AERIAL BOMBS AND BOMB RELEASES

NEWNES

PRACTICAL MECHANICS

JULY 1939

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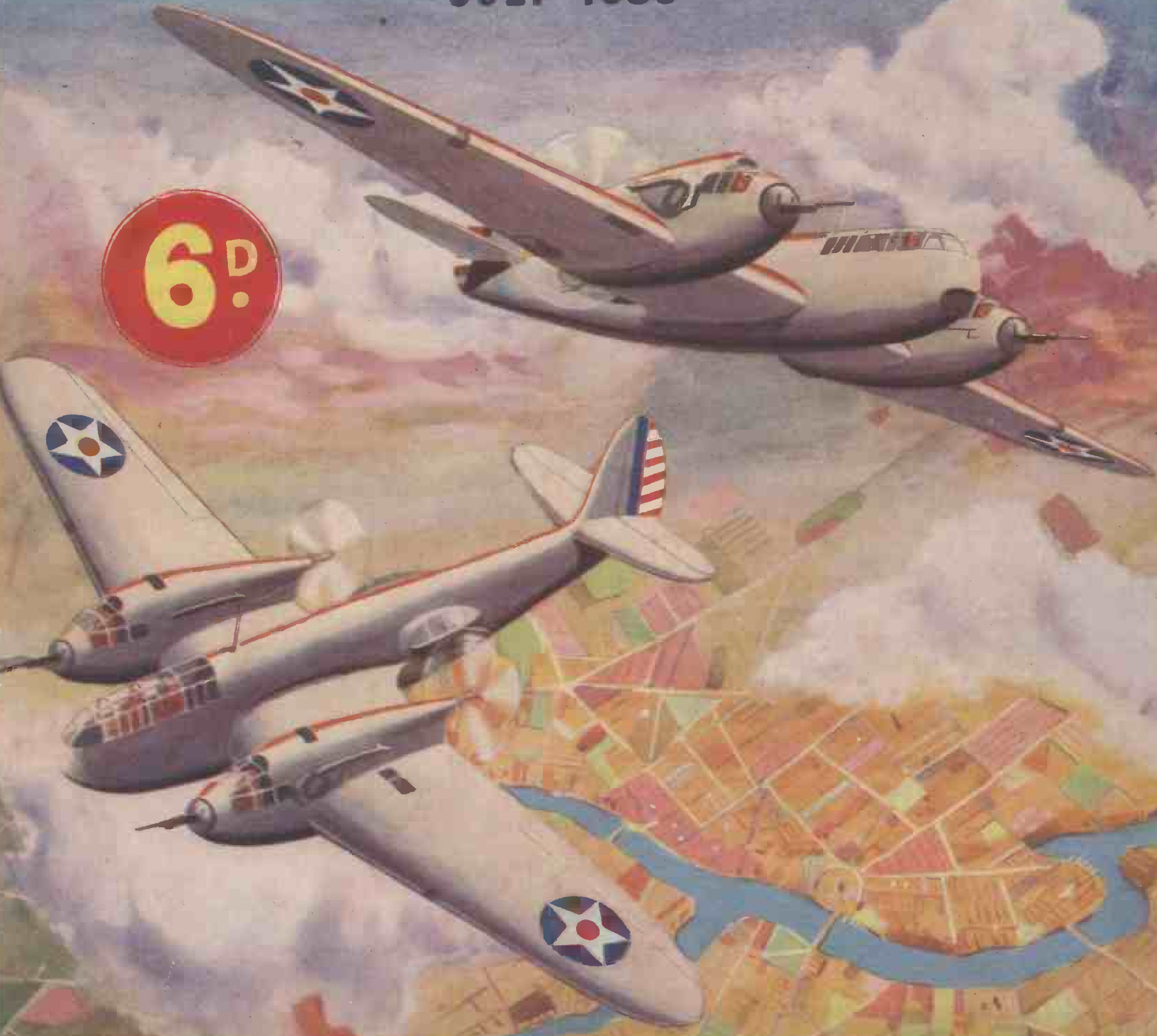

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PRACTICAL MECHANICS

Editor: F. J. CAMM

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THE OLD ORDER CHANGES

OTHER times, other methods! The other day I was inspecting a new housing estate, and some of the dwellings—" modern, desirable residences "—had reached that state of completion where the decorators took charge, in company with those whose job it is to " make good " the various blemishes and imperfections in woodwork, painting and plastering which it seems impossible to avoid. Incidentally, have you ever reflected that we still build our houses by methods which date back to bible times? We still lay one small brick upon another small brick, leaving holes for the doors and the windows. It seems an old-fashioned method, and people still accept plaster as the inevitable material for ceilings, still accept the cracks inevitable with plaster, and still put up with burst pipes, when, if the building trade would only consult scientists, these annoyances need not exist. Plaster is a material totally unsuitable for ceilings, but we continue to use it. The building trade is, in fact, the most backward of all the practical crafts—or how can you explain the fact that after the ceiling has been plastered, electricians must bore holes in it, often cracking it in the form of a star and needing the services of a plasterer to " make good "? Often after the floors are laid it is necessary to lift the boards. The workmen knock the plaster about when with a little forethought and the exercise of a little " design "—that word which architects so overwork but so seldom accurately apply—this could be avoided. However, at this building estate to which I have referred, the decorators had taken charge.

Not many years ago this meant the arrival of a few rolls of paper, which were pasted and stuck to the walls. Usually they were of some fantastic figured design and within a few hours the walls had been covered. To-day, wall decoration has become an art. Ground papers in various shades with overlaps, cornice pieces and panelling, are available in great variety, and before walls are decorated an interior decorative artist will produce a scheme of decoration from which the decorator works.

The planning department is doing what the skilled craftsman should have learned to do. The craftsman did not progress, so a new industry sprang up to supply the demand for modern and improved methods.

It is the same in many other crafts. You cannot hold back progress, and old methods must give place to new, when those old methods have disadvantages which the public will not tolerate.

There are many crafts which have not become modernised. Our road-making methods are still obsolete. Upholstery is still an old-fashioned process. There is a reluctance to accept new methods because they are new—particularly among older craftsmen.

We must accustom ourselves to changing times, and the change in public taste which they bring with them.

The engineering trade is one of the few which has progressed, and will continue to progress. We, too, must change our methods to keep pace with the times. The other day an old-established firm in London which had made harness for centuries complained of lack of business. Where they formerly employed 150 people they now employ six.

That firm still believes that horse-drawn vehicles will survive, and refuses to change its outlook to cater for motor cars. It must eventually die. It is of little use to deplore that " things are not what they used to be." They never were and never will be, and the successful individual is he of sufficient elasticity of mental outlook to refashion his methods to suit the changing times. The industry which is replacing another, however old, is the one for which to go. Where only the shadow of the substance remains, abandon the reflection for the tangible substance. Coming events may cast their shadows, but past events merely leave them. The past is nice to reflect upon, but the rising sun of the future, with its prospects and its hopes, bears greater promise than the lachrymose bleatings about what used to be.

Choice of a Career

SEVERAL readers have made the suggestion that we should publish a series of articles explaining how to select and train for a career. I shall be glad to do this, but should first prefer to take the opinion of all readers on the subject. If, therefore, you would like to have a series of articles explaining various careers in engineering, electricity, radio, the Civil Service, chemistry, the building trade, the Air Force, etc., will you please address a postcard to me expressing your interest. If the result warrants it, I shall then commission experts in the various branches to write the articles.

Our Query Service

WILL readers please note that they must comply with our Query Rules when sending questions. A number of readers are omitting to enclose the query coupon cut from the current issue and the three penny stamps. All questions should be written on one side of the paper only, and questions on separate subjects should be written on separate sheets of paper as they are handled by experts in various subjects. In every case it is necessary for the reader to append his name and address, and a *nom de plume* if he does not desire his name to appear in print. A stamped addressed envelope, must of course, also be enclosed, when a postal reply is desired. It is recommended that this course be adopted owing to pressure on our space.

Fitting a torpedo to a Redland bomber

AERIAL BOMBING

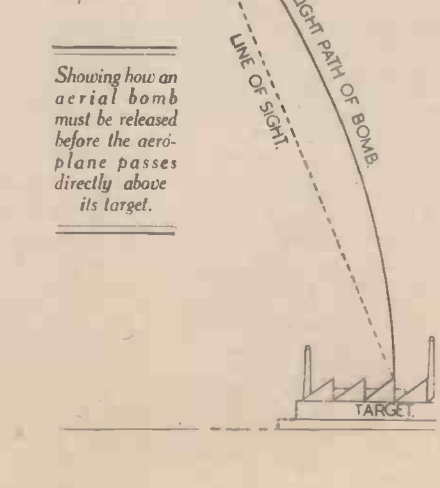
An Outline of the Technique of Aerial Bombing as Revealed by Experience Gained in the Last War.

DEPLORABLE, indeed, as the modern practice of aerial bombing may appear to be, there seems little doubt of the fact that until a lasting international agreement for its suppression can be obtained, the bombing of cities and industrial centres, particularly those of great strategical value, must, in our present troublous times, be looked upon as an inevitable concomitant of up-to-date scientific warfare.

In military tactics, the bombing raid, when suitably carried out, is held to be of great value. Such a raid, of course, need not necessarily be one aimed at a centre of civilian population. On the contrary, it may be confined to objects and centres of military preparation, and, no doubt, in the light of war ethics, its employment in such instances is justifiable enough.

First Bombing Raids

The aeroplane was hardly a year old when the earliest notions of employing it as a military bombing instrument were first put forward. For practical purposes, however, the first bombing raids which were made from aeroplanes took place during the early days of the 1914-18 war, when small hand-bombs were manually cast overboard from low-flying planes on to the enemy's lines. Both sides indulged in this practice, but at a slightly later date, the French developed the "pencil dart" or "flechette," which consisted of a sharply-pointed steel dart. These articles were released in small showers over enemy gatherings of personnel,



Showing how an aerial bomb must be released before the aeroplane passes directly above its target.

and, simple in principle as they were, it is recorded that they were able to inflict considerable casualties among both men and horses.

The further progress of bombing developed through large grenades which were dropped from 'planes, and through incendiary bombs which were rained down in large numbers over enemy structures. Bombing proper, however, may, perhaps, be said to have been given its first "try-out" when, in November, 1914, three large British Avro 'planes flew some 250 miles over German territory and bombed the Zeppelin sheds at Friedrichshafen, inflicting, it is said, severe damage upon the structures in that vicinity.

It would appear, however, that the first aerial bombs which were used constituted almost as great a danger to the airmen who carried them as they did to the troops upon which they were aimed! For such bombs were often too sensitive, exploding, sometimes, almost before they left the aeroplane, whilst others, after being carefully and successfully aimed at enemy targets, refused to explode at all.

Aerial Bomb Construction

It was not long, however, before aerial bomb construction became very greatly improved. The development of bomb-aiming devices was the thing which held back the practice of bombing, for, with the growing frequency of aerial attacks during the last war and the speedy installation of anti-aircraft guns, the low-flying necessary for the accurate aiming of bombs soon became virtually impossible.

Nowadays, thanks to a prolonged investigation of the subject, bomb-aiming sights are used which enable a truly remarkable accuracy of aim to be accomplished, even from a high-flying aircraft.

Experiments were at one time made in order to determine the minimum height at which an aeroplane must fly in order to be safely out of range of a bomb's explosion. In regard to this matter, it was found that some forty pounds of high-explosive could be exploded with safety (from the airman's point of view) on the ground when the aeroplane was flying at a height of about 350 feet. This, the "minimum safety height," would now, of course, be out of the question in the case of a bombing 'plane over enemy lines, since (and, perhaps, fortunately) the sighting devices of anti-aircraft guns have also undergone an enormous improvement during the last few years.

Dropped from Great Heights

Bombing 'planes, therefore, must nowadays release their charges from great heights when flying over centres of military activity, otherwise they stand great chances of becoming the victims of anti-aircraft fire.

Despite such facts, however, it has been the practice of many pilots to release a charge of bombs at the end of every steep and swift power dive, the 'plane diving from, say, 4,000 feet to less than 200 feet within a few seconds, dropping its bombs upon a selected target and then speeding upwards again. Needless to say, such tactics entail a very great risk to the machine and its occupants.

Although there is a very large number of varieties of aerial bombs available for use nowadays, these may be classified into merely a few main types, to wit, the high explosive (H.E.) bomb, the fragmentation or shrapnel bomb, the incendiary bomb and the gas and smoke-producing bombs.

Of the above, by far the most formidable is the H.E. bomb, for it may be made in varieties which not only contain relatively large charges of high-explosive but which are also definitely armour-piercing. The fragmentation bomb is a much smaller device, yet it is a very troublesome one, since, owing to the large number of flying fragments which it gives rise to, a single bomb of this type is capable of causing many casualties (not necessarily fatal ones) among a gathering of troops.

The gas bomb, which, on explosion, would spray a limited area with a poisonous liquid, such as mustard gas, although much has been made of its danger, is not really a very formidable device unless employed in very large numbers. Smoke-producing bombs are, of course, used to cover up movements of troops, whilst another type of bomb not mentioned above, the "flash bomb" contains a charge of magnesium which burns brilliantly and so enables a selected ground area to be illumined powerfully for a brief time during the night.

Incendiary Bombs

Incendiary bombs contain a charge of thermite, which is a mixture of aluminium powder and iron oxide. Suitably ignited, this mixture burns with intense fierceness, attaining a temperature of more than 3,000°C., and thus enabling iron and most other metals to be melted. There is no doubt of the fact that thermite or incendiary bombs, suitably aimed, are capable of effecting much material damage, although the actual casualties which they would bring about would be but slight.

The mode of construction of the average aerial bomb is quite straightforward. The nosepiece of the bomb carries a percussion cap which, on impact, detonates and fires an "exploder charge" which in its turn explodes the entire bomb. In the case of the heavy H.E. bombs, the necessary detonation of the bomb is not left to chance, a mechanism being provided whereby a mechanical blow is delivered upon the percussion cap of the bomb after a predetermined space of time.

In the early days of bombing, single-seater fighting aeroplanes were usually employed as bombers, the pilot releasing the bombs in addition to performing his other hazardous duties. After a time, however, two-seater 'planes began to be used as standard for this work.

Before the end of the war, fighting 'planes had been developed which were capable of lifting some 2,000 lbs. of bombs, whilst single bombs weighing as much as 1,600 lbs. had, on occasions, been employed over enemy fortifications.

Weight Carrying Capacity

Nowadays, of course, the weight-carrying capacity of a heavy and long-distance bombing 'plane has been very greatly augmented so that it is now possible to carry and to release a truly prodigious load of bombs over enemy territory.

Usually, the bomb load is carried by present-day machines in a series of "bomb racks" which are situated under the fuselage of the 'plane. In other instances, however, the bombs are carried vertically under the wings of the aeroplane in addition to a number which are accommodated horizontally under the 'plane's fuselage.

The modern bombing sight is an extremely delicate instrument. It makes provision for the height of the 'plane, its speed, the velocity of the prevailing wind and, also, the speed of a moving target. Even in up-to-date 'planes, the bomb aimer frequently lies prone in the nose of the fuselage, from which vantage point he has the best of possible views of the target. A bomb is not released by a 'plane when the machine is directly above its target. Actually, the missile is released at an instant considerably in advance of that at which the 'plane passes directly over its target. After being released from the travelling 'plane, the bomb makes a forwards curve or trajectory to the ground, such a curve being technically known as the "flight path" of the bomb.

Showing two methods of fixing bombs to bomb racks.

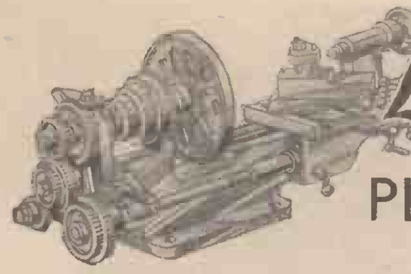
Bomb-Aiming Sight

The modern bomb-aiming sight necessarily allows for the above necessity of having to release the bomb before the 'plane is directly above its target. So accurate, indeed, is the mechanism by which this provision is accomplished that merely a steady flying speed for a few seconds and at a given height previous to the release of the bomb is all that is demanded.

Bombs, can, of course, be released from the modern aeroplane singly or in preselected numbers.

Sometimes, an aeroplane flying over its own territory or that of a friendly nation may have to make a forced landing or even, from one cause or another, may crash to earth. Provision is made for all such eventualities in modern bombing equipment, it now being possible either to drop the bombs "safe," that is to say, without any fear of their exploding, or to land the machine with the bombs in this "safe" or non-explodable condition.

The total bomb weight of an average general-purpose machine or a medium-sized bomber may normally comprise some 500 lbs. released by electrical bomb-releasers which drop the bomb-charge at the mere touch of a button.



Lathe Work

PLANING IN THE LATHE

A SIMPLY-MADE rig for planing surfaces in the lathe is shown in the accompanying drawings. The object is to use the lathe saddle as the work support and traverse the work, bolted to the saddle, along the work bench, the top slide being removed and the plate or other piece to be planed or shaped, bolted to the cross-slide. It is shown in Fig. 1.

The tool consists of a heavy steel or cast iron bar A, of good diameter, which is mounted between lathe centres. At its left-hand end it has a parallel hole bushed with brass or phosphor bronze, B. This journals on a parallel centre, carried as usual in the taper end of the headstock mandrel. The end of the centre is tapered as shown and fits the centre taper in the bushed hole, the centre taking the end thrust. The other end has a hole for a similar centre in the barrel of the tailstock. This has no rotary motion, but the centre is used solely as part of a double support.

Cutting Tool Support

A cast iron clamp, C, fits round both the bar and the tailstock barrel and has a depending leg, D, which goes down between the ways of the lathe bed and is wedged to prevent any rotary movement of the bar, which is simply a rigid support for the cutting tool.

