined inside a steel case and rotated slowly in its major axis. So beautifully balanced are these monsters that a midget 15-h.p. motor serves to keep them turning.

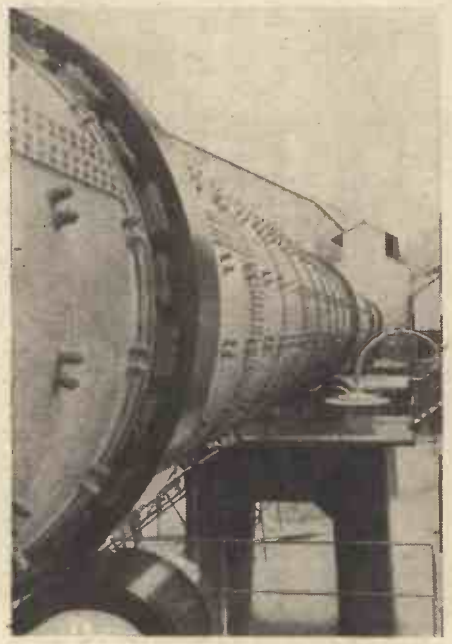
About two-thirds the way down a flame of pulverised coal is blown into them producing a zone of white heat. Here the chalk clay slurry is fused into molten cement clinker. Up at the top end of the kiln, which is set on a slight slope, where the slurry enters, the hot gases passing from flame zone to the chimney dry out the slurry and prepare it for firing. Down past the hot zone the clinker sets and cools, warming up as it does so a draught of air which is passing up to burn the coal. As the clinker leaves the kiln it is quite cold and ready for the grinding mills.

Ball Mills

Just as the old stone kilns have given place to modern furnaces, so Aspidin's millstone grinders have been replaced by fine grinding mills of the highest efficiency, but ones which use a very simple principle. The clinker is fed continually into steel cylinders half filled with hard, heavy steel balls. The cylinder rotates at about 16 revolutions per minute, so turning the balls over and over on one another. The incessant rolling impact so produced on the clinker grinds it down to a particle size of less than 1/200th inch. In the grinding operation, a small percentage of gypsum is introduced, which has the valuable effect of slowing down the setting of the cement so that it can be worked into position.

Concrete

Concrete is not, of course, neat cement. It is a matrix of clean stone and sand keyed together with cement which coats and sets every particle together. One part of cement, two of sand and four of clean, sharp stone is almost the rule of three of modern building. It is as strong as stone and better than stone, for it can be poured into position round a web of steel girder and reinforcement of steel bars which key it and give it tensile strength which stone cannot possess. Thus the modern engineer throws out straight beams of concrete where the architect of old would have been forced to throw a rising arch. It is because the wide concrete span has become possible that modern architecture tends to follow square lines.



View along a rotary kiln showing the trunnion bearings. These kilns run up to 500 ft. in length with a diameter of 14 ft.

Steel

If concrete is the body of modern building steel forms its ribs and backbone. Bessemer gave the engineer steel in bulk for building in 1856. But it was not till 1909 that Parliament permitted the engineer to depart from the heavy construction necessary for brick and mortar building, and enabled him to design the modern shells of steel clothed in concrete which spring from their foundations to completion with fascinating ease and speed. To speed is now added silence, for the pneumatic rivetter is fast being replaced by the arc of the electric welder which literally burns the whole steel fabric into one homogenous whole.

Finish

Nor is the appearance of the finished building overlooked. The concrete can be faced with brick, or pre-cast concrete stone can be lined into the shuttering, clothing the building as it rises in a clean, smooth weather-proof mantle. Plastic paints have been perfected which serve the same end with even greater brilliance, and, finally, there is glass.

Glass Bricks

Glass bricks are the coming material of the buildings of the immediate future. With them whole walls of translucent glass can be built into the web of steel and concrete. Their manufacture is amongst the most recent of the glass-moulder's art.

Glass bricks are made by pressing molten glass into the shape of hollow half bricks. These half box forms are then cemented immovably together with a bond of metallic aluminium while the moulded forms are still hot. A coating of silica cement baked on to the sides and ends of the bricks gives a key so that the bricks can be built up by ordinary methods, course on course, with mortar. The face is left corrugated in various forms so as to admit light without permitting a clear view into the building. Since the brick is formed hot, its hollow interior is under a semi-vacuum. This has the advantage that the brick is self heat-insulating. It is a curious thing that this newest of building materials should be coming into general use in the year which was marked by the destruction of the first of the "Crystal Palaces."

RADIO NEWSPAPERS

(*Continued from page 426*)

programmes the American broadcasts take place in the early hours of the morning, and the time-switch avoids the necessity of the operator sitting up to switch on and off. The apparatus is joined to the loudspeaker terminals as in the original Fultograph system, and synchronising note or impulses are also employed to start the stylus at the right point on the paper. In principle the arrangement is standardised, the carrier of the transmitter being modulated by a special frequency which also carries the modulations of the picture of news material being broadcast. This is effected by a standard photo-electric cell arrangement, the original "copy" being passed between the cell and a light source. The signal variations are rectified in the radio receiver in the usual way, and this results in impulses being fed to the output stage which, if passed to a loudspeaker, would sound somewhat like an ordinary Morse signal at very high speed. These impulses operate a magnet system which transmits to the stylus the impulses corresponding to the original signal fluctuations and thus re-creates on the paper the message or picture. A synchronous motor or a synchronising impulse keeps the roller at the receiver in step with the feed at the transmitter.

Whether the idea will obtain a greater hold on the American public than it did on the English listeners, or whether the apparatus now in use is more effective than the original apparatus, will not become evident for some time, but no doubt there is a definite sphere for this additional branch of radio, not only in disseminating news, but in providing the experimenter with a field into which he may turn his energies now that radio from the sound point of view has been brought to such a high stage of perfection. At the moment there are 15 stations in America making these broadcasts and five manufacturers are making the receiving apparatus.

One of the R.C.A. "newspaper" receivers in use.

The Life-Wave Generator

By F. W. BRITTON, D.Sc.

The Generation of Currents by Bacterial Activity

RECENTLY, some remarkable experiments have been continuing at a laboratory in Holland. The apparatus used, for want of a better term, has been named the Life-Wave Generator. This emanation appears to bear little resemblance to ordinary radio-waves, since its maximum speed is around thirty miles per hour, with a length of about 10 in. A peculiar characteristic of the radiation lies in the delayed electro-magnetic action, for a complete electric field is not immediately set up but appears only after some time—ten days or so.

Anti-Bacterial Power

Robert Pape, the discoverer of these radiations has been successful, not only in preserving the vitality of certain forms of plant-life but also in resuscitating flowers, etc., after their vital powers had considerably flagged. It appears that the radiation is generated through the intermediary of two streams of air—one moist, the other dry—oppositely charged. The atoms of these streams, on combination, gradually set up a static current which develops as the ionisation proceeds, finally inducing a field of great intensity over a radius of about thirty yards. The range of the wave is not limited by substances interposed between it and the material to be experimented upon. Its penetrability is such that it passes through wood, glass, iron, lead, brick, etc., and is unaffected by conditions of temperature and humidity. There is no interference with, or by, the usual electro-magnetic waves used in wireless although the field influences the magnetic needle.

Obviously the principle use to which the apparatus could be put is in the storage of food-stuffs. Actual tests have proved that eggs, meat, poultry, milk and fish in addition to various kinds of vegetables remain perfectly fresh after long periods of time and in circumstances favourable to the development of putrefactive change. Indeed, it is extremely interesting to conjecture at the tremendous possibilities which the new radiation seems to offer. Naturally the chief factor to consider is the question of space necessary for the housing of the generator; this does not appear to be great by any means and could, I should imagine, quite conveniently be accommodated in the hold of any decent-sized cargo-vessel.

From a study of the types of earth existing in some of the northern countries, Scandinavia, the inventor of the above wave came to the conclusion that there must be some peculiar combination of physical conditions which affected the growth of the minute organisms present in dead bodies buried therein. Such organisms we commonly refer to as putrescent bacteria, and thus, by arresting their growth it is possible to prevent indefinitely, the decomposition of organic bodies following their decease. This factor brings me to a consideration of the energy developed by the organisms themselves, for it seems to me that by interfering with this minute current with a long-wave radiation of the above nature, decomposition may be delayed for a considerable time.

The Energy of Bacterial Action

And now, talking of putrefaction and decomposition of organic substances through the intervention of living organisms, I mention a few facts which the experimenter might care to know preparatory to carrying out investigations for himself, and then we will go on to show how the quantity of current may be calculated.

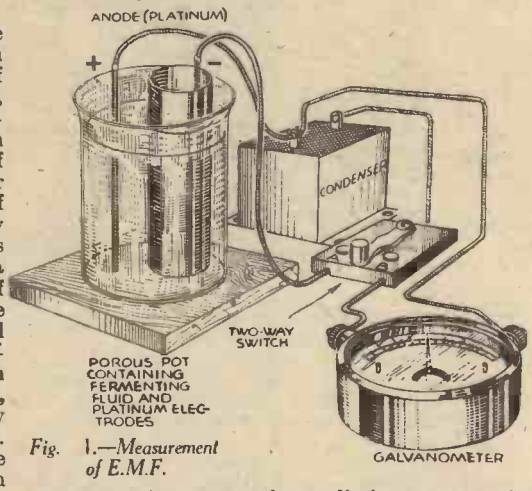


Fig. 1.—Measurement of E.M.F.

In the foregoing, the radiation was typically due to certain inanimate physical conditions such as might be induced by any suitable system of directive energy. It is well-known that all life produces certain concomitant electric forces, no matter how minute either the organism or these forces may be. Personally, I think that one of the most interesting features of this is seen in the radiation from growing cells—called "mitogenetic radiation", but space precludes their discussion here and we must content ourselves with a description of the current induced through bacterial action.

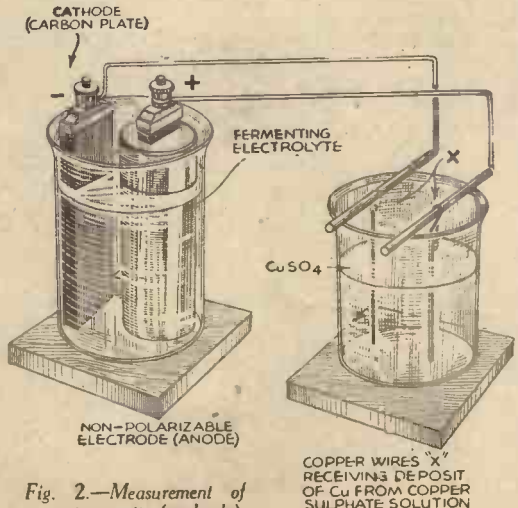


Fig. 2.—Measurement of current quantity (coulombs).

An Important Fact

One important fact should be borne in mind. There is generally a rise in temperature when organic matter decays, this indicates that there is some excessive potential of heat—caloric—in the substance prior to decomposition. An example is that of the fermentation of sugar which yields alcohol. In this process heat is evolved, and if the caloric value of the sugar is compared with that of the resulting alcohol, it is found to be far in excess of the latter. Now most of us will say that this heat presupposes the presence of electricity and, of course, we shall be right, for it is possible to determine quite accurately the quantity of energy liberated during a fermentative process, while the intensity of this energy (the E.M.F.) is an important factor. Considering that a bacterial action is typically a fermentation process, there are several interesting implications here, for if such a reaction involves pathogenic or disease organisms, registrable reactions may be measured in terms of current equivalents. Some years ago, I mentioned in a paper before the College of Physiology of London, that it should be possible to determine the number of putrefactive bacteria present in a dissociating biological electrolyte or fermentation cell containing a culture medium. But in the present article I shall simply describe an arrangement for measuring the energy of fermentation.

How to Measure the Energy

It will be seen that in Fig. 1 a porous pot is immersed in a solution containing the culture medium, the electrodes being platinum wires dipping respectively into pot and outer container. The external circuit is shown in the diagram, and consists of a single-pole two-way switch in circuit with a galvanometer and condenser. To operate this system all that is necessary is to introduce the bacteria (yeast) into the porous pot and to subject the solution, which is the same in both inner and outer vessels, to the correct temperature (about 86°F) when fermentation sets in and activates the electrodes. A charge accumulates on the plates of the condenser only when favourable conditions of fermentation prevail. This E.M.F. may be measured by momentarily changing over of the switch, shunting the capacity charge from the condenser through the galvanometer. Since the platinum electrodes are polarisable, they are not suitable for measuring the milliampèrage of the reaction and they may be substituted for non-polarisable carbon plates arranged as in Fig. 2.

The solution in the porous pot (Fig. 1), since it contains the ferment, is the active one, the organisms excite the pot electrode and develop a negative charge. This therefore is always the cathode. A certain weight of culture medium, for instance, will generate a certain amount of current

energy. This is best computed in terms of coulombs (the unit of electrical quantity), the amount liberated by one ampère per second. Fig. 2 shows an ordinary Leclanché porous pot immersed in a large beaker either heated with an immersion heater or else arranged over a constant source of heat thermostatically regulated. The fermentable fluid plus the ferment is placed in the beaker and a carbon plate electrode immersed in it; the porous pot is then introduced and the respective terminals of the cell connected to a copper/copper-sulphate cell. This cell simply consists of two copper wires dipping into a solution of copper sulphate. In order to calculate the number of coulombs generated, all that is necessary is first to weigh one of the copper wires (that forming the cathode) before the experiment, then to place the active ferment into the generating vessel and, finally, to reweigh the same wire after copper has deposited on it out of the solution. This calculation is readily made since 66 milligrams of copper are always deposited by one coulomb.

Referring to Fig. 1 it will be observed that the switch is in the neutral position. During excitation, it is moved to position A so that in order to measure potential a charge accumulates on the condenser; on moving the switch to position B the condenser is thrown into circuit with the galvanometer and a momentary deflection denotes the tension of the discharge. In Fig. 2 the porous pot is an ordinary Leclanché type as already mentioned, which forms the anode of the system so that on referring to the copper-sulphate cell, it will be seen that the piece of wire to be weighed is suspended from the leading wire from this electrode and not from the active carbon electrode immersed in the fermenting fluid. It is best for this purpose to use a straight length of copper wire and to bend the end in the form of a loop so that it may easily be hooked over the cross support as shown at X. In these illustrations the exciting vessel has been represented standing on a flat resistance heater, which I have found is admirable. In the absence of an automatic thermostatic control, the current will have to be switched in and out manually, using a thermometer standing in the electrolyte. The solution in the copper sulphate cell is merely a saturated aqueous one of copper sulphate.

Obviously, different cultures will generate different amounts of current and it should be useful as a means for correlating the activity of various ferments. In the case of a fermenting sugar solution, one gram of this yields 6 coulombs.

What Shape is the Earth?

THE article published in our March issue entitled "What Shape is the Earth," has created considerable interest among our readers. This article answers some of the interesting points raised by them.

Referring to Fig. 1, if any chord, x—y to the circle of reference is drawn, and its "geometrical" inverse is also drawn, this latter will be found to be a circle, passing through the centre of the circle of reference and the points C and D where the chord cuts the circle of reference. From a glance at the sketch it can be seen that any point A on the small circle is the geometrical inverse of the corresponding point B on the chord and the same radius, since it satisfies the condition $OA \times OB = R^2$.

Referring now to Fig. 2. This gives a proof that the angles of sight at the surface of the sphere of reference are the same. If CY is a line of sight on the "outside," CP (the tangent to the small circle) will be the corresponding line of sight on the "inside," and V W is a "horizontal line" in both cases. The "elevations" are the angles numbered 4 and 5, which are seen to be equal.

It is a matter of simple geometry to show that the angles 6 and 7 are equal.

Shadow of the Earth

Fig. 3 shows diagrammatically the interpretation of the "shadow of the earth on the moon" phenomenon on the field theory. This is simply a matter of drawing the diagram in ordinary geometry, and then transferring the diagram into "field" geometry. In a similar manner all the other phenomena of observation, such as eclipses, phases of the moon, orbits of the planets, etc. can be explained on the "field theory."

Fig. 4 gives the explanation of the "Hull Down" phenomenon in similar fashion to the above.

In general, the field theory is simply another geometry applied to the description of the Universe, It describes it, at least, as well as the more orthodox Euclidean geometry, and in some respects it is better.

The use of other geometries than the Euclidean to describe the Universe is well-known, thus we have Riemann's geometry, on which Einstein's theory of relativity was based, and many others.

It is always difficult for the unscientific mind to grasp these new concepts and geometries at first, but in time they come to be accepted as a matter of course once they have established their claims, The field theory has not yet reached this stage, but may do so some day.

The Light of the Sun

The question as to whether the light of the sun would be polarised by being refracted by the intervening space cannot readily be answered, since there is no experimental evidence regarding the effects of such space on light. It is obvious, however, that the empty space postulated is unlikely to have the same effect on light as the dense refracting and reflecting media we know on the earth's surface. It is hoped that future research on the behaviour of light in a vacuum, conducted in the light of the field theory may elucidate this point.

"G. M. B."

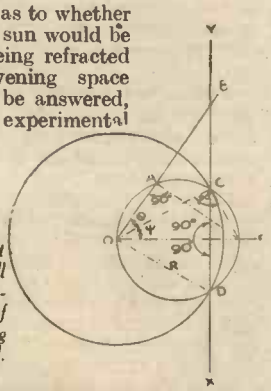


Fig. 1.—Any point A on the small circle is the geometrical inverse of the corresponding point B on the chord.

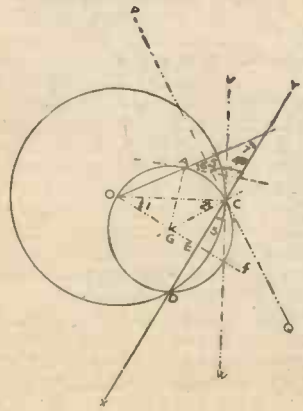


Fig. 2.—xy is any chord to the circle of reference. Circle OACJD is geometrical inverse of xy. OAB is any chord to smaller circle. VW is tangent to large circle at C. PQ is tangent to small circle at C. The angle 1 = the angle 2 since triangle OGC is isosceles. The angle 1 = the angle 3 since triangle OCE is similar to triangle ECJ; also the angle 3 = the angle 4 since they are vertically opposite. The angle 5 is the angle between tangents and the angle 2 is angle between corresponding radii. Therefore the angle 5 = the angle 2, but the angle 2 = the angle 4 (since the angle 1 = the angle 2 the angle 3 = the angle 4). Therefore the angle 5 = the angle = 4.

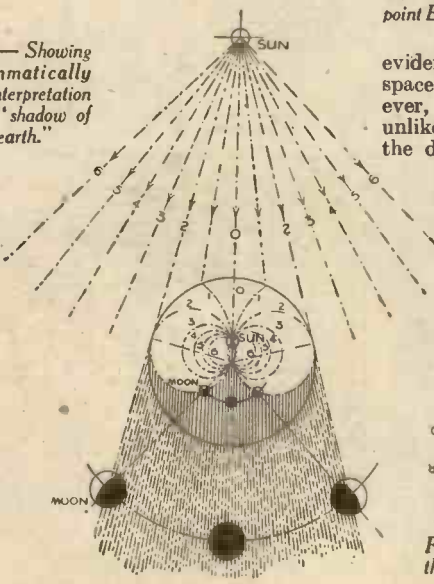


Fig. 3. — Showing diagrammatically the interpretation of the "shadow of the earth."

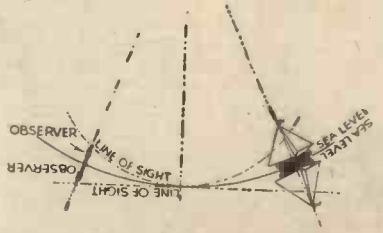


Fig. 4.—The "hull down" phenomenon in the "inside theory." Turn the diagram upside down for the orthodox theory.

MASTERS OF MECHANICS

A fine example of the old English weightdrivers "split-clock" device for slowly revolving a roasting spit before the fire. It is supposed to be the invention of Leonardo da Vinci.

No. 33.—Leonardo da Vinci—Painter, Sculptor, Anatomist, Engineer and Founder of Modern Mechanics.

WHAT is known as the Italian Renaissance, or the medieval enthusiasm for new learning and knowledge, was approaching the zenith of its expression in southern Europe when, in the year 1452, Leonardo was born in the little market-town of Vinci, between Florence and Pisa, in Italy. His father was a lawyer, one Peter da Vinci, and since Leonardo, when quite a young boy, displayed a variety of natural gifts and talents, many of which were of an artistic nature, the father placed the lad under the educational care of Andrew Verrocchio, an artist of note, with the intention that he should learn painting as a profession.

There was, however, little use in Leonardo being set to learn the art of painting, for such an art had been born within him and he only awaited the opportunity of displaying it in a suitable manner.

The boy, under the guidance of Verrocchio, acquired the manual technique of painting fast and furiously. He seldom had actually to learn anything. The knowledge of it, in some strange way, was already in his mind. We are not surprised, therefore, to find the worthy and somewhat perplexed Verrocchio exclaiming with reference to his pupil that "he finishes nothing, because he is ever starting to do something else."

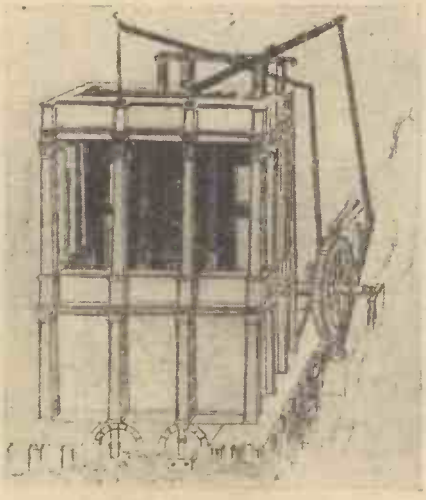
One day when Verrocchio was engaged in the painting of a religious subject he pointed to his picture and, commanding Leonardo, said: "Here, boy, let me see how thou canst paint in the kneeling figure of an angel."

As a Painter

Leonardo, for a few moments, stood before the unfinished picture, lost in thought. Then, taking up brushes and paints, he worked away with them with amazing rapidity until the angel detail of the picture was finished.

For a few instants the astonished Verrocchio struggled with the demon of jealousy. He had strived to attain supreme excellence in his art through years of patient study. The boy, Leonardo, however, then not more than fifteen or sixteen years of age, had achieved excellence without an effort.

Verrocchio laid his hand upon his pupil's shoulder: "I have found my master," he said gently, "keep my brushes; I will paint no more."



Reproduced from da Vinci's own sketch, showing his idea for a water-wheel operated water-pump.

The above incident is quoted as an example of the intuitive manner of inborn genius with which da Vinci invariably accomplished anything which he set himself to do. Of his career as an artist and a sculptor we cannot here dwell upon, except, perhaps, to remark in passing that his two most famous pictures, the "Last Supper" and the celebrated enigmatical "Mona Lisa" are among the world's greatest art treasures.

Of Leonardo da Vinci, the anatomist and physiologist, we also cannot deal, but must pass on at once to his essential work as an engineer and a mechanician.

The entire bulk of Leonardo's mechanical knowledge and inventions is contained in upwards of five thousand sheets of manuscripts and drawings which he left behind at his death. And, without any doubt, these closely written pages constitute the strangest set of manuscripts which the world has ever seen.

A Curious Writer

For one thing, da Vinci invariably wrote with his left hand from the right-hand side of the paper to the left. Then again, for some curious reason he wrote in mirror fashion, that is to say, his writing appears "reversed" and just as it would look if it were normally carried out and viewed in a mirror. Furthermore, da Vinci never used any form of punctuation and throughout these manuscripts, which extend over thirty years of his lifetime, he employed a complicated and extraordinary system of abbreviations, thereby making his script more difficult than ever to decipher.

Can anyone wonder, therefore, that da Vinci's mechanical works lay buried in libraries for centuries, and that other generations of inventors arose and passed away without ever dreaming that many of the principles of mechanism which they had contrived had been thought out and committed to paper centuries previously by this remarkable Italian artist-engineer?

Where da Vinci obtained his fundamental knowledge of mechanics from we do not know. One can only say that he must have studied the rudimentary mechanics of Aristotle and the other ancient writers. During his lifetime he was acquainted with a few mathematicians and architects of his country, but these individuals, so far as we can ascertain, did little to help him and certainly Leonardo's debt to them must have been a very small one.

"The paradise of the mechanical sciences," Leonardo da Vinci lovingly describes his favourite studies. And Leonardo was no charlatan, either. The alchemists of his time he rejects and spurns, and even the myth of perpetual motion, which was then in its hey-day, he perceives in its true nature.

Perpetual Motion

"Oh, speculators on perpetual motion," writes Leonardo, "how many vain projects of like character you have created! Go and be the companions of the searchers after gold!"

Da Vinci's physical researches began with conjectures on the nature of force. "If a force carries a weight in a certain time through a definite distance, the same force

will carry half the body in the same time through double the path."

Here we have the first accurate statement concerning force and work. Centuries after Leonardo had died the same idea was re-formulated and, of course, augmented, but all the same, it remained essentially his own statement.

Da Vinci, during his lifetime, not only discovered new mechanical principles but he also applied them in actual practice. It is for this reason that he has been called the "founder of modern mechanics."

As a civil engineer and an architect, da Vinci entered the service of several noble Italian families. He also seems to have acted as a military engineer, for we find him putting forward schemes for the construction of cannons and other instruments of war, one of which, "a covered wagon, not to be impeded by ever so dense a mass and behind which the infantry can follow without danger," seems to be a forerunner of the modern military tank or armoured car.

During his career as an engineer da Vinci did much constructional work, and for probably the first time in recorded history made practicable the transmission of mechanical power by means of gear wheels.

There is no doubt, of course, that the transference of power from one wheel to another by means of simple gearing had been known for thousands of years. Previous to the time of da Vinci, however, such systems had hardly been used. It is to him, therefore, that the world owes the first practical—or shall we say industrial?—use of mechanical gearing.

Mechanical Power

The transference of mechanical power through a right angle was first made practicable by da Vinci, although, in all probability it was known in theory long before his day. In order to obtain right-angle gearing da Vinci constructs a wheel having a number of pegs or teeth projecting outwards around its periphery or circumference. These teeth engage with a number of upright pegs arranged around a vertical shaft.

"Simple!" you remark. Undoubtedly, but so too is the principle of the screw, yet it took a genius, Archimedes, to first think it out.

Other nowadays "simple" mechanical principles which were invented or, at any rate, practically perfected and demonstrated by da Vinci are pulley systems, trains of three or more gear wheels, friction drives, weight-lifting systems, flywheels, pumping actions, the mechanical principle of leverage and the elements of stresses, strains and engineering weight distribution.

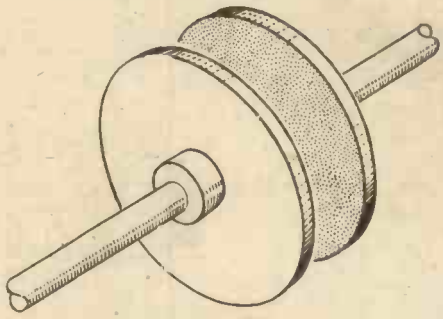
An appliance very much like a modern motor-car lifting-jack, operated by lever and rack, was invented by da Vinci. He constructed a treadle lathe having a large flywheel which worked very easily and so made possible the construction of various types of wheels and other round or circular objects. A travelling crane for use in building operations was another of this master's inventions and he even went so far as to devise an elaborate machine for grinding out and polishing hollow metal cylinders for pumps.

Yet, despite the fact that da Vinci must have been acquainted with some rudimentary form of piston and cylinder, he never seems to have been struck with the notion of utilising the power of steam by means of these devices. If, indeed, the merest suggestion of this principle had presented itself to the mind of da Vinci, the record of mechanics and, in fact, the entire history of civilisation might have been very different.

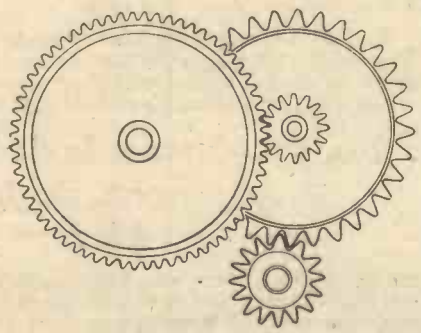
Welter of Writings

But it was not to be. Da Vinci, as we have seen, buried his then remarkable inventions, his original and re-discovered mechanical principles and his other pioneer notions among a welter of strange writings on art, painting, sculpture, medicine, botany and many other subjects in his voluminous and almost hieroglyphical manuscripts which for centuries remained almost untouched and undeciphered in the great libraries and museums of Europe.

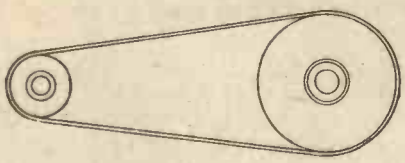
SOME OF THE SIMPLE FORMS OF GEARING INTRODUCED BY LEONARDO DA VINCI



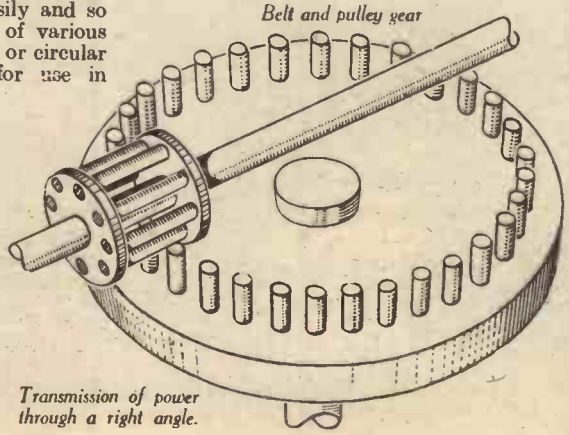
The friction gear.



Train of toothed wheels.



Belt and pulley gear



Transmission of power through a right angle.

In these, even nowadays, little-known manuscripts are to be found reasoned conjectures, not mere fortuitous prophecies, concerning the invention of self-propelled and horseless carriages in which da Vinci dimly foresees the coming of the motor car. He describes something very much akin to the modern bicycle and, in a treatise on the Flight of Birds which he wrote, this Italian genius reasoned out for himself the probable chances of man's being successful at some future time in constructing an "aerial engine" which would enable him to fly.

It was from his first master, Verrocchio, that da Vinci gained his early acquaintance with the various sciences then extant, for Verrocchio's tastes were wide and he moved in what we should now called "learned circles."

A Fool or a Genius

In 1483, at the age of twenty-one, Leonardo offered himself as an artist, architect and engineer to the Duke of Milan. He wrote the Duke a letter, putting forward in it all the things which he felt competent to do. This letter is still in existence and very curious and interesting reading it makes, too, for in it the enthusiastic Leonardo enumerates a multitude of arts and sciences of which he claims to be a practitioner.

The Duke of Milan's remark upon receiving this now historical application for employment was significant. "Either these are the words of a fool," he said, "or of a man of genius!"

Anyway, to cut a long tale short, the Duke took da Vinci into his service and soon proved to his satisfaction that the young man had, indeed, extraordinary abilities. Leonardo remained in his service for some sixteen years, carrying out many different artistic and engineering works the while.

In 1499, owing to political troubles, he returned to Florence, but seven years later we again find him in employment in Milan.

Finally, in 1515, Francis I, of France, persuaded him to give up his work in the then troublous Italy and to enter the royal service in France. Da Vinci, agreeing to the proposal, was given a castle of his own, near St. Cloud, not far from Amboise, a town in France, and here he spent the remainder of his days, dying in the castle on May 2, 1519, at the age of sixty-seven.

Throughout his life Leonardo da Vinci worked at high pressure, and there is little doubt that his multifarious activities and the constant outpouring of mental energy which they occasioned prematurely aged him.

Married to Art

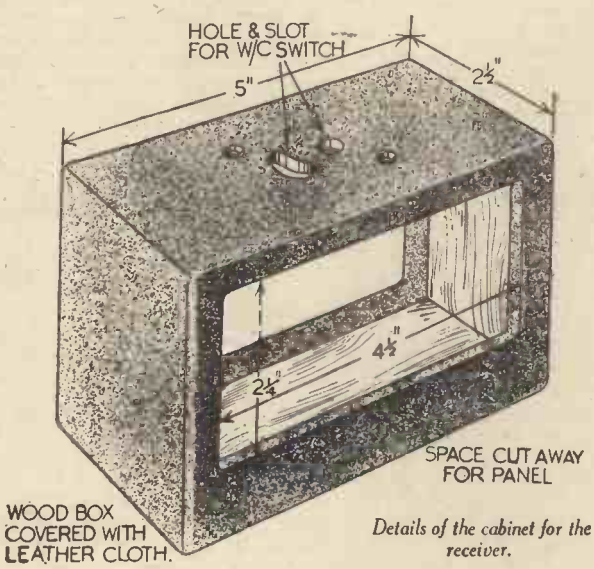
Da Vinci remained a bachelor all his life. He was married to his art, to his mechanical investigations, to his sculpture and architecture and there was little room in his existence for anything else. Noted throughout his life for his beautiful features and personal charm of manner, da Vinci remained ever a sincere, simple soul, easy of access, benevolent and kindly in his actions.

The world has long known and appreciated Leonardo da Vinci, the painter and the sculptor. But Leonardo, the civil engineer and mechanician, has only in comparatively recent times come to be recognised. Although, during his lifetime, da Vinci escaped the ill-treatment which was accorded to Galileo, his future countryman and scientist, his labours for the advancement of mechanical science, in which, incidentally, he was at least a whole hundred years ahead of his time, were permitted to fall into complete obscurity for nearly three long centuries.

"PRACTICAL MECHANICS" WIRELESS EXPERIMENTER

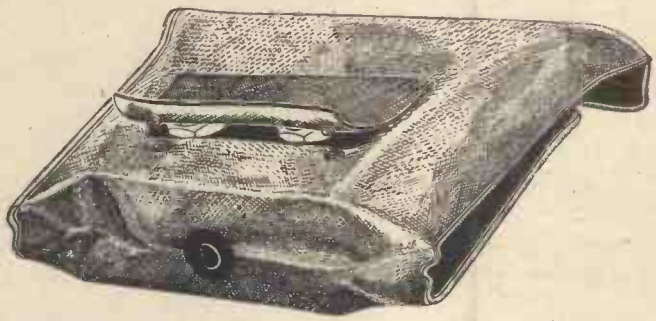
A MIDGET FOUR-VALVE PORTABLE

A Self-Contained Lightweight Receiver Specially Designed for Cyclists, Hikers, etc.



Details of the cabinet for the receiver.

The finished receiver in the waterproof carrying case.



WITH the arrival of summer, and the desire of most people to get out into the open, the attraction of the wireless programmes weakens. It often happens, however, that an interesting item is broadcast which is missed through the lure of the fine weather. Also a cycling run or a hike in the country would be more enjoyable if it were possible to listen to a little light music during a halt. Thus this self-contained midget receiver will prove ideal as it can be carried about in the pocket.

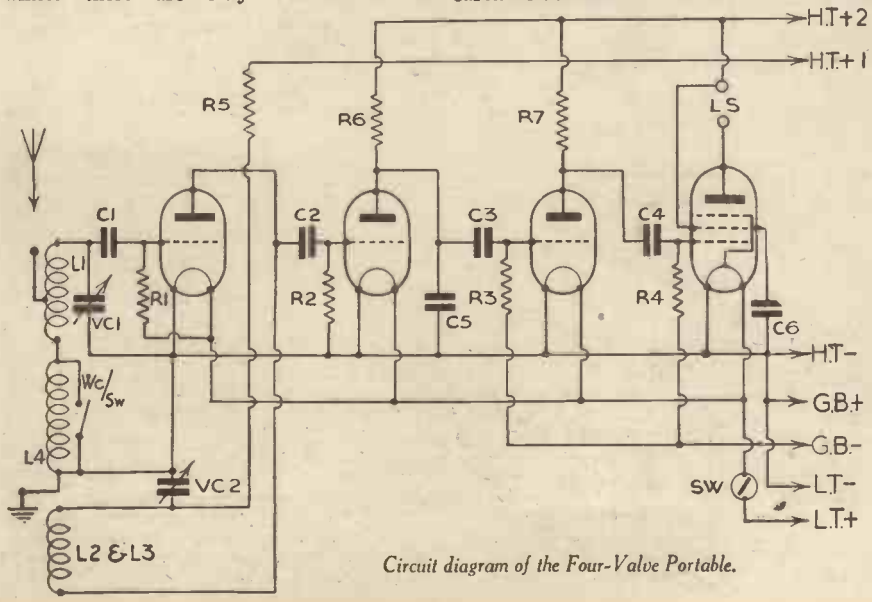
A straightforward four-valve circuit has been employed using midget valves arranged as follows: a high-impedance leaky-grid detector stage is tuned by a home-constructed coil, then comes a low-frequency stage in which is included a "threshold Howl" filter condenser C5, for stabilising quality for the next amplifying stage, which is a low-impedance valve; finally, a pentode valve constitutes the output stage. All four valves are resistance-capacity coupled, whilst there are only two controls—switching and tuning, which are sunk into the panel to avoid unwanted capacity.

The Cabinet

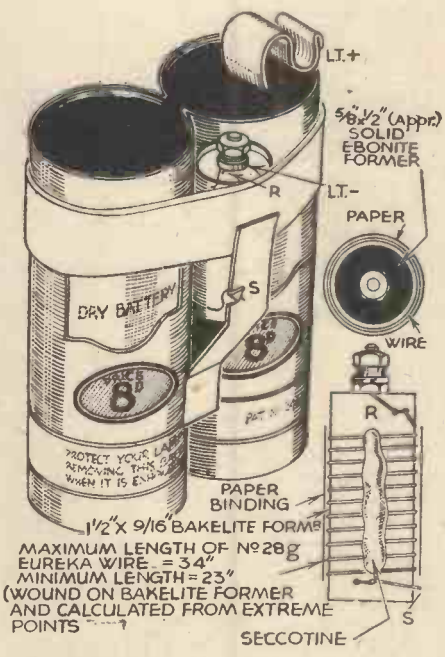
The cabinet is of wood, covered with leatherette, and costs approximately 1s. The method of drilling is shown in the sketch. The wave-change switch consists of a modified commercial loudspeaker switch, which is fitted into the top of the 1¼ in. former used for the coil. The wave-bands chosen range from approximately 160 to 450 metres, for the medium wave, and 650 to 1,800 metres on the long wave, whilst a centre-tapped medium wave winding is used to obtain maximum input signal strength.

It will be noticed that the control of the wave-change switch is done by the 2-pin plug which is fitted into the top of the set, the idea here being that the aerial and earth connections to the set can be made through the medium of the plug, thus extra sockets or terminals are not required and the connecting up of the receiver is therefore simplified still further. The plug is, of course, supplied with the switch.

The chassis is fixed in the cabinet by the two screws securing the wave-change switch, and although the coil is not designed to be a permanent fixture to the chassis, surprising rigidity is maintained after assembly.



Circuit diagram of the Four-Valve Portable.

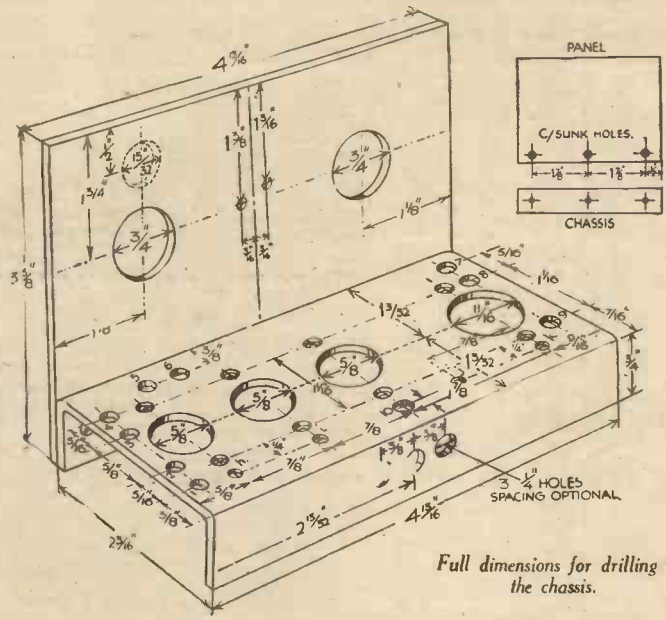


Two dry cells are used for the L.T. circuit.

Battery connections are made simply by plugs and sockets, this applying also in the case of the two speaker leads, as by experiment it has been found far better than by using terminals, principally by reason of the compact nature of the design.

L.T. Battery

The all-important question of weight received extra consideration, and to get over the difficulty occasioned by the apparent necessity for an accumulator for



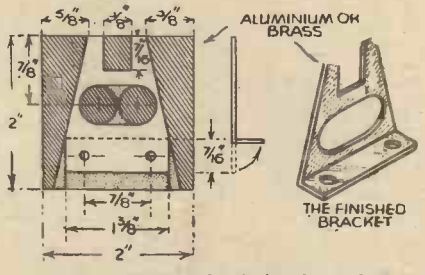
Full dimensions for drilling the chassis.

supplying the L.T., it was decided to use an inexpensive cycle lamp battery, and adjust the voltage by a suitable resistance. The life of this battery under continuous load, that is to say that if the set were left on—would be 6 hours, consequently the requirements of the average cyclist for entertainment on the road and when picnicking, are amply met, and the user has the added advantage of being able to rely upon the battery over a matter of days or even weeks of disuse, whilst an accumulator would require periodical charging; and so far as the difference in weight is concerned, it will be agreed that this is very appreciable, whilst danger of creeping acid or possible damage to the accumulator plates is obviated.

Suitable carriers are obtainable at about 6d. each, one being required for housing the receiver and L.T. battery—grid bias not being essential on 75 volts H.T.—whilst there is room for a 3-volt midget battery—the other is required for the H.T. battery.

The overall weight of the receiver alone is 1½ lb., and even this weight will be appreciably reduced if aluminium is used throughout. An aerial 10 ft. in length will be found suitable for good quality moving-coil output, whilst a longer aerial will be required if foreign stations are desired.

The only metal parts to be made are the front panel, chassis and condenser brackets. Unless otherwise stated, aluminium will be taken as the basis of the design throughout, and this should be from 16 to 18 gauge. The panel and chassis could, if desired, be obtained ready cut to size, or a sheet of aluminium 7 ⅛ in. × 4¾ in. should be cut and bent as shown. Place the sheet of aluminium in a vice, and having scribed the cutting and bending line, cut along the line indicated in the diagram. The lower half of the metal is to be used for the chassis, and this likewise should be placed in the vice and the two runners bent over as indicated.



Cutting and drilling details for the condenser brackets.

LIST OF COMPONENTS

FIXED CONDENSERS
Two .0003 mfd. (Tubular)—4601/s. Dubilier
One .002 " " " "
One .02 " " " "
One .01 " " " "
One .1 " " 4603/s. "

RESISTANCES
Two 50,000 ohm } All ½ Watt type. POLAR N.S.F.
One 12,000 " "
Two 2 megohm "
One 250,000 ohm "
One 1 megohm "

VARIABLE CONDENSERS
Two .0005 mfd. 1 ⅛ in. Spindle Length. J.B.

VALVE HOLDERS
Three 4-Pin Type (Midget) Type V6. Clix
One 5-Pin " " " "

SWITCHES
One Type 28 Control Panel and Plug. Clix
One " S80.T. Toggle (on-off) Switch. Bulgin

VALVES
One Type X.D. (Midget) ... ... Hivac
One " X.L. " ... ... "
One " X.P. " ... ... "
One " X.Y. " ... ... "

PLUGS
Five. HT—Black. HT+Red. HT+Yellow. No. 3. GB—. GB+. No. 3. Clix

SPADE TERMINALS
Two LT—LT+. No. f14. Clix

CONNECTORS
Four. 2 Red and 2 Black. No. 22. Clix

BATTERIES
One 75 Volt H.T. ... ... Exide
One 3 " Type; 800. ... Ever-Ready
One 4.5 " Torch (Optional) ... "

SPEAKER
Moving Coil Speaker. Stentorian W.B. (Midget)

MISCELLANEOUS

METAL WORK
16 or 18 S.W.G. Aluminium (Machine or Plain finish). ... ... Peto Scott

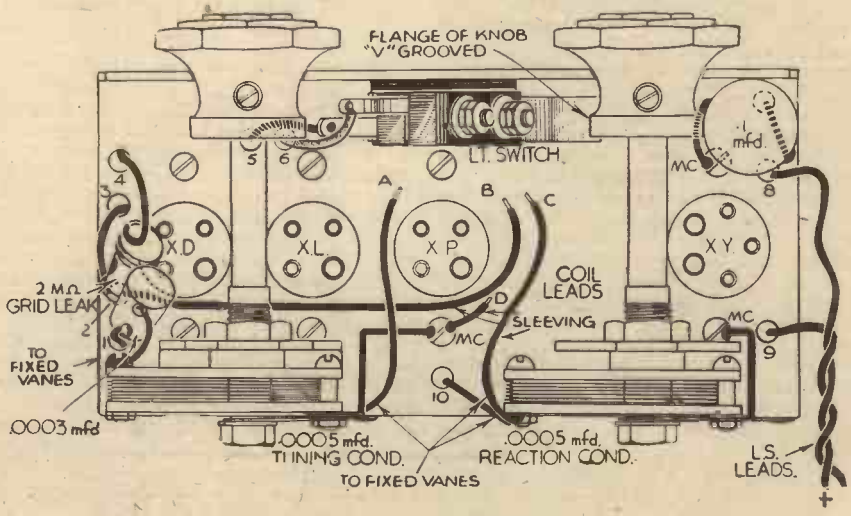
FORMERS
One 2½ in. x 1¼ in. dia. Bakelite Former
One 1½ in. x 9/16th in. dia. Bakelite Former
One Solid Ebonite Former. 5/8 in. x 1½ in. Approx.

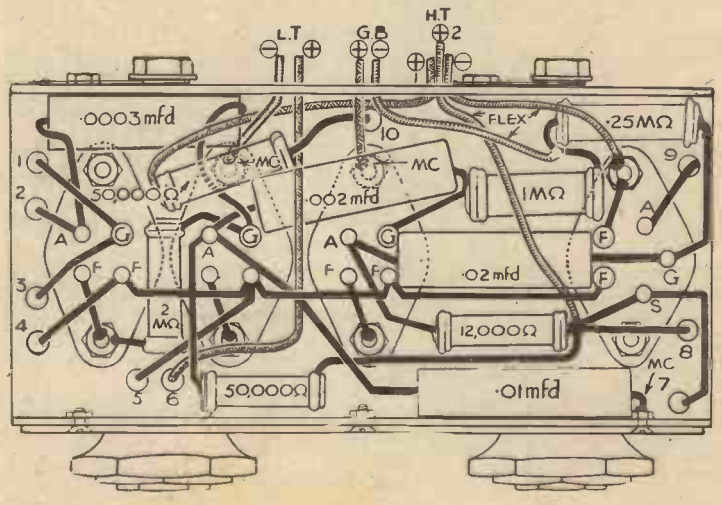
BRACKETS
Two Type E.H.9. ... ... Bulgin

KNOBS
Two Hexagon. Type No. K.40. ... Bulgin

WIRE, Etc.
One 2 oz. Coil of 32 S.W.G. Enam. No. 757. Bulgin
One 2 oz. Coil of 35 S.W.G. Enam. No. 758 Bulgin
One Coil of Glazeite.
One Yard of 28 S.W.G. Eureka Wire.
"SYSTOFLEX."

WIRING DIAGRAM OF THE MIDGET FOUR-VALVE PORTABLE





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by more than 10,000 men between the ages of 16 and 60, including eminent Doctors, members of the Army, Navy and Air Force, Professional Men, Business Men, Clerical and Manual Workers, Golfers, Footballers—in fact in every walk of Life

KING OF BODY-BUILDERS

"fitness wins"

Harold Laurance Triple British Strength Champion, Official Olympic Games representative.

HAROLD LAURANCE
OFFERS HIS AMAZING
"WORLD BEATER"
COURSE OF HOME TRAINING

which ensures you

★ RADIANT HEALTH ★ PERFECT PHYSIQUE ★ VIRILE MANHOOD
★ MENTAL POWER ★ MIGHTY STRENGTH ★ SELF CONFIDENCE
★ MAGNETIC PERSONALITY ★ TIRELESS ENERGY

UNDER A SENSATIONAL GUARANTEE

for only 1/- PER WEEK

TO ENCOURAGE THE MANHOOD OF THE COUNTRY IN THE PURSUIT OF PHYSICAL FITNESS HAROLD LAURANCE OFFERS—

£1,000 IN PRIZES

★ Two 1st PRIZES of £100
★ Two 2nd PRIZES of £25
★ Two 3rd PRIZES of £15

● Every Pupil taking the "WORLD-BEATER" COURSE at 1/- per week is eligible for the Grand Award of £100. Every pupil has 9 separate chances of winning £10, £5, £1, 1 Medal or a Diploma. The same pupil can win an unlimited number of awards month by month.
● The prizes will be awarded on the progress reported by postal pupils in relation to each pupil's original measurements on joining. Thus all have a fair and equal chance in every month.
● The Judges under this offer are Editor of "Health and Strength," Geo. Walsh and Frank Miles, so you know you can rely on a fair decision.

HERE is a clarion-call to every man—a golden opportunity for all between the ages of 16 and 60 to gain glorious health, wonderful strength and superlative physique in 1938.

Young men will secure and delight in the pride of Strength and Beautiful Development. Professional men, Business men, Men in the 30's and 40's will regain and maintain the full fitness and vigour of youth. Men in the 50's and 60's will rejoice in the healthiest form of rejuvenation of body and mind.

Nothing like the "WORLD-BEATER" course offered to-day has ever before been seen. Simple to follow, with no special diets and requiring in some cases only 10 minutes and never more than 20 minutes of time every day, it can lift the weakest, thinnest man from physical inferiority to the very pinnacle of perfection. It shows pupils how to rid themselves for ever of such troublesome complaints as indigestion, constipation, catarrh, bad circulation, anæmia, pimples, bad breath, etc. It teaches the care of the vital organs so that perfect health may be preserved throughout life. It reveals the true secrets of respiratory power and scientific muscle-manipulation. It directs the pupil how to systematically increase his bodyweight where desired and increase his muscular development to the very limit of his possibilities. Every pupil is under the personal care of Harold Laurance; each lesson is personally prescribed to suit the pupil's individual requirements; every pupil is supplied with a splendid assortment of apparatus FREE; and every pupil is guaranteed SUCCESS under Harold Laurance's amazing declaration:—

"Enrol for my 'WORLD-BEATER' course," he says, "complete the 8 lessons and if at the end of that period you are not fully satisfied that you have reached 'Supermanity' I WILL CONTINUE TO TRAIN YOU AND SUPPLY APPARATUS—WITHOUT ANY CHARGE WHATSOEVER—UNTIL YOU ARE COMPLETELY SATISFIED."