The cutting tool is held in the end of a cylindrical vertical holder, E, which has a vertical central hole in which the tool is clamped by the set screw, F. It is shown in section at H. The main bar is slotted with a back saw some distance along from the hole in which the tool holder fits, and a screw, G, is fitted clearance at one side of the slot and tapped Whitworth at the other, so that when tightened it allows of an adjustment of the bearing of the tool holder in the hole in the bar so that it can be tightened enough to prevent shake or chatter and yet allow the tool holder to be moved down to feed into the work or up to clear it. This is shown inset, at X. This is arranged solely for the feed of the tool and not for a cutting stroke.

A block, J, is clamped to the top of the tool holder as shown and extends outwards at one side, and there is bored, parallel to the bore which takes the tool holder, to take a feed screw, K. This screw screws into a tapped vertical hole in the bar parallel with the hole which takes the tool holder. It is shown also below. A collar at the end prevents the feed screw passing upwards through its top bearing hole and a similar collar at the top prevents it drawing down out of the hole. These collars are secured by taper pins through collar and screw. The top of the screw is filed with a square end on which is fitted the handle, L, shown below the screw, which has a square hole. So that turning the handle feeds the tool towards or away from the work.

The Bar

The length of the bar will be to suit the lathe as will be all the other dimensions. It is shown divided in the drawing to save space and give bigger details.

The work is traversed on the saddle along the lathe bed by the lead screw or the self-act sliding splined gear shaft, which should be well lubricated along its length and especially at the thrust collars at each end. The headstock mandrel, will, of course, be rotating, but it will be rotating in the lubricated bushed bearing in the left-hand end of the bar; two holes for lubrication being provided as shown drilled, and counter sunk from above. One hole feeds lubricant to the anti-friction bush and the other to the hardened tapered end of the special lathe centre, which locates the bar endways.

The thrust of the cut, the work moving in the direction of the arrow shown, is taken by the tailstock in which the bar has no working motion, being doubly clamped. This, of course, relieves the headstock centre of any thrust under rotation.

The speed of traverse—the cutting speed—will be arranged by a suitable arrangement of the screw-cutting train, and the lathe mandrel will be driven at a good speed with the cone locked, the back gear out of operation and the belt on the smallest step of the mandrel belt pulley.

The detail drawings show the parts to the same scale in different views and sections. Dimensions will be decided by the size of the lathe centre holes, the diameter of the tailstock barrel, the height of the centre and the width between the ways of the bed—for the depending torque member which prevents the tool from rotating. The reverse gear of the lathe is used for returning the tool after one cut.

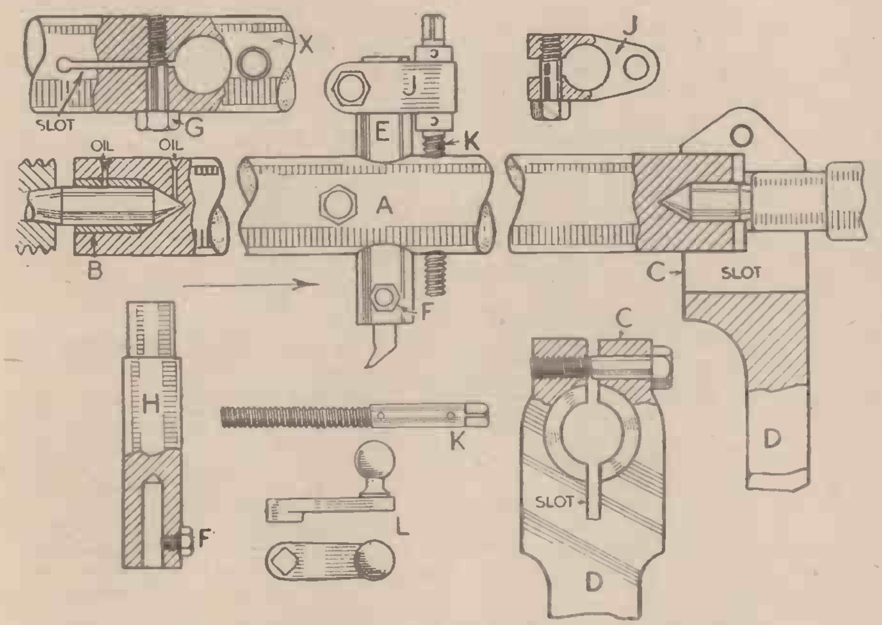


Fig 1.—Constructional details of the rig for planing surfaces in the lathe.

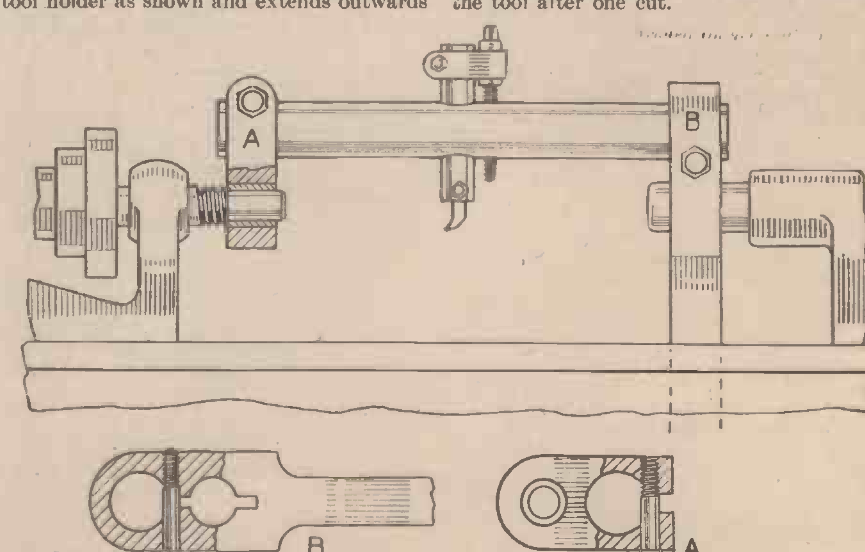


Fig. 2.—Where a lathe has too low centres to accommodate the work, the bar can be made as shown.

A Simple Electric Reflector Lamp

How to make an Efficient and Inexpensive Floodlight for Photographic and other Purposes

Fig. 1.—The funnel reflector attached to the upper end of the narrower tube.

THE simple electric reflector-lamp which is described and illustrated in this article was originally designed and constructed half by way of necessity and half in consequence of a desire to find out by actual trial whether an entirely home-made piece of apparatus could compete, in regard to the matter of working efficiency, with the orthodox and trade-produced type of reflector-lamp for photographic and flood-lighting purposes.

Trials quickly proved that the reflector-lamp illustrated herewith was equally efficient for the above purpose as any commercially sold article and that, in point of actual fact, it had one or two advantages over the latter, mainly on the score of compactness and "adjustability."

Fig. 2.—By passing an iron rod through the holes in the lower tube and through coinciding holes in the upper tube, the lamp assembly is supported steadily at any required length.

"Electrician's tubing"—the steel tubing employed by electrical contractors for running electric cables through—forms the raw material, as it were, of the reflector-lamp and, together with an old tin can of convenient size and a discarded funnel of ample proportions, constitutes practically all that is required for the making of it.

Cost of Material

If, as is very often the case, the above materials can be acquired gratis, then the cost of the completed lamp, exclusive, of course, of its electric bulb, lampholder and flex, will be practically nothing. Even, however, if the necessary electrician's tubing and the funnel have to be purchased, the total expenditure upon a single-reflector-lamp of the type described in this article will not come to more than a shilling or two, provided that the necessary metal-working has not to be paid for.

Two lengths of electrician's tubing are required for the making of the lamp-stand. The first should be about four feet long and the second, which must be of a smaller diameter than the first so that it slides neatly and without much side-to-side play within the former tube, should be an inch or two longer.

The Wide Tube

The wider diameter tube should have a hole drilled through it at about half an inch from its upper end. The lower end of this tube is then given a number of saw cuts with a hacksaw and the strips of metal are gently splayed out, as illustrated at Fig. 4.

The upper end of the *narrower* tube is hammered flat and through the flattened portion a hole is drilled of a diameter sufficient to take a substantial metal bolt. A series of holes is drilled along the length of this narrower tube, each hole being about an inch or so distant from its neighbour. The diameter of these holes should be equal to that of the single hole drilled half an inch from the upper end of the wider diameter tube.

Metal Funnel

A large metal funnel is now obtained. This should have a mouth diameter of between six and seven inches and, as such, it will accommodate electric lamps up to 100 watts power. The narrow neck of the funnel is carefully cut away and an ordinary bakelite electric lampholder is secured to the remaining "stump" of the funnel. This attachment is easily effected, the lamp holder being held firmly in position up against the funnel "stump" by means of its retaining ring.

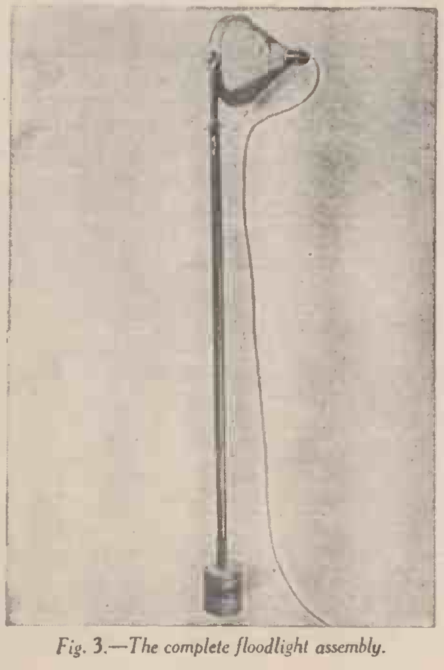


Fig. 3.—The complete floodlight assembly.

Through the side of the funnel a hole is drilled. A metal bolt passes through this and serves as a means of attaching the funnel to the flattened upper end of the narrower metal tube. By means of a wing-nut and a split-washer, the funnel may be held perfectly firmly against the flattened end of the tube. The funnel may, also, be swivelled upwards and downwards and may be held in any position by screwing up the wing-nut.

Before inserting the electric bulb into the funnel lampholder, give the interior of the latter two coats of a white enamel. The popular white "Japanese lacquer," sold at all paint shops, serves this purpose very well.

At this point, the funnel ceases to be a funnel any longer. Instead, it becomes a reflector!

The Reflector

The reflector, *in situ*, is shown at Fig. 1. Fig. 2 illustrates the method of adjusting the height of the reflector and of securing it firmly at that height. An iron or brass rod—an iron nail will suffice, although one is rather apt to catch one's clothing on it—is passed through the hole in the upper end of the lower tube and through a coinciding hole in the inner sliding tube. The metal rod will support the weight of the sliding inner tube which carries the reflector at its upper end. What is more, it will absolutely preclude any twisting of the sliding tube around its own axis.

The Support

In order to support the entire reflector-lamp assembly, the bottom end of the lower tube which has been cut into strips and splayed outwards, is placed within a convenient-sized tin can, supported in a perfectly vertical manner, and either molten lead or a suitable cement mixture is run into the tin. Molten lead is by far the better material to use for this purpose, since it is heavier than cement and makes a very steady base for the lamp-stand. The scrap lead can be melted down in an old saucepan over a gas-ring, skimmed to remove any dross or impurities and then poured gently but quickly into the tin can in which the lower tube of the lamp-stand has been placed. The molten metal will run between the splayed-out portions of the tube and, solidifying, it will firmly embed the lower tube of the lamp-stand and make it perfectly secure and steady.

Final Assembly

In the photograph showing the complete

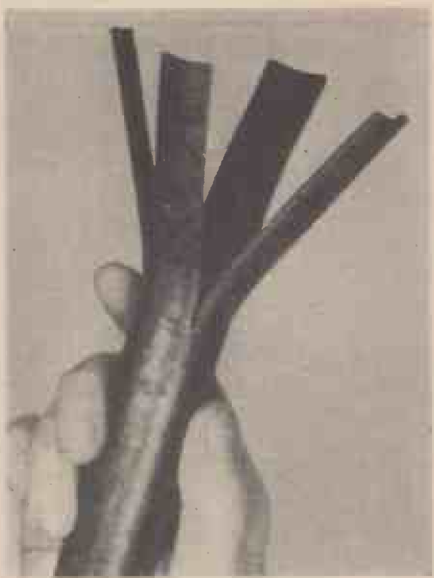


Fig. 4.—Showing the splayed-out ends of the bottom tube.

reflector-lamp assembly (Fig. 3) the lower tube is embedded in lead contained in a syrup tin of the old pattern. This tin (having a liquid capacity of about a pint) holds approximately 12 pounds of the metal and, not only is it compact in dimensions, but it also provides a rock-steady base for the lamp-stand structure above it.

If the reader has not the facilities for drilling the metal tubing in the making of the reflector-lamp, this work will be undertaken by any garage.

The completed lamp will be found to have many uses both photographic and otherwise. For home photography, indoors, it can, of course, be of much service, since it allows a brilliant circle of light to be directed anywhere. For ordinary reading and for house-use, the lamp has many advantages, also. Being freely adjustable, both as regards height and the direction in which its rays may be sent, it is able to concentrate light very efficiently, and for many purposes, electric light bulbs of a minimum wattage may be used in it, thus ensuring a great economy in current consumption.

BOOKS worth READING

"100 Years of Medicine." By Wyndham E. B. Lloyd. The Scientific Book Club. 344 pages. 2s. 6d. to members.

THIS book gives an interesting account of the progress made in the campaign against disease during the past century. It opens with a consideration of the origin of medicine, the theories and practice obtaining among medical practitioners, and the health and diseases of people of the eighteenth century. The book then goes on to describe many of the discoveries relating to medical science and their application to the diagnosis and treatment of disease. Such matters as the Reform of the Hospitals, Medicine and the State, Mothers and Children, National Health Insurance, and Occupational Diseases are among the other subjects dealt with. Technicalities have been largely avoided, and the book should prove equally interesting to the doctor or layman.

"The New Turner's Handbook." By W. Pitt. Pitt's Popular Publications. 64 pages. 1s. nett.

THIS handbook gives much useful information concerning turning and screw-cutting, and the hints given as to the correct adjustment of lathes should be of great help to the turner in a new shop. This little book contains many hints and tips concerning lathe tools, and also includes several useful tables of change wheels, standard threads, and natural sines and tangents.

"Aeroplanes and Aero Engines." By P. H. Sumner. The Technical Press, Ltd. 282 pages, 236 illustrations. Price 15s. nett.

THIS book, which is the third edition of this work, has been considerably enlarged, and includes three new chapters, "Service Aeroplanes, 1939," "Civil Aircraft, 1939," and "New Engines," in order to bring the book up to date and to keep abreast of the recent advance in aircraft design and construction. The volume deals mainly with British practice, and is well illustrated throughout with line drawings and half-tones.

"Men Who Are Shaping the Future." By Edgar Middleton. Published by The Scientific Book Club. 238 pages. Price 2s. 6d. to members.

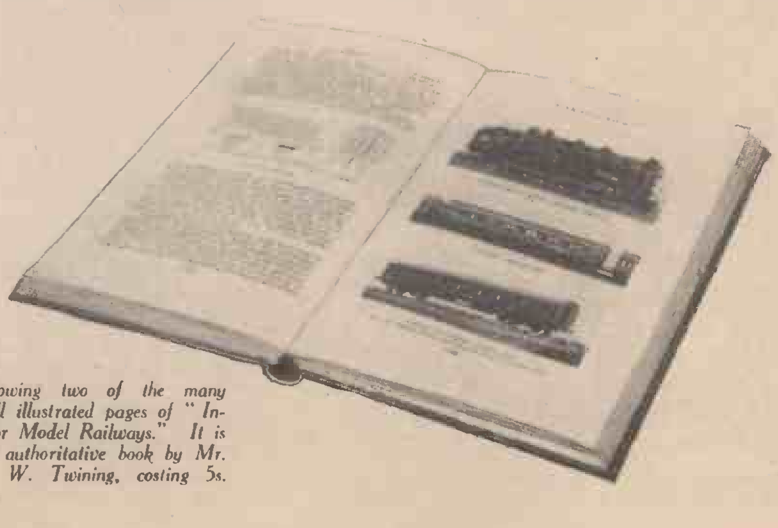
THE purpose of this book is to give details of the scientific achievement of democratic countries, and of Britain in particular. It is written by a journalist who specialises in science for other scientific amateurs, and the story is told in as simple and non-technical language as possible. The descriptions of the fine work of such men as Sir William Bragg, Sir Edward Mellarby, Julian Huxley, Professor F. L. Hopwood, Sir James Jeans, Sir Arthur Keith, John Logie Baird, and S. M. Low make interesting reading. The story of the discovery of insulin by F. G. Banting, and the account of Sir F. G. Hopkins' work in connection with vitamins are also included in this interesting volume.

"Indoor Model Railways." By E. W. Twining. Published by Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Price 5s.

THIS book, which contains 126 illustrations in line and tone, deals exhaustively with the subject of model railways, and is a complete reference book on all its branches. Mr. Twining is one of the best known authorities on model railway design, and has contributed many articles to "Practical Mechanics."

An interesting foreword is written by Mr. F. J. Camm in which he gives a brief biography of the author.

Containing 151 pages, the book deals with the following subjects: Early Small Gauge Railways; Origin of HO and OO Gauges; Gauges, Scales and Dimensions; Electric Traction Motors, Rotation and Reversing; Modelling Prototype Locomotives; Motor Mechanisms and Their Adaptation to Prototype Engines; The Twin Railway, its Locomotives and Electrical Working; Electric Motor Coaches, Carriages, Wagons, and Auto Couplers; Track, Layout and Engineering Works; Third Rail and Two Rail Systems, Control and Signalling and Architectural Features.



Showing two of the many well illustrated pages of "Indoor Model Railways." It is an authoritative book by Mr. E. W. Twining, costing 5s.

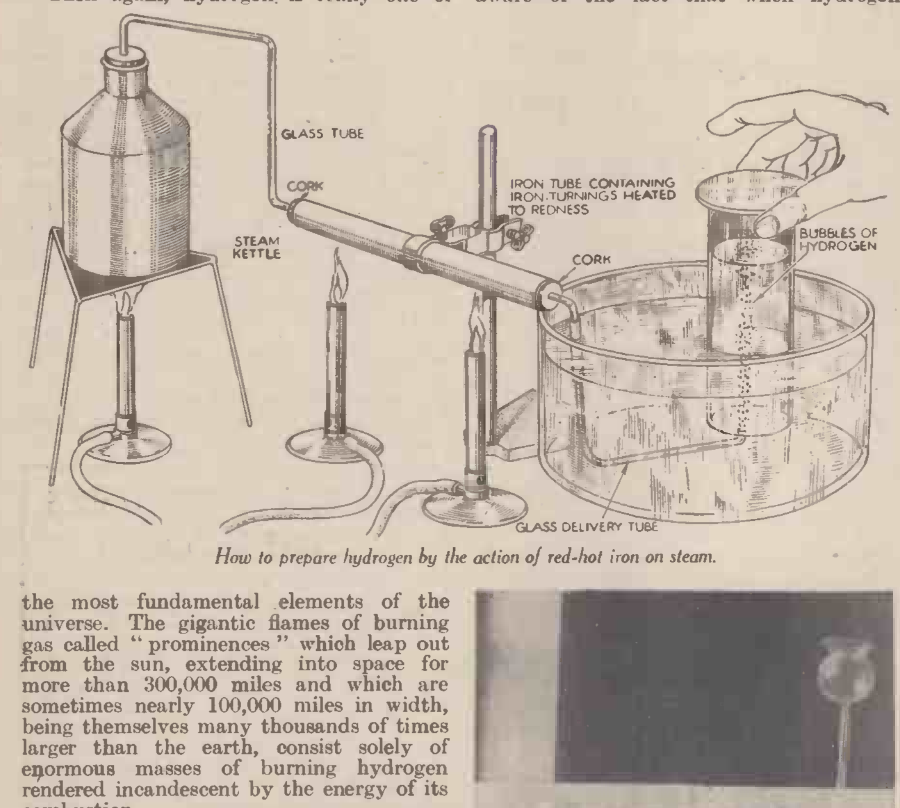
Chemistry for Amateurs

No. 4. Hydrogen, the Water Element—Its Preparation and Properties, Together with Some Interesting Substances which May be Made from It

HYDROGEN gas is one of the most interesting of all known substances. In the first place, it is the lightest thing known, being nearly 14½ times lighter than air, and secondly it is, of course, the "water-producing" element (Greek: *hydor*, water; *gennao*, I produce), for water (H_2O) contains one-ninth of its weight of hydrogen.

Then again, hydrogen is really one of the most fundamental elements of the universe. The gigantic flames of burning gas called "prominences" which leap out from the sun, extending into space for more than 300,000 miles and which are sometimes nearly 100,000 miles in width, being themselves many thousands of times larger than the earth, consist solely of enormous masses of burning hydrogen rendered incandescent by the energy of its combustion.

In the earth's atmosphere, however, very little hydrogen is present. It has been estimated, for instance, that in our atmosphere there is only one volume of hydrogen gas to every 20,000 volumes of air. This, of course, is, from our point of view, an eminently desirable state of affairs, for hydrogen forms with air or oxygen a highly explosive mixture, so that, although hydrogen itself is not directly poisonous, civilised life in an atmosphere containing appreciable amounts of hydrogen mixed with oxygen would obviously be impossible.



How to prepare hydrogen by the action of red-hot iron on steam.

Lightest Substance

The fact that hydrogen gas is the lightest of all substances has, in the past, made it of use for filling the envelopes of balloons, dirigible airships and, nowadays, of course, for the inflation of our A.R.P. balloon barrages, since the upwards "lift" or buoyancy of pure hydrogen is greater than that of any other gas. For such purposes, hydrogen has the great disadvantage of being inflammable and, in view of this fact, it is, whenever possible, for airship inflation, replaced by helium, the next lightest of known gases.

Making calcium hydride by passing a stream of hydrogen gas over heated metallic calcium.

Nearly every chemistry amateur will be aware of the fact that when hydrogen burns, it combines with the oxygen of the air to form water. Or, as the chemical equation puts it:—

$$2H + O = H_2O$$

Now, when a jet of burning hydrogen is fed with a jet of oxygen, the temperature of the resulting non-luminous flame becomes exceedingly high, so much so that the flame is able to cut through sheet iron and steel with the same ease as a candle flame melts butter or fat. In this *oxy-hydrogen* flame we have the means of cutting through thick plates of metal and of welding them together with convenience, speed and facility.

The preparation of fairly pure hydrogen is one of the easiest of laboratory operations, although care must be taken with it in view of the extremely explosive nature of a mixture of hydrogen, gas and air.

Acid Upon Zinc

Reasonably pure hydrogen is most conveniently prepared in the home workroom by acting upon scrap zinc with sulphuric acid.

All we require for this experiment is a strongly made bottle fitted with a cork through which passes a thistle funnel and a glass delivery tube for the liberated hydrogen.

Into the bottle is placed a quantity of scrap zinc, this being just covered over with water. We now pour down the thistle funnel a little strong sulphuric or hydrochloric acid. Immediately the acid enters the bottle, an effervescence will be set up, the zinc becoming attacked by the acid and hydrogen gas being disengaged. After, *but not before*, the elapse of three minutes from the commencement of the vigorous effervescence, a light may be applied to the issuing stream of hydrogen. It will at once ignite and burn with a non-luminous flame, giving off droplets of water.

On no account must a flame be brought near any hydrogen-generating apparatus until you are perfectly sure that all the air has been swept out by the hydrogen stream. If this precaution is neglected, a violent explosion will take place, resulting in the complete shattering of the apparatus.

Collecting Jars

Hydrogen gas is only very sparingly soluble in water. It may thus be collected in jars by the usual method of water-displacement, the hydrogen delivery tube being allowed to dip under water and a

Apparatus for generating hydrogen. The bottle contains scrap zinc (or iron) and sulphuric (or hydrochloric) acid.

glass jar full of water being inverted above it, whereupon the hydrogen bubbles will collect in the jar.

When a small fragment of metallic sodium is thrown on to the surface of water, it swims about with a hissing noise, emitting a stream of hydrogen gas. Metallic potassium acts likewise, but, in this instance, the energy of the reaction is so great that the hydrogen gas takes fire. These familiar reactions have been alluded to in a previous article of this series and they are of little use for collecting hydrogen gas in any great quantity.

If, however, a small lump of sodium metal is placed in a small piece of lead tubing and the latter then dropped into a bowl of cold water, a rapid but steady stream of hydrogen will result, and by inverting a glass jar full of water over the stream of ascending gas bubbles the jar will quickly become filled with hydrogen gas of high purity.

Another way of preparing hydrogen gas is by the electrolysis of water. For this purpose, all we require is a 6-v. accumulator and a couple of pieces of platinum foil or, alternatively, two carbon plates. The accumulator is connected to the pair of platinum foils or carbon plates by means of well insulated wires, the platinum or carbon electrodes being submerged in a bowl of water which has been slightly acidified by the addition of a few drops of sulphuric acid to make it readily conductible.

On turning on the current, hydrogen gas will be liberated at the negative electrode, whilst oxygen will be set free at the positive electrode. Here we have an instance of the electric current being employed for the purpose of splitting up a compound into its elements. Thus:—

$$H_2O \rightarrow H_2 + O$$

Electrolysis of Water

If platinum electrodes are employed for the electrolysis of water it will be found that twice as much hydrogen is liberated as oxygen. If, however, carbon poles are used, a portion of the liberated oxygen will be absorbed by the carbon, so that, in this instance, more than double the amount of hydrogen will *apparently* be set free at the negative electrode.

Other methods of preparing hydrogen gas are the following:—

(a) By boiling scrap zinc in a solution of caustic soda. In this instance, the zinc combines with the caustic soda, forming a white substance known as sodium zincate, and liberating hydrogen gas. Caustic potash also acts in the same way:—

$$2KOH + Zn = H_2 + ZnK_2O_2$$

Caustic potash — Zinc — Hydrogen — Potassium Zincate

(b) By heating sodium oxalate with caustic soda we also get hydrogen liberated and sodium carbonate formed:—

$$Na_2C_2O_4 + 2NaOH = H_2 + 2N_2CO_3$$

Sodium oxalate — Caustic soda — Hydrogen — Sodium carbonate

(c) If, again, we immerse a quantity of scrap zinc in a solution of copper sulphate so that the zinc becomes covered with a film of metallic copper and then boil this "zinc-copper couple," as the coppered zinc is termed, with water, the steam evolved will be charged with hydrogen, the zinc having split up the boiling water in accordance with the equation below:—

$$Zn + H_2O = ZnO + H_2$$

Zinc — Water — Zinc oxide — Hydrogen

Sometimes, this "zinc-copper couple" will evolve a stream of hydrogen gas on simply being warmed in a quantity of water.

Red-Hot Iron on Steam

Finally, one of the most interesting methods of preparing hydrogen gas is by the action of red-hot iron on steam. This is a very cheap means of preparing the gas and it is one, also, which is used on a manufacturing scale.

Obtain a stout iron or a porcelain tube and fill it with clean, grease-free iron turnings. The contents of this tube must be heated to bright redness and a current of steam passed through it, the steam being generated in a flask or in a suitable tin "kettle." From the outflow end of the heated tube, a glass tube should dip below the surface of water, and by this means the bubbles of hydrogen gas which will arise may be collected by the usual method of water-displacement in jars.

Hydrogen has many interesting properties. It is, of course, a colourless, tasteless and (when perfectly pure) odourless gas, which is inflammable and which burns with a non-luminous, hot flame to form water. So great is hydrogen's affinity for oxygen that a mixture of two parts of hydrogen and one part of oxygen forms a most violent explosive mixture, detonating with great energy to form hydrogen monoxide, or water, in accordance with the equation:—

$$2H + O = H_2O$$

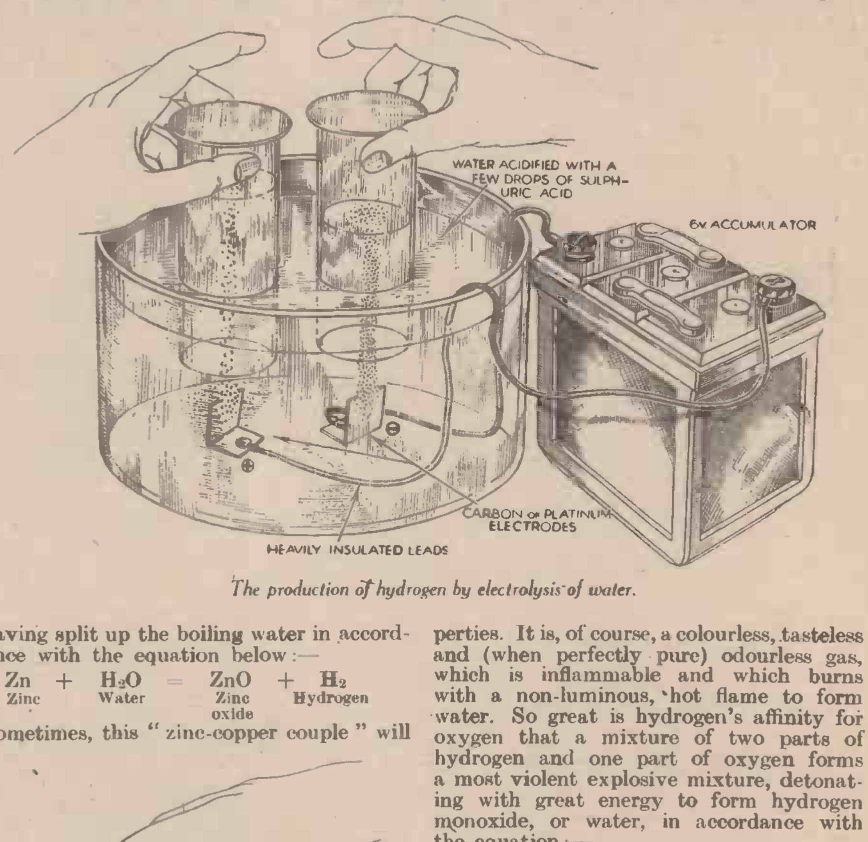
It will be of interest for the amateur chemist to experience the force of this hydrogen-oxygen detonation. This can be effected quite safely by half-filling a glass jam-jar with hydrogen and by allowing air to mix with it. The upturned jar of gas is then ignited electrically by means of a distant-controlled sparking device or by the aid of a burning taper attached to the end of a long pole. Needless to say, this experiment must be conducted in the open air.

When hydrogen is breathed in any quantity it has a peculiar effect on the voice, making it rise to a shrill pitch.

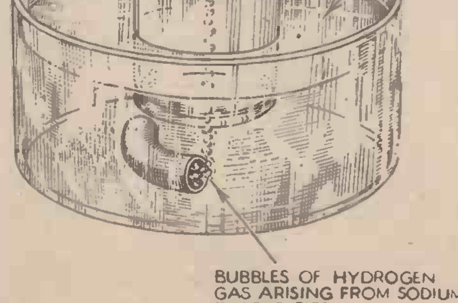
Poured Upwards

Owing to its extreme lightness, hydrogen can be poured *upwards* from one jar into another, an empty jar merely being held over a jar which is full of hydrogen.

In modern gas cylinders which are employed for the inflation of balloon



The production of hydrogen by electrolysis of water.



An easy method of making hydrogen from metallic sodium contained in a lead pipe.

barrages and for other purposes, hydrogen gas is compressed to the extent of 150 atmospheres, that is to say a hundred and fifty times the normal pressure of the atmosphere, which, incidentally, is 15 lbs. per sq. inch. Usually, such hydrogen is manufactured by the electrolysis of aqueous solutions or by the action of red-hot iron on steam.

Just as oxygen combines with most metals to form oxides, so hydrogen combines with some metals to form *hydrides*. Some of these hydrides are nowadays very important bodies, since they are light-sensitive and find much use in the construction of photo-electric cells, the hydrides of caesium and potassium being especially employed on this account.

By passing a stream of hydrogen gas over metallic sodium (or potassium) heated in a glass bulb tube, sodium hydride is produced:—

$$\underset{\text{Sodium}}{Na} + \underset{\text{Hydrogen}}{H} = \underset{\text{Sodium hydride}}{NaH}$$

Sodium and potassium hydrides are white crystalline substances which react with water to form hydrogen and sodium or potassium hydroxide as the case may be. In the construction of some photocells, a thin deposit of potassium or caesium is laid on the glass and subsequently hydrogen gas is allowed to act upon the metallic deposit under strictly controlled conditions, thereby setting up within the glass bulb of the photocell an extremely thin layer of potassium of caesium hydride, which is highly light-sensitive.

By passing hydrogen gas over red-hot metallic calcium, calcium hydride is obtained. This substance, a white powder, which has the formula CaH_2, is a commercial product, being manufactured under the name of "Hydrolith." It is used for the generation of hydrogen, since it evolves a rapid stream of hydrogen gas when acted upon by water, just as calcium carbide produces acetylene by the addition of water.

Most metals, such as copper and iron, do not usually form hydrides by direct combination of hydrogen with the metal. To obtain the hydrides of these metals we must proceed by various and roundabout methods which cannot be explained in detail here. As an example of one of these methods, however, it may be mentioned that copper hydride, Cu_2H_2, is obtained as a red powder by adding a solution of sodium hypophosphite to a solution of copper sulphate and gently warming the mixture.

Gearboxes for Model Aeroplanes

Gears Prove Extremely Efficient on the Larger Rubber-Driven Models Where Weight is not so Important

NO doubt, at some time or another, you have wondered if the model you are flying, or intend building, could be improved by gearing, and this is still one of the most controversial points in model aviation to-day.

First, let us deal with the different types of gearbox used on models. The gearbox can have straight gearing where two-gear wheels of the same size are used, with the top one soldered to the airscrew shaft. (Fig. 1.)

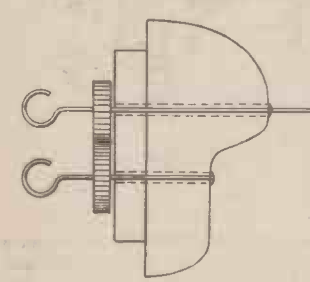


Fig. 1.—Straight gearing where two gear-wheels of the same size are used.

When compared with the turns that can be applied to a single skein motor, this gearbox shows an increase of approximately 50 per cent., with an increased rubber weight of 35-40 per cent. If it is desired, 3 or 4 gears can be used instead of 2. (Fig. 2.)

This method has the advantage of raising the thrust-line, while keeping the centre of gravity low.

Another method is to use a smaller gear at the top and so increase the number of revolutions of the airscrew in comparison with those of the rubber. By using this method, a smaller airscrew can be fitted.

Usually, the gearboxes are fitted at the front of the model, as here the weight of the gears can be used to the best advantage. Fitting the gearbox at the rear of the fuselage is not generally good practice as it makes a model tail heavy. There is no end to the different combinations of gears that may be used and it rests with the reader to decide the number of gears, and which arrangement is most suitable for his machine.

A Duration Model

For the normal duration model, I rather doubt if gears are of any great advantage, as their weight is a factor which must be taken into consideration, and the majority of machines flown in duration contests to-day rely on the straight drive single-skein motor.

It is on the larger rubber-driven models, where weight is not so important, that gears prove efficient, for here the amount of rubber, if stored in one single skein, is unwieldy and a tremendous improvement can be obtained by splitting it into several separate skeins. Also, scale-model enthusiasts find gears a great asset, for here the weight of the gearbox helps considerably towards balancing the machine properly, and the use of gears allows a scale airscrew to be fitted.

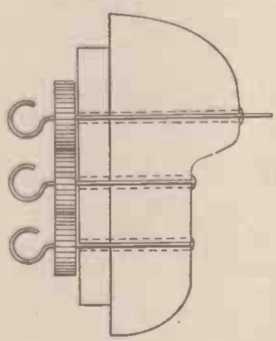


Fig. 2.—A treble-gear drive.