The great "WORLD-BEATER" course of home training is offered on unprecedented terms. For the small sum of 1/- per week Harold Laurance guarantees to give every one who enrols for his course Radiant Health, Superlative Physique, Mighty Strength, Virile Masculinity and Dominating Personality !!

As an extra incentive and encouragement to pupils Harold Laurance also offers in addition to the Priceless Gifts of Perfect Health and Physical Strength, £1,000 in prizes for progress on the "WORLD-BEATER" course. Every pupil has nine separate chances to win one of the monthly awards including prizes of £10, £5, £1, Medals and Diplomas, besides a chance to win the larger awards of £100, £25 and £15 for progress over the entire course.

Never before has such an offer been possible—because never before has such an astonishing record of success been achieved. More than 90 per cent. of Harold Laurance pupils report prize-winning progress !!!

Take the first step to-day—Post the Coupon below.

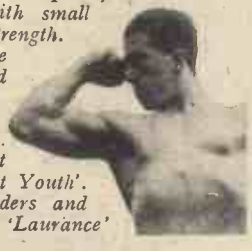
★ **The Apparatus which is sent FREE to every pupil is the Simplest, yet most effective, requiring NO FIXING OR FITTING and can be used in the smallest space. It includes The "LAURANCE STAMINATOR" PRONOUNCED BY EMINENT DOCTORS THE GREATEST BODY-BUILDING APPLIANCE OF ALL TIME, SPINAL DEVELOPERS, WRIST UNITS, TRIPLE RESISTANCE UNITS, Etc.**

The "World-Beater" Course consists of 8 complete lessons. There is no special diet, but pupils are shown how to double the value of ordinary foods. The newly-evolved and wonderfully effective tendon strengthening movements are included. Special instructions in scientific muscle-manipulation, the control of nervous energy, the strengthening of the vital organs and the preparation of the body for maximum muscular development are all part of this gigantic Course. The range of scientific exercises for the rapid development of great strength and muscular symmetry is the greatest and most comprehensive ever compiled. Pupils are also taught how to overcome common ailments—indigestion, constipation, catarrh, bad breath, pimples, anaemia, etc. Detailed instructions are given on weakening complaints and habits. The "WORLD-BEATER" Course transcends in positive value and amazing effectiveness anything that the world has seen before.

GRATEFUL PUPILS TESTIFY TO VALUE OF LAURANCE TRAINING

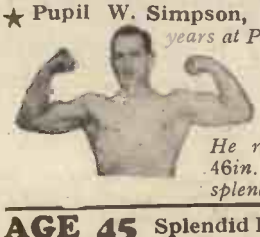
AGE 19 Body Weight Increased

★ **Pupil A. Knight, of Northampton,** *was a typical young man with small measurements, below average strength. In 18 months Harold Laurance personal instruction increased his weight from 9st. 2lbs. to 12st. 6lbs. and his chest measurement from 34ins. to 45ins. Pupil Knight is now a claimant for the title of 'Britain's Strongest Youth'. His deep chest, herculean shoulders and powerful arms speak volumes for 'Laurance' methods.*



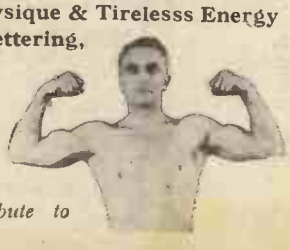
AGE 30 Strength and Measurements increased

★ **Pupil W. Simpson, of Dundee,** *had spent many years at Physical Culture without achieving the desired results. He found the 'Laurance Staminator' and 'Laurance' personal instruction the ideal method for real results. He rapidly reached 14st. in weight, 46in. chest, 16in. biceps, and other splendid measurements.*



AGE 45 Splendid Physique & Tirelesss Energy

★ **Pupil No. 6590, of Kettering,** *commenced training under Harold Laurance at 45 years of age. His radiant health, tireless energy and splendid physique are a wonderful insurance against middle-age decay. Pupil 6590 is a young man at 45—a striking tribute to Laurance methods.*



POST THE COUPON TODAY

★ Please send me free of cost or obligation particulars of your "WORLD-BEATER" COURSE which I can obtain for 1/- a week and details of your £1,000 Prize Offer.
★ Also Free Copy of your interesting fully illustrated book "Supermanity" together with prospectus of the Laurance Institute and a FREE Presentation Copy of your specially reproduced and autographed Prize-winning Pose Photograph.

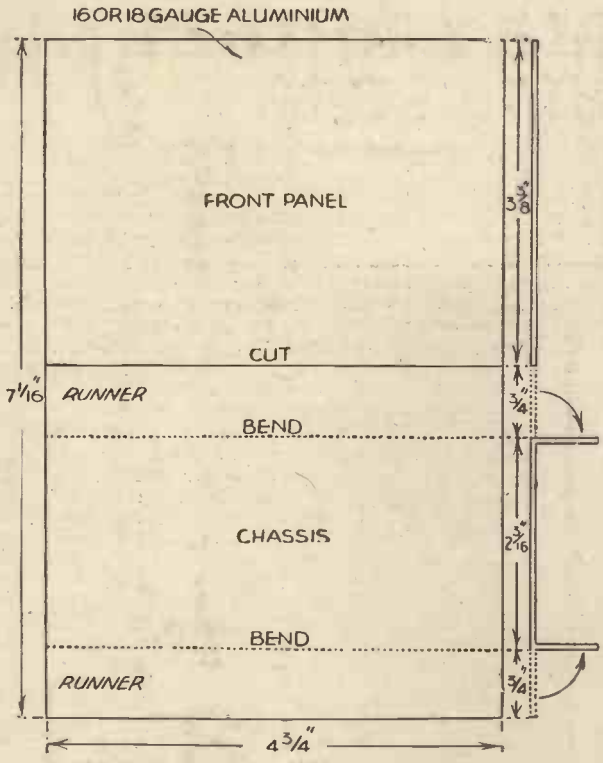
NAME.....

ADDRESS.....

Practical Mechanics, May, 1938......

Post To—HAROLD LAURANCE, Laurance Institute of Health and Stamina, Ltd., Ludgate House, 110 Fleet Street, London, E.C.4

Post in Unsealed ½d. STAMPED envelope.



Cutting and drilling dimensions for the metal chassis.

(*Continued from Page* 434)

The panel and chassis should now be marked out and drilled as shown and fitted together with three ¼-in. countersunk 6 BA brass screws and nuts. Small spring washers should be fitted under the nuts on the inside for rigidity.

The Coil

A 2½-in. length of 1¼-in. diameter bakelite must be cut and slotted in accordance with the measurements given, the small wiring holes being drilled with a 3/64-in. drill. The medium-wave winding L1 should first of all be made, and the ends of the centre-tapped wires being terminated by threading through the wiring holes twice. The reaction winding L2 should be wound in exactly the same direction as for all windings, and when the last turn on L2 has been reached, carry straight on into the narrow slot, and as evenly and as carefully as possible pile wind the 50 turns required for L3, terminating in the usual manner. L4 is wound with the same wire as L1, namely 32 S.W.G., and this should likewise be wound whilst applying an even pressure. The finished coil should be identical with that shown in the sketch, and particular stress is laid on the close proximity of coils L1 and L2. The leads to the switch in the top of the former, should be left sufficiently long to permit ease of wiring, and should be taken up the centre of the former and covered with systoflex. This should be clear from the blueprint (obtainable for 1s.) and pictorial illustration.

The Battery Resistance

Before assembling the coil on the chassis, and as this would mean fitting the power valve XP before carrying out battery tests, the L.T. cycle lamp battery resistance should be made. It will be seen that the bakelite former is used for the winding of Eureka wire, and the solid ebonite former fits tightly into this former providing a suitable base for the terminal mounting. The Eureka wire should be wound evenly and tightly on this former with the ends terminating through small wiring holes in similar fashion to the method adopted in the tuning coil wiring. A liberal amount of glue applied over the whole length of one side of the wiring will ensure the winding retaining its position, and having bound the finished coil with paper or insulation tape, it may then be cleated between two cells of the battery, one end being fixed to the length of contact by snipping and turning over the strip of brass in the manner shown.

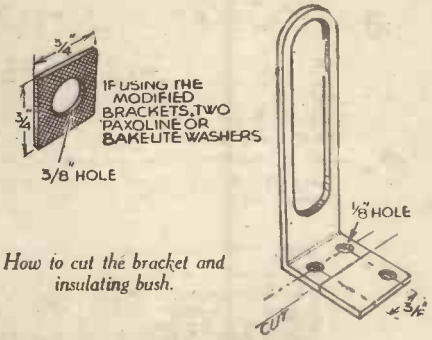
The set should now be wired as shown in the wiring diagram or from the blueprint.

Testing Out

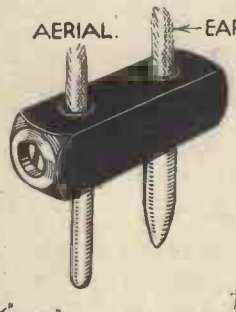
If the contacts on the L.T. switch have been aligned carefully, it will be found that the receiver will switch on after turning the reaction control through as little as two degrees to the right, and any further increase in the rotation will naturally build up reaction, the right-hand knob being the tuning control. When the wave-change switch plug is at an angle to the edge of the cabinet, the receiver is on the long waves, and when in line with the edges of the cabinet, the receiver is on the medium wave-band.

Whilst conducting experiments in reception, the speaker leads should be kept away from the aerial or XD valve section of the receiver, as stray high-frequency, or what is known as "feed back," will cause a parasitic howl resulting in acute distortion.

To facilitate the carrying of the set in the pocket it can be enclosed in a leather case, details of which are shown in the sketch.



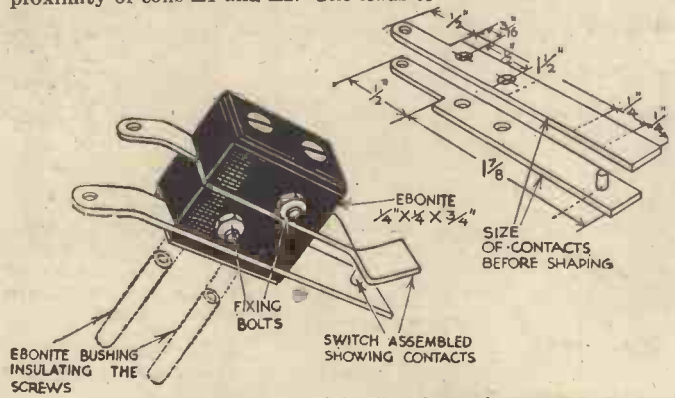
How to cut the bracket and insulating bush.



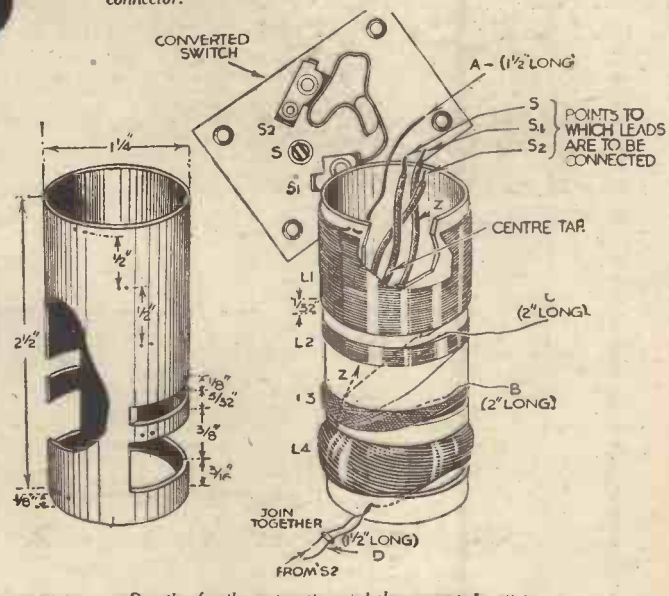
(Left) The Clix speaker plug used as aerial - earth connector.

Treating Airscrews

100 HOURS is the guaranteed flying life of wooden propellers fitted to some of the R.A.F. aeroplanes, as they are damaged by sand and stones whilst they are in motion on the ground and by hailstones and heavy rain in the air. Metal propellers are also effected, and, after every flight, have to be examined for dents and scratches. A London scientist, however, has invented a preparation, known as rayoid, which, when propellers are dipped into it, gives them a protective covering.



Full contructional details of the switch.



Details of coil construction and the converted switch.

Fire Engines Through

A Cavalcade of Mobile

Fig. 1.—The "parish" engine of the 18th century.

THE Fire Brigade is perhaps one of the most spectacular branches of our public services and "split-second" efficiency is taken for granted. Whilst this efficiency is, of course, achieved through the high degree of mechanical perfection of the modern fire engine, it is only by tracing the developments in mechanisation that one can fully appreciate the vast strides which have been made in a comparatively short space of time. As late as 1889, manual engines were still being constructed and it was not until 1904 that the first automobile fire engine was used in London. The Merryweather engines which have been supplied to the London Fire Brigade graphically illustrate the march of progress from the "Parish" type, of the 18th century, to the 1938 Limousine model.

After the Great Fire

One would have imagined that, after the Great Fire in 1666, London would have become "fire-conscious" but even for a further two hundred years only hand-worked pumps were employed. The "Parish" fire engines (sometimes called the "four-poster") were constructed in the 18th and the earlier part of the 19th centuries and received their name from the fact that they were provided out of the funds of the London Ecclesiastical Parishes. The cistern in which the pumps were fixed was filled by buckets and the water projected through a long branch pipe. This was coupled to the pump delivery outlet by a universal joint but neither suction nor delivery hose were used. No fire brigade was in existence at this period and the engines were manned by the churchwardens and overseers.

Fig. 2.—The London Fire Brigade manual engine.

The Manual engine, shown in Fig. 2, represented the next progressive step in fire-fighting and was used by the London Fire Engine Establishment and the Metropolitan Fire Brigade until the end of the 19th century. This machine had two single-acting pump barrels and delivered 100 gallons per minute when worked by twenty-two men on the side levers. The engine shown in Fig. 3 is of great historical interest for it is the first horse-drawn steam fire engine supplied to the London Fire Brigade in 1866. Fitted with a "Field" tubular boiler it had a single cylinder direct and double-acting pump with a capacity of 200 gallons per minute. The reign of the horse-drawn steamers was comparatively short for in 1902 the last one was supplied to the London Brigade. This engine, shown in Fig. 4, had an oil-fired boiler with a double-acting pump capable of delivering 150 gallons per minute. This actual machine may now be seen in the South Kensington Science Museum.

The First Automobile Engine

The year 1904 marked the next big step with the introduction of the first automobile engine. Whilst the general design was based on the horse-drawn steamer, the actual engine was used for propelling as well as pumping. Supplied in two sizes, the pumps were capable of delivering 400 and 500 gallons per minute. As the oil-fired boilers were always kept under steam pressure, the engines were able to turn out for duty in a few seconds and were capable of a speed of 30 m.p.h. In the following year, another 5 m.p.h. was added to the road speed when the first petrol fire appliance was used and a glance at Fig. 6 will show the first comparable likeness to our 1938 machines. This engine consisted of a chassis with a four-cylinder 50-h.p. motor and carried a first-aid water cylinder of 60 gallons capacity, a full complement of men, hose and appliances and a 50-ft. sliding carriage telescopic fire escape ladder. The engine shown in Fig. 7 was built in 1908 and had a 50-h.p. petrol motor with chain drive to the rear axle. The capacity of the pump was 500 gallons per minute.

Fig. 5.—An historic machine, the first automobile engine of 1904.

Fig. 3.—The first horse-drawn steamer

Fig. 4.—The last horse-drawn steamer built in 1902.

The Ages

Fire Fighting Equipment

Gradual Improvement

From this period onward to the present day the improvement has been gradual rather than revolutionary, but on considering the specification of a modern fire engine one is impressed by the extreme efficiency which has been built up during the last 30 years.

The machine illustrated in Figs. 8 and 9 gives a good impression of modern design. The side frames, of the Merryweather-Albion chassis, are of pressed steel and tubular cross members give maximum strength with minimum weight. Carefully designed suspension gives easy riding and good road-holding qualities under all conditions. The petrol motor is of the latest four cylinder monobloc type, capable of developing 80 b.h.p., and has cylinders of 4⅝ in. by 5½ in., with two detachable and interchangeable cylinder heads. Steel connecting rods, fitted with split white-metal-lined bronze bushes at the big ends, are used, whilst the aluminium alloy pistons are of the three-ring type. The lubrication is of the forced feed system and the magneto ignition is supplemented by a separate battery and coil system for use in emergency. The carburetter is supplied from a 20-gallon petrol tank and has both foot and hand control. A robustly constructed clutch, of the single disc type, transmits the drive to the gearbox which gives four speeds forward and one in reverse.

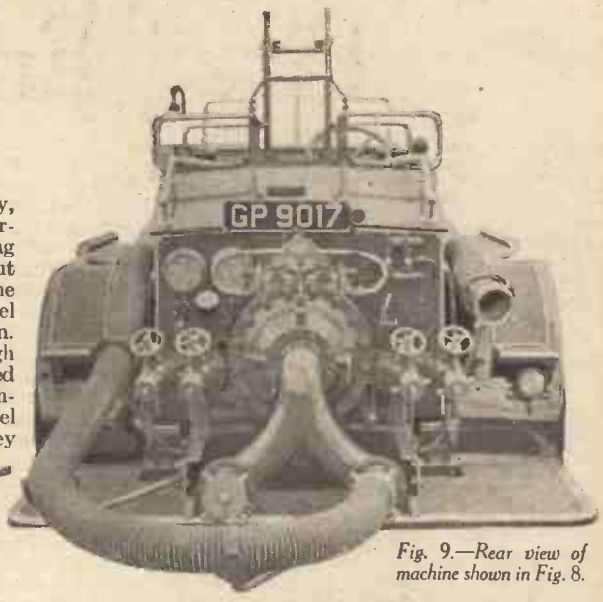


Fig. 9.—Rear view of machine shown in Fig. 8.

Fig. 6.—1905 saw the introduction of the first petrol-driven appliance.

Fig. 7.—The first petrol-motor fire pump, 1908.

Fig. 8.—Side view of a modern machine.

The Axles

Great care has been given to the design of the axles for it is probable that greater strains are imposed on a fire engine than on any other form of road vehicle. The front axle is of a special single forging with the pivot pins supported on taper roller bearings. The rear-axle body, carrying the worm and differential gear, is a single forging and the final drive is carried out by underslung worm gear. The road wheels are of pressed steel and are fitted with 36-in. by 6-in. tyres. The importance of high road speed is, of course, coupled with the importance of high-efficiency braking. Four-wheel brakes are employed and they are of the internal expanding type operating on large diameter drums which are secured to the road wheels. A Servo cylinder is fitted on the off-side frame and compensating mechanism ensures correct distribution of braking force between front and rear wheels. The steering is of the worm and segment type and is enclosed in an oil-tight case.

We now come to the pump, which after all is the very heart of a fire engine, and this is worthy of careful study. The turbine pump is made entirely of gunmetal and is capable of delivering 550 gallons at 125 lb. pressure, 650 gallons at 100 lb. and 800 gallons at 50 lb. The receiving vanes are so designed that it is possible to machine the entire surfaces of the water passages and thus obtain maximum efficiency of delivery. The suction inlet of the pump is in the centre of the rear cover and is

(*Continued on page* 465)

Fig. 10.—The limousine type—a 1938 model.

WORLD OF SCIENCE

A "Probability Machine"

TWO Americans have recently been carrying out tests on a machine which records the amount of grain in a cinematograph film by means of charts. The machine has been named a "probability machine." A film is passed under a microscope, and light passed through the film is reflected to a photo-electric cell. The fluctuations of light, as registered by this cell, are recorded on a movie film like a sound track. The movie is then put on a slitted drum in the integrator. The light passes through the slits on to another photo-electric cell, which is moved across the width of the film. The light beam from the cell falls on a scale which indicates the amount of grain in the film. The inventors believe that their machine can be used to advantage in the statistical field.

A New Dirigible

G. W. PECK, designer and vice-president of the Interocean Dirigible Corporation, and C. C. Jones, have designed a new type of lighter-than-air craft which prominent authorities believe will revolutionise air transportation and establish American supremacy in the dirigible field. Their craft, featuring many innovations, will be entirely rigid and entirely metal clad with dural, an aluminium alloy. Through the hull will run a hollow metal cylinder, on the Venturi tube principle, to reduce air resistance and increase propulsion activity on the rocket principle. The new ship is designed to ascend and descend vertically, landing, if necessary, on top of a small building or in a small field. The first ship, the George Washington, will be completed within 18 months.

New Streamliner

A NEW streamlined three-car diesel light passenger unit, recently completed at the L.M.S. works at Derby, has been successfully tried out. This vehicle, which represents the most important experiment yet made in this country in the application of diesel traction to British railway practice, is shortly to undergo extensive service trials on the L.M.S. railway.

Typically American

AMONG the latest American inventions for which patents have been granted, appear the following amusing ideas. Lynde De F. Hokerk, of Utica, New York, must have found it exceedingly annoying to continually lose his soap in the bath, so he thought it a good idea to have his soap made with a hole in it, place a cord through the hole and hang the cord and soap round his neck.

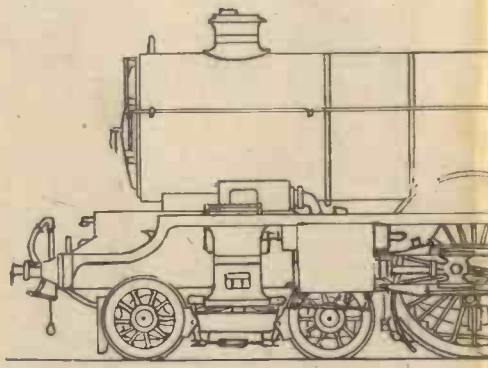
Mr. P. E. Robertson, of Los Angeles, had a preference for soft-boiled eggs, but complained that the sulphur in the shell tainted the eggs. The result was that he has now devised a shell-less vacu-boiler. The egg is broken into an egg-cup-shaped aluminium pan, yolk intact. An egg-shaped lid fits on tight, and the whole thing is boiled in a pan. When cooked for the required time, the egg is soft-boiled, sits up in an egg-cup in the usual way, but without its shell

PROGRESS OF THE BR
LOCOMOTIV

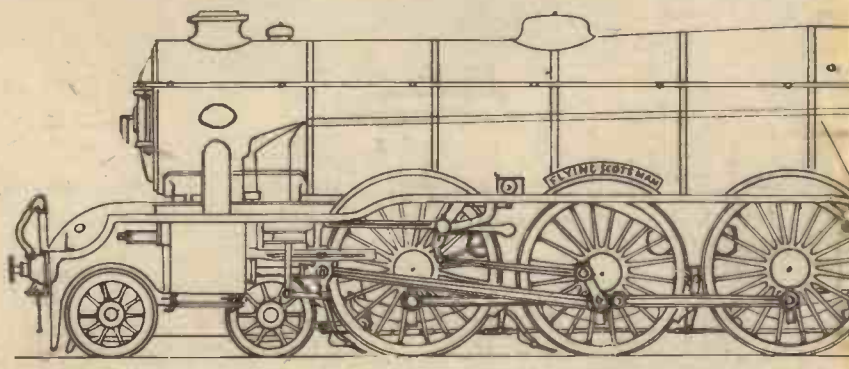
The Fourth Instalment Of This
The Period From 1908

Churchward's 4-6-2 "Great Bear," G.W.R. 1908

IT is to Churchward again that Great Britain owes its first locomotive of "Pacific" wheel arrangement, for in 1908 he brought out the "Great Bear"—an enlarged version of his Star class 4-6-0's. The 4-6-0 wheel arrangement cramps the design of the firebox, but the "Pacific," like the "Atlantic," can have a large firebox spread right across the frame behind the rear pair of coupled wheels. The "Great Bear" had four cylinders, 15 in. in diameter of 26-in. stroke; driving wheels were 6 ft. 8½ in., the firegrate had the unprecedented area of 42 sq. ft., and the engine with its bogie tender weighed the huge amount of 143 tons. But the "Great Bear" was before its time. Such a great power output was not required on G.W.R. trains, and the long wheel base of the engine did not suit the reverse curvature of the principal West of England main line, and eventually the "Great Bear" was converted to 4-6-0 wheel arrangement, as No. 111 "Viscount Churchill."



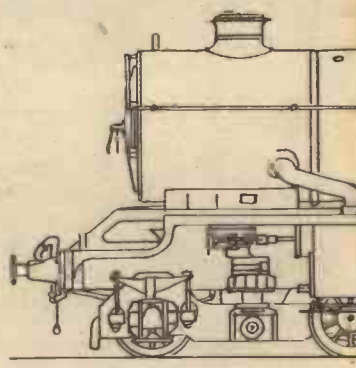
Churchward's 4-6-2 "



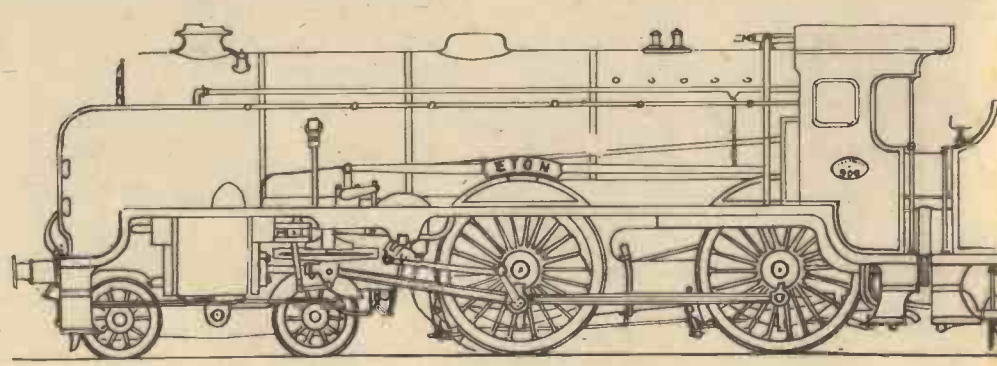
Gresley's "Pacific," G.N.R., 1922.