When two gears are used, the two skeins are wound in opposite directions, and this enables lighter construction in the fuselage, another advantage, especially to scale enthusiasts who have to keep the tail light.

When constructing a gearbox, decide on the number, and size, of the gears required, and draw a working diagram. The gears used in the gearbox (Fig. 3) are 11/16-in. dia. and 16 gauge wire is used for the shafts.

First cut a piece of plywood to shape and mark on a centre line. Then thread the gears on to pins which fit fairly tightly. (If these cannot be found, sharpen points on pieces of 16 gauge wire.) The pin with the first gear on it is then pushed firmly into the plywood and the second and third gears are fitted so that the teeth mesh firmly.

This is the most important part in making a gearbox, because if the spacing is bad, the gearbox is spoiled, however well the rest of the work is done. Drill the three holes with a ⅛-in. drill and also drill two holes at the top and bottom of the plywood for fixing to the front portion of the gearbox.

Now fit standard 16 swg screwed bushes into the three holes. These bushes should screw in, and if a little slow-drying cement is used make a very firm fit.

Screw the nuts up tightly on the inside of the plywood and cut off the surplus bush. Now the rubber hooks should be bent and the shafts thoroughly cleaned with emery-paper.

The gears can best be soldered by holding the shaft in a vice and spinning the gear until the solder appears on the other side. Wipe off the excess solder and clean with emery-paper. The shafts are then fitted through the bushes and in order to take the pull of the rubber, care should be taken in soldering the ends. I have found that a small nut, drilled out to fit the shaft, is effective, and if this is carefully soldered, there is no danger of the shaft pulling out. If a ball-race is fitted on each shaft it will greatly improve the running. The gears will now probably be a tight fit and hard to turn. However, put on a little metal polish and turn the gears, and you will soon find that they work smoothly.

The front piece can be made of balsa wood, to fit the shape of the model, but where the plywood is screwed on, two small bamboo dowels should be cemented in as screws will hold better in them than in the balsa wood. Then fit a 16 swg bush in the front piece.

After the gearbox is assembled there is little to worry about, apart from keeping grit away from the gears. In order to do this some people totally enclose their gears.

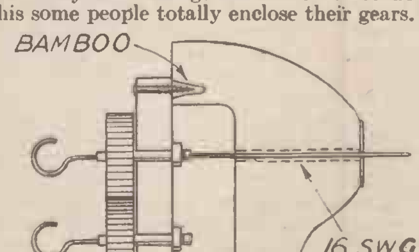


Fig. 3. Constructional details of a gearbox.

THE MONTH IN SCIENCE AND

The driver pouring in a charcoal and anthracite mixture to fuel the latest tractor.

A Recording Mat

A GERMAN mechanic has invented a mat which records the number of drinks consumed by customers in hotels, inns, etc. Records of the "rounds" of drinks are made by the waiters, who use a special key to press a button on the mat.

Power from Wood

IN woods just beyond Princes Risborough, Buckinghamshire, a vehicle has been at work that might well prove to be as great a force in transport as the invention of the petrol engine itself. It has been engaged in clearing a mixed plantation of elm, lime and poplar, and the power to do the work is obtained from the wood itself. In other words it is a Latil producer gas vehicle, running on charcoal. Outwardly, the Latil tractor does not differ materially from any other ordinary tractor. One feature perhaps, a series of tubes over the driver's enclosed cabin, known as scrubbers, and forming part of the gas circulation, gives it a faintly futuristic appearance, but they are not too conspicuous.

The charcoal container does not seem very unusual. The engine of the tractor is, in appearance, like any other tractor engine.

Tunnel Through Mountain

HONG KONG'S world-famed 1,825 ft. mountain, Victoria Peak, is to have a tunnel bored through the base. The tunnel, which will be 2¼ miles in length, will link up the north and south sides, and would cost £770,000 to construct.

Rain Made to Order

IN Hollywood Nature is a pawn in the hands of technicians, who make it rain or snow, and even make the grass grow—at a moment's notice.

Bringing the English countryside and seasons to California for scenes in *Wuthering Heights* required a new kind of ingenuity, for every illusion had to be created in a direct clash with nature. A downpour was one of the desired effects, but even in Hollywood rainfalls are somewhat unruly. Hence when the action called for rain on Pennistone Crag, the whole company moved indoors. There, in the studio, the countryside was rebuilt and overhead was strung a system of sprinklers resembling the modern fire prevention apparatus in office buildings. As they poured out 1,000 gallons a minute the wind machines were turned on to scatter the water and give the "even downpour" effect illustrated.

One of the wind machines, a 400-h.p. Liberty motor, is shown at the right. Its propeller and those of the other units were used to create summer breezes, "drive" a rainstorm and make the winter winds "howl."

New P.O. "Trunks" Scheme

THE Post Office are shortly introducing a scheme for signalling and direct dialling over the trunk telephone network. With the present system the distant exchange is first called by the operator who in turn passes the call on to the subscriber.

With the new scheme trunk exchange operators can supervise the connections on distant main automatic exchanges without the help of intermediate switching. The first trunk circuits to be fitted with the new dialling and signalling system will be those between London and Bristol and Bristol and Plymouth.

Longest Electrified French Railway

THE longest electrified railway line in France has recently been put into operation. It is from Paris to Hendaye via Bordeaux—a distance of 505 miles.

A special train consisting of nine Pullman cars having a total weight of 500 tons accomplished the journey between Paris and Bordeaux, a distance of 363 miles, at an average speed of over 69 m.p.h.

Italy has the distinction of having the longest electrified railway in a single state in Europe, as the line between Brenner Pass and Reggio-Calabria is 620 miles long.

The Art of Walking

MR. W. M. METCALF, an inventor, who has spent 15 years in research on the art of walking, contends that the present design of shoes are the cause of unnecessary friction, strain on the foot, wasteful exertion, and slowing up of the gait. He has now evolved a device which obviates the three separate contacts on the road surface made by a walker, substituting a smooth and easy rolling contact made from heel to toe and incorporating a forward impulse which saves much effort.

Utilising the gap under the instep of the ordinary shoe the device functions in the following manner. Upon stepping forward the heel shock is absorbed with a depression of the spring at the heel. The heel spring then rebounds, giving a lift to the foot on to the main spring under the arch. The depression of the main spring then provides comfortable resiliency and the rebound completes the forward impulse. Invisible when worn, the device should prove of inestimable value to those who walk to any extent. Tests made with this 2½-oz. device have amply justified the inventor's claims. Alleviation of vibration through the system nullifies fatigue and it is claimed that a pedestrian can double his walking range when using the device. See illustration on page 537.

Automatic Letter-box

THE necessity of sticking stamps on to letters has been dispensed with in America—by an automatic letter-box which has been introduced in U.S. post offices. A dial is turned on the letter-box to indicate the stamp value, a coin is inserted and the letter or card is posted in the ordinary way. As the letter drops into the box it is automatically stamped to the required value.

A Railway Shunting Robot

THE latest ingenious device which has made its appearance on the railway is a mechanical shunter which was used for the first time recently at the L.M.S. sidings at Toton, Long Eaton, Derbyshire. Previously, shunting work was carried out by men who ran beside the wagons, using the brakes to prevent them running at too great a speed into other stationary trucks.

The robot shunter consists of a steel platform 62 ft. long, known as a retarder and as soon as a wagon which is running free reaches it, the platform is raised six inches by hydraulic power. At the same time the speed of the wagon is checked by two steel clamps which grip the wheels.

An operator in a control tower can change the points to run wagons into any one of 12 different roads, by simply pressing a button. There are four retarders, and they are all operated from the same control panel.

THE WORLD OF INVENTION

"Invisible" Eye Glasses

OPTICIANS have now produced "invisible glasses" which cannot be noticed by the naked eye at a foot distance and enable the wearer to still look normal. They have a number of advantages over the ordinary spectacles, chief of these being that they can be worn longer without having to be changed because they automatically correct astigmatism.

The lenses are shaped to fit inside the eyelids onto the eyeball and are made of blown or ground glass, or of plastic material—which is the latest development. They are about 1·200th part of an inch in thickness, and once the wearer is used to them they can be worn without inconvenience for hours. Other features are that they do not steam, break or fall off. The glasses cost about £20 a pair and opticians find it difficult to fit the lenses, because they must not touch the pupil.

Kenneth Wright, engineer of Flint, Mich., shown with the autocycle he invented and which he brought to the New York World's Fair. The autocycle is a cross between a car and a bicycle. It weighs 175 pounds. The operator sits in a cushioned seat with his feet on rests by the front wheel. Gear shift and accelerator are hand-operated. Fuel is a mixture of oil and gas and the autocycle will do 50 miles to the gallon at cruising speed of from 35 to 45 miles an hour.

New Atlantic Plane

A GIANT plane, weighing roughly 45 tons, and powered by six motors, is to be built for the Lisbon-New York service. It is expected to cover the route which is 3,000 miles in 20 hours.

Television Experiment

A SUCCESSFUL experiment in television using an ordinary telephone line instead of cable was recently carried out by engineers of the National Broadcasting Company of America. Previously, coaxial cable has been used by American engineers who considered it the only type of wire channel suitable for television. The experiment over the telephone wires was made possible by the development of special amplifiers. The experiment is not new, however, as telephone wires have been used for television for some time past in this country.

Tree Culture

THE National Research Council in Ottawa, Canada, are always experimenting in their efforts to produce trees of better quality and fast growing potentialities for reafforestation purposes.

New crosses have been produced in pine, spruce and poplar, and in the near future the crossing work is to be extended to elm, basswood, birch, larch, maple and ash.

How film producers make it rain or snow to order.

World's Longest Arch

WHAT is claimed to be the world's longest concrete bridge arch is being constructed over the Angermanalven, one of the great rivers in the north of Sweden.

It is 265 metres in length and is about 45 metres in height above the surface of the water. The length of the complete bridge will be 1,256 metres.

An Oscillator Clock

A NEW quartz crystal oscillator clock has recently been installed in the time department of the Royal Observatory at Greenwich. A synchronous motor drives the dial of the clock. The current for operating the motor is generated by the clock itself and the frequency of the supply is controlled to a high degree of accuracy. A valve circuit oscillates at a frequency which is controlled by means of a quartz crystal at 100,000 cycles per second.

For the "Kiddies"

AN invention which will appeal to kindergarten teachers consists of a book, which may be used for educational purposes and also to amuse children.

The book contains at least three pages. The first page bears printed matter narrating the adventures of Little Red Riding Hood, or some other subject which interests the very young. The second page has a number of illustrations, each about the size of a postage stamp. These tiny pictures are perforated, so that they can easily be detached. The illustrations may not follow the sequence of the story, but may be indiscriminately arranged. The third has blank spaces to which the pictures are intended to be gummed. But the pupil is required to affix them in the correct order of the story. This exercise has a beneficial reflex influence upon the mind of the child.

THE WONDER OF THE ATOM

The History and Development of the Atom

WHEN the famous English chemist, Dalton, "discovered" the atom in 1832, scientists thought that the riddle of matter was solved. From that date we have been apt to think of it as a speck of something which is the ultimate state of matter, the smallest particle, so to speak, into which a substance can be divided. The first jolt to our imagination came with the discovery around 1890 that the atom was not the smallest particle, but that these could be further divided into electrons. First of all it had to be decided exactly how the electrons went to make up an atom. Lord Rutherford and Sir J. J. Thompson, two Englishmen whose names will go down into history like that of Newton, startled the twentieth century with the picture of the atom as being a little universe in itself.

The atom, they said, consisted of a centre, or proton, around which the electrons were arranged in the manner of satellites revolving around the sun. The whole was self-contained and practically indestructible: that is to say, the electrons could not be torn from their orbits around the proton. Scientists in all countries set to experimenting and to everybody's pleasure the atom as pictured by the two Englishmen answered splendidly to their requirements, so that mathematical theory began to murmur that not only was the origin of matter solved but they could predict the results of experiments beforehand by calculations.

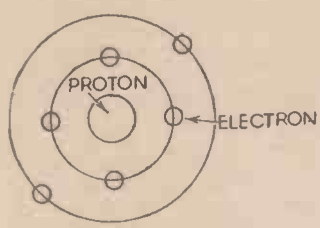


Fig. 1.—The Rutherford atom.

Unexpected Results

But somehow or other things began to go wrong. First of all one or two experiments produced entirely unexpected results. They not only were unexpected but unfortunately contradicted some of the earlier experiments. Slowly but surely the seemingly perfect structure of theory began to crack here and there, more contradictory experiments came in from this country and that until affairs looked like becoming mildly chaotic.

A German, whose name is now a domestic word in science, Max Planck, pointed out that our conception of how the atom with its electrons behaved wanted modifying. He introduced the famous Quantum Theory which said that energy could pass into and out of the atom only in small "packets" or quanta. For the time being the trouble among scientists was smoothed out, at least temporarily.

There now entered the stage a young pupil of Rutherford, a Swede by the name of Niels Bohr, gifted with a penetrating imagination backed by a thorough grasp of mathematics, who twirled, as it were, the electrons of the atoms into motion. The Rutherford action became the Bohr idea of an atom: a proton around which the electrons whirled at incredible speed. All the electrons followed particular paths, in some cases circular orbits, in others ellipses. Once again the furrowed brow of science was smoothed and everywhere experiments began to reveal the reality of this new picture of an atom. It was successful in further explaining radiation, the phenomena of heat and other mysteries. The possibility of splitting the atom became an accepted fact.

Discovery of Radium

Radium had meanwhile been discovered, while Einstein had published his Relativity Theory, both of which were to play a big part in the development of our knowledge about the atom. This brought us to 1913.

The following ten years were not only crammed with surprise but a shadow too was passing over the scientific world. The atom so confidently thought to be a concrete thing in the mind, made up of a proton surrounded by revolving electrons, gradually began to recede from reality.

Instead of experiments bringing man nearer to the truth about matter they carried him farther away.

He was therefore confronted with the anomaly of finding out more about a subject and knowing less. Wonderful apparatus had been devised which could split the atom, send its component electrons in any devised direction. Spectroscopes had been brought to an unheard-of state of efficiency and accuracy to watch the behaviour of an atom when it was vibrating, being split up or formed to other atoms. By what is known as a Wilson cloud-chamber, the path of an electron could be followed as clearly as a meteorite rushing through the heavens. There was little that the physicist could not do, and new, important facts were being produced daily in almost every country of the world where scientists were at work.

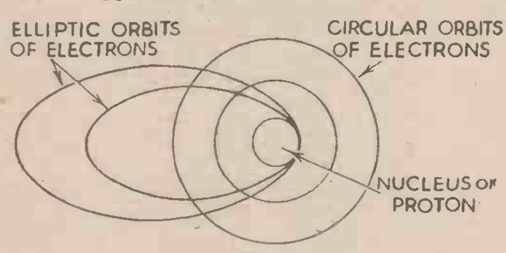


Fig. 2.—The Bohr atom.

A Curious Thing

Still the atom continued to recede as something we could never hope to explain. About the middle of the 1920's things came to a pretty pass, to use a colloquialism. We could not shake off the idea that the atom and the electron were something substantial. It was agreed that they might only be ultimately a kind of point charge of electricity, but, nevertheless, something that we could place in our idea. The curious thing, however, about the whole story was that the electron could behave like a wave or simply like a corpuscle, according to the experiment we chose to illustrate the property.

The path of science is lined with brilliant men, and when it reached 1927 one traveller to appear on the road was a Frenchman by the name of de Broglie. Of a titled family, a prince by birth, this young mathematician sprang an entirely new idea upon science. He asked why consider the electron as something material or like a corpuscle? Why not simply consider it as a wave of energy and leave it at that? Just suppose that electrons are waves of energy following around the proton or centre of the atom. With the intuition of genius he predicted mathematically that electrons would show the wave character clearly if we could find a small enough lattice through which to pass them and cause diffraction, as with light.

Wave of Energy

G. P. Thomson in England and Davisson and Germer in the United States quickly supplied the answer. They used the atoms contained in a crystal as the grating and the electrons, as forecast, were seen to be waves of energy. This was in 1929.

The 1930's then saw the entry of a new kind of scientist, the mathematical philosopher. The conception of the atom as a reality had now receded so far that the ordinary scientist felt he was just beating the air in his attempt to find out exactly what an atom was like. Schrodinger and Heisenburg are two of these new scientists who stand out. They revealed that the atom must no longer be thought of as a little universe of its own, having a central sun and revolving planets. Our mind must, therefore, be rooted out from the idea that this little universe which, incidentally, measures less than a billionth of an inch across, can be pictured at all. Think of it, they say, as merely a mathematical abstraction. The electron is not a "something" but a "probability" that a wave will have its crest at that point. The electron can be everywhere at the same time, but not in the imagination, only in an equation.

For Ever Hidden

It is a sad fact that the atom as we know it has gone, vanished into unsubstantiality. It no longer exists as we would like to think of it in Figs. 1, 2 and 3, which represent the history of development of the idea of the atom. And it is an equally sad fact for those who would like to quarrel with this new conception of "matter" on the grounds that it leads us nowhere, that the new mathematical picture is justifying itself on all sides with experiments. We must perhaps reconcile ourselves to the fact that the riddle of matter may be for ever hidden from us.