Gresley's "Pacific," G.N.R., 1922

Fourteen years passed before the next "Pacific" of British Railways, and this time the wheel arrangement with this American nickname came to stay. At the Great Northern Railway's Doncaster works Nigel Gresley had succeeded Ivatt, and after introducing some successful 2-6-0 "Mogul" locomotives for mixed traffic, in 1922 he brought his first Pacific No. 4470 "Great Northern." This new engine was designed to handle 600-ton trains—a load unheard of in its magnitude in those days—and proved so by running to Grantham and back with a 600-ton test train at an average of over 50 miles an hour. The "Great Northern" was a three-cylinder engine; and, lineal descendant of the Ivatt "Atlantics," it had a wide firebox



Collett's 4-6-0 "*King George V.*" *G.W.R.*, 1927.



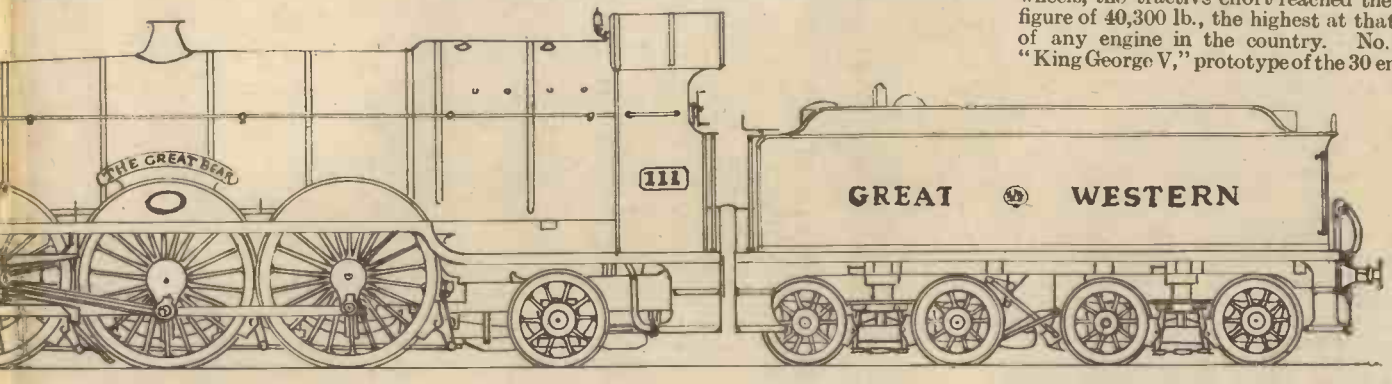
ITISH STEAM E—PART IV

Series Covers to 1930

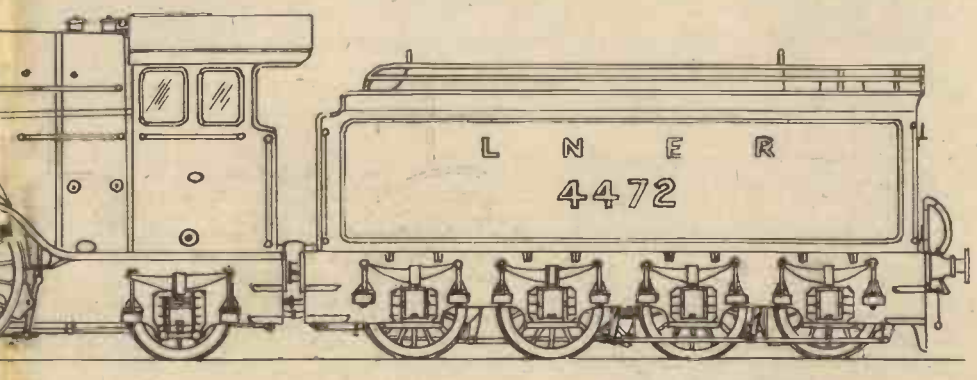
The elevations which illustrate this article are all to the same scale, 3½ mm. to the foot and are suitable for 16 mm. gauge railways. Detailed drawings are available for those readers interested.

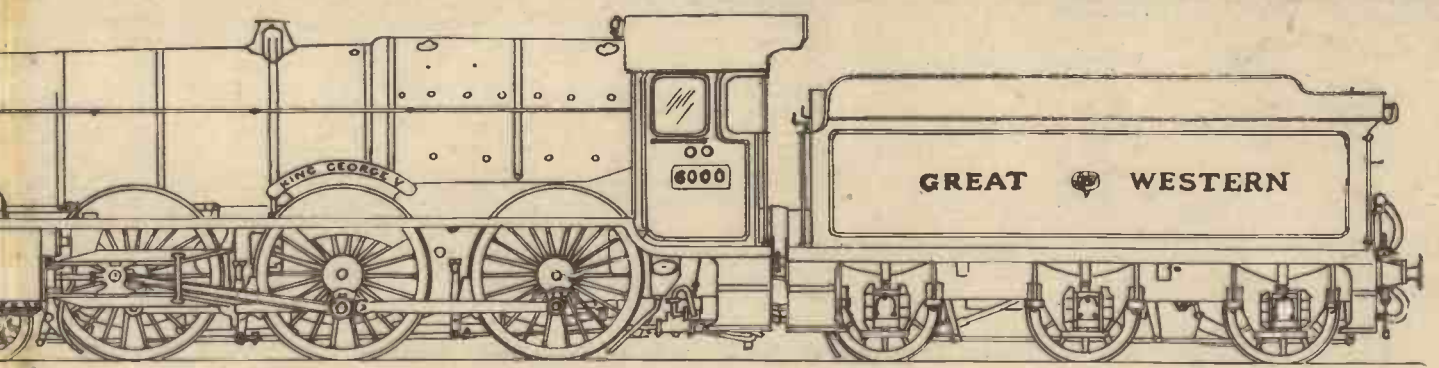
By

W. J. Bassett-Lowke, M.I.Loco.E.

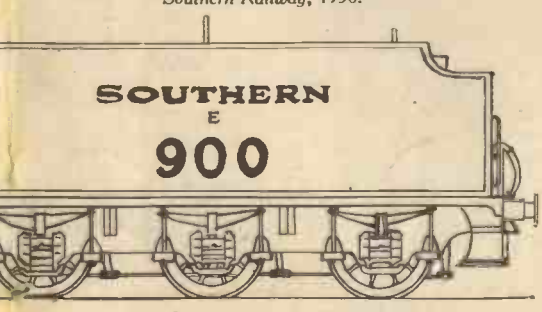


Great Bear," G.W.R., 1908.





(*Below*) *Maunsell's 4-4-0 "Schools" class, Southern Railway, 1930.*



an engine of such size, power and weight should be a 4-6-2; but the "Great Bear" was not forgotten and because of Great Western main line curvature, the 4-6-0 wheel base was decided upon. The engine, however, was to weigh close on 90 tons, with the huge total of 67½ tons on the three coupled axles. On this engine for the first time working pressure rose to 250 lb. per sq. in., and with four cylinders 16½ in. diameter by 28 in. stroke and 6 ft. 6 in. driving wheels, the tractive effort reached the large figure of 40,300 lb., the highest at that time of any engine in the country. No. 6000 "King George V," prototype of the 30 engines of this class, has been across the Atlantic, representing Britain at the Fair of the Iron Horse in Baltimore in 1927, and the brass bell mounted on its buffer beam is a permanent memento of this trip.

Maunsell's 4-4-0 "Schools" Class, S.R., 1930

From the largest 4-6-0 locomotive in England we travel to the largest and most powerful 4-4-0 type—the "Schools" class, a fine example of the locomotive stock of the Southern Railway. In 1930 this railway (a great porportion of which is now electrically worked) needed a more powerful locomotive type for work over the difficult gradients of its Hastings branch. 4-6-0 design was ruled out because of the scant tunnel clearances, so Maunsell decided on a 4-4-0. This "Schools" class has shown itself capable of practically anything the 81-ton "King Arthur" 4-6-0's can do, though the 4-4-0 engine without tender weighs only 67 tons. Ten "Schools," displaced by the Portsmouth electrification, to work on the main Waterloo-Bournemouth line, have shown they can work trains of 13 and 14 bogies to time (that is loads up to 450 tare tons) while the usual limit for 4-6-0's on this service has hitherto been 400 tons. The "Schools" have three cylinders 16½ in. diameter by 26 in. stroke, 6 ft. 7 in. driving wheels and 220 lb. steam pressure, and can exert a tractive effort of 25,130 lb., most exceptional for an engine carried on four axles.

across the full width of the engine frames.

The next batch of "Pacifics" to emerge from Doncaster—the present class A 3—improved on the "Great Northern" by being provided with a steam pressure of 220 lb. instead of 180 lb., and long-travel valves which greatly improved their efficiency.

Collett's 4-6-0 "King George V," G.W.R., 1927

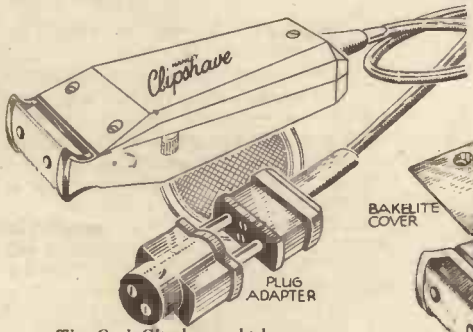
Returning to the Great Western Railway, Mr. C. B. Collett had now succeeded Churchward, and had done good work with the G.W.R. "Castles," but they were not his "*pièce de résistance.*" This came in 1927—the most powerful 4-6-0 that has been produced in Great Britain! Normally

(*To be continued*)

INTRODUCING—

AN ELECTRIC RAZOR

ALTHOUGH there is no novelty in an electric razor, the Orel Clipshave illustrated herewith, is neat and compact in design, and operates on the clipper or shearing principle. It removes the toughest beard or the finest body hair swiftly, cleanly and effectively. Under test it did not pull, irritate, or give the least discomfort during or after use. The razor is self-cleaning, non-clogging and completely sanitary. It dispenses with shaving soap and cream and removes whiskers in their natural dry condition. The shearing action of the Clipshave is due to two simple but effective clipper elements—an outer stationary part and an inner part which agitated at great speed by the motor. They are self-sharpening, improve with use, and with proper use will last indefinitely.

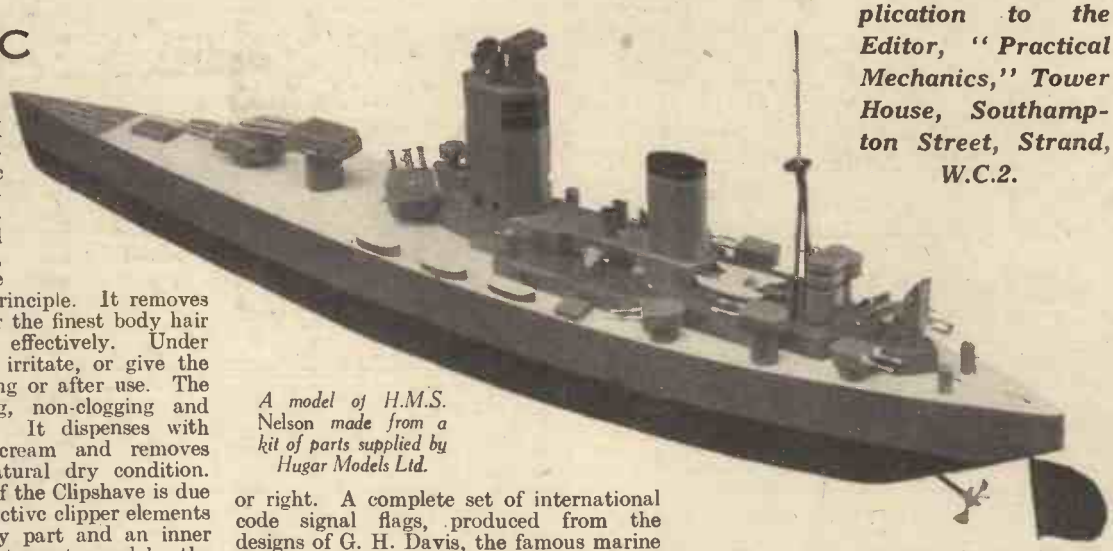


The Orel Clipshave which removes whiskers without the use of shaving soap or cream.

The razor operates on A.C. or D.C. Clipshave marked 230 volts will operate on supplies of 200-250 volts. It will run slower on 200-volt supply and will become slightly warm on 250 volts. The razor can be supplied for any voltage from 6 volts for motor-cars, to 250 volts. It is marketed at £3 3s.

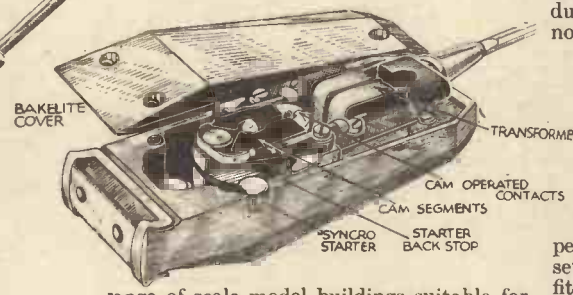
SCALE MODELS

WE recently received a kit of parts from Hugar Models, Ltd., for constructing a scale model of H.M.S. *Nelson*. The kit, which costs 25s., includes an electric motor complete with battery for driving the model. The hull, gun turrets, guns, funnels and all accessories are supplied ready turned and shaped and it is quite a simple matter to build the boat. Glue, nails, screws, paint and paint brushes are also included in the kit. The model, when finished, is neat and attractive in design, as will be seen from the accompanying illustration. The motor is ingeniously controlled by a switch fitted underneath the gun situated just in front of the main control tower. The switch is operated by swinging the gun to the left or right. A complete set of international code signal flags, produced from the designs of G. H. Davis, the famous marine artist, are also included with the model. If desired, the firm will supply a finished model for 36/6. Other models obtainable are the H.M.S. *Southampton*, R.M.S. *Queen Mary*, R.M.M.V. *Stirling Castle*, R.M.M.V *Athlone Castle*, S.S. *Orcades*, S.S. *Orion* and S.S. *Epsom Downs*.



A model of H.M.S. Nelson made from a kit of parts supplied by Hugar Models Ltd.

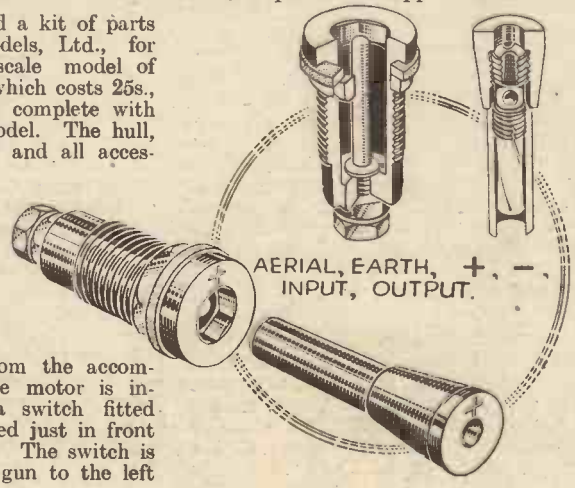
Hugar Models also stock an extensive range of scale model buildings suitable for "00" gauge railways.

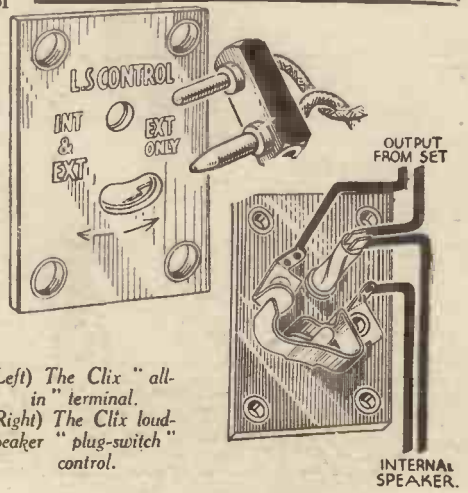


TWO NEW CLIX ACCESSORIES

A PROBLEM often met with by wireless constructors when building experimental apparatus is that of making simplified connections. Crocodile clips are extremely useful, but in some circuits, especially where high voltages are present, they may be the cause of damage as they will not remain stationary, and swing about in certain conditions. Similarly, simple terminals can often cause trouble due to shocks or short circuits. There is now a terminal on the market, however, which is insulated and shock-proof and at the same time offers perfect contact in all conditions. This terminal is known as the Clix "all-in" terminal and is marked Aerial and Earth, + and —, and Input and Output. It costs 6d.

The other device is a loudspeaker "plug-switch" control which provides a perfect method of controlling either your set speaker, external speaker or both. It is fitted with a quick make-and-break switch, operated by a slight movement of the plug. It costs 1s.





(Left) The Clix "all-in" terminal. (Right) The Clix loudspeaker "plug-switch" control.

The address of the makers of any device described below will be sent on application to the Editor, "Practical Mechanics," Tower House, Southampton Street, Strand, W.C.2.

WHEELS FOR MODELS

By "Handyman"

The Fourth Article of a Short Series Dealing with the Construction of Wheels Suitable for every Type of Model.

THE various parts of the wheel mould should now be as drawn in cross section in Fig. 19, where *A* is the portion which will mould the tyre and balance. *B* is the boss and crank, showing the two pointed pins referred to. *C* is a section of the tyre around the rest of the circumference, where the balance weight does not come. This shows a spoke in profile. *D* and *E* are cross sections of a spoke; the first taken at a point near the tyre and the other at a point where it joins the boss. *F* is the runner in the other part of the mould, the parting line being at *G*.

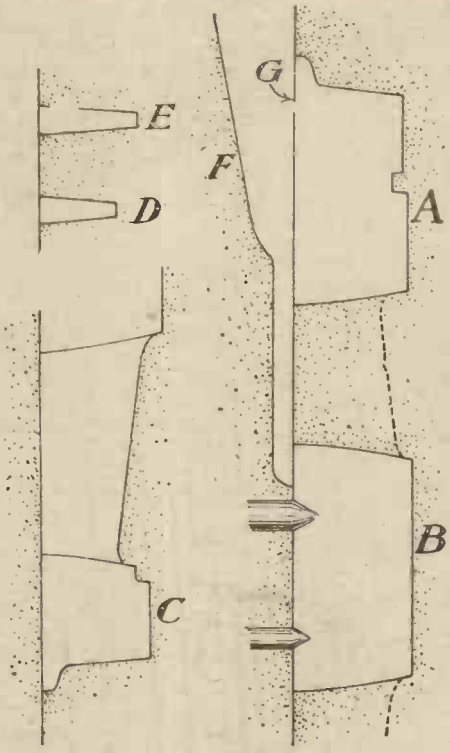


Fig. 19.—Section at various parts of the mould.

Hardening the Moulds

It is quite possible that, without anything further being done, the moulds could now be used for casting, but they would certainly not stand up for long, especially if an insufficient amount of "draw" or taper has been provided. What would happen would be that, in removing the casting, portions of the plaster would pull away with it. So it will be advisable to harden the plaster by soaking it in a thin solution of gum arabic, celluloid lacquer, or weak shellac, the last being the best. It must not be strong enough to remain on the outside as a yellow varnish, but must soak right into the plaster and, when dry, leave the surface dull and a pale ivory colour. Pour the shellac—which is ordinary brown flake lae dissolved in methylated spirits—into a plate and place the moulds face downwards in it, leaving them for an hour or more. Then put them in a current of dry air for a day or two until all spirit moisture has evaporated. Be sure that they are thoroughly dry, and then well blacklead the faces and polish off.

Casting

We now come to the most interesting part of the work: the casting of the required wheels and seeing the result of our labours.

The two moulds are placed together in their relative positions as described and lightly clamped with a "G" cramp, a thin bit of soft wood being interposed on each side to prevent damage to the plaster. Some small iron vessel must now be found in which the metal can be melted. This should have a lip for convenience in pouring. The best vessel to use is undoubtedly a proper ladle, which can be bought at an ironmongers, but a very small saucepan will do, or even a stout tin can which is beaded together, not soldered. Whatever is used, it should be large enough to hold sufficient metal for all the castings which are to be made.

By the way, if there are not enough solders available go to a printer whom you know and ask if he has any old worn-out type which he can let you have, for really it is type-metal which is required.

Drop the metal into the ladle, or other vessel, and place it on a gas-ring. When all is quite melted and just as a slight scum is beginning to form on the top, pour into the mould. Get it in as quickly as possible, and stop pouring when the runner is nearly full.

Fig. 20 shows the operation being performed, and also the clamping-up of the mould.

Faulty Castings

After filling the mould, leave for a few seconds, unclamp, and gently remove the casting. If it is found that some parts are missing, such as the spokes, it is evident that the metal was not hot enough. The remedy is to leave it longer over the gas flame and try again.

When all the castings needed are obtained, the runner must first be sawn off with a hacksaw and then the back of the wheel filed flat.

Copying Existing Wheels

It may happen that the reader already has a wheel which he wishes to duplicate and, providing this has a perfectly flat back, he can use this to form his mould, instead of modelling it in plaster with a strickle. Proceed as before in respect of the plaster in one of the boxes. When this has set, coat the wheel well with vaseline, lay it face upwards on the smooth surface of the plaster, and place the second box round it in line with the first. Now pour into the second box liquid plaster, seeing that it runs around and completely covers the wheel and fills the box. When it is set separate the boxes, remove the wheel, and there, in the second box, will be a facsimile from which, after drying the moulds, shellacing and blackleading them, additional copies of the original wheels can be made.

Of course, any holes which may be in the original wheel must be filled up before attempting to make a mould from it; putty, plasticine, or wax will serve for this.

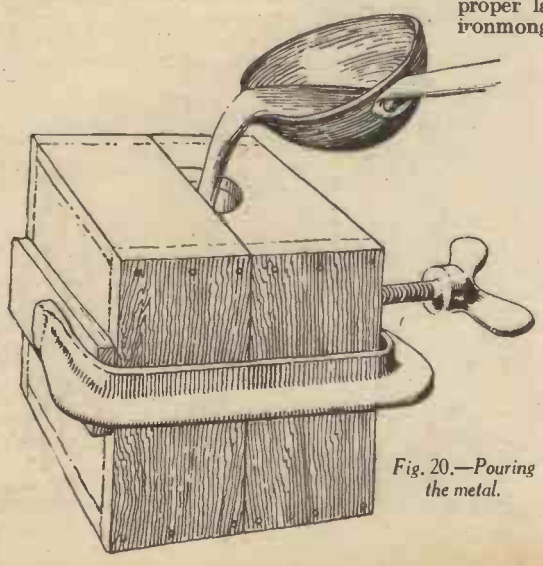


Fig. 20.—Pouring the metal.

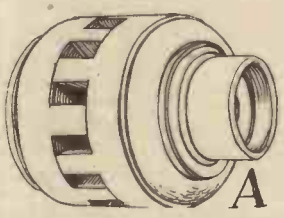
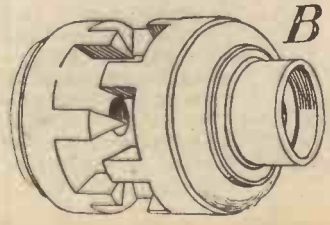
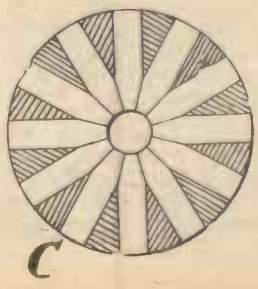


Fig. 21.—Detail views of divided hubs.





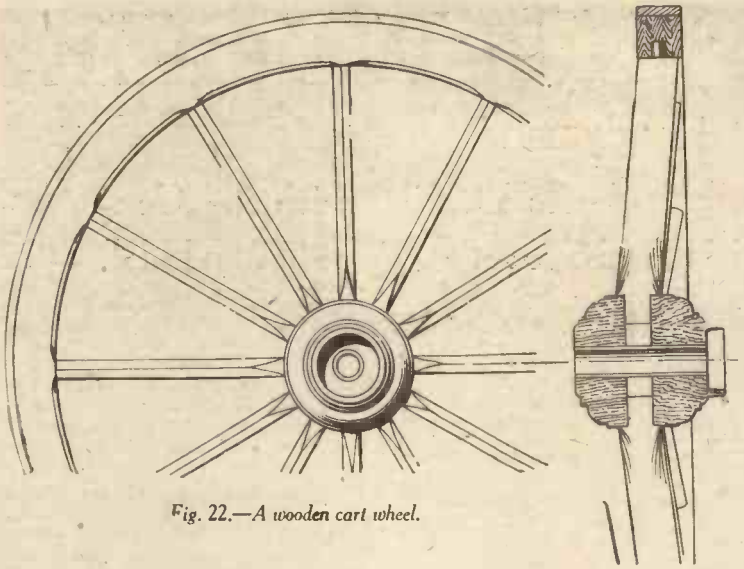


Fig. 22.—A wooden cart wheel.

Cart and Carriage Wheels

Next in order we will deal with the making of wooden wheels of light and heavy types for models of horse-drawn road vehicles. On small models and toys of the ready-made, mass produced kind, which may be seen in the toy shops, wheels are usually die cast in white metal, and if the model maker can adapt such wheels to fit the scale of the model he is building, the simplest way will be to buy such toy as may be suitable, for the purpose of removing and utilising the wheels; for these parts of some toys are generally excellently well proportioned.

If the model in hand is to a large scale it will be necessary, of course, to build the wheels up, and on an important piece of such work one would naturally wish to do the whole one's self.

To build a wheel, which shall look like the prototype, it is not possible to depart very radically from full size methods of construction, but there are a few points in which, in models, improvements can be made in regard to strength, durability and simplicity. This is notably the case in connection with the rim, which, in a full size wheel, is composed of a number of felloes, all built in separately and only bound together by the iron tyre. If the same construction were followed in a model, an extreme degree of accuracy in workmanship would be necessary in order to obtain the requisite strength, so the writer will give two methods of building, either of which will be found efficient, fairly easy in the making and equally correct in appearance.

Construction Needs

There is one outstanding feature about any wheel in which the spokes are introduced separately from the hub (or more correctly, as it is called, the *Nave*) and rim, and that is that either the nave or rim must be made up of two or more pieces, because, if both were made of single pieces of wood, it would not be possible to get the spokes into their places unless they were simply butted up to nave and rim at each of their ends. Such construction would, perhaps, suffice for a glass-case model, but it would have no lateral strength; therefore, it is essential that the spokes be mortised and tenoned at both ends or tenoned at one end and dowel-pinned at the other.

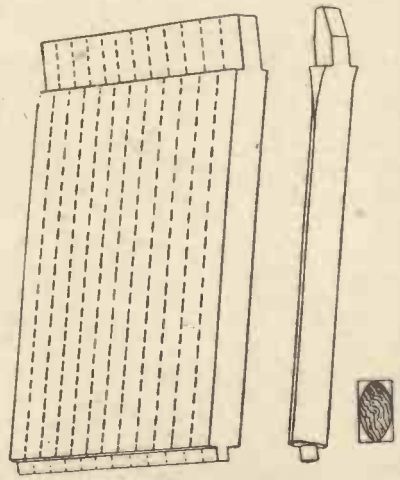


Fig. 23.—Spokes profiled in block.

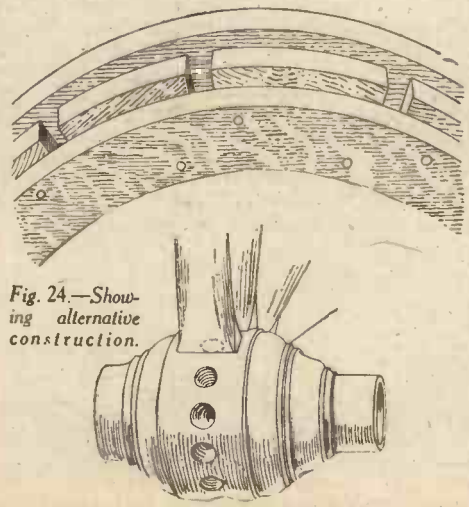


Fig. 24.—Showing alternative construction.

The Divided Nave

The first method of building a model wheel provides for making the front and back halves of the nave of two pieces and notching these so that when they are fitted together they provide square mortises for the spokes. Fig. 21 shows such a nave; the sketch at *A* representing the two portions placed together. *B* shows them slightly separated, while *C* is a cross section. This last indicates the spaces (between the hatched lines) which will be filled by the tenons on the inner ends of the spokes.

Fig. 22 gives a view of the outside faces of the wheel and a cross section through it. In this latter the tenons on the spokes are seen in the nave and entering the rim only by means of short round pins formed on their outer ends.

In such a wheel as this the rim has no felloes, but is cut as a complete circle from one thick piece of plywood or two or more plywoods glued together. To all intents and purposes, therefore, it is solid, and so the spokes must first be fixed into the rim and the two halves of the nave passed into place between the tenons on the spokes and glued there last of all.

Boxwood Naves

For the rims a ply which is faced with a smooth wood, which does not show the grain, will be advisable. The same thing with regard to grain applies to spokes, such a wood as box or beech being advisable. For the nave nothing can be better than box, because from it such beautifully sharp mouldings can be turned on naves for carriage wheels and others which are somewhat of an ornamental nature.

Fig. 23 suggests a method of making the spokes so that all are of exactly uniform length. A piece of straight grained wood is selected, planed to thickness and rebated at each end dead square with the sides, which sides must, of course, be parallel. This piece of wood is then either run through on a small circular saw with the fence set to the approximate spoke thickness, or marked off with a gauge and sawn by hand. They are then planed dead to thickness and afterwards shaped to oval form with chisel.

The alternative construction, which the author suggests, more nearly resembles the actual practice. In this the nave is in one piece, but instead of having square mortises for the spokes, round holes are drilled and the inner ends of the spokes are neatly filed to fit.

The rim of such a wheel as this will be made up of two circles, which can be of plywood, and a ring of felloes. These latter will be of the same thickness as the tenons to be formed on the outer ends of the spokes. If the felloes are also of plywood, then the tenons must be cut to the thickness of the same.

Fig. 24 shows a solid nave having proportions which are approximately those of a carriage or light vehicle, such as a baker's van. This sketch shows the holes for the pins and also the two rings and felloes referred to. Fig. 25 shows two sections through the wheel, the drawing on the left indicating three spokes in position with the felloes between.

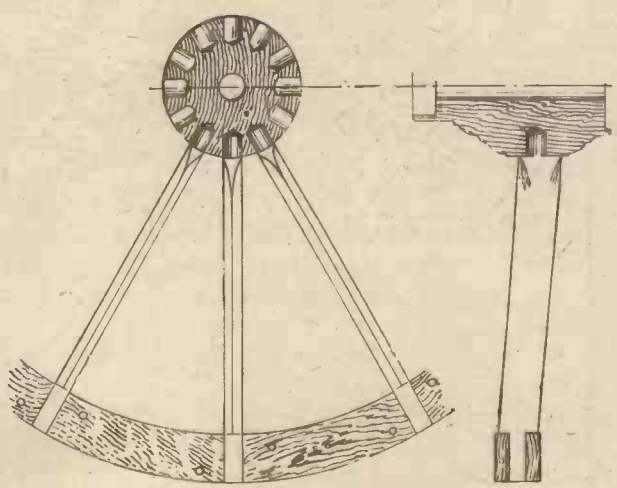


Fig. 25.—Two sectional views through a wheel.

CONJURING WITH COLOURS

By Norman Hunter
(The Well-known Conjurer of "Maskelyne's Mysteries")

Further Articles on the Secrets of Conjuring will appear Regularly and Exclusively in this Journal

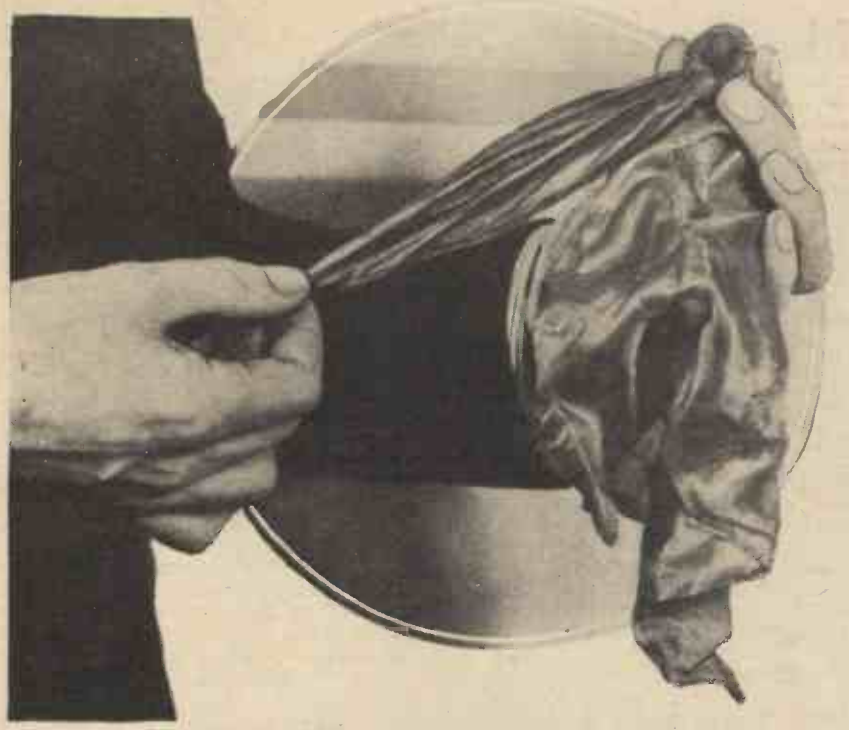


Fig. 1.—A trick handkerchief that changes colour when pulled through the hand. The handkerchief is double and when a corner is pulled through the ring shown in the picture, the handkerchief turns inside out.

OF the different kinds of magic that may be performed, using colour as the theme, there is the trick of changing the colour of an object, the trick of causing several objects of different colours to become one large object embodying all the colours and the opposite effect of splitting a multi-coloured article into its component parts. For instance red, white, and blue ribbons may be turned into our national emblem or, conversely, a large green handkerchief may be magically converted into two smaller ones, blue and yellow.

Another type of colour magic consists of picking out, whilst blindfolded, a chosen colour from a mixture of colours. Then again loose commodities such as sand, of different colours, may be mixed and separated again by magic. A type of apparent thought reading too, can be performed with coloured articles, the conjurer naming correctly the colour of an article hidden by the audience during his absence.

These few indications will serve to show how large and varied is the range of tricks in which colour plays the chief part.

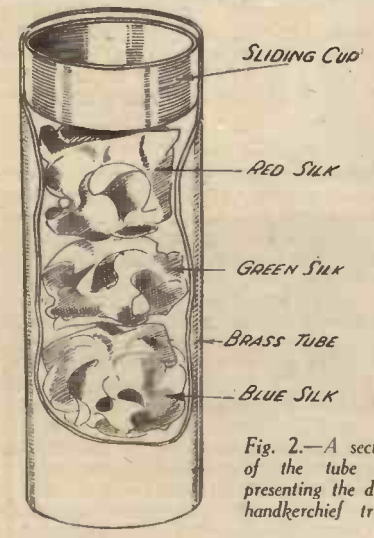


Fig. 2.—A section of the tube for presenting the dyed handkerchief trick.

The Handkerchief Trick

One trick which nearly every conjurer performs in some shape or form consists of passing a number of white silk handkerchiefs through a tube of paper and making them come out at the other end dyed various bright colours. The number of handkerchiefs used rests with the performer. The secret of the trick lies in the use of a piece of apparatus to contain the coloured silks at the beginning of the trick and the white ones at the end of it.

Reference to Fig. 2 will show a section of this gadget. It is a length of seamless brass tube in which a brass cup slides like a piston without a shaft. The ends of the tube are turned in to prevent the cup coming right out. The coloured handkerchiefs are packed, one at a time, into one end of the tube, forcing the cup to the other end. In this condition the tube is laid on the table and a piece of paper about ten inches by twelve is laid over it. The paper should be rolled into a tube and allowed to open again to give it a slight curve so that it will cover the tube without revealing its presence.

To perform the trick first show three white handkerchiefs. Pick up the paper with the right hand and lay the white silks down over the tube from the front with the left hand. I am assuming that you are

Fig. 3.—Dyeing handkerchiefs by magic. Section view showing the brass tube used to contain the coloured silks, from which they are ejected by pushing the white ones in at the other end.

standing with your left side to the audience. This move leaves the fake tube concealed all the time. Roll the paper into a tube and hold it in the left hand. Pick up the white silks in a bunch with the tube inside. Tuck the silks into the paper tube, introducing the fake first and so tucking the silks into this. As the white silks are pushed in at one end of the fake the coloured ones are pushed out at the other. To the audience the handkerchiefs appear to change colour as they go through the paper tube. In Fig. 3 is seen a section of the paper tube cut away to reveal the trick at this stage.

Disposing of the Fake

Continue tucking the white silks in until they are all well inside the brass fake. Now draw the coloured ones from the other end of the tube and lay them one at a time on the table. As you spread the last coloured silk on the table allow the fake to drop out behind them as shown in Fig. 4. It will be noticed that two fingers of the hand holding the paper tube grip one corner of the last coloured silk while another corner is held in the free hand. Thus spread out, the silk forms a perfect screen for dropping the brass tube, the paper tube coming exactly behind the silk.

Another way of getting rid of the tube is to drop it into a hat or box as you hang the silks over the front edge of either receptacle. Or again the tube may rest at the start in a pocket behind the table, or in a black art well in the middle of the table. It can then be picked out with the white silks which have previously been dropped just in front of it and subsequently allowed to slip back into the bag at the end of the trick.

Producing Flags

I have explained this trick at some length because the method used is very useful for a variety of different effects. By loading the brass tube with a flag for instance, red, white, and blue handkerchiefs can be transformed into our national emblem. Or again a single large silk and a length of ribbon can be pushed through the paper roll and emerge as a silk mat with ribbon sewn round the edge. Yet again skeins of embroidery silk may be pushed through the tube with a piece of plain material, and be converted into an embroidered mat. This latter effect would be especially good if the embroidering were done in three stages. For this, four mats would be needed, one plain, one fully embroidered, one embroidered say with the red part of the pattern only and one with red and green. The complete mat would be packed into the tube first, followed by the red and green one, the red going in last. In performing, the plain mat and a red skein would first be pushed through the paper, and the paper might well be the cover of a periodical devoted to needlework. The mat would then emerge with red embroidery on it. This mat plus a green skein, on going through the tube, would come out as the same mat (apparently) with green added to the design. Finally a third journey accompanied by a skein of blue silk would result in the finished product, ornamented with red, green, and blue. An effective trick and quite easy to do.

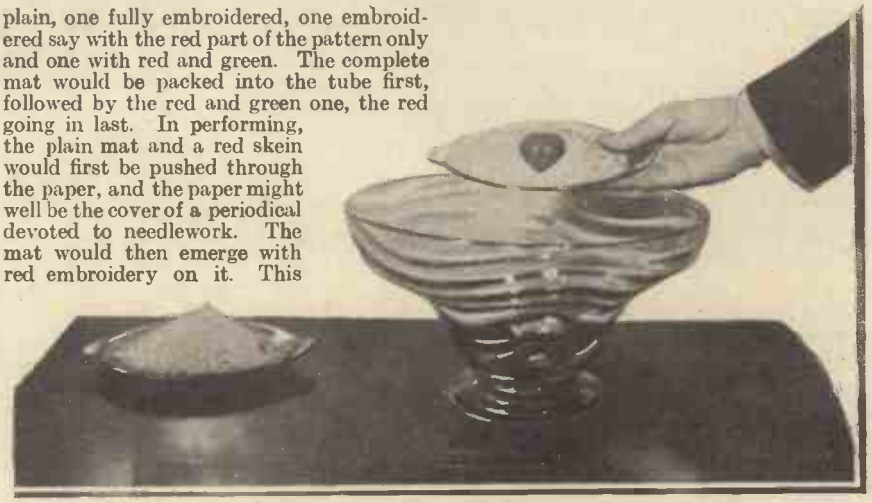


Fig. 7.—The sand trick. A block of sand prepared with grease to make it waterproof is concealed in each plate of coloured sand. The sands having been mixed in the bowl of water any colour can be produced by taking out and crumbling the prepared blocks.

If the making of the brass fake tube presents difficulty, a good substitute is a length of cardboard postal tube fitted with loops of tape in place of the sliding cup. Cuts are made across the centre of the tube and the tape glued through as shown in Fig. 5. The tape thus forms a bag which can be pushed to either end of the tube at will. Either form of fake may be made any reasonable size to suit the articles for which it is to be used. It is a good idea to have several such tubes of different sizes.

A Simple Trick

The colour-changing trick is sometimes performed in a quicker and less elaborate manner by simply drawing a single handkerchief through the hand. For this a specially made double handkerchief is required. To make it, obtain two silk handkerchiefs of quite different colours, say red and green. Lay them on the table one over the other, flat out. Now sew two of the edges together as shown in Fig. 6, leaving about an inch unsewn at the corner A. Next put a few small stitches through the centres of the two silks to catch them together. Now fold corner C over on to corner D and sew along the sides up to A. If preferred this may be done at the same time as the first stage of sewing. I have described it separately to make the construction clear.

The handkerchief is now in the condition shown in Fig. 8. The next stage consists of stitching a small metal or bone ring into the corner A, and sewing the silk round to form a tube. The corner B of the inner handkerchief is now tucked inside the double silk and drawn out through the ring. Fig. 9 shows the complete fake in diagram form.

To cause the handkerchief to change colour, hold the ring in the left hand, take hold of the projecting corner with the right hand and pull it quickly and deliberately through the ring. The handkerchief will turn inside out and so change from red to green or vice versa. Fig. 1 shows the change in process. One advantage of this trick is that it needs no preparation, for the act of changing the silk from red to green leaves it all ready to be changed back from green to red again.

Coloured Sand

The sand trick is one of the most effective pieces of colour conjuring and the secret is not very well known. A bowl is filled with water and a quantity of sand of different colours is poured in. The sand and water are well stirred, then, showing his hand empty, the conjurer dips it into the water and brings out a handful of sand of any colour called for, not only separated from the other colours but also perfectly dry !

The secret of keeping the sand dry and of keeping it separate is one and the same. The sand is prepared beforehand in small cakes. A quantity of red sand is heated in a metal pan with a small piece of wax. While the sand and wax are hot they are well stirred together and packed into moulds or shaped into small blocks, then left to cool. A block of sand so prepared can be dropped into water and, when lifted out and crumbled, will pour out quite dry. The wax, of course, prevents the sand from being soaked by the water.

Several cakes of each colour sand should be prepared at one time and each colour should be shaped differently. For instance red sand may be cube shaped, green sand a ball and natural-coloured sand a flat disc. The blocks should be small enough to

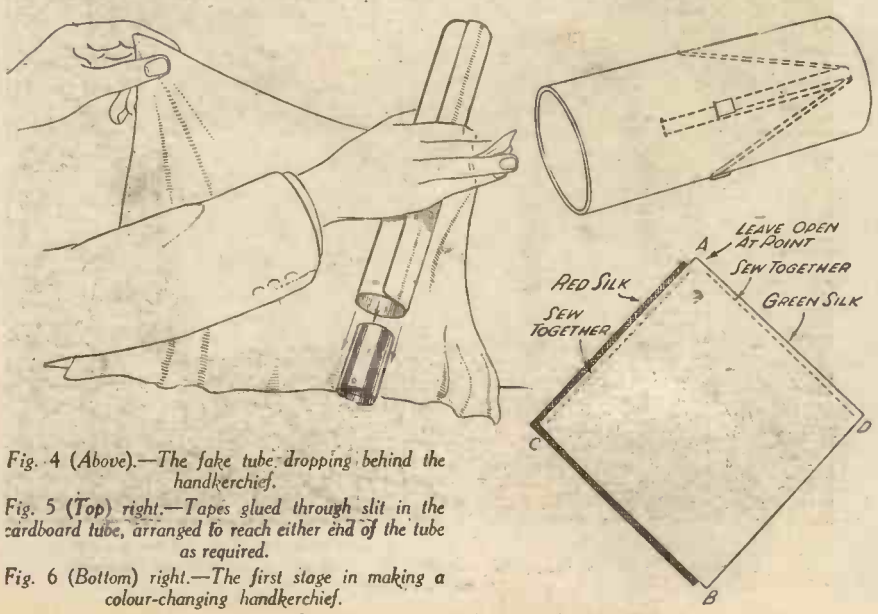
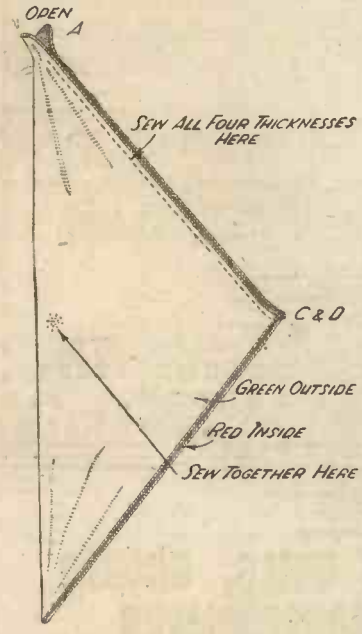


Fig. 4 (Above).—The fake tube dropping behind the handkerchief.

Fig. 5 (Top) right.—Tapes glued through slit in the cardboard tube, arranged to reach either end of the tube as required.

Fig. 6 (Bottom) right.—The first stage in making a colour-changing handkerchief.



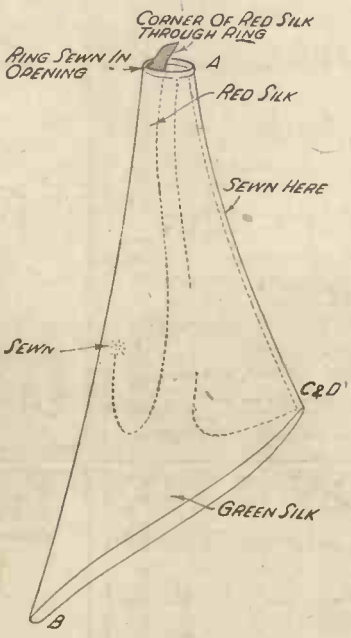


Fig. 8 (Left).—The second stage of making a colour-changing handkerchief. Fig. 9 (right). The colour-changing handkerchief complete.

conceal easily in the hand.

Fine silver sand is the correct article to use and it may be dyed various colours by soaking it in hot water to which some aniline dye powder has been added. This should be done and the sand dried before making it into the waterproof cakes.

The manner of secretly introducing the cakes of sand into the water is shown in Fig. 7. Here I have shown two lots of sand, each on a flat glass plate. I have used a small ball to represent the cake of waterproofed sand in order to make it show up clearly. The ball is also partly exposed for the same reason. In actual practice a cake of sand is placed on a saucer and sand of the same colour is poured on until the cake is covered. The same process is gone through with as many other colours as it is desired to use.

Performing the Sand Trick

In performing the trick a large bowl is shown empty. A glass bowl is to be preferred but is not essential. Water is then poured in and the saucers of sand emptied into the water. Each saucer is tipped down into the water so that it shall not splash. This move also enables the cake of sand to slip in unobserved. The photograph shows a view from the back. The saucers are held to the front of the bowl and tipped over so that the bottom of each saucer is seen by the audience.

The sand is now stirred up and a handful of wet mixed sand is taken out and dropped on to a spare saucer to show that it is really mixed. The hand is then rinsed, shown empty and a colour asked for. It is an easy matter to remember the shape of the cake of the required colour.

Coloured Counters

Picking out one colour from several may also be performed with a bag of various coloured counters. The counters should be big ones, about the size of a penny and there may be any number of colours. Bag and counters are examined and the counters well shaken up, after which the conjurer, who may be blindfolded for the trick, proceeds to pick out counter after counter, naming its colour before taking it from the bag.

No preparation is needed. All the conjurer has to do is to conceal in his hand one counter and remember its colour. Say it is blue. When the bag is returned to him he dips in his hand and announces that he will pick out a blue counter. With his hand in the bag he brings the blue counter to his finger tips and conceals another counter in his hand. He then brings out the visible blue counter and throws it on the table. In doing this he can catch a glimpse of the one concealed in his hand. Suppose it is yellow. He then announces his intention of picking out a yellow counter and again goes through the same movements. In this way he can carry on picking out counters and naming the colours in advance because, as will be seen, he is always one ahead of the audience.

"But," you may ask, "how about the blindfold? He won't be able to see the counters." Oh, yes he will. That is another little trick that most conjurers know. If you have a handkerchief tied over your eyes you will find you can look down your nose and see anything held below your face and near your body.

Trick with Cards

Another colour-separation trick can be done with a pack of cards. The conjurer begins by separating the red from the black cards, to show how long it takes. He then shuffles the pack, or someone else can do so and with one cut again separates the red suits from the black.

A special pack is needed for this trick but it is useful for so many other tricks that it is well worth acquiring. All the cards are cut slightly tapering at one end, as shown in Fig. 10. It will now be seen that if any card or cards are turned round, their wide corners will project beyond the narrow ends of the other cards. A stroking movement with fingers and thumb along the edges of the pack will draw the reversed cards out.

To do the colour-separating trick with such a pack, start with all cards the same way. Deal out reds into one heap and blacks into another. When you put the packets together again turn one packet round. All the black cards will now have their wide ends against the narrow ends of the red cards. The pack can be shuffled and shuffled and shuffled without affecting this condition. To separate the colour, hold the pack as shown in Fig. 11, with fingers and thumbs at the edges of the cards half-way between the two ends. Grip the cards firmly and draw the hands apart.

Fig. 10.—The tapered pack of cards explained.

Fig. 11.—Separating the reds and black. The cards are cut slightly tapering. All the red cards being put one way and all the blacks the other, they can be stripped apart with one movement however much shuffled.

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STARGAZING FOR AMATEURS

By N. de Nully

A GUIDE FOR MAY

THERE will be total eclipses of both the Sun and the Moon this month, unfortunately neither will be visible from these islands. The Moon will be at first quarter on the 6th, full on the 14th, last quarter on the 22nd, and new on the 29th. It will be in apogee at its farthest from us this month—251,930 miles—on the 18th; and in perigee at its least distance —223,240 miles—on the 30th.