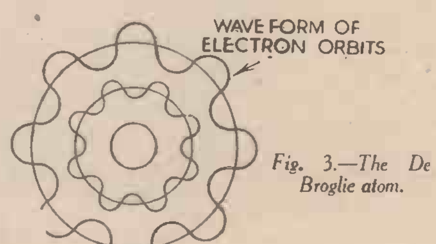
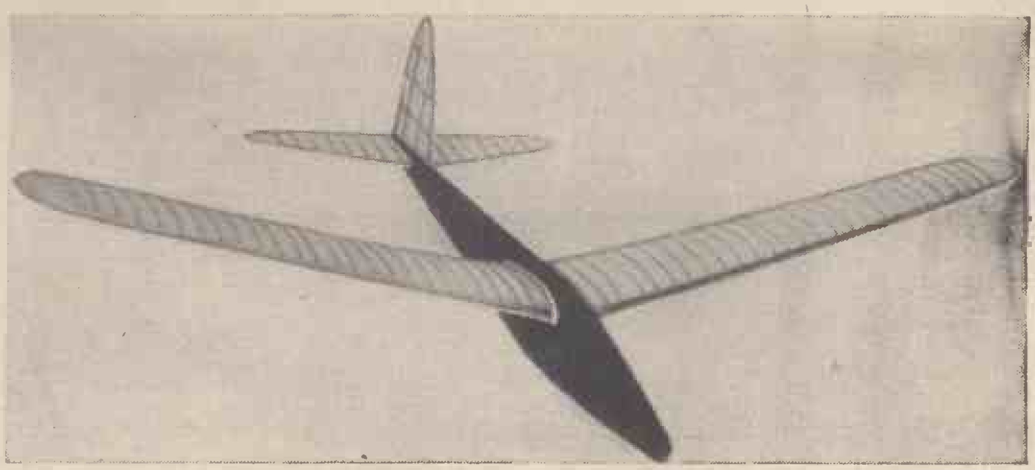


Fig. 3.—The De Broglie atom.

A LIGHTWEIGHT GLIDER



Photograph of the finished glider which complies with the conditions and competition rules for this year's King Peter's Cup Contest.

Features of this Glider are its Streamlined Fuselage and its Lightness of Weight. It has a Wing Span of 58 in.

IT is astonishing that we should revert to flying model gliders, for they were the earliest forms of model. In this connection we have followed the full-size machine, for the Wright Bros.' experiments in gliding were taken as representing the ultimate in that fine art. After the War, full-size gliding was reverted to, firstly by students in the Rhone Valley in Germany, and later in this country.

The pre-War model gliders, like the Wrights' full-sized glider, were capable of very short duration. With our greater experience of streamlining, wing section, air flow, and the greater range of light materials now available, we are able to build gliders which can remain in the air almost as long as some of the rubber-driven models.

Competitions for gliders are regularly run by most of the clubs, and glider flights figure in the S.M.A.E. records. The King Peter Cup—which last year was won by a Britisher and is now on view at the Royal Aero Club—will this year be awarded for model gliders.

King Peter II Cup

This year the King Peter II Cup competition will be flown in England. The elimination trials have already been held. All gliders competing will probably have to comply with the following rules :—

1. A minimum wing-loading of 4.92 oz. per sq. ft. wing area.
2. The minimum value of the maximum cross sectional area— $\frac{(\text{overall length of the model})^2}{200}$
3. Maximum tailplane area equal to 33 per-cent. of mainplane area.

The minimum span allowable is 70 cm. (27½ in. approximately), but this is too small to be really efficient; and the maximum span of 350 cm. (11½ ft. approximately), is, I think, too large, because if an aspect ratio of 12 : 1 is used, the wing area will be about 11 sq. ft., which means a glider weighing 55 ozs. and the structural difficulties would be enormous. Therefore, I think that a span of 5 or 6 feet will probably prove the best.

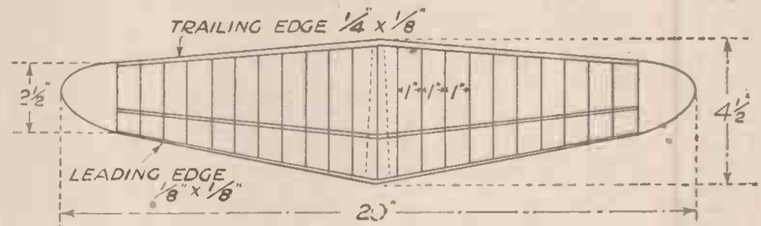
This glider has a span of 58 in. with a wing tapering from 6½ in. at the root, to 4½ in. at the tip, this giving a total wing area of 288 sq. ins.; therefore the glider must weigh 10 ozs.

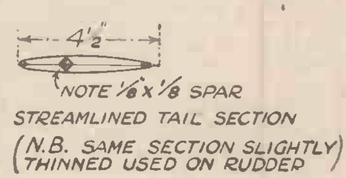
Fuselage

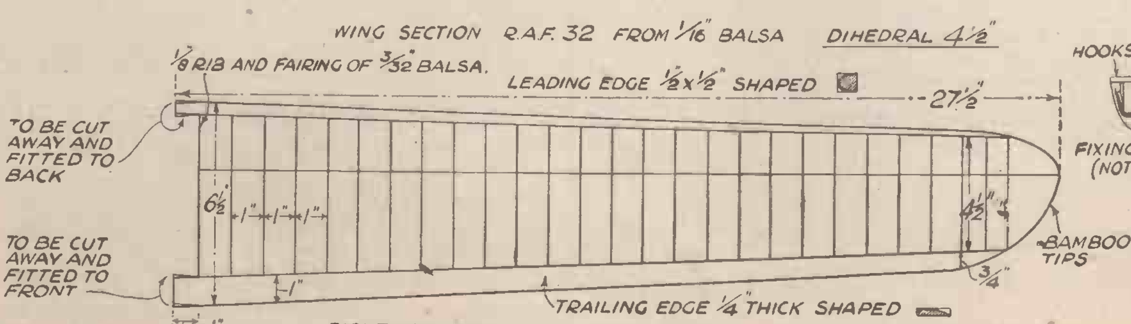
The fuselage is streamlined, with the maximum cross section a 4½ in. x 3 in. ellipse, and an overall length of 35 ins. The construction is very strong, and should withstand any number of hard knocks.

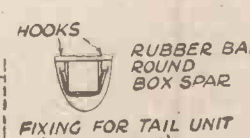
First, obtain a 3-ft. length of ½ in. sq. balsa, and be certain that it is true. Around this build a box spar of 1/16 in. hard balsa, 9/16 in. wide, as shown. Taper the last 4 ins. to follow the shape of the fuselage. This box spar acts as a jig on which all the formers fit, and enables you to build the fuselage true.

Draw your formers on hard 1/16 in. balsa,









(Left) Plan of a half wing and (above) details of the tail construction.

and if you use the method shown here you need not worry about the plan view of the glider, as all the formers are 2/3 ellipses.

Now glue former No. 10 in its correct position, and work backwards to the tail, making sure that all the formers line up correctly.

The boxes into which the wings fit have to be made; the box for the trailing edge must be 1 in. x ¼ in. inside measurement, and the box for the leading edge ½ in. x ½ in. (I.M.). Make these of very hard ⅛ in. sheet balsa, cement well and bind tightly with thread all along.

Mark the dihedral angle on formers No. 6 and No. 9 and cement the wing boxes to them. Be very careful about this. Then cement the braces under the boxes as shown in the drawings. No. 9 former is now fitted on the box spar and cemented in its correct position. Note that the wing box faces the nose of the glider.

Formers

Then formers Nos. 8, 7 and 6 are cemented; the wing box on No. 6 also facing the nose. When former No. 6 is in position, make sure that the distances between the wing boxes are correct, as the wings are dependent upon them for their dihedral and incidence angles. Now cement the remaining formers in place and stick the small paper tube to the tail.

Bend two launching hooks as shown, cement and bind them to a piece of bamboo approximately ¼ in. x ⅛ in., and let this bamboo into the formers, starting at No. 3 and finishing at No. 7. Take care with this, as the landing shocks come on these hooks.

At this stage, examine the parts you have assembled, and see that everything lines up correctly. If so, the fuselage is ready to be planked. This is done by cutting wide sheets of 4-in. or 6-in. by 3/32 in. soft balsa into the shapes shown in the diagrams. The easiest way to plank the fuselage is to work from four directions.

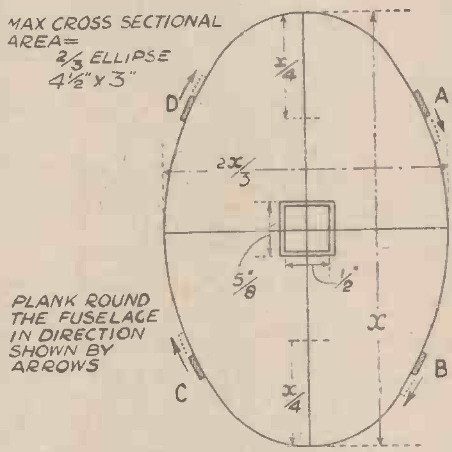
Cement a strip on A, B, C and D; pins will be found useful for holding these strips in position until the cement dries, and then work round the fuselage, a strip at a time, until there is only room for one strip behind each of the four points.

These last four strips will probably have to be shaped separately in order to make them fit well, but with a little care a very neat job can be made.

Covering the Fuselage

Examine the fuselage, and if there are any small gaps a piece of balsa can easily be cemented in. When you are satisfied, sand the fuselage all over until it is about 3/64 in. thick. By now there should be no cracks or bumps on the fuselage.

Now cover the fuselage with tissue, the grain going round the fuselage; and when dry, sand lightly to remove any surplus paste. Then cover with another layer of tissue, this time with the grain going along the fuselage. When dry, sand lightly again. Apply four or five coats of banana oil, sanding lightly between each coat.



This diagram shows a cross-section of the fuselage, giving the proportions in order to comply with the competition formula.

Now for the wings. The trailing edge is made of ¼ in. med. balsa, tapering from 1-in. at root to ¾ in. at the tip, and is shaped to follow the airfoil section.

Make a template (of cardboard or thin plywood) of the largest and smallest rib, and between these place all the ribs required for one wing, roughly shaped. They can then be cut and sanded to perfect shape. Don't forget to make two sets of ribs (one for each wing).

Leading Edge

The leading edge is made from ½ in. x ½ in. medium balsa shaped to the airfoil section. Pin the leading and trailing edges to a flat board and cement the ribs in position. The tips, which are made by bending bamboo around a flame, are then cemented to the leading and trailing edges.

The wings are now lightly sanded to remove any corners or surplus glue.

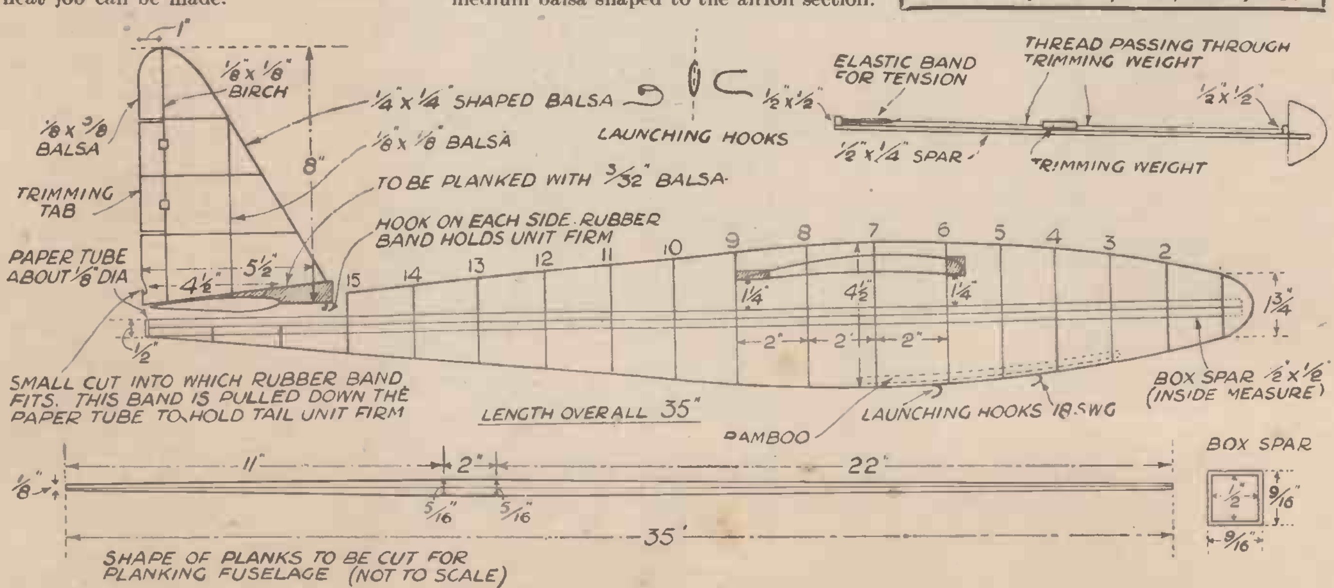
The root rib is made from ⅛ in. balsa and sanded to take the shape of the fuselage. The fairing is of 1/32 in. sheet steamed to shape. When these are cemented in their correct positions, the wing is covered with tissue, doped, and given two coats of banana oil.

The tailplane is made with a ⅛ in. sq. balsa leading edge, ¼ in. x ⅛ in. trailing edge, and with a ⅛ in. sq. spar set in diamond fashion running through the ribs, which are cut from 1/16 in. balsa. The construction is very simple and can easily be followed from the drawing.

The rudder is made of a ¼ in. sq. leading edge shaped to the rib section, a ⅛ in. x ⅜ in. trailing edge, a front spar of ⅛ in. sq. balsa, and a rear spar of ⅛ in. sq. birch. The ribs are 1/16 in. balsa, the trimming, which is made separately, being hinged with aluminium.

Shape a piece of ⅛ in. balsa to fit the last 6 in. of the fuselage, and into this fit the tailplane and rudder, making sure that they line up correctly. Fix the two hooks as shown, and cut the former which is to fit against former No. 15. Cement this in position and plank the tailplane and rudder fairing.

The noseblock can be made from a solid block of balsa cut and sanded to shape. Into this put about 1¼ ozs. lead to balance the fuselage. A spar ¼ in. x 16 in. is then cemented to the noseblock as shown, and a trimming weight of 1 oz.—1¼ oz. is made. This weight lies on the spar running through the fuselage. Final adjustments to flying trim are made by moving the weight backwards or forwards.



Side elevation of the glider fuselage with details of the hollow box spar, the launching hook, and the trimming weight

MASTERS OF MECHANICS

No. 46—The Life Story of the Brunels, Civil and Mechanical Engineers

The Clifton Suspension Bridge over the River Avon near Bristol. It was designed by I. K. Brunel.

A FEW years before the time of the French Revolution, a little boy stood on one of the quays of Rouen, in France, wondering in his own mind what might be the meaning of two large iron cylinders which had just been landed from an English sailing vessel.

He made many inquiries as to the purpose of these mysterious objects, but, at last, a friendly boatman came to his aid and informed him that the iron cylinders were parts of a large steam pumping engine which had come from England, where all such engines were made.

"England?" exclaimed the lad. "Well, then, when I am grown up I shall go and see that great country!"

Youthful prophecies sometimes come true. Certainly the above one did in the course of time, for the inquiring youngster, Marc Isambard Brunel, lived not only to attain the heights of fame as a civil and mechanical engineer in England but, also, to receive the honour of knighthood in our country.

Son of a Farmer

Marc Isambard Brunel was born at Hacqueville, Normandy, on April 25, 1769. His father was a prosperous farmer whose earnest wish was for his son to enter the church. For this purpose the lad was entered at the College of Gisors and, later, at the famous Seminary of St. Nicaise, in Rouen. But it was all to no purpose, for the boy refused to take to classical learning, and, indeed, not even the punishment of solitary confinement which was on one occasion meted out to him could make him take an interest in the Latin and Greek languages or break his love for mechanical drawing and the construction of engine models.

Ultimately, it became clear to Brunel's father that his boy was not destined for classical pursuits. Doing, therefore, what he considered to be the next best thing, the father sadly made arrangements for him to study a course of mechanical subjects with the aim of putting him in the French navy.

And so, eventually, young Marc Isambard Brunel, the despair of his parent, entered the French naval service in which he spent some half a dozen years. Little is to be related concerning Brunel's naval service, but when he left the navy in 1793, he found the land of France in the turmoil of the Revolution. Staying with a relative at Rouen, his Royalist sympathies met with the disapproval of some of the authorities of the day. Indeed, matters became so dangerous for him, that he decided his best plan was to get out of the country forthwith, a feat which he accomplished in the July of the same year, although, let it be said, not before meeting with a certain English girl in Rouen, a Miss Kingdom, who ultimately became his wife.

A Forged Passport

Brunel sailed from Havre on an American vessel bound for New York. He had not been on board for more than half a day when he discovered that he had forgotten his passport! This was a serious matter, but, nothing daunted, young Brunel borrowed a passport from an accommodating fellow passenger and quickly made for himself an exact duplicate of it in his own name.

It was a lucky piece of work, for, hardly had the American vessel got fairly out to sea when a French frigate came in sight and signalled the Yankee ship to stop. French officers than boarded the American vessel and examined all the passports of the passengers, hoping to find a number of unauthorised refugees aboard. Happily, Brunel's forged passport survived the scrutiny of the French officers, so that, the remainder of the voyage being uneventful, he was able to land in New York in the September of 1793.

In New York, Brunel fell in with a couple of fellow countrymen, Mm. Pharoux and Desjardins, who had come to organise a survey of a large tract of land in the neighbourhood of Lake Ontario. Brunel, it would seem, had no difficulty in getting himself engaged in this survey, and, subsequently, in association with an American, he made another survey in connection with a scheme to join the river Hudson to Lake Champlain by means of a canal.

The Royal Albert Bridge at Saltash, Cornwall. It was I. K. Brunel's last engineering feat.

The Younger Brunel

The scheme was quite successful and it added much prestige to Brunel, the young French civil engineer, who was then becoming well known in New York. He commenced a practice as a civil engineer in that city, but, for some reason or other (perhaps, if the truth were known, the reason being a certain Miss Kingdom in far-away Rouen) Brunel could never settle down in New York. Consequently, he sailed in 1798, for England, and landed at Falmouth in the March of that year after a nearly three months' passage through heavy seas.

Not long afterwards he married Miss Kingdom, whom he had first seen at Rouen six years previously, and eventually—on April 9, 1806, was born Isambard Kingdom Brunel, who, in after years became "the famous son of a famous father."

During the first few years of his settling in England, the elder Brunel occupied himself in bringing out various mechanical inventions, many of which were very successful in actual practice. His most successful invention of this period, however, was his devising of a mechanical method of manufacturing "ships' blocks," or wooden pulley-blocks which were used in enormous numbers in the naval services in connection with the rapid hoisting of sails.