The Planets

Mercury, Jupiter and Saturn are "morning stars" inconveniently placed for amateurs. Mars still hangs over the western horizon in the dusk until setting at 10.30 p.m. Venus sets about the same time but gets later each night. It is moving eastward (from right to left) and will overtake Mars on the evening of the 7th, when the two planets will be found unusually close together. Viewed through a binocular or small telescope they will present an interesting spectacle. The larger dazzling, slightly gibbous, disc of Venus will be in striking contrast to the smaller reddish one of Mars.

The Stars

Before the luminous nights of spring dim the stars too much, let us make a telescopic survey of those within the celestial "arctic circle." Most important is, of course, Polaris the pole star, which is such an invaluable aid to mariners in finding their way about the oceans Polaris does not, however, mark the exact point of projection of the geographical pole on the sky, being situated a trifle over a degree from it. This is nevertheless sufficiently near for practical purposes and to create the illusion of the entire vault of heaven revolving around it. A camera directed to the star and left so fixed for several hours, would record a distinct trail; showing that, owing to the rotation of the Earth, Polaris describes a tiny circle, with true north in the centre. Officially, the pole star is designated α (Alpha) Ursae Minoris, and is the chief component of the constellation of the Little Bear. It is really a spectroscopic double; but there is a 9th magnitude star in the same telescopic field, which used to be regarded as "loosely linked." This is, however, probably merely another unconnected star in the same line of sight. Polaris and the little star can be easily seen in a small astronomical telescope, but the real "companion" is invisible. Delicate observations reveal that Polaris itself is of the "pulsating" type subject to regular outbursts at intervals of four days; but they are not perceptible to unaided vision as they make a difference of only one-tenth of a magnitude. The winding constellation Draco (the Dragon) embraces many interesting objects within reach of a fairly good astronomical telescope. Among them are the double stars β (Beta), γ (Gamma), υ (Nu), o (Omicron), η (Eta) and μ (Mu). Draco also contains the smallest known sun, which needs very powerful optical assistance to perceive. It is about half the size of the earth and in the White Dwarf category; immensely massive and four times as hot as our Sun. α (Alpha) Draconis is notable for having been our pole star about 4,500 years ago. Displacement from that proud position was due to the slow change in the direction of the Earth's axis, which gradually gyrates in a circle, somewhat after the manner of a spinning top. This imperceptible movement is termed precession and occupies nearly 26,000 years in making a complete circuit. The neighbouring group Cepheus is also worthy of examination on dark clear nights. Its chief star α (Alpha), is known as Alderamin, and will be our next pole star in about 6,000 years; but meanwhile, γ (Gamma) will temporarily secure the honour 2,000 years hence. Other interesting stars in the group are β (Beta) Cepheii, a bluish double, k (Kappa), ξ (Xi), δ (Delta) and μ (Mu); the last-named being a deep garnet colour. Delta Cepheii is the most remarkable variable of its class, and is also a double star composed of two suns

The pole star as seen through a telescope.

easily discernible in a small telescope; the larger component is another of the "pulsating" type. A star atlas is essential to identify the objects mentioned; and a Philip's cardboard revolving planisphere, costing only a few shillings, will readily indicate the locations of the constellations above the horizon at any hour on any day or night.

Notes

An analysis of sunspots observed last year, points to a peak of solar disturbances in July, and it is consequently thought that this may have been the actual time of maximum of the present cycle. Immense spots appeared throughout 1937, those of July 27 and October 4 having been of exceptional dimensions. Taken altogether, the past twelve months have witnessed the greatest sunspot activity since 1870. Moreover 1938 has already produced several more abnormal specimens accompanied by magnetic storms and at least one magnificent display of aurora as far south as these latitudes. This year may therefore ultimately be able to establish its claim to be regarded as the turning period towards the next minimum, as had hitherto been anticipated.

* * *

It is confirmed that the "pulsating" star ϵ (Epsilon) in the constellation Auriga —referred to in the March Practical Mechanics—is an eclipsing binary. Its light variations are the result of a grazing eclipse every 27 years. The larger component is non-luminous and more massive than the smaller bright star. The former is believed to be surrounded by a semi-opaque shell which partially obscures the latter during the progress of each eclipse.

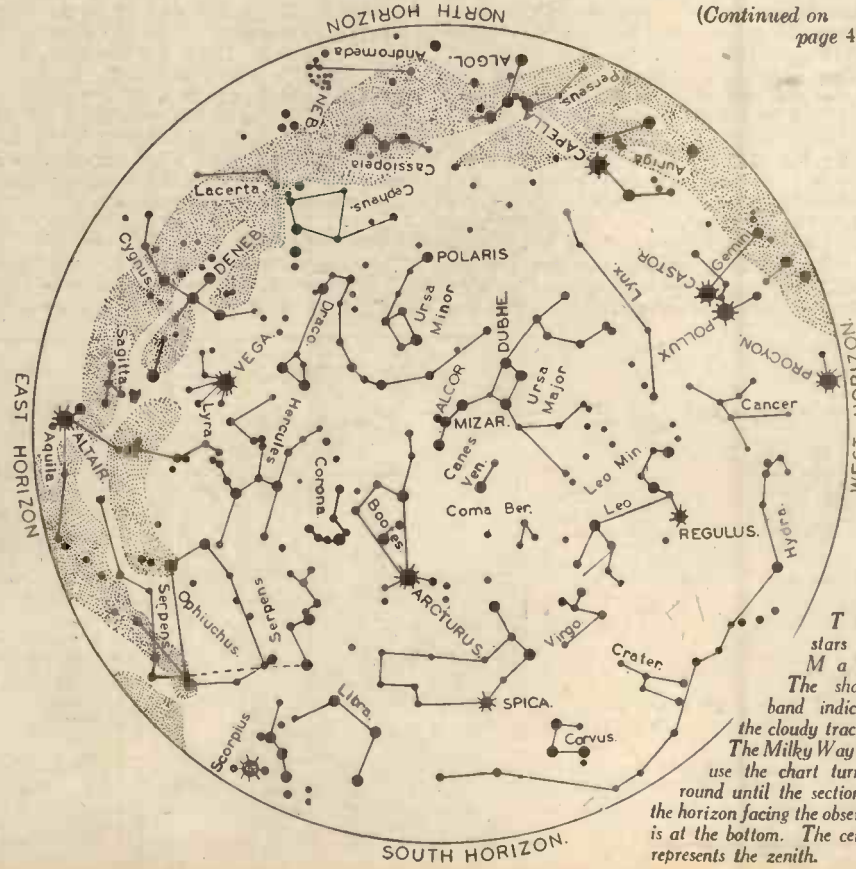
* * *

It is asserted that if the Earth were flat, the mammoth 200-inch reflecting telescope for California, now approaching completion, would enable a person in San Francisco to read an advertising sign in New York as clearly as it can be read from the street in the latter city. This represents a distance of over 2,500 miles, or rather farther than from the West coast of Ireland to Newfoundland.

* * *

An account is to hand of the fall of a meteor in Japan in 1934. A Japanese and

(*Continued on page 465*)



The stars in May. The shaded band indicates the cloudy track of The Milky Way To use the chart turn it round until the section of the horizon facing the observer is at the bottom. The centre represents the zenith.

Television in Colour

By H. J. BARTON

The Transmission of Colour has been Demonstrated on the Screen Recently by Baird. This Explains Clearly how it is Done

Fig. 1.—Mr. Baird (on the right) with the new colour television transmitter referred to in this article.

WHEN moving black and white cinema pictures were shown for the first time, prophets were quick to point out that in a short time these would be developed so rapidly that they would soon be superseded by pictures in full colour. That promise is only just being fulfilled, for the difficulties associated with the work were enormous, and wedged in between was the all important advent of the "talkies." After the early demonstrations of low definition television similar predictions were forthcoming. In 1928 Baird certainly did show colour television pictures with a definition of thirty lines, using a cable ink between transmitter and receiver, and judged by the standards then ruling the experiment was successful. Since that year, however, little has been heard concerning colour television pictures for the bulk of the development work has been directed towards the improvement of monochromatic systems. Quietly and patiently Mr. Baird has devoted considerable time to the intricate problems involved in transmitting television pictures by radio for subsequent reproduction at the receiving end in colour. An indication of the stage which has been reached was revealed to the public and press recently in demonstrations given at the Dominion Theatre, London. Here for the first time in television's chequered but intensely interesting career, colour television pictures were shown on a screen measuring 12 ft. high by 9 ft. wide, and although the inventor himself agreed that imperfections were present the results left no doubt that enormous progress had been made.

At the Studio End

Details concerning the new process have only been made known very recently and although in theory the method employed is on similar lines to that used ten years ago the equipment and picture standard bears no resemblance, while the image size has grown nearly three thousand times in area.

The transmitting studio is located in a room at the base of the South Tower, Crystal Palace, and for the purpose of scanning the person or object to be televised a special camera has been developed. This is seen in Fig. 1. Mounted on a rubber-wheeled truck to allow tracking movements to be made when required, and carefully balanced on trunnions so that the operator can carry out horizontal or vertical panning is a metal casing shrouded in padding cloth. Inside this is the ingenious mechanical optical scanning equipment which has been devised for this colour process. The action will be made clear by referring to Fig. 2 which shows a simple pictorial representation of the apparatus. Assuming for the purpose of illustration that a person's head and shoulders is being televised, this is first of all flood-lit by the two arc lamps. In addition, a third arc lamp floods the rear of a translucent back screen but this screen is raised so as not to obscure the camera.

Transmitter Scanning

The large diameter lens covering the whole of the camera aperture focuses an optical image on to an 8-inch diameter mirror drum having twenty facets, each of which is set at a different angle axially to its immediate neighbour. The drum revolves in a vertical plane on a horizontal axis, being driven at a speed of 6,000 r.p.m. by a synchronous motor. In this way a succession of optical

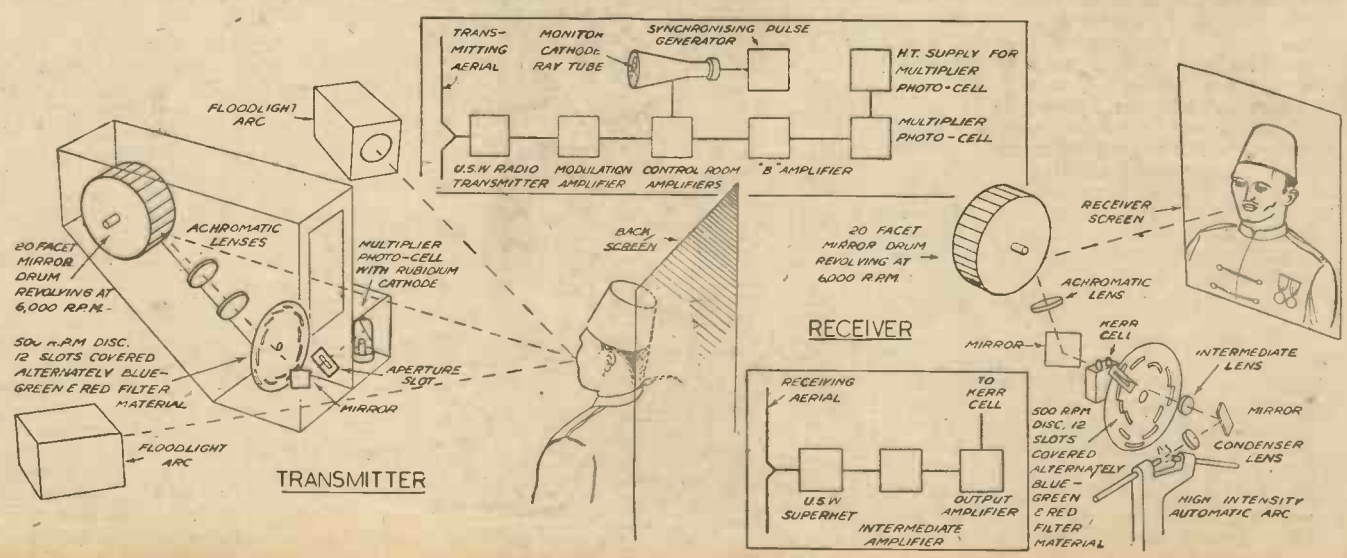


Fig. 2.—Diagram illustrating the process of colour transmission and reception as used in the recent Baird demonstration

Colour

CHAPPLE

Television Pictures in onstrated on a Big Baird. This Article the Process Works.

Fig. 5.—The interior layout of the receiving room, which houses the scanner, arc lamps, modulator, etc.

" slices " of the main image are reflected from the mirrors of the drum and focused by an achromatic lens on to a rectangular slot in a fixed mask. Since the mask (seen in the bottom right-hand corner of the camera in Fig. 2) is parallel with the vertical side of the camera, a mirror is conveniently interposed in the optical path to ensure that the images are reflected to the required position. Behind the mask is a rotating disc having twelve concentric slots at different distances from the periphery. This disc is revolved in a vertical plane at 500 r.p.m. by a reduction gear drive from the mirror drum motor, and the staggered slots as they pass over the mask cut out form an aperture which moves backwards and forwards as the disc turns. By

Fig. 3.—The rubidium type multiplier photo-electric cell showing the multiplier grid stages.

this means the field given by the 20-face drum is interlaced six times to give a final 120-line picture dissection which is repeated twice for each revolution of the disc.

Using Light Filters

Each of the disc slots is covered with a light filter, blue-green and red being used alternately, the effect of this being to transmit alternate lines of the picture corresponding to a blue-green image and a red image. Elemental areas of the light filtered image pass in turn through the aperture, therefore, and are directed on to the active rubidium cathode surface of a Baird multiplier photo-electric cell which is mounted in a separate metal screened compartment which can be seen at the bottom right-hand corner of the camera in Fig. 1. The form taken by the cell is indicated in the photograph—(Fig. 3)—which has a cut-away multiplier section to show the grid stages. The cell has a chain of secondary amplifying stages and the electron current passes in sequence down the chain, being amplified at each stage. Each stage consists of a grid, the surface of which is specially prepared and treated to give a high secondary factor. The primary electrons incident upon the first grid liberate secondaries at low velocity which are attracted by a positive potential through the meshes to the second grid. This they strike with sufficient velocity to liberate further secondaries, which are in turn attracted onward down the chain. The grids are arranged as parallel circular discs inside a metal screen with an aperture to allow the electrons from the photo-electric cathode to reach the first grid. At the end of the multiplier is a secondary emitting plate and the electrons from the last multiplying grid impinge on this, producing a final large multiplication. The electrons liberated from the plate are collected by an unsensitized open mesh grid and pass into the output circuit of the multiplier.

Fig. 4.—Showing the specially built room accommodating the colour television receiving apparatus.

As will be seen from the bottom of the Fig. 2 diagram the picture signals pass from the cell through amplifiers before being made to modulate the ultra-short wave radio transmitter, whose carrier wavelength is 8·3 metres. Picture monitoring is undertaken by the engineer through the medium of a cathode ray tube, which of course only shows a monochromatic image but enables the contrast and gain levels to be set correctly to ensure satisfactory picture reproduction at the receiving end. From the radio transmitter the picture signals pass up a long feeder cable to be radiated into space from one of the aerials on the top of the South Tower balcony.

Receiving Equipment

The receiving equipment used in connection with this colour television process is accommodated in a specially built fireproof room at the back of the stage of the Dominion Theatre, London. Its position in relation to the screen is shown in Fig. 4. The top section houses the electrical apparatus, scanning gear, amplifiers, etc., these being enclosed in metal casings to conform to the L.C.C. fire regulations in relation to places of public entertainment. The layout of the interior of the cubicle is disclosed in Fig. 5, the arc and scanner being on the right, while the final modulated light beam emerges from the wall aperture, seen clearly in Fig. 4.

As will be gathered from an examination of the pictorial diagram, Fig. 2, the mechanical and optical scanning arrangement is built on similar lines to that of the transmitter, except that the order of operation is reversed. The crater of a 150-ampere high intensity and totally enclosed automatic arc lamp is focused on to a slot in the fixed diaphragm by means of a condenser

lens and reflecting mirror surface. Behind this mask revolves at 500 r.p.m., the geometrically similar slotted disc, whose slots are covered alternately with blue-green and red light filters. The moving disc slots as they pass over the diaphragm slot produce the aperture, whose size represents the elemental area of colour filtered light beam which passes into the nicol prism Kerr cell combination seen in Fig. 2.

Radio Reception

From the ultra short wave aerial on the theatre roof the television signals received from the Crystal Palace pass down the feeder cable to the superheterodyne receiver to which is linked the intermediate and output amplifiers. The last named unit is connected to the Kerr cell so that the light beam passing into it is modulated in exact accordance with the intensity of the incoming television signals. This modulated and light filtered beam is mirror reflected and focused by means of an achromatic lens on to the outer surface of a 12-in. diameter mirror drum having twenty angulated facets and kept revolving at the constant speed of 6,000 r.p.m. The result of this ingenious combination is that the mirror drum projects on to the back of a large screen 120 vertical modulated and properly coloured light strips. Naturally the number of lines in the picture is a function of the relative speeds of the disc and drum together with the numbers of drum mirrors and disc slots employed, but in the demonstration at the theatre this was fixed at 120 lines, using vertical scanning and a picture radio of 4 to 3.

A Special Screen

The translucent screen of dimensions 12 ft. by 9 ft. is seen in Fig. 6, together with the three large public address speakers used for the accompanying sound. Ordinary frosted glass is too directional for use under such stringent theatre conditions and a great deal of experiment was undertaken before the chemically treated cloth screen was evolved which would be capable of yielding sufficient light from back projection to enable the picture to be seen without eye strain in all parts of the Dominion Cinema, which has a seating accommodation of three thousand.

Fig. 6.—The 12-ft. by 9-ft. screen used for portraying the 120-line colour television pictures.

The actual demonstrations of the Baird colour television process were introduced by a compere from the stage who pointed out that this was the first time in the world that wireless colour television pictures had been shown on a big screen, and while imperfections were present in comparison with the normal black and white processes these were being eliminated very rapidly. After the curtains had parted and shown the Union Jack, an artist gave several impersonations with suitable aural descriptions. Ladies then gave a fashion display of coloured hats and in conclusion was shown the white ensign and a photograph of the King. The colours were portrayed with great vividness while there was ample picture brilliance for everyone to see. Slight flicker was noticed since the fundamental picture frequency was 8½, but the multi-mesh interlacing system used, reduced this very considerably. In addition, the effect of bars slowly moving from left to right was apparent on the picture screen, but the results shown left no doubt that colour television is an accomplished fact and it is certain that ultimately all cinemas will have their own colour television screen for the entertainment of patrons.

50 TONS AT ONE SCOOP

THE LARGEST POWER SHOVEL IN THE WORLD?

WITH a capacity of 50 tons at one scoop, one of the largest power shovels has recently been put into operation by the Northern Illinois Coal Corporation. The new giant is an immense dipper, or bucket, which has a rated capacity of 32 cubic yards, struck measure, or approximately 40 cubic yards heaped up—enough to fill an ordinary room at one scoop. In coal stripping operations where it will be handling earth, shale, and broken rock, the weight of one dipper load is approximately 50 tons.

The dipper itself is fabricated from aluminium plates and castings, with an armour of special wear resisting steel at the points where the greatest wear is encountered. The use of aluminium results in a marked saving in weight over the ordinary all-steel construction and this saving in weight permits the carrying of greater pay loads with little or no increase in the duty of the mechanical parts or of the electric equipment. The dipper is roughly 9 ft. 8 ins. × 8 ft. 4 in. × 16 ft. 4 ins. The largest dipper previously used is of 20 cubic yards capacity, of a lightweight all steel construction weighing 40 to 50 per cent. more than the larger aluminium dipper of the new giant.

Despite its great size and the amazing capacity of its dipper, the new machine possesses surprising agility. The movement of the dipper is closely and easily controllable by the operator, one complete cycle of operation being accomplished in only 45 or 50 seconds. This rapidity of action accounts for the immense output capacity of the machine, it being estimated that under normal working conditions the shovel will be able to move more than one million cubic yards of material per month. This amount of material is represented by a trench 50 feet deep, 100 feet wide, and a mile long. In regular coal-stripping operation, the removal of this amount of overburden will uncover well over 100,000 tons of coal, making it immediately available for loading into cars for transportation to the tipple.

The new shovel has a boom over 100 ft. long and a dipper handle or stick in excess of 65 feet in length. Material can be picked up at the working level. A mental picture of this operation is obtained when it is imagined that this shovel can pick up a fifty-ton load and place it on the sixth or seventh floor of an ordinary office building.

The equivalent ratings of all motors, and generators on the shovel total more than 3,500 horse-power.

Slight pressures of the operator's hands on the master switch handles produce working pressures of several hundred thousand pounds at the dipper teeth.

The world's largest power shovel.

NEW INVENTIONS

A.R.P.

AIR-RAID precautions are in the air. An addition has been made to our already large family of alphabetical abbreviations. The triplets, A. R. P., will soon find a home in the appendix of the dictionary.

The whole nation has adopted the motto of the Boy Scouts, "Be prepared." Naturally, the inventor plays an important part in the scheme of national defence. His ingenuity has been fully occupied in thinking out the most effective kind of gas mask and in designing an impregnable air shelter.

Shall we arrange huge refuges to accommodate the civil population *en masse*? Or shall we supply a large number of more limited shelters? Shall our cities be furnished with catacombs? Or shall our back gardens be provided with burrows?

Killed By the Cure

AN inventor, who has patented an air raid shelter in this country, remarks that, hitherto, structures of this kind have usually been of the underground type. He maintains that, owing to the amount of excavation necessary and the quantity of concrete required, the cost of such structures is prohibitive to the majority of the people. Further, he points out that subterranean shelters are vulnerable in the event of flooding and of descending gas. Also, he adds, that in the case of a direct hit by a heavy highly explosive bomb, the occupants of the shelter might be imprisoned or buried by debris.

By the way, during the Great War, a cautious citizen had a funk hole constructed in his garden, and while trying it out buried himself alive. He resembled a patient treated with a vaunted remedy for consumption, who, according to "Punch," was healed of the disease but died of the cure.

An Economical Shelter

THE aim of the inventor in question has been to design a shelter, simple and comparatively cheap to erect, but which will effectively protect the people who seek refuge within it.

His plan is for a structure above ground. It has a lining of corrugated iron or similar material and of arc shape in cross section. This lining is covered with a layer of concrete and a layer of earth surmounts the concrete. It is shaped so as to offer the minimum resistance to blast pressure waves. The walls at the ends of the shelter are protected by a splinter and blast proof layer adjacent to the outer faces. Additional splinter and blast proof protection is located near the end walls but sufficiently distant to allow room for a passage.

The shelter is gas proof and it is fitted with inlet and outlet pipes for ventilation. These pipes extend upwardly beyond the structure, projecting above the level of the average concentrated cloud of noxious gas. Arrangements have been made for a supply of water and electric light.

Psychology and Bombs

WHEN not required as a protection for air raids, the inventor asserts that the shelter may be converted into a garage, a storeroom or a workshop.

This reminds me of a man who made his own coffin. As it was not immediately required for its original purpose, he set it up on end, put shelves in it and used it as a cupboard.

In devising a shelter above ground, the inventor states that he has aimed at constructing a structure which will retain the psychological effect of security which has hitherto been attainable only in underground shelters, dug-outs and trenches.

That word "psychological" suggests an important factor of air raid precaution.

Bombs cause physical injury, but the fear of them has a devastating effect upon the nerves of the people. Therefore, anything which makes for a sense of security —even if false—prevents nerve-shock and panic and preserves the morale of the citizens.

For example, a man has told me that, during a raid in the Great War, his wife suggested that the family should take refuge under the table. The cover was futile. In fact, my informant—the father, a man well over six feet, mentioned that half his body was outside the improvised cover. But the mental influence upon the children was distinctly beneficial.

A Light Tip

THAT magic wand, the conductor's baton, which extracts rhythmic rapture from wood, brass and catgut should be very conspicuous. For instance, a baton de luxe with an ebony staff should possess an ivory or silver apex, while the humble wood of which its poor relation is made should have a stick of light complexion. This enables the orchestra easily to note the beat. They have to keep one eye on the music and the other on the conductor.

To make it possible for the players unmistakably to observe the conductor's beat, there has been patented a baton coroneted with a scintillating electric bulb. The bulb is detachable and can be replaced by an unilluminatable tip.

Equipped with this device, the bandmaster forking beats with a flashing tip can indeed become a lightning conductor.

Bashful Earthquakes

IT is a moot point whether a spring of water can be discovered by a forked hazel twig. But it is definitely claimed that valuable deposits underground can be disclosed without the necessity of drilling expensive test holes. This, it is affirmed can be achieved by means of recently patented surveying apparatus.

The method consists in using artificially generated elastic waves in the crust of the earth to map the structure of subterranean strata and to determine the dip of such structure. The device is styled seismic surveying apparatus. That word "seismic" relates to an earthquake. I remember once reading a poem entitled "The Bashful Earthquake," and, as a matter of fact, the invention in question causes Mother Earth slightly to wobble.

A Good Point

PENCIL sharpening is an art. However, a graceful, tapering point is not always produced even by constant practice. One requires the gift. True, the mechanical pencil sharpener enables one to attain the desired end or rather point. But the blade of the cheap cutter all too soon looses its keenness. Even the more expensive brand, which reduces the cedar wood to a very good imitation of tobacco, at times gets out of order.

An interesting invention of this type, hailing from Sweden has been granted a patent in this country. This cutter is made in such a way that its action is similar to the ordinary manner of sharpening a pencil. The cutter holder works with a swinging and spiral movement. Let us hope that the result is very much to the point.