Previously, such blocks had been laboriously and slowly made one by one by hand-methods alone. By entirely mechanising the process, however, Brunel, was able to manufacture the blocks at a third less cost and at about ten times the speed of the hand-made block.

The block-making machinery was officially adopted by the British government of the day, but, owing to official delays, Brunel had great difficulty in obtaining an adequate recompense for his services, and it was only in 1810, after half a dozen years of extremely arduous work, that he managed to extract from the Government a payment of some £17,000 for his efforts.

Brunel Enters the Debtors' Prison

The elder Brunel also erected several saw mills near Battersea and invented a means of obtaining extremely thin veneers of decorative woods for furniture making. But, owing to one factor and another (including a disastrous fire at his mills), this invention brought nothing but financial difficulties.

In 1811, Brunel the elder invented machinery for the making of boots and shoes. He again contracted with the Government for the supply of these articles. But, a period of peace ensuing in political and military affairs, the Government rescinded the contract, and Brunel was left with a vast quantity of unwanted footwear in his factory, a loss which eventually brought him to the debtors' prison in 1821, and from which desperate position he was only extricated by the help of influential friends who petitioned the Government to vote him a sum of £5,000 for the discharge of his debts.

After this period, Marc Isambard Brunel entered into the comparatively smooth waters of life, in which he remained until the end of his existence. With his famous son, Isambard Kingdom Brunel, then about eighteen years of age, he designed and engineered the Thames tunnel, the first of the subterranean passages to be cut below the bed of the Thames, and, as a just reward for his many endeavours on behalf of the British Government, he was awarded a knighthood, becoming Sir Marc Isambard Brunel.

Isambard Kingdom Brunel, or "Brunel the younger," as he is now conveniently called, first saw the light at Portsea on the date previously mentioned. Just as Robert Stephenson inherited the mechanical abilities of his celebrated father, so, too, the young Brunel acquired the mechanical genius of the elder. He was educated in England and in France, and, in 1822, he began his professional career by entering his father's office soon after the latter had been released from the debtors' prison.

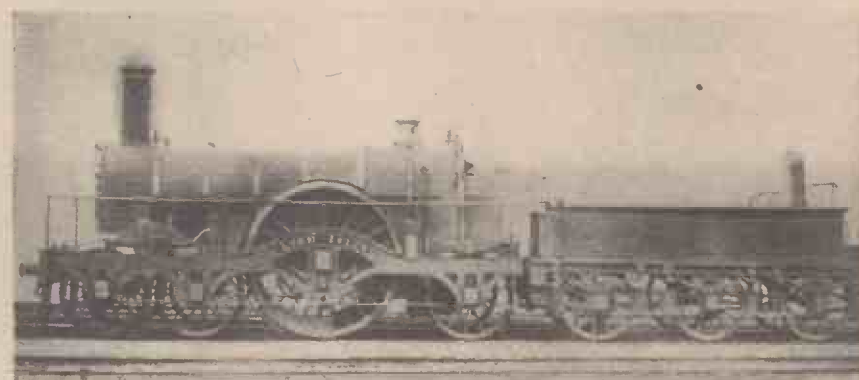
Zenith of His Fame

Brunel the elder was now rapidly attaining the zenith of his fame, and whilst the younger Brunel was a capable and independent engineer there is little doubt that at this time he contented himself by following strictly in his father's footsteps.

As we have already noted, the young Brunel assisted his father in the construction of the then famous Thames tunnel, a feat which was, in those days, truly a stupendous one. Indeed, Brunel the younger became resident engineer on the tunnel construction when but little more than eighteen years of age.

His first independent effort, however, was his designing of the Clifton suspension bridge which carries a roadway high above the river Avon, thereby uniting the counties of Gloucester and Somerset. Such a roadway had long been projected, and, in 1828, the design of a suitable bridge was made a matter of public competition. Even Telford, the great road and bridge-building pioneer entered a design in the competition, but the proposed bridge design of Isambard Kingdom Brunel won the day and formed the commencement for him of a lifetime of engineering success and prosperity.

On account of the lack of funds, Brunel's Suspension Bridge over the River Avon at Clifton was not completed. Instead, the materials prepared for its construction were employed in the building of a somewhat similar bridge which was erected across the Thames at Charing Cross and which was opened for traffic on April 18th, 1845. This bridge was, of course, subsequently replaced by the one connecting Charing Cross railway station with the south bank of the Thames.



An old broad-gauge locomotive "Lord of the Isles." used on I. K. Brunel's railways.

The Clifton Bridge

The Clifton bridge project was eventually completed and its design brought the name of Brunel, jun., under the observation of a group of men who were connected with railway enterprise in the West of England. The Stephensons—George and Robert—had made such a success of their railway system in the North and Midlands that it was desired to extend the railroad facilities down to the shores of the Bristol Channel, and even beyond into Devon and Cornwall. The directors of the newly-founded Great Western Railway Company were unanimous in employing the younger Brunel's services as engineer of their lines, and hence at this period of his life, Isambard Kingdom Brunel became identified with railway engineering to almost as great an extent as were the Stephensons.

But Brunel differed widely from the Stephensons in his views on railway engineering. Brunel, for instance, departed from the narrow gauge railway of the Stephensons, a four feet eight and a half inch gauge, and laid down his rail tracks on a broad gauge of seven feet.

This broad gauge asserted Brunel, had the advantage of enabling more powerful locomotives to be employed and, therefore, of greater speeds being attained. Moreover, he contended that greater comfort in travelling accrued from the employment of the broad gauge railways, whilst—as his directors pointed out—the use of the broad gauge "kept the Stephensons out" of the West Country railroads.

The narrow gauge rails of George and Robert Stephenson were laid on transverse wooden sleepers like the present-day rail tracks are constructed. Brunel, however, departed from this procedure by putting down his broad gauge rails on stout longitudinal timbers—heavy wooden planks which ran in the same direction as the lines.

Battle of the Gauges

For many years the "battle of the gauges" raged in England, some engineers preferring the narrow gauge system, others advocating, with Brunel, the wider 7-foot gauge. Eventually, as we know, the cause of the narrow gauge triumphed so that nowadays this gauge is permanently established as standard throughout Britain.

Brunel at this time not only constructed railways in England. He engineered the Dublin and Wexford and the Cork and Waterford lines in Eire, whilst in Italy and even in far-away India, broad-gauged railroads were constructed under his direction.

As a docks and harbour builder, Brunel the younger showed remarkable industry. He designed and constructed docks and waterworks at Plymouth, Bristol, Neath, Birkenhead and Sunderland.

Then he turned his attention to steamship designing.

Ocean-Going Liners

Isambard Kingdom Brunel designed two steam vessels, the *Great Eastern*, a vessel, of 1,350 tons displacement, and the *Great Britain*, of 3,500 tons. Both these ocean-going liners were successful in point of design and efficiency, but, to some extent, the *Great Eastern* was rather before its time. The building of this vessel led to the formation of the Great Eastern Company which traded with Calcutta and the East. Unfortunately, although the *Great Eastern* was able to perform the then remarkable feat of voyaging to Calcutta and back within two months without stopping to take in coal, the Great Eastern Company proved a failure and led, perhaps, to the younger Brunel's death from disappointment following severely arduous work which event occurred on September 15th, 1859.

Brunel, however, in the year of his death, had at least the satisfaction of witnessing the completion of one of his, nowadays, most celebrated engineering feats.

This is the famous "Royal Albert Bridge," a high structure which suspends the Great Western railway above the estuary of the broad River Tamar 'twixt the counties of Devon and Cornwall.

High up over the portal of this bridge which must be known to thousands of trippers entering Cornwall is still to be read the inscription : *I. K. Brunel : Engineer.*

Electricity in the Garden

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

An Electrically Heated Garden Frame which Will Provide the Amateur Gardener with an Ideal Forcing Frame for Fruit, Vegetables and Flowers

THE effect of electricity upon the growth of plant life has long been observed more or less as a curiosity, its results being variable and due to causes unknown. A more scientific study of these effects in recent years has resulted in a far better knowledge of what is now known as "Electroculture," and it has given the amateur gardener a most valuable means of producing fruit, vegetables, and flowers at times when they would be altogether out of season if left to unassisted nature. The electrically heated garden frame is an example of this progress in practical science and is something that will appeal to every lover of the garden, besides which it is neither difficult nor expensive to make.

Of course, the hotbed derived from the chemical fermentation of manure, and its effect upon the rapid germination of seeds, is a thing well known, but its preparation is a messy job and often fails in producing the desired results, unless at the hands of the professional gardener. So much depends on experience in knowing when to turn and stack up the bed and in estimating when the proper time has arrived to start up the bed in use. At the best it will last only three or four months, and in no case can anything like a constant temperature be depended upon. Electrical soil-heating, however, by means of a buried cable, the heat of which is automatically regulated by a thermostatic switch, which operates at a perfectly definite temperature for an indefinite number of months or years, has made things comparatively easy for the amateur gardener who desires to cultivate crops which are otherwise entirely out of season, with a certainty of success, little attention, and small expenditure.

Numerous Experiments

The way in which electricity can affect plant growth has been the subject of a number of different experiments. One is that of "electrifying" them from very high-voltage overhead wires, the theory being that there is some stimulating effect produced by the "aura" surrounding this highly charged network of overhead wire. The high initial cost of such installations and the considerable risk of having to work in close company with high-tension wires at a potential difference from earth of some 60,000 volts has discouraged any considerable developments along what may be termed electroculture by static electrification.

Growth stimulation by irradiation is another attempt to increase crops, by the effect of strong light continuously applied.

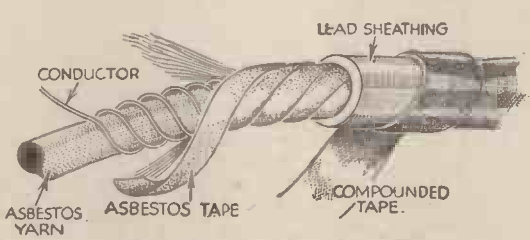
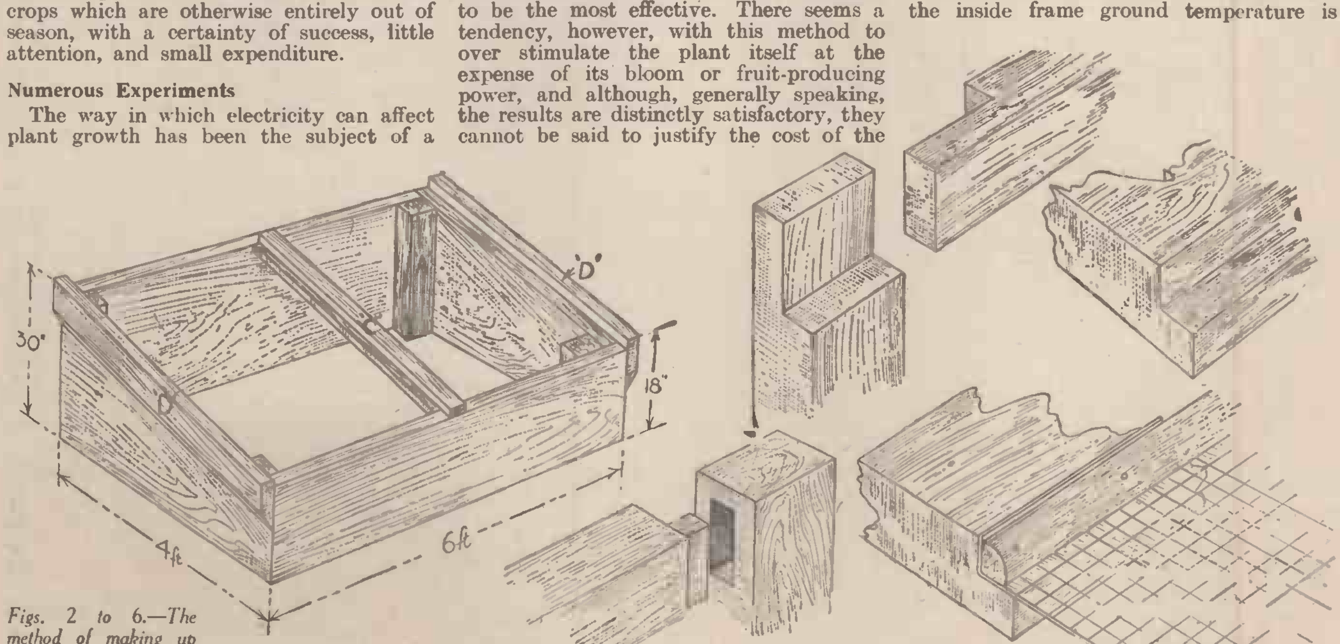


Fig. 1.—Details of the soil-heating cables.

In fact, this may be likened to artificial sunshine, which is well known to be beneficial, both to human beings and to plants. It has certainly a pronounced effect on the ripening and sweetening of fruits. Various kinds of illumination have been tried, such as arc lamps, mercury vapour lamps, neon lights, gas-filled lamps, etc., those giving an abundance of red and yellow rays appearing to be the most effective. There seems a tendency, however, with this method to over stimulate the plant itself at the expense of its bloom or fruit-producing power, and although, generally speaking, the results are distinctly satisfactory, they cannot be said to justify the cost of the experiment from the amateur gardener's point of view.

The Best Hotbed Method

On the whole, the hotbed method of maintaining a sufficiently high temperature at all seasons of the year by the use of buried soil-heating cables has proved the simplest and most practical. A hot-water system of underground pipes is, of course, productive of much the same results, but here again the objection is the cost of the initial installation and the need for the frequent stoking of a boiler. There is nothing automatic about it, and forgetfulness on the part of the attendant may result in dire consequences and ruin the complete crop. A solution of this difficulty is found by utilising the "soil-heating cables" combined with a thermostatic switch produced by Siemens Bros. & Co., Ltd., of Woolwich. These cables are made in different forms and ratings, but the one best suited for the amateur's seed-raising frame is the size measuring 10 yards in length, taking 200 watts, and provided with an automatic cut-in and cut-out switch which can be set to operate at temperatures of either 50, 60, or 70 degrees F., with a latitude of a very few degrees either way. This switch operates by opening or closing two contacts in the main circuit due to the warping effect of heat upon a bi-metallic strip enclosed in a sealed glass tube exhausted of air, closing the circuit again when the temperature falls below the prescribed point. When the outside air is cold the heater remains longer in circuit, and vice versa. But in all cases the inside frame ground temperature is



Figs. 2 to 6.—The method of making up he frame.

maintained at about the same level, and the growing plants are thus prevented from receiving any check to their growth due to cold nights or a sudden frost, to which disasters they are so susceptible in the early stages.

Soil-heating Cables

The nature of these soil-heating cables is shown in Fig. 1. A core of asbestos yarn is wound with a spiral of high-resistance conductor, protected by a layer of asbestos yarn followed by asbestos tape. Over this comes a lead or copper sheath, and finally corrosion is guarded against by a further wrapping of waterproof taping thoroughly compounded. Each length of 10 yards consumes 200 watts, and one 10 yard length will suffice for a frame 6 ft. by 4 ft. About sixty watts per square yard is found sufficient to maintain a soil temperature of 70 degrees F. in cold weather, so that the running costs are very small, especially as most supply companies provide current for soil-heating purposes at a specially low tariff.

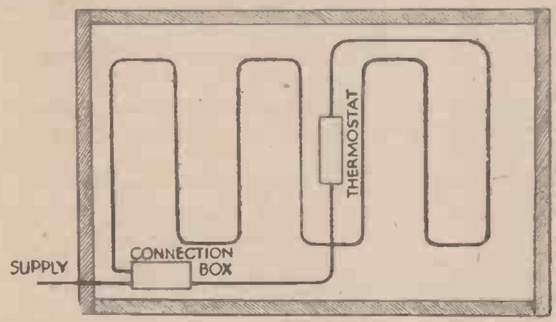
The method of making up the frame is shown in Figs. 2 to 6, and is well within the capacity of all who can manage rough carpentry. Choose a site for the frame as near to the house as possible, since this will economise the length of cable required to supply it with current, and if possible arrange the situation so that the slope of the frame faces south and is not overshadowed by high trees or walls. Since the frame must be regarded as more or less a permanent institution, the method of building it up as shown is to be recommended in preference to making one of the portable or collapsible type. After roughly levelling the ground, a shallow pit is dug to a depth of 15 in. on a plot measuring 6 ft. by 4 ft., and in each of the four corners drive well into the ground a 3 in. by 3 in. oak post (A in Fig. 2), pointed previously, to a depth sufficient to give firm support depending on the nature of the ground. Around these corner posts the rest of the frame can be built up from 1-in. tongued and grooved board to the approximate dimensions given in the illustration. The two sashes slide in the guides C and D, which stand up beyond the main body of the frame by 1¼ in. The framework of the sashes themselve are made from 2½ in. by 1¼-in. pine, either mortised at the corners, as at Fig. 3, or halved together as in Fig. 4, and before fixing the corners a ½-in. by ½-in. rebate is worked round the inner edges to take the glazing, as in Fig. 5. The lower ends of the sashes have this rebate carried right across so that rain can run clear off at the bottom without collecting in a pool. Make a point of thoroughly painting all woodwork with at least one coat of "priming" before putting it together, including all tongues and grooves, and finish with two coats of oil paint afterwards; the job will then last for years if it is given one coat of paint annually. On no account use creosote; it takes too long to get rid of the fumes, which are injurious to young plants.

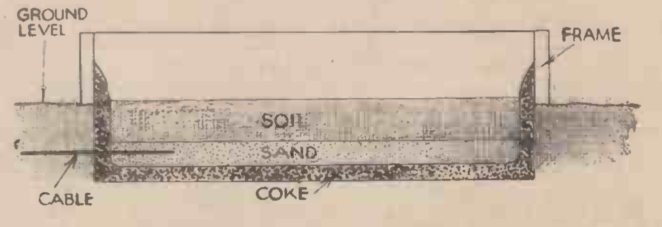
"Windolite"

The material to be used for the frame lights is "Windolite," which is superior in many ways to glass, can be cut with strong scissors or shears, requires no puttying, and is unbreakable. It is obtainable in rolls 36 in. wide, two 4 ft. 6 in. lengths being enough for the two sashes. It is cut 1 in. wider than the measure between the rebates, so that each edge can be turned up in a flange for the fixing beads to hold, as shown in Fig. 6. Tack it first in position as tightly as possible, fix one side permanently with the quarter-round band, and the opposite bead will then strain the material tightly as the second bead is nailed home.

The bed itself for the heating cable can next be prepared. To economise heat and also provide for sufficient drainage, a thick layer of coke breeze or cinders is first laid down at the bottom of the pit to a depth of 4 in. to 6 in., and also banked round the sides. Over this comes a layer of sand 1 in. thick, into which the heating cable is to be well bedded. The cable is usually distributed in zig-zag fashion, as in Fig. 7, and its ends are brought into a small cast-iron box, such as a junction box employed for steel conduit wiring, where, after making the junction with the supply cables, it is sealed with bitumen compound and rendered quite watertight. Over the layer of sand containing the heating cable spread a sheet of galvanized wire netting of about ¾-in. mesh, which will protect the cable from accidents through subsequent digging or soil changing operations. The last item is to cover the foregoing with a final layer of good soil from 6 in. to 9 in. in depth, according to the nature of the plants to be grown and the normal root space they require. A section of the whole arrangement is given in Fig. 8. The supply of current from the house service to the hotbed is best carried out by cutting a trench 1 ft. deep or more and running a short length of armoured 2-core cable the shortest distance possible between the frame and the house meter. A twin lead-covered cable may be employed, and is cheaper, but should be protected by covering it in the trench with half-round drain tiles before filling in. In either case the cable need not be larger than 3-strand 0.029, as the current consumed will be less than one ampere on most town circuits. Connection can be made with the house circuit at the distribution board if no special tariff for soil-heating is obtainable, but it is advisable to fit a double-pole ironclad fuse and switch at the point of entry into the house, so that the garden circuit can be completely isolated.

Under ordinary climatic conditions the normal frame-heating requirements will be from 2 to 2½ units per day, so that when a favourable supply tariff is available the running costs would never exceed 6d. per week.





Figs. 7 & 8.—(Left) Showing the usual method of distributing the cable. (Above)—A section through the complete frame.

PLANING IN THE LATHE

(Continued from page 510)

Setting the Tool Holder

The length of the bar will be according to the length available between lathe centres and the length of work likely to require planing. The tool holder will be set a little to the left of the centre of the bar. This will give the maximum available length of cut on the work which can be done. Clamps or dogs will hold the work down to the cross-slide top surface, which will be stripped of all top hamper which can be removed.

While the saddle traverse will give the cut, the cross-slide will give the side feed and the tool holder the depth of cut. The cross-slide will be traversed for each cut and this can be either away from or towards the operator as the nature of the job most suitably requires.

All the operations in making the rig are boring and turning operations and the only pattern required for iron castings is the top member on the tool holder and the torque member which prevents the bar from turning.

Where a lathe has too low centres to accommodate the work, the bar can be made as shown in Fig. 2. Here two iron castings are bolted to the steel bar, one clamps on the tailstock barrel and the other carries the bearing for the bar on the lathe parallel centre and is bushed. The bars A and B should be of good width so as to prevent the bar springing. The bar, B, is extended down between the ways of the lathe bed and wedged to steady the bar.

End views of the bars show how they are clamped by slotting and fitting a clamp screw—which engages with a slot in the bar and prevents rotation of the bar. The right-hand bar extends down between the ways of the lathe bed and is slotted to clamp from rotation the tailstock barrel which is also locked when the tool is in operation by its own clamp screw.

BRITISH HALL-MARKS

By Victor W. Clarke

Authenticated Marks which are the Craftsman's Guarantee of Quality. How they First Came into Existence Makes an Interesting Story

(Reproduced by permission of the Editor of the "Watchmaker and Jeweller.")

THE story of British hall-marks is a very necessary part of the education of the retail jeweller. He will often be called upon to solve some question of date, style or maker by his client.

You will experience a real interest in this subject when you can say without hesitation which are the marks of London, Birmingham, Sheffield, Chester, Newcastle, Exeter, York, Norwich, Edinburgh, Glasgow, and—by no means least—which are the marks of Ireland as represented by Dublin. The phrase "Hall-Mark" is distinctly a craftsman's guarantee.

Protecting the Public

At the commencement of the thirteenth century it was necessary to restrain by means of an ordinance the fraudulent use of more than the proper quantity of alloy in the manufacture of gold and silver ware, and to protect the public against the fraudulent use of inferior metal by the dishonest worker, and a little later it was found necessary to embody this principle in a law.

Lion passant London mark · *Britannia mark* · *London* · *Birmingham* · *Sheffield* · *Chester* · *Edinburgh* · *Glasgow* · *Dublin* · *Newcastle*

In 1300 it was decreed that no gold or silver ware should be sold until it has been assayed by a duly authorised person.

This law ordained that the mark of quality should be a leopard's head, and that wardens of the craft might be amongst the goldsmiths and silversmiths, search their stock, and anything found of less than the required quality was forfeited to the King.

Here is another interesting point: no goldsmith, silversmith, or jeweller was allowed to set any stone in gold unless it was a natural one. Fortunately, or unfortunately, this law is not enforced to-day.

It was ordained that every goldsmith dwelling in the towns of England should be ordered to come to London "to be ascertained of his touch." There was thus a great army of craftsmen throughout the country who made beautiful silver, and who kept its quality. Although there was no convenient place where their goods could be stamped, they identified their work first with a mark containing some reference to the arms of the town in which they practised and, secondly, with their own initials or monograms.

Craftsmen in Remote Towns

Craftsmen working in remote towns and villages of Cornwall, Devonshire, and other counties, found it very inconvenient, by reason of time, distance and risk, to send their work to the nearest hall to be marked, and that is why so many hundreds of provincial marks have puzzled the antiquary for many years. It was Chaffers and Cripps who led to the more complete investigation by Sir Charles Jackson, and later by De Castro.

It is still the law that no goldsmith or jeweller in the City of London should sell anything wrought of silver unless it was marked with a leopard's head, and that all articles imported should be marked in the same way as those made here. This explains why you find on an article a series of foreign marks, either Dutch, French, or German, together with specially distinctive marks showing that these things are of foreign manufacture. Unless these articles are more than one hundred years old they may not be sold without being sent to be assayed and marked.

Forgery

The marks were further protected against forgery by a very severe penalty for counterfeiting the mark of another die, transposing the mark from one article of gold or silver to another, or the possession of a forged die or any article bearing the mark of a forged die or a transposed mark.

Exeter · *York* · *Norwich* · *Norwich*

This is a very important law, and one which many jewellers have unwittingly broken. There have been cases where the London Assay Office has searched stocks in London, within the last few years, for articles bearing these unlawful marks.

The necessity for this drastic action has been brought about by unscrupulous people who have used a small piece of silver with an old mark to incorporate it with a larger and more important piece; and constant watchfulness on the part of the wardens has been necessary during the years that marks have been compulsory.

The National Association of Goldsmiths was primarily formed with the object of resisting any attempt to interfere with the law of hall-marking, as there have been many attempts to restrict its power and to reduce quality.

This watchfulness has resulted in a series of marks being used by the hall which we call "hall-marks," and we find that the British standard of plate, as represented by those marks, received recognition in every country.

It is interesting to note that nearly all Continental countries have had their own system of hall-marks for many years, notably Holland, France, and Russia—whilst other countries have well-defined, guaranteed quality marks emanating from many of their provincial cities.

Now this country—especially London—possesses so clear a series of authenticated marks that it has become an easy matter to distinguish the very year in which they were placed, with very few exceptions, from 1478.

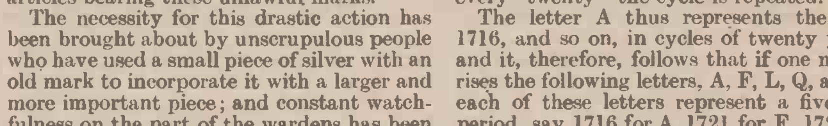
To place a particular mark to a particular date is quite an easy matter—one in fact which you can memorise without difficulty if certain quite easy references are borne in mind.

Memorising London Marks

The date letters for London are in a series of twenty, leaving the letters J, W, X, Y, and Z. This makes it very easy to memorise, because, although the earlier lettering from the year 1478 commences with a different letter every twenty years, in 1696, 1716, etc.—every twenty—the cycle is repeated.

The letter A thus represents the year 1716, and so on, in cycles of twenty years, and it, therefore, follows that if one memorises the following letters, A, F, L, Q, and V, each of these letters represent a five-year period, say 1716 for A, 1721 for F, 1726 for L, 1731 for Q, and 1736 for the last letter, V. In all the cycles these letters recur at

(Continued on page 542)

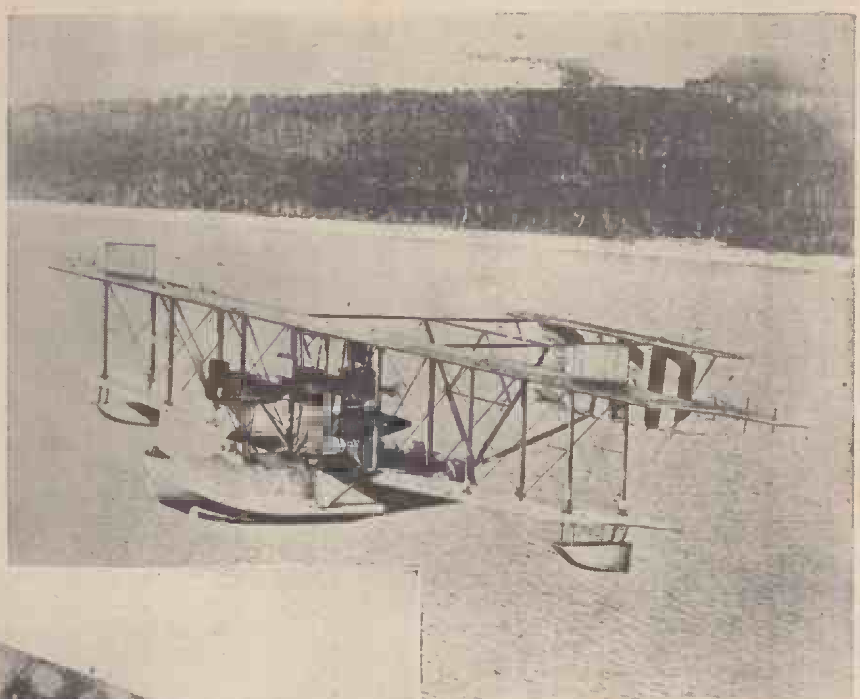


The pointed shield up to 1737. · *Old Chester mark.* · *Indented shield 1737-55.* · *Shield and black letter 1756-76.* · *Shield and small letter 1776-96.*

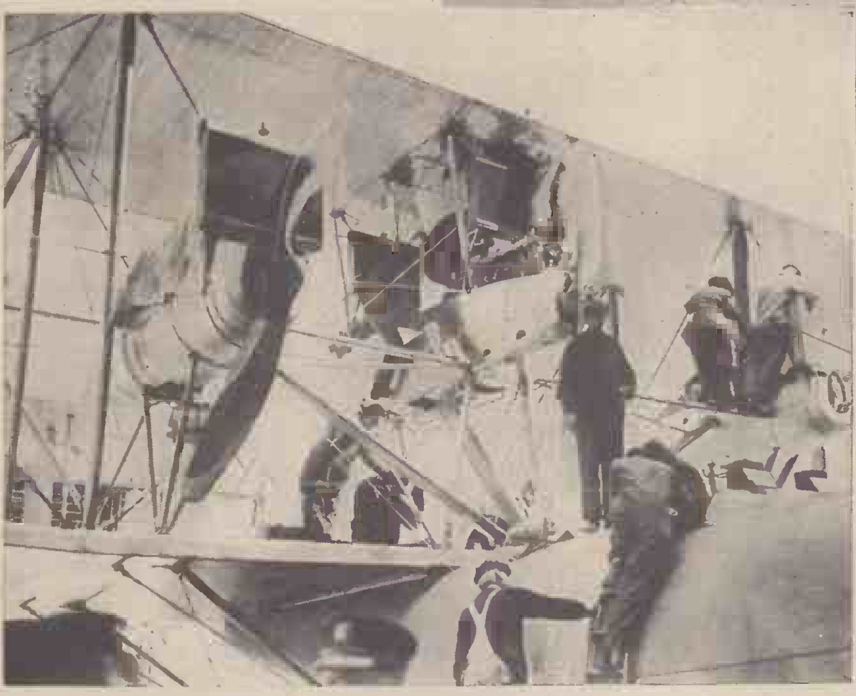
Styles of London shields and letters. 1796-1816. 1816-36. 1836-56. · *Leopard without crown 1821.* · *The King's head facing left, 1789.* · *The King's head facing right, 1786.*

The First Plane to Cross the Atlantic

It was on May 16th, 1919, that Lt.-Commander Read and his Crew set out from Trepassey Bay, in Newfoundland, in the NC-4, to make Aviation History by successfully Flying the Atlantic.



The NC-4 winging her way over the water in 1919.



Mechanics overhauling the engines of the NC-4 before the start of its transatlantic flight. Note the cumbersome arrangement of the motors.

TWENTY years have passed since the American naval seaplane NC-4, manned by a crew of six, blazed the transoceanic airway trail to achieve fame as the first heavier-than-air machine to fly the Atlantic. Since then many daring fliers have made the crossing, but all these earlier attempts stand out in marked contrast when compared with the recent successful round-trip inspection flight of the Yankee Clipper, and the non-stop flights of the Mercury and the Caledonia.

Honours for the first non-stop across the Atlantic belong to two Englishmen, John Alcock and A. W. Brown, who took off from St. Johns, Newfoundland, for Ireland, almost a month after Lieutenant-Commander Albert C. Read and his crew in the NC-4 flew out of Trepassey Bay, in Newfoundland, on May 16, 1919, for the Azores. The first-mentioned flight was a hazardous adventure in a war-type land plane, but that of the U.S. Navy was a well-planned test to prove the feasibility of flying ships long distances over water—a forerunner of the present-day mass flights in which whole squadrons of navy planes are ferried to distant stations.

The Start of the Flight

At the Trepassey take-off, the NC-4 was accompanied by two sister ships, the NC-1 and the NC-3, which were forced down en route. The NC-4 reached Horta on the afternoon of May 17th, after covering the 1,200 nautical miles in fifteen hours and eighteen minutes at something less than 80 miles an hour. After successive hops to Ponta del Gada, also in the Azores: Portugal and Spain, the flying boat finally reached Plymouth, England, on May 31st, 1919. The total airline distance, beginning with the start from Rockaway Beach, Long Island, on May 8th, and including stops at Cape Cod and Halifax, was 4,10? miles.

Growth of Aviation

But it is in comparisons of the NC-4 and the Yankee Clipper, Mercury and Caledonia, that one best realises the tremendous growth of aviation in a generation of transatlantic flying. This decided advancement is even more pronounced as the Clipper retraced the Southern route of the NC-4. On the flight from Trepassey to Horta, the NC-4 did a little better than a mile a minute: the Clipper flew from Baltimore to Horta, a distance of 2,800 miles, at 165 miles an hour. The NC-4 had a crew of six, while the Clipper had a complement of 21 men, the largest number ever carried in a heavier-than-air craft on a transatlantic flight. As a navigation aid the NC-4 received radio reports from destroyers stationed along the route, but the Clipper charted her own course.

Only 1,600 H.P.

The picture on this page shows the historical plane, NC-4, winging her way over water during a flight in 1919. Its wing span was 126 ft. and the length of the hull, 45 ft. Four water-cooled 12-cylinder V-type Liberty motors of 400 h.p. each, gave the 28,000 lb. flying boat a cruising speed of 77 m.p.h. Its maximum speed was 95 m.p.h. Note the cumbersome arrangement of the motors, the "forest" of struts and the exposed positions of crew stations. Streamlining was employed on the struts, engine housings and the hull, but everything else was sheer "drag." Engine trouble in flight always meant a forced landing before it could be repaired. The centre engines were mounted in tandem, with the rear motor turning a "pusher" propeller.

The Yankee Clipper

Now glance at the 74-passenger Yankee Clipper shown flying over Washington, just before starting on its 11,000-mile inspection flight across the Atlantic and back. Its clean, air-flow lines are in decided contrast with those of the NC-4. This giant monoplane-type flying-boat, which weighs 42 tons, has a wing spread of 152 ft. and measures 109 ft. from nose to tail. It is an ultra-streamlined all-metal plane, and the four air-cooled motors, each developing 1,500 h.p., are "faired" into the wings. Easily accessible, these engine stations can be reached while in flight through a catwalk which extends through the wing. In these stations and along the catwalk, every control cable, fuel line and electrical conduit is visible and is easily reached.

The Yankee Clipper shown flying over Washington.

REVERSIBLE PITCH PROPELLERS

Propellers that can be Reversed to Create a Negative Thrust, thus Facilitating the Manœuvring of Large Planes

DEVELOPMENT of an electrically-operated reversible pitch propeller for use, particularly with large multi-engined flying boats, has been announced by the Curtiss Propeller Division of the Curtiss-Wright Corporation, New York, U.S.A. The development has been carried on with the co-operation of the Bureau of Aeronautics of the U.S. Navy.

The reversible pitch propeller—so-called because its pitch may be reversed to create a negative thrust—is expected to greatly facilitate the manœuvring of large four-engined patrol planes or commercial flying boats on the water.

Used for Braking

Thus by operating two propellers in reverse pitch and two in normal position, they may be used as brakes to decrease forward motion, to turn sharply within a small space or even to back up.

With the accelerated development of larger seaplanes and the resultant increase in the problems of handling such immense craft in restricted spaces because of their size and greater inertia, the reversible pitch propeller should greatly facilitate their manœuvring on the water.