Pneumatic Bathing Costume

A NEW buoyant bathing suit has been floated; at least, a patent has been granted for such a suit. This garment has pockets; but they are not designed to hold one's money—if any. These pockets or cells are contained between two plies of rubber and they are inflated with air. One blows up the suit after the manner of a bicycle tyre by means of a single mouthpiece.

As an aid to people who cannot swim, this pneumatic bathing costume will be of use. But it will militate against that self-reliance which characterises the efficient swimmer. No buoyant bathing suit was required by Lord Byron, who swam the Hellespont.

Telescopic Umbrella

A COLLAPSIBLE umbrella is not novel. This accommodating portable shelter from rain is convenient, providing it does not collapse at the wrong moment. To guard against such a débâcle there has been devised an umbrella with ribs that telescope and a locking arrangement brought into operation by the expanding movement of the ribs. Unlocking may be effected by turning the ribs. But, if desired, this result can be obtained by twisting the runner of the umbrella about the stick.

Here allow me to observe that there is room for a "gingham," more expansive than that now in use. The standard size covers a very limited area. Now, I do not wish to be encumbered with a "gamp" having the generous proportions of a carriage umbrella. Nor do I desire to carry one of those movable tents deferentially held by bemedalled commissionaires. But an umbrella capable of enlarging its sheltering compass optionally would be a boon when Dame Nature's tears are copious. If such an umbrella has not been devised, inventors, please note.

Talkative Clocks

AN improved talking clock of the type connected to a phonograph has been accepted by the United States Patent Office. This timepiece literally tells the time, mentioning the hours as they transpire. Evidently it is a lineal descendant of the watchman of Old London, who not only published the time but also informed the drowsy citizens the state of the weather. It may be inferred, however, that, as the invention comes from the United States, the articulation of this verbose clock will not approximate to that of a B.B.C. announcer.

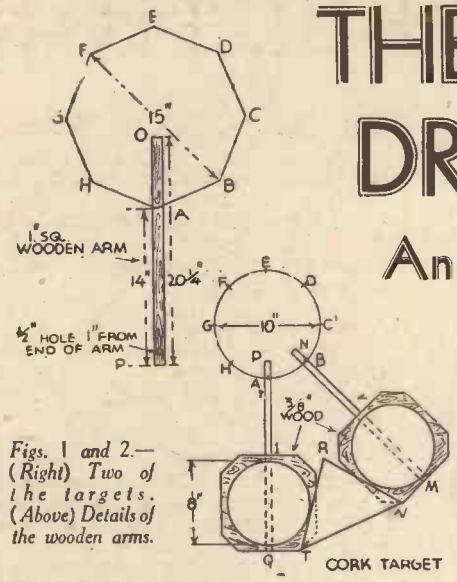
On these lines, there might be devised an alarm clock, which at the exact appropriate moment would arouse the slumbering worker and enable him to clock-in punctually. Sloth is one of the seven deadly sins and it would be useful to have a wise old grandfather's clock which would quote that ripe verse by Dr. Isaac Watts, the eminent moralist :—

(*Continued on page* 465)

THE GAME OF DART DROP

By V. E. Johnson, M.A.

An Amusing Game that can be Played by a Number of Players



Figs. 1 and 2.—(Right) Two of the targets. (Above) Details of the wooden arms.

FOR several years the writer has been seeking to devise a mechanical game which should provide minimum simplicity and space for the maximum number of players. The game is cheap and simple to make, and although the players have only to perform a very simple operation, judgment and skill are essential. The various parts of the device are easily detachable, thus the entire apparatus is easily portable. Dart drop, which can be played by both sexes, can be built for any number of players, the one about to be described being for eight players. The actual cost of materials is about twenty-five shillings, including a small 220-volt electric motor fitted with a worm and cog-wheel reduction gear. A maximum diameter of 44 in. should be allowed for the apparatus. It stands on the floor and since the players can stand practically shoulder to shoulder around it, the game can be played in quite a small room.

What the Game is

There are eight revolving targets, two of which are shown in Fig. 1. The targets are fitted to arms A B C D E F G H arranged symmetrically round a central circle. They are driven by an electric motor and revolve at a suitable pace above A B C D E F G H, Fig. 2. Extensions are fitted to each arm and an upright wooden rod is attached to the ends of each. (See Fig. 3.) The length of these rods is 42 in., and at the top of each rod is fixed a wire ring 3¾ in. in diameter, and a clip-holder. These arms are so arranged that they can be contracted or expanded at will, and the clip also permits a height adjustment if desired. (See Fig. 4.) The copper ring can thus in all cases be *centrally* adjusted over the target and the rotating arms and wooden platforms carrying the targets are each painted a different colour. Each player has a set of three darts painted the same colour as the target at which he is to aim, and the game is to register the highest score by *dropping* the darts one at a time on to the appropriate coloured target. It is important to note that the darts must not be thrown. The target is a piece of thin white kitchen paper fitted over the cork discs and secured by four small drawing pins. How the paper is divided into scoring circles is shown in Fig. 5. The darts are held between the finger and thumb so that the lowest part of the dart is approximately on a level with the wire ring. Under test an average score for the ordinary individual was found to be about 60, and *average* winning score 90, but scores of 120, 180 and 200 were not infrequent. When played at a party a good game is to play five rounds, add up the total individual scores, and the maximum being, of course, the winner. Numbers running from 1 up to 8 should be placed on the end of each arm.

Whereas any individual can regulate the speed of the revolving targets to suit his individual taste, it was found that a speed of thirteen revolutions a second was most suitable.

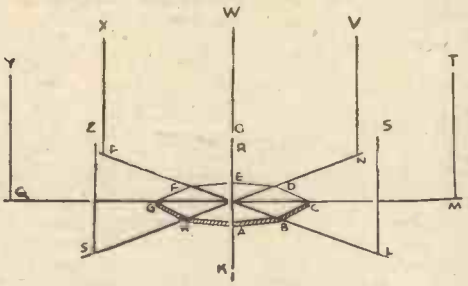


Fig. 3.—Extensions fitted to each arm.

Target Holders and Targets

The target holder is made of ordinary ⅜-in. wood as in Fig. 1, the cork targets being ordinary 8-in. table mats. These are

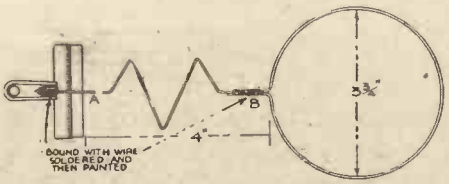


Fig. 4.—Details of the target holder.

covered with a disc of thin white paper divided into annular or concentric rings to the dimensions and scoring values shown in Fig. 5. They were fastened to the cork

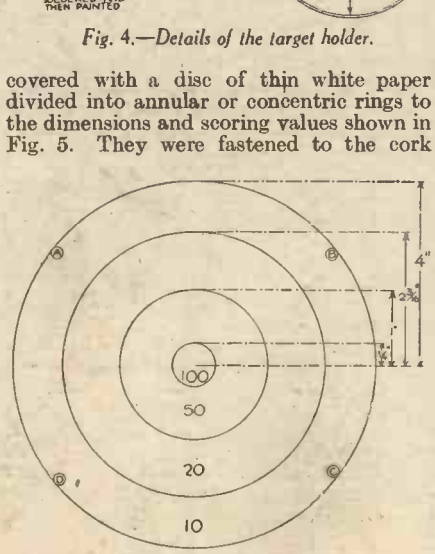


Fig. 5.—Method of marking out the targets.

mats with small drawing pins at the points A B C and D, Fig. 5. When playing the game, if a dart falls and *sticks* into *another dart* it does not count. A dart must stick into its proper coloured target, and should any player drop one of his darts on to a colour not his own he must deduct from his score whatever he scores on that target.

The Lower Portion of the Apparatus

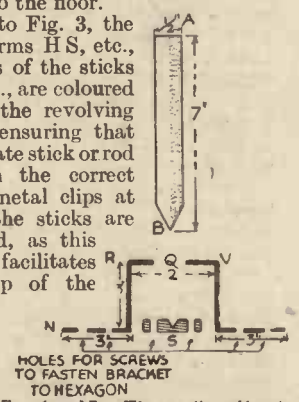
This consists of a hexagonal shaped central piece of seven-ply shaped as shown in Fig. 3, with eight similar and symmetrically arranged arms of 1-in. section square wood, screwed to the top of the hexagon. 1 in. from the end of each arm is drilled a ½-in. hole to hold the wooden uprights, shown in Fig. 3. Great care should be taken to drill these holes truly at right angles to the arms, the arms not shown passing through B C D E F G and H.

Centrally on the octagon is screwed the iron bracket shown in Fig. 7 with a hole at Q and a piece of iron or brass S, placed centrally under Q. This contains a partly drilled V-shaped hole in which the pin pivot of the axle B, Fig. 6, can turn freely, the only other support for the axle being the hole Q, Fig. 7.

The Revolving Upper Part

This is shown in Fig. 1, and consists of two arms, targets and wooden triangular pieces R T V, made from a piece of ⅜-in. 3-ply and arranged symmetrically round the circular piece of ½-in. wood A B C D E F G H, which has a groove round the edge to accommodate a thin leather belt. The circle A B C, etc., is shown 10 in. in diameter, but it can be larger if necessary to slow down the speed of the targets. The arms are 1-in. square section, and the wooden pieces carrying the cork targets 9 in. × 9 in. × 3 in. as shown in Fig. 1. They are screwed underneath the wooden pieces carrying the targets, otherwise the darts will drop through on to the floor.

Referring to Fig. 3, the end of the arms H S, etc., and the tops of the sticks Z S, R K, etc., are coloured similarly to the revolving arms, thus ensuring that the appropriate stick or rod is placed in the correct hole. The metal clips at the top of the sticks are also coloured, as this considerably facilitates the fitting-up of the apparatus. The game is started by setting the revolving part so that the coloured arms correspond with the dabs of colour on K L, etc., and on the top of the rods.



Figs. 6 and 7.—The spindle and bracket

AIRCRAFT CONSTRUCTION

How Motor Car Manufacturers are Helping in the Production of Aeroplanes.

A scene at the Standard Motor Company's "shadow" factory at Coventry. The men are electro-plating aero-engine cylinders.

THE scheme for Government factories was announced by the Prime Minister in the spring of 1936, the underlying principle being that certain engineering firms, which do not normally make munitions, would be invited to set up some measure of munition production and thus create a reserve source of supply.

This decision was taken following a review of civil industry by the Committee of Imperial Defence which found that it was desirable to earmark the resources of a number of firms for particular types of production, naval, military and air, in order to increase normal sources of supply as speedily as possible in time of emergency.

Under this scheme various motor firms were allocated for Air Ministry work and, as the increased reserves of aircraft and aero-engines required under the programme for the expansion of the Royal Air Force were beyond the normal capacity of the regular aircraft and engine manufacturers, arrangements were made for these motor firms to assist immediately in the provision of these reserves.

A Twofold Purpose

The scheme adopted by the Ministry has, therefore, a twofold purpose :

(*a*) to provide part of the reserves of aircraft and aero-engines required under the expansion of the Air Force, and

(*b*) to give the motor firms assigned to the Ministry experience in the production of aircraft and aero-engines which they will be able to utilise in time of emergency.

The second objective is of prime importance and will result in increased productive capacity, ready planned and trained, which will be rapidly available when required.

In order to achieve both objects new Government factories have been erected as close as possible to the " parent " motor factories. The cost of erecting these new works and installing the necessary plant is being borne by the Government and is provided for in Air Ministry votes. The firms undertake the management of the factories as agents, the aircraft and engines produced being paid for on an agreed basis.

Obtaining Experience

The scheme enables the firms to obtain in peace-time practical experience in aircraft and aero-engine production with the least possible interference with their ordinary commercial business. It will provide them also with a reserve of trained personnel, while the proximity of the Government works to the " parent " motor factories enables supervision to be simplified and full advantage to be taken of common services.

The motor firms participating in the scheme are :

(1) The Austin Motor Co. Ltd., Longbridge, Birmingham.

(2) The Daimler Co. Ltd., Coventry.

(3) Messrs. Rootes Securities Ltd. (Humbers), Coventry.

(4) The Rover Co. Ltd., Birmingham.

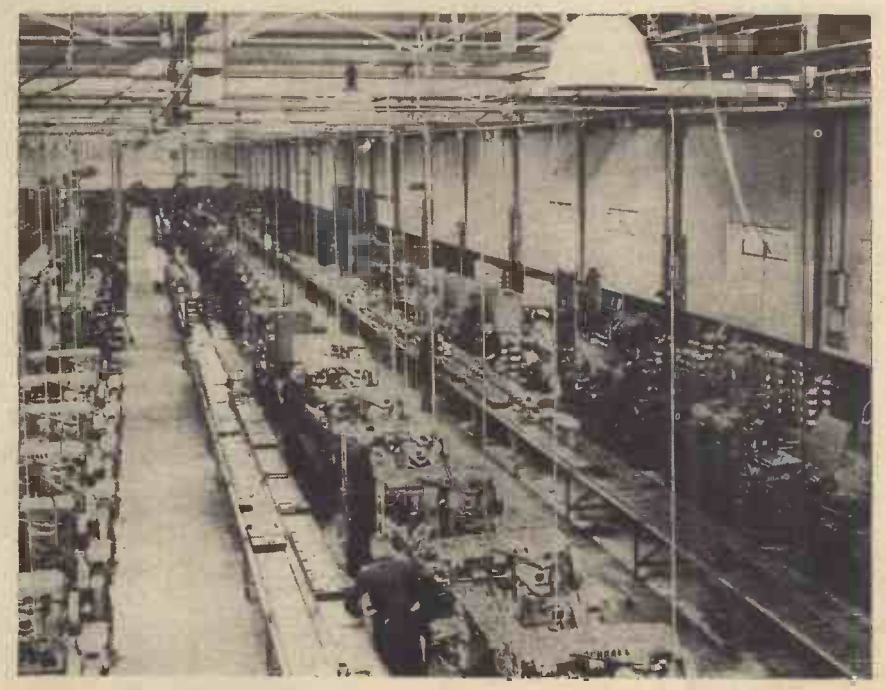
(5) The Standard Motor Co. Ltd., Coventry.

Each of these companies is engaged in the manufacture of certain components of the Bristol " Mercury " air-cooled radial engine and two of them, the Austin Motor Co. Ltd., and Messrs. Rootes Securities Ltd., are also undertaking the production of air frames of modern bombers. The Austin Motor Co. Ltd., is further responsible for assembling and testing half the number of aero-engines produced, and the Bristol Aeroplane Co. Ltd., which has also had a Government factory specially built for the purpose on a site of eight acres at Bristol, assembles and tests the remaining half.

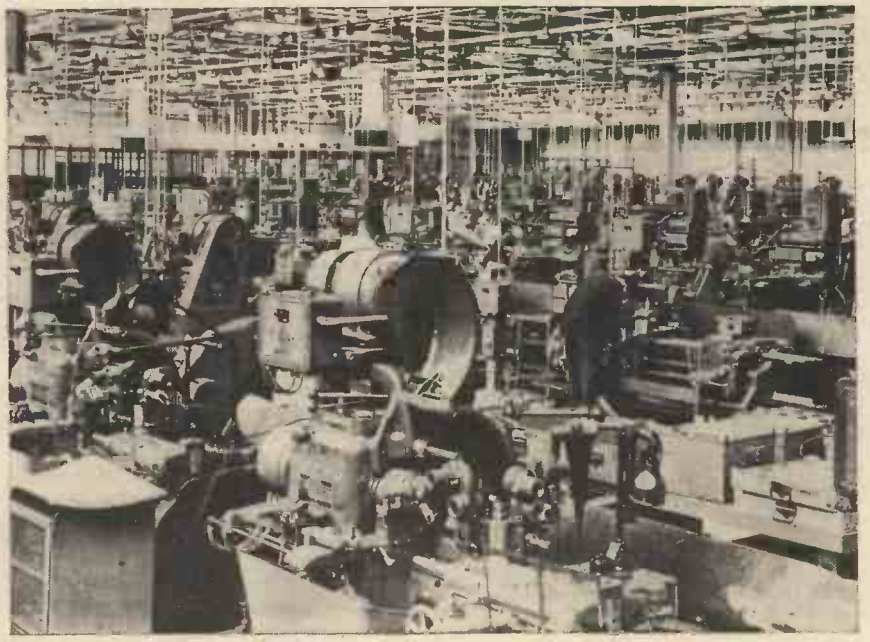
The Bristol " Mercury " Engine

The decision to produce for the time being a series of components of the Bristol " Mercury " engine, in preference to the manufacture of complete engines at each factory, has the advantage of avoiding the duplication or multiplication of orders for jigs, gauges, tools and plant. Furthermore, it simplifies the technical supervision by the Bristol Company.

The first set of components from each of the Government factories was recently completed, and has been passed by the Aeronautical Inspection Directorate of the Ministry. The result was highly satisfactory, the quality of the workmanship being excellent. Assembly has since taken



A general view of the machine shop in the Standard Motor Company's factory.



A general view of the machine shop at Messrs. Rootes Government aircraft "shadow" factory at Coventry.

place and the first complete engine is now undergoing its tests at the Bristol works. The production of components is progressing steadily and within the next six months maximum peace-time production, on a one-shift basis, will be reached.

The *esprit de corps* shown by the firms in the engine group is beyond praise. The final success of the scheme is now assured, and the greatest credit is due to the firms. This success depended largely upon the willing co-operation of the Bristol Aeroplane Company and their technical staff, and every possible assistance has been rendered by them.

A Remarkable Achievement

The design and erection of factories and the securing of the necessary plant and tools, particularly at a difficult period such as the present in the face of demands from other munition industries, represent a remarkable achievement. Its successful accomplishment and the production of the first aero-engine within approximately a year of the effective start of the work are conclusive evidence of the energy which the firms have displayed.

The layout of the factories and the plant installed follow the latest and best practice in large-scale engineering production.

The Airframe Factories

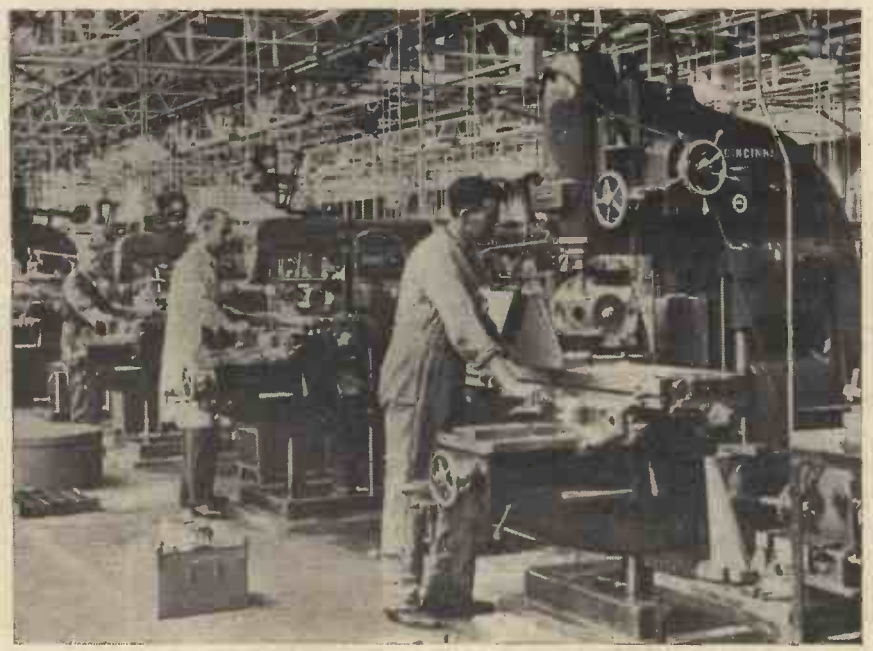
The scheme for the production of aircraft did not present the same problems as those associated with the manufacture of aero-engines and the Ministry decided, in view of the capacity of the regular aircraft manufacturers, that it would be sufficient to arrange for two Government factories to be erected for the construction of airframes. As already noted, the firms selected were the Austin Motor Co. Ltd., and Messrs. Rootes Securities Ltd. To the former has been assigned the production of Fairey "Battle" aircraft, and to the latter Bristol "Blenheim" aircraft, two of the fastest bomber types in the world.

Both of these factories have been planned for large scale production. The factory being managed by Austin's has been erected at Longbridge, Birmingham, and is adjacent both to the "parent" motor factory and the new aero-engine factory. Together with the engine factory, it covers an area of fifteen acres and was virtually completed in September. Half the equipment has already been installed, and production is in hand on some 50 per cent. of the various components of the "Battle" aircraft. Production of the first complete aircraft is expected in the early part of 1938. The work is proceeding with the co-operation of the Fairey Aviation Company and valuable production experience is being obtained as a result of this combination of aircraft and motor manufacturers. An aerodrome has been established adjacent to the factory where the "Battles" will be tested before being officially handed over to the Air Force.

The second aircraft factory under the management of Messrs. Rootes Securities Ltd., is being established at Speke Aerodrome, Liverpool. Owing to the transfer of this factory to its present location erection is not yet complete, but it is expected that it will be ready for production by the end of next summer. The factory will cover an area of nearly fourteen acres. The makers' test of the Bristol "Blenheims" will take place at Speke.

A £40,000 "BOMB"

DOWN the Mackenzie River, last autumn, steamed two cargo-steamers, specially built to withstand the rigours of a sub-Arctic winter. They had a precious cargo of radium aboard—radium from a mine on the edge of the Arctic Circle, discovered by a man who, a few years back, was a penniless prospector. The discovery of that one man has brought down the price of radium from £15,000 to £5,000 a gramme, helped to make possible the modern treatment of malignant disease by radium in comparatively large quantities. One of the chief and most up-to-date centres of radium treatment to-day is the Westminster Hospital Radium Annexe, London. Most of the treatment here is carried out by means of a 4-gramme radium "bomb." Bought when radium was double its price, these four grammes are mounted in a container of tungsten alloy which absorbs most of the radium rays except in one place where a beam is allowed to escape for treatment. The radium is put into one of two containers according to size of beam required. The container that gives a small beam has a solid platinum muzzle which serves to make the beam very sharply defined. The other container is all tungsten which gives a beam 3½ in. in diameter. Radium is dangerous to people always working with it, so when it is necessary to change the radium from one container to another or move the bomb up and down, this is done from a control panel about 4 yards away. In addition other precautions are taken for the protection of the operators. Chief is a record of the daily dose received by operators during duties. They carry little containers which record how much radiation they have received. Care is taken to keep the amounts down to safe limits.



Making crank-case covers at Messrs. Rootes factory.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 467, must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the sender. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

REWINDING A FIELD COIL

"CAN you tell me how to rewind the field coil of a 12-v. Lucas starter motor to lessen the consumption and yet leave sufficient power to drive a light flexible shaft to be used for light buffing and drillings up to $\frac{3}{16}$ inch?] Is it possible to do this, or would it be necessary to rewind the armature also? The field windings consist of at present (four pole, four brush), two pairs of windings in parallel." (N. M., Timperley.)

IF you rewind the fields, each with the same number of turns of No. 16 D.C.C wire this will give you quite sufficient power. Take care with the work and leave the armature alone, but to make a 100 per cent. job of it rewind the armature with No. 20 wire. Connections, etc., are exactly as before.

LIGHTING A WORKSHOP

"I HAVE a C.A.V. dynamo which was originally in use on a car. It is a 6-volt machine of the third brush type. It is desired to use the dynamo for lighting a workshop but when connected to an engine, does not generate. The field coils have been tested for continuity, and the brush gear megger tested for insulation and both seem to be O.K. Is an external resistance required across the shunt brush, and if so, of what value. It is not desired to use an accumulator, but to deliver current direct to lamps." (C. C., Herts.)

WE advise you to look up back numbers because it is very difficult to use this type of dynamo without a battery.

Any 6-volt accumulator will do, and if you do not use one, the lights are liable to burn out with even a slight engine speed variation. You will not get the engine to charge without a battery.

A SPARK COIL

"CAN you supply me with winding details, number of turns for primary and secondary, also gauge of wire and type of core used in a spark coil to suit a 2 c.c. petrol motor?" (L. W., Sheffield.)

YOUR best plan would be to use an old ignition coil from a car as these are far more efficient and easier to make than a home-made one.

Primary : 14 yards No. 18 D.C.C.

Secondary : ¼ lb. No. 38 D.C.C.

Core : 5 in. by ½ in. and condenser : 25 sheets 2 in. square.

ELECTRIC DEPOSITING

"I HAVE several plaster casts about 9 in. square from which I wish to obtain some copper reproductions by electro depositing.

"I wish to work the plating bath off of 240-volt D.C. mains.

"Can you tell me :—

"1. The amount of resistance I will require to step the voltage down sufficiently and to pass enough current for the plating?

"2. The best method of preparing the casts for the deposit (as I do not wish to spoil them) I want this to be a thick deposit but a perfect reproduction.

"3. The best composition for the bath, and any other details which you think will be likely to help me." (Kinch.)

1. WE advise one 100 watt lamp in series with the bath for a start then this can be replaced with a small 500 watt fire or some more lamps. Use the 100 lamp for about half an hour.

2. Coat the plaster with carbon or graphite, i.e., "Zebo."

3. Use copper sulphate solution to which has been added a little sulphuric acid. Experiment first with some old casts, as this is difficult work and requires care.

A SOLENOID COIL

"I WISH to construct a solenoid coil to exert a temporary pull of at least 8 oz., the stroke to be 7½ in. using a ⅜-in. bore tube, with a 3-in. long armature inside, to work on 200 to 250 volts A.C. and D.C. current.

"Is this practicable? If so, will you kindly give me the necessary data, wire gauge, quantity, etc." (E. S., Sth. Wales.)

TO get a 7½-in. stroke, you will have to use a lever from the core if this is to be only 3 in. long. You could, however, use a coil about 9 in. long, but this would not be so good. Whatever system you adopt, you will require at least 4 lb. No. 24 D.C.C. wire for 250 volts. This is for A.C. only, as much more is required for D.C.

REWINDING AN ARMATURE

"I HAVE in my possession an old square type 12-volt C.A.V. dynamo, the armature of which is badly burnt out.

"I am desirous of rewinding this, so perhaps you will be good enough to guide me on the following points.

"There are 24 armature slots, 48 commutator bars and the coils are former wound. There are 16 turns of wire to each armature coil.

"Does this mean that the armature coils are group-wound in pairs, each coil of 16 turns being in reality 2 coils of 8 turns each with a centre tapping allowed for when winding the 16 turns?

"Will d.c.c. wire be sufficient if taped or is double-silk wire necessary?

"I shall have no difficulty in setting the neutral point or winding the coils; it is just the matter of whether the coils are group wound in pairs of 8 turns each, because if not, how do I account for the extra 24 commutator bars?" (L. S., Cambs.)

THE armature is wound exactly as if it had 48 armature slots, which means that 2 coils are put in each slot. Each coil must have 16 turns in it, therefore, if you imagine that the armature has 48 slots, no trouble will be encountered.

Double cotton wire will be quite suitable.

IMPROVED CIGARETTE PACKET

"CAN you advise me as to the value of an improved cigarette carton, a practical example of which is enclosed herewith.

"As you will see, a slip of cardboard (or the like) is inserted in the ordinary form of wrapping. After opening the slip of cardboard is pulled in an upward and backward direction thus presenting the cigarettes in a single row and making them easy to remove.

"Many people have suggested to me that despite the little improvements that have been effected in cartons, a device such as this is a great necessity, but as I am a non-smoker I am not in a position to hold a practical opinion on it.

"I have taken out a provisional patent and would like an answer to the following two questions:—

(1) "Do you think the idea has practical and commercial value?

(2) "Can you give me a list of the principal cigarette manufacturers, or advise me where I can obtain same?" (S. J., Sussex.)

THE improved cigarette carton is ingenious, but it is not thought to be broadly novel. You are advised to make a search amongst prior patent specifications before incurring the cost of completing your patent application.

(1) The idea appears to be a practical one, but there may be some difficulty in adapting the wrapping machine to include the addition, but as to this manufacturers will readily advise on putting the invention before them. Provided the invention is novel and there is no difficulty with regard to the "wrapping," it should have a certain commercial value from an advertising point of view.

(2) The following cigarette manufacturers might be interested in the invention:—

Abdulla & Co., Ltd., 124 Commercial Street, E.1.

Ardath Tobacco Co., Ltd., Worship Street, E.C.2.

Carreras, Ltd., Arcadia Works, Hampstead Road, N.W.1.

J. Wix & Sons, Ltd., 210 Old Street, E.C.1.

Rothmans, Ltd., 5a Pall Mall, S.W.1.

British American Tobacco Co., Ltd., Westminster House, Millbank, S.W.1.

Imperial Tobacco Co. (of Gt. Britain and Ireland), Ltd., 20 Kingsway, W.C.2.

IMPROVED MUSICAL INSTRUMENT

"THERE is at the present time an organ on the market whose sound production depends entirely upon electro-magnetic impulses, amplified and reproduced through loudspeakers. I understand the principle of this organ regarding the production of the fundamental notes, and I have evolved a somewhat different principle for producing electrical frequencies corresponding to any note of almost any musical instrument. I consider this idea to be of value and I would like your advice." (A. B., Lancs.)

THE improved electrical musical instrument is thought to be novel, and forms fit subject matter for protection by letters patent. The idea appears to be sound in principle, and if practicable, should be commercially valuable. A constructional difficulty which may have to be overcome may arise from the close proximity of the magnets to one another and the closeness of the tracks on the disc. The idea appears to merit further experiment and is worth protecting.

You are advised to file an application for patent with a provisional specification which will give you protection for about 12 months, during which time it should be possible to ascertain the practicability of the invention, and to obtain financial assistance, if required, in marketing the invention.

AN IMPROVED VACUUM FLASK

"I HAVE designed a vacuum flask, which, I think, is an improvement on the existing design. It enables tea, sugar and milk to be carried in separate compartments, whilst a small spoon is fitted into the cork.

"Can you advise me if it is worth patenting?" (W. D. F., Inverness-shire.)

THE improved vacuum flask is thought to be novel and forms fit subject matter for protection by patent. The subject matter or invention is small, but if the idea is broadly novel and proves to have greater utility in practice, i.e. commands a better sale than existing flasks, then any patent granted for the invention should be a valid one.

As you are apparently not a manufacturer the only chance of marketing the invention is to interest vacuum flask manufacturers in the idea, and as it will not be safe to disclose the idea until protected, you should apply for a patent with a provisional specification which will give you protection for about 12 months, during which time you should be able to ascertain if the invention is likely to be commercially successful.

A NEW GAME

"I HAVE invented a game, details of which are enclosed, which, I think, is unique. Do you think the design worth protecting? If so, can you tell me how to do this?

THE improved game is possibly novel, but there have been a considerable number of somewhat similar games marketed within the last ten years.

The only way of obtaining protection will be to register the playing board as a design, and rely on "copyright" for the description and rules for playing the game. An application for registration as a design must be filed at the Patent Office (Designs Branch), 25, Southampton Buildings, London, W.C.2. The appropriate form is (Design No. 2) stamped with a 10*s.* stamp and accompanied with three identical representations or specimens. The design when registered is in force for 5 years, and can be extended for two further periods of 5 years each. Copyright in the description and rules accrues on publication in printed form.

TOOL FOR RUG MAKING

"I HAVE designed a small gadget for simplifying the making of wool rugs.

"It can be produced quite cheaply and will cut wool into standard lengths."

THE improved apparatus for cutting rug wool into lengths is thought to be novel, and forms fit subject matter for protection by letters patent. You are advised to apply for a patent with a provisional specification which will give you protection for about 12 months, during which time it should be possible to ascertain if the invention is likely to prove a commercial success before having to incur any great expense. As the device appears to be eminently practicable and capable of being inexpensively manufactured, it should be a success if properly marketed.

Should you require professional assistance in protecting your invention, which is advisable, you should get in touch with a reliable chartered patent agent, namely, Mr. A. Millward Flack, Imperial Buildings, Ludgate Circus, E.C.4.

ELECTRO-HYDRAULIC STEERING

"I AM a marine engineer working for a firm which makes electro-hydraulic steering gear, with telemotor controls.

"I have an idea for the improvement of this type of gear, and wondered if it forms suitable material for letters patent." (J.B., Edinburgh.)

THE improved hydraulic steering gear provided it is novel and practicable forms fit subject matter for protection by letters patent. It appears to have advantages over existing gears and should therefore have the possibilities of being made a commercial success. You are advised to file an application for patent with a provisional specification which will give you protection for about 12 months at the least expense. During the 12 months' protection it should be possible to ascertain whether the invention is likely to prove commercially successful before having to incur any great expense.

If you require professional assistance in obtaining protection for your invention, which is advisable, we suggest you get in touch with a reliable chartered patent agent, namely, Mr. A. Millward Flack. Imperial Buildings, Ludgate Circus, E.C.4,

EXPERIMENTS WITH CLAY

"A RED clay is ground down, and after water has been added to make it plastic, it is allowed to dry and afterwards burned to 1,000 deg. C. and allowed to cool. This is quite satisfactory but the colour is not too good. I am wondering if I could add some substance or chemical to the water when mixing which would enrich the colour of the finished article. A deep red is desired. I should like to make quite a few experiments with this particular clay (as to its composition, etc.). I know little about chemistry, and I should be extremely grateful for some idea of the lines along which I must work, and the apparatus I shall need to carry out my experiments. Also any book which I should find useful. (A. W., Burton-on-Trent.)

IRON oxide or the product known as "Rose-Pink" or a mixture of both will, when added to your clay, colour it according

to your requirements. Both of these materials may be obtained cheaply from any firm of drysalters or paint sellers. They are insoluble in water, non-volatile and will thus remain in the clay no matter to what temperature the latter may be heated.

The analysis of clays is one of the most complex operations of inorganic chemistry and you will thus realise that it would be quite impossible for an individual unacquainted with chemistry to undertake it. We suggest that you obtain one or two "general" textbooks of inorganic chemistry, as, for instance, Newth's "Chemistry," and that you attend a few classes in experimental chemistry at your local technical institution. After this, but certainly not before, you would be able to attempt the elementary analysis of simple clays.

There are several books on clays, among which you might find interesting:—

H. Ries: "Clays: Occurrence, Properties and Uses of."

C. F. Binns: "Manual of Practical Potting."

E. A. Sandeman: "Manufacture of Earthenware."

All these are expensive, but may probably be available at your local reference library.

"TEAR GAS"

(1) "HOW can I make 'tear gas'? (2) "Why is perpetual motion impossible with a motor driving a dynamo, which in turn generates current for the motor?" (L. B., Birmingham.)

(1) YOU refer to "laughing gas," a name which was many years ago given to nitrous oxide, N_2O, on account of its supposed ability to excite laughter when inhaled in small amounts. The name, however, is quite a misnomer, for the gas causes rapid unconsciousness when inhaled.

Nitrous oxide is readily prepared by gently heating a quantity of powdered ammonium nitrate in a flask or retort. The flask or retort should be provided with a delivery tube dipping under *hot* water. The nitrous oxide gas is not very soluble in hot water, and it will bubble through the liquid and can be collected in an inverted glass jar. You will not be able, however, to store the gas for any length of time since it will leak away from the collecting jar.

For further particulars concerning nitrous oxide, refer to any textbook of organic chemistry.

(2) If perpetual motion in any form were possible, we should be obtaining something for nothing, for the reason that we should be faced with a machine which continued to do work without energy having to be supplied to it. Such a thing, however, is impossible.

In the instance which you mention, the dynamo would not develop sufficient electrical energy to operate the motor which was intended to drive it. If you are at all inclined to disbelieve this statement, try it out and see!

SELENURETTED HYDROGEN

(1) "HOW can I make selenuretted hydrogen?

(2) "Has the star Nova Herculis been examined with a spectroscope, if so, what elements have been found on it?

(3) "Do iron electrodes give off more ultra-violet rays than the carbon arc, also, if the voltage is increased in an arc light, does it give more heat and increase the power of the ultra-violet rays?

(4) "Is there anything which when added to mercury and then heated solidifies it?

(5) "What colours reflect ultra-violet and infra-red rays best?

(6) "I have heard it said that all things have a wavelength of potasium, oxygen, and hydrogen? Is it in metres or millimetres?" (F. P., Herne Hill, London.)

(1) HYDROGEN selenide or selenuretted hydrogen, H_2Se, may be obtained fairly readily by acting on iron selenide with dilute hydrochloric or sulphuric acid. You will have to make the iron selenide yourself, since it is not commercially available. It can be prepared by heating selenium and iron filings to low redness, whereupon the mixture will glow vividly and will subsequently cool down to a grey crystalline or coke-like mass.

The hydrogen selenide obtained as above will be contaminated with a quantity of hydrogen, but this will not affect its experimental properties in any way.

The gas should be prepared out of doors, for it has a most irritating effect upon the eyes and nose, as well, of course, as an abominable smell.

(2) Most of the larger stars have now been spectroscopically examined, particularly by the spectrographic sections of the great American Observatories. Besides the common elements, hydrogen, nitrogen, carbon, iron, etc., which have been found in the star, n-Herculis, traces of chemical compounds, as, for example, certain hydrocarbons (compounds of hydrogen and carbon) have been detected. Similar compounds have also been detected in the "atmosphere" of some comets.

(3) The arc obtained across a pair of iron electrodes has fewer violet rays and more ultra-violet radiations. Much, however, as regards the intensity of the ultra-violet radiation depends upon the design of the electrodes, the intensity of the current, etc. Excess current passing through an arc is ordinarily productive of unwanted heat. Above a certain maximum, if the current intensity of an arc lamp is increased, an increase in light radiation does not occur.

(4) Strictly speaking, no. Mercury is a liquid metal at all temperatures about 38.8 deg. C. and nothing will solidify it above that temperature.

At the same time, you can turn mercury solid by adding about 50 per cent. of bismuth, or some other similar metal to it. In this instance, however, the "solidified mercury" will not be pure mercury, but an amalgam of mercury with the other metal.

(5) From a practical point of view, a light sky-blue tint is as good a reflector of ultra-violet rays as any other colour. Some white surfaces reflect ultra-violet rays well—other white surfaces (as, for instance, a surface painted over with Chinese White—zinc oxide) actually absorb ultra-violet rays.

Red surfaces are the best reflectors of infra-red rays.

(6) We are afraid that you have been confused over this query. Material things, such as potassium, oxygen and hydrogen, cannot themselves possess wave-lengths for the simple reason that they are not waves! Usually speaking, the term "wave-length" denotes the length of an ether wave (measured from crest to crest). Light, wireless radiations, radiant heat, are all supposed to consist of waves in the ether. Hence they can be measured in terms of "wave-lengths."

NEW INVENTIONS

(*Continued from page* 457)

" 'Tis the voice of the sluggard, I heard him complain,
'You have waked me too soon; I must slumber again.' "

Why not a clock on the cuckoo clock principle which would perform the " cock's shrill clarion "—the réveille of the farmyard?

Milk Safe

THE safety of milk has engaged the attention of more than one inventor. I am not thinking of the purity of the liquid but of the bottles of milk which, when the sun is dusting the shadows from the streets, are deposited upon our doorsteps. The bottles are subject both to theft and fracture. But a recently patented device will frustrate the unprincipled folk who are guilty of these misdemeanours. A species of small milk safe fixed near the door of the customer's house is opened by the dairyman with a key.

As an inhabitant of Eire might put the matter, it is a letter box for milk.

Cigarette Ring

IT has been said that you cannot do two things at one and the same time. Nevertheless, many people smoke while they work. It is occasionally inconvenient to hold a cigarette when the hand is required for some other purpose. To enable one to overcome this difficulty, a specially contrived finger ring has made its .début. Attached to it is an arrangement which grips a cigarette. This relieves the smoker of the necessity of continually laying down a lighted cigarette. And incidentally it contributes to the welfare of the material upon which the cigarette happens to be placed. It may prevent oak from being involuntarily fumed.

Aerated Beds

A CERTAIN Sybarite, who belonged to an ancient people proverbial for luxurious living, could not rest one night. Upon being asked why, he replied, " I found a rose petal doubled under me and it hurt me." Such a victim of self-indulgence would be intrigued by one of the latest forms of the rubber mattress, which has made its appearance in the United States. Eliminating padding, springs, tufts and buttons, it is eminently soft and its perfectly smooth surface conforms to all sleeping positions. Formed of sponge rubber, made of latex, it is pierced by finger-sized holes in an all-over pattern. This slumber cushion is said to be 85 per cent. air and 15 per cent. rubber, so that its weight is very much lighter than the ordinary mattress. It resembles a sponge, but instead of water takes in and breathes out air. One would like to have with such a sleep-inducing couch at least a nodding acquaintance.

Anti-Laddering Process

THE besetting sin of the artificial silk stocking is laddering. As the puncture is to the motorist and cyclist, so is this unwelcome series of textile rungs to the fair pedestrian. A process for obviating this undesigned open work has lately been protected by the British Patent Office. A few particulars will give the ladies an inkling of the method of attaining this most desirable object.

The procedure includes steaming, immersion in a bath containing a solution of alum or aluminium sulphate, bathing in a soap solution and rinsing in cold water followed by ordinary washing.

It is claimed that this process renders the fabric ladder-proof, fuses all the threads and makes them more elastic.

I trust that the net result of this work will be no network.

Handy For Legs

IF your chair or stool is not high enough, you may soon be able to fix to the legs a recently invented gadget which will raise it to the desired altitude. Within limits, more than one height is possible; but I cannot guarantee that grandpapa's armchair can be converted into a high chair for the baby. At least this chair leg extender enables one to be slightly elevated.

DYNAMO.

FIRE ENGINES THROUGH THE AGES

(*Continued from page* 439)

flanged for the reception of a two-way breeching. One branch has a screwed connection for the attachment of a 4-in. diameter suction hose and the other a reducing piece to allow for direct coupling to two separate street hydrants. Four delivery outlets are each controlled by shut-down valves and are with a round thread gauge. The pump shaft is driven from the second-speed wheel on the layshaft of the gearbox and the control is operated by a hand lever from the driver's seat.

The " last word " in fire engines is shown in Fig. 10 and it embodies all the very latest in automobile design and fire-fighting equipment. It has a six-cylinder engine, which develops 115 b.h.p. whilst the chassis has been specially constructed for fire engine work. As will be noted, the superstructure is totally enclosed. Two rows of seats are provided at the forward end for the accommodation of the driver and a crew of six. The rear portion of the van is divided into two horizontal compartments for the stowage of hose and other gear. A door at the rear enables the hose to be run out from the upper compartment and at each side are two doors which give access to both compartments. The Merryweather turbine pump is mounted at the rear of the chassis and is capable of delivering 850 gallons per minute at a working pressure of 175 lb. per sq. in.

STARGAZING FOR AMATEURS

(*Continued from page* 451)

his wife were about to take lunch when they heard a rumbling sound. Suddenly, something struck the top of their house. They rushed outside and saw steam rising from a near-by ditch. From this they dug out the main portion of an aerolite: and, under the roof, they found another fragment too hot to handle. The roaring sound lasted some time and was so loud that a group of mechanics working in the vicinity amid the clatter of machinery, stopped work to listen. On subsequent examination the pieces of the "bolt from the blue" (which happily were small) proved to be of the same colour as the sky from which they fell. Yellowish granular particles were however mixed with the metallic substance.

* * *

Investigations into the possibility of our Sun having a " companion " like so many of the other stars, have yielded negative results. Ever since the discovery in 1915 of Proxima, the companion to Alpha Centauri, speculation has been rife regarding the likelihood of another body, even closer, that might be gravitationally linked with our luminary. Mathematical deductions demonstrate that such a star would have to be single and at least one thousand times less luminous than the Sun.

BOOK RECEIVED

The Amateur Guncraftsman, by James V. Howe (Funk & Wagnalls Company, 17s. 6d. net).

THE Title Page describes this book as a practical handbook for those who like guns. It is intended to interest the beginner and inspire him to become a permament citizen of the fascinating realm of guncraftsmanship. The book deals with The Initial Trial; Choosing a Location; The Necessary Tools; Getting Acquainted with the Tools; Instruments, Aims and Methods; Woods for the Craftsman; Selecting the Gunstock Design; The Inletting of Actions; The Exterior Form; The Final Finish; Lines and Diamonds; Wood Engraving; Simplified Bluing Methods; Selecting Arms for Remodelling; Gun-Barrel Alterations; The A.B.C. of Shotgun Facts; Practical Trigger Details; What to Do with Handguns; Attaching Sights and Telescopes; Metal Decoration; Elementary Metallurgy. It is illustrated by a number of practical diagrams, and should certainly be purchased by all those interested in guns. It is well indexed, contains formulae for browning gun barrels and deals especially with the care of the gun.

AROUND THE TRADE

An Amazing Offer

NEW TIMES SALES CO. are making a special offer which will appeal to all wireless experimenters. They are supplying three 2-volt battery valves (list value £1 15s.) for 5s. 6d. complete with valve-holders and suitable circuits in which the valves may be included. The valves comprise two S.G.H.F.'s and one output pentode packed in original cartons

Radio as a Career

THERE are many radio enthusiasts who would, no doubt, be glad of the opportunity of improving their knowledge of radio, servicing or television, and the Technical and Commercial Radio College offer excellent opportunities for those who wish to make radio their career. The Courses are particularly comprehensive and thoroughly up-to-date, and the fact that a student can study in the privacy of his own home, at whatever hours suit him best, is of great convenience to all those whose working hours are irregular. Readers interested should make further inquiries regarding method of tuition from the Technical and Commercial Radio College, Fairfax House, High Holborn, London, W.C.1.

New Showrooms

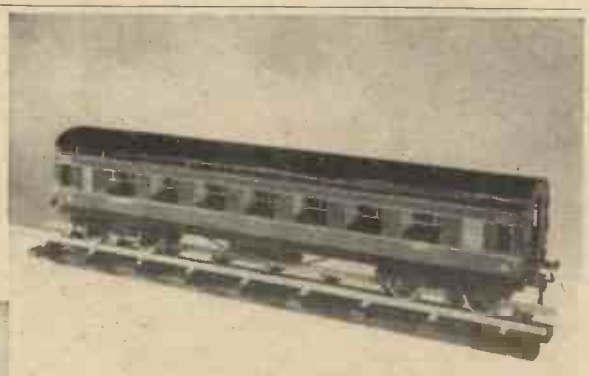
LONDON model railway enthusiasts will be interested to know that Mills Bros. (Model Engineers), Ltd., St. Mary's Road, Sheffield, makers of Milbro Models, are opening showrooms at 2 Victoria Colonnade, Victoria House, Southampton Row, W.C.2.

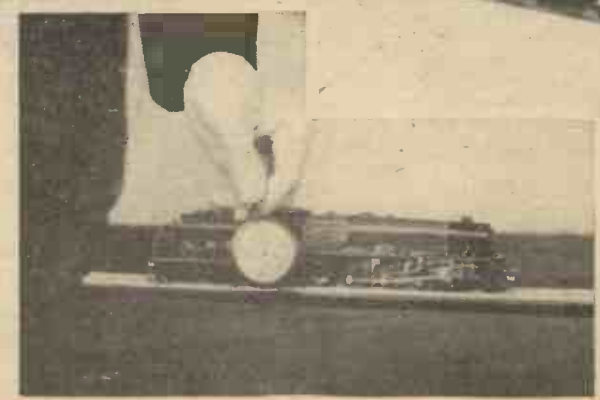
Luton Minor Insurance

THIRD party insurance is compulsory for the Luton Minor light aeroplane, the construction of which was described in our issues for October, November, December, 1937, and January and February, 1938. Policies so far taken out have cost £7 10s. per annum, the insured bearing the first £5 of every claim. This insurance may best be effected through Luton Aircraft Ltd., Phoenix Works, Gerrards Cross, Bucks.

Registration, which is non-recurring, costs £1 1s. Application is normally made to the Air Ministry, who supply a form for completion and return, together with the fee. The permit to fly is issued with the registration, provided the insurance policy is submitted to the Air Ministry for examination. The above company will be pleased to arrange registration for constructors without any additional charge.

TWO NEW TWIN TRAIN MODELS FOR SEASON 1938/9





(Above) A scale-length bogie corridor coach which is fitted with internal lighting.

(Left) A scale model of the L.M.S. 4-6-2 Princess Elizabeth.

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Advertisements are accepted for these columns at 3d. per word (minimum 12 words at 3s.—advertisements of less than 12 words are charged at the minimum rate of 3s.) subject to a discount of 2½% for 6 consecutive monthly insertions or 5% for 12 consecutive monthly insertions. TERMS:—Cash with order. Cheques, Postal Orders, etc., should be made payable to George Newnes, Ltd. *The Proprietors reserve the right to refuse or withdraw advertisements at their discretion.* All advertisements must be received on or before the 5th of the month preceding date of publication and should be addressed to the Advertisement Manager, "Practical Mechanics," George Newnes Ltd., Tower House, Southampton Street, Strand, W.C.2.

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OWN A BOAT or canoe this year. Home kits from 27/6. Completed craft of all types also. List stamp. Trade. Metacraft (P), Christchurch, Hants. London Stockist: Lewis, Weybridge Station, Surrey. Ireland: Hammond, 104 Middle Abbey Street, Dublin.

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CINEMATOGRAPH FILMS. Standard Size from 6d. 100 feet. Machines, Accessories. Sample Films 1/- and 2/6 post free. Catalogues free.—"Filmeries," 57 Lancaster Road, Leytonstone, E.11.

WANTED IMMEDIATELY for CASH—Small lathes, precision tools, fractional A.C. motors—Microscopes, telescopes, binoculars—Modern cameras and enlargers—Home-cine films, cameras and projectors. Highest cash prices paid.—Frank, 67 Saltmarket, Glasgow.

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¼-h.p. A.C. MOTORS. REPULSION or CAPACITOR, All voltages, £2/2/6 each. D.C. £1/2/6.—Johnson Engineering, 86 Great Portland Street, W.1.

SUPER A.C. MOTORS. Brand New, 1/10 h.p., 30/-; ¼ h.p., 38/6; ⅓ h.p., 38/6; ½ h.p., 55/-; larger sizes. Electric Tools, Machines, Pumps, Compressors, etc.—John P. Steel, Clyde Street Mills, Bingley.

ENGINES

8-h.p. ENGINE, 15/-. Austin 7 Chassis. Pathé Projector.—48, Warmington Road, Sheldon, Birmingham.

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MODEL parts machined, Light Engineering Repairs. Estimates free.—LEWIS GATENBY, Engineer, 205, Wakefield Road, Moldgreen, Huddersfield.

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12,000 American, Mechanix, Inventors, Scientific Magazines, Books. Samples, 2/6; Catalogue, 2d.—G. A. Final, 15 Nashleigh Hill, Chesham.

MICROSCOPY

THE MICROSCOPE. The British Journal of Microscopy and Photomicrography, 1s. monthly. All Newsagents, or 1s. 1d., post free, from The Microscope, 20/21 Took's Court, London, E.C.4.

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PRACTICAL MECHANICS, MAY, 1938.

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