While this propeller offers the most immediate advantages to the operation of multi-engined seaplanes, Robert L. Earle, General Manager of the Curtiss Propeller Division, indicates it may also prove of advantage on large landplanes for reducing landing run.

Mr. Earle said the new reversible pitch propeller marked another logical step in the advance of the electrically-controlled propeller as its basic design readily permits incorporation of this new feature.

The increase in weight required for accomplishing pitch reversal on the Curtiss Electric propeller is negligible, consisting only of the necessary cockpit switch and wiring.

Taxi-ing

When taxi-ing with the propellers in normal position, the switch is simply moved to the reverse pitch position and the blades of two of the propellers rotate in the hubs to a position in which operation of the engines in

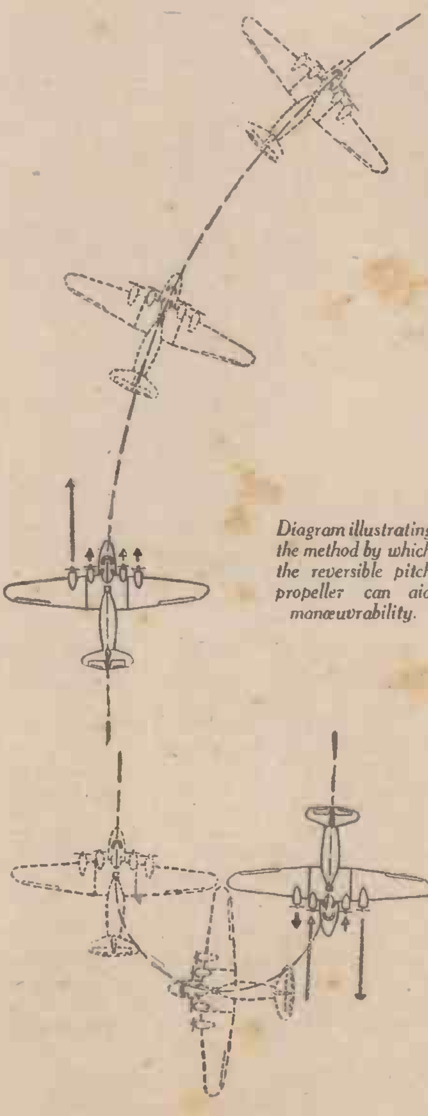


Diagram illustrating the method by which the reversible pitch propeller can aid manœuvrability.

the normal direction of rotation results in reverse propeller thrust.

The change to reverse pitch takes place very quickly, the pitch change being accelerated by the same voltage booster unit used for fast "feathering." Tests indicate that even though the air is blown away from the engines instead of toward them, the latter will cool satisfactorily at the power out-put required for such manœuvring.

The Curtiss Propeller Division of the Curtiss-Wright Corporation developed the first "feathering" type of propeller, this having been recognised by the Collier Trophy Committee in 1938 as an outstanding technical achievement and as one of aviation's major contributions to safety in recent years.

Unshrinkable Wool

A NEW (Dri-Sol) unshrinkable finish for wool has been perfected for eliminating the felting properties of wool which are a direct cause of its shrinkage during washing.

The treatment is as simple as it is novel. Wool, in any form, is steeped for about one hour at room temperature in a 1 to 2 per cent. solution of sulphuryl chloride in white spirit. It is then removed and hydro-extracted, so that the wool contains not more than 1½ gallons of liquor per 100 lb. of dry wool. After this, the wool is washed with water to which is added a suitable amount of an alkali—for example, ammonia or soda ash or sodium bicarbonate, for the purpose of neutralising the acid which is present in the wool. Subsequently the wool may be soaped or treated with softening agents or it may be bleached by stoving or with the aid of hydrogen peroxide in the usual manner.

After such treatment the wool will be found to be non-felting so that when washed in soap it retains its normal dimensions and does not become matted. Its softness of handle and tensile strength will be unimpaired if not improved, and in no way is the durability of the wool decreased.

THE ENIGMA OF ENERGY

Curious Facts Concerning Nature's Most Mysterious Entity

James Prescott Joule who was the first scientist to study the now well-known relations between heat energy and mechanical energy.

THERE is in Lancashire an old saying which has it that "tha ne'er gits owt fer nowt," meaning, of course, that one never obtains something for nothing.

How far this dictum may be correct in the world of humanity is a matter which is clearly foreign to this article, but so far as the varied and multifarious operations and changes of old Mother Nature are concerned, no greater truism was ever uttered.

The world in which we live and have our being and, indeed, the great and illimitable universe which surrounds it and in which it is but a microscopical speck, is governed entirely by two twin entities or fundamentals—matter and energy.

Matter, of course, comprises the material things which we see around us. It is atomic, and, still further, electronic, in structure, as most of us are well aware. But what of energy, that great principle which is seemingly the inseparable companion of matter and by means of which the myriad varieties of matter are activated not only here on earth but on an infinitely greater scale in the vast and unfathomable universe around us? What is, indeed, this mysterious energy, which can so act upon, enter into and impel dead matter in a manner which is as automatic as it is efficient?

Alas, there is, as yet, no really satisfactory answer to that question. Some scientists have supposed that energy is, after all, the only really and fundamental "stuff" of the universe and that matter itself is merely a peculiar complex of energy. Other scientists have asserted that energy is actually a sub-material entity which permeates all bodies, entering into them and departing from them according to the conditions which they are made to undergo.

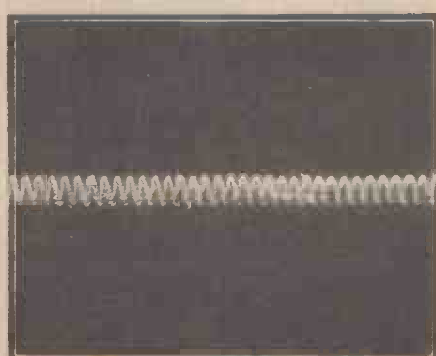
A third group of thinkers conceive energy as constituting a component of a fundamental quantity which they call "action." Now "action," according to this school of thought, is "energy acting for a given time." In other words, "action" is the product of energy and time.

Manifestations of Energy

Whatever energy may ultimately turn out to be, there is no doubt that we are very clear as to its precise effects in Nature. Every reader of this article will be familiar with the various common manifestations of energy, such as heat, light, wireless-radiation, electricity and so forth. He will also be well aware of the fact that it is not a difficult matter to convert one form of energy into another. The friction of a razor blade against its strop results in the heating of the blade. In other words, some of the energy of motion of the blade has been turned into heat energy.

Again, electrical energy in a circuit is partly converted into light energy (and more so into heat energy) in the filament of an electric lamp. The energy contained in steam is converted into mechanical energy by means of a steam engine, and, likewise the energy of petrol is changed into mechanical energy in the internal-combustion engine. All engines, in fact, are merely devices for changing one kind of energy into another.

All the various forms of energy are interchangeable. Heat may be changed into mechanical energy, mechanical energy into heat. Electricity is readily convertable into mechanical energy, or into light and/or heat, and, of course, the reverse of these changes is, also, readily possible, as witness, for example, the dynamo method of converting mechanical energy into electricity.



A typical energy converter of the present day. An electric lamp filament highly magnified.

It is a rather curious fact, however, that when any given form of energy is granted a free choice, as it were, in its transformations, it invariably tends to convert itself into the energy of heat. Heat, therefore, would seem to be one of the most fundamental forms of energy in the Universe, the vast and illimitable reservoir of piled-up energy into which all other forms of energy resolve themselves when free to do so.

A star cluster in space. In these regions it has been conjectured that energy may actually be in process of creation.

J. P. Joule

The first scientist to study the now well-known relations between heat energy and mechanical energy was the famous James Prescott Joule, of Manchester. Actually, Joule was an amateur scientist, having been a brewer by trade. In his spare time, however, he set up in his private house an ingenious arrangement whereby he was able to determine the amount of heat into which a definite quantity of mechanical energy had been changed.

Joule's first experiments were performed on the heat due to mechanical friction. A metal vessel was constructed in which a quantity of water was churned by a paddle moving within fixed vanes. The paddle-wheel was rotated by means of falling weights just as a grandfather clock is operated by this "gravity" principle.

The whole rotating gear was made as frictionless as possible so that all the mechanical energy of the falling weights would be expended in churning up the water inside the vessel.

Now this churning up of the water was accompanied by friction. Consequently, the temperature of the water increased.

For the measurement of this increase of temperature, Joule had made by a scientific instrument maker, of Manchester, John Benjamin Dancer by name, three of the most sensitive thermometers which had ever been constructed. These thermometers are still in existence, and, strangely enough, their sensitivity has never yet been exceeded.

Another series of experiments was made by Joule in churning up mercury in an iron vessel, and, again, by heating a coil of wire immersed in water by an electric current of known strength.

In all these experiments Joule found that the expenditure of a given amount of energy always produced the same quantity of heat. In other words, this amateur scientist showed that there was a fixed and definite relationship between mechanical energy and heat energy.

Conservation of Heat

That, indeed, is Joule's great contribution to science. For from his monumental work developed immediately the fundamental doctrine of the conservation of energy, which says that although energy can readily be changed backwards and forwards into its many forms, it can never be destroyed.

Likewise, we can never make energy. The energy which our muscles supply comes directly from the food with which we regularly fuel our bodies. And, similarly, all the energy-forms with which we are acquainted have their sources in already-existing supplies of energy.

It is precisely for the reason that we cannot make energy that the old Lancashire saying about our never being able to procure "owt" or "nowt" bears with such deadly truth in the natural world about us. It is precisely for this reason, also, that perpetual motion, that fantasy of generations, is impossible.

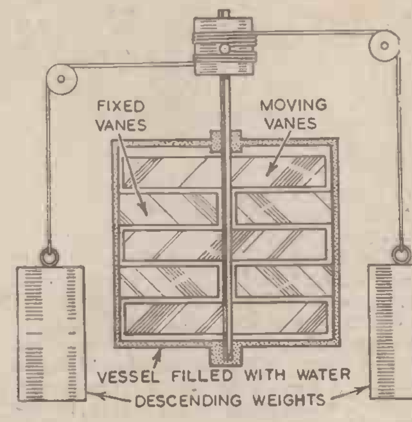
For a mechanism to remain in motion for ever a constant energy-flow into the device would be required. Perpetual motion inventors, however, have always postulated that their machines shall run endlessly without any internal supply of energy. Hence, such machines (if they are ever to be brought into being) must actually create energy for themselves. However, by the Law of the Conservation of Energy, we know that energy cannot be made, and thus it is that any machine, mechanism or device which purports to have achieved perpetual motion must be based upon a fallacy and must, of course, be untrue in its design and operation.

Perpetual Motion

So sure are we of the impossibility of perpetual motion that any modern scientific society would refuse to accept any paper, thesis or lecture which violated this great principle.

Although energy cannot be created or destroyed, it frequently changes itself into a useless form—that of uniform heat. Energy, in fact, is like a "head" of water. It is forever tending to run from high potentials to low potentials. In consequence of this fact, the world and, indeed, the Universe in which we live is somewhat akin to a gigantic clock which has been initially wound up and which is slowly but surely running down.

On our own earth, for instance, Nature has given us supplies of energy in the form of coal, oil, water power and so forth. But these supplies are by no means unlimited. Sooner or later, all the energy supplies of the earth will become exhausted, and even, indeed, the earth's energy of motion will eventually become used up and dissipated. What will take place then, or



A diagram of the apparatus used by Dr. Joule to demonstrate the conversion of mechanical energy into heat energy.

before that time, we can barely conceive. What will happen to our own little system of planets and moons when the sun's energy begins seriously to wane and when that luminary no longer supplies its due quota of light and heat cannot be predicted with any exactitude. Nevertheless, considerations such as these reveal to us the fact that the high potentials of energy in the Universe, apparently vast and portentous as they are, are slowly but surely running down to one uniform level—a level in which the hush of stillness and of death will reign over all things since the total supply of energy in the Universe will have run down to an unavailable condition.

Another Theory

A few modern scientists, revolting against such conjectures, have put forward a theory that far out in the depths of space and in the neighbourhood of gigantic star clusters some process of energy creation may actually take place, despite our well-proved provisions of the law of the conservation of energy. With such conjectures there is, as yet, hardly room for argument. We do know, of course, that in certain regions of space some of our well-known "laws" break down rather badly. Matter, for instance, when travelling at speed in certain parts of space, seems to be actually able to increase in mass without any apparent cause. Thus, we have to imagine that a table hurtling through the great voids of inter-stellar space at an extremely high velocity will become, in some strange and magical way, actually bigger, or, at least, actually denser—which is a conjecture directly contrary to all experience.

If, however, energy be capable of creation in stellar regions and in defiance of our earthly conservation of energy law, such a fact would naturally be entirely without influence on our own lives. For mankind, energy is the fundamental "stuff." Remove energy supplies from our terrestrial domain or render them, in some way, useless and unavailable and our earthly existence would stop short almost as suddenly as the note of any organ pipe bereft of its wind.

HOW PORCELAIN IS MADE

PORCELAIN is, literally, Glass on Steel; in fact, that is also the only description which really conveys the two great features of this finish—a clean, hard, smooth finish of glass supported by the tremendously strong steel sheet on which it is fused.

It is significant that Porcelain has been in use for many thousands of years, and in its earliest known forms it was used in the preparation of works of art. It is only in comparatively recent times that it has been adapted to commercial purposes, and only in the last few years has it been fully applied to its most logical purpose. It originated long before the Christian era, and its first known form was its application by the Chinese and other Orientals to objects of Art, such as statues, jewel chests and certain types of pottery. These objects, now of priceless value, may be seen in a few of the world's great Museums. In those days its production was a secret, known only to a few families, but centuries later we find it first applied to commercial purposes in Germany and Austria. In the natural course of time, it has gradually evolved into an exact science, and the modern porcelain article is, therefore, literally a product backed by thousands of years of human experiment and endeavour.

Production

Its present production is, in itself, an interesting story. In its composition there are nitrate of soda, vallendar clay, cryolite, nickel oxide and cobalt, manganese, feldspar and quartz, fluorspar, soda ash and borax. These are collected from the four corners of the earth, from Chile and Russia, Germany and Greenland, from Canada and Newfoundland, and many of the American States.

These materials are brought together and thoroughly mixed in their correct proportions. They are then heated to a temperature which converts the compound into a molten mass of glass. After maintenance at this heat for some time, the molten glass is released into a larger tank of water, and being thus suddenly contracted it crumbles into minute fragments. This resultant product is known as "Frit." Next, it is milled or ground with water and clay until a liquid of the consistency of thick cream is produced. This is enamel in its crudest form, and is now ready for its first application to the metal which is to form its base.

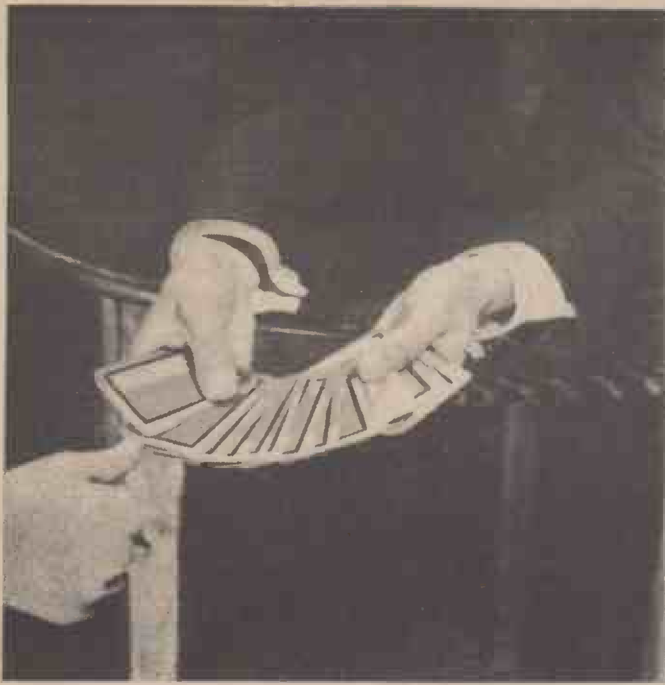
It is an essential part of the vitreous enamel process that the steel is completely free of dirt, grease or foreign matter of any kind, as the porcelain in its later processes is not only applied to the metal, but actually fused into it. Even the slightest amount of foreign matter might cause the porcelain to be defective. The steel is, therefore, degreased, acid dipped, neutralised and thoroughly rinsed in hot and cold water, a series of tanks being employed for this purpose.

Here it is either dipped or sprayed with the first coating of Frit and clay. It is immediately passed into a drying chamber, where it is heated to a temperature of 130 degrees F. This chamber is nothing more than a super-heated drying room, which has for its purpose the complete elimination of all moisture. From this chamber the parts pass to a conveyor, and here the real process of vitreous enamelling first begins.

Picture to yourself the huge brick oven, technically known as a "Muffle," from which a terrific heat can be felt even when closed and at a great distance. This oven is an oil-burning furnace—crude oil being forced under pressure through large jets producing a sheet of flame beneath the oven, heating it to a temperature of 1,700 degrees Fahrenheit. On one side is a great steel door which is electrically lifted when a consignment of parts is ready to be processed. So terrific is the heat when the door is opened that anything to be placed inside must be first laid on a conveyor and propelled mechanically forward through the door into the inside chamber.

The Process

We have already seen our steel sheets with their first coating placed on a conveyor. A button is pressed—the steel door rises, and in goes the first batch of parts—for just three minutes or thereabouts they are inside, again the door lifts, the conveyor operates, and back they come, but this time they are white hot and must be left to cool before handling. As they cool down we see that our dry, mat, rather coarse-looking covering, is changed to a glossy even surface. When the sections are cooled, they pass on to a spraying plant where a second coat of the liquid enamel is applied with spray guns. They are placed in the drying room for a second time, then on to the oven or Muffle, where the fusing process is repeated. The whole of this process takes place a third time, the parts receiving another layer of porcelain at each process.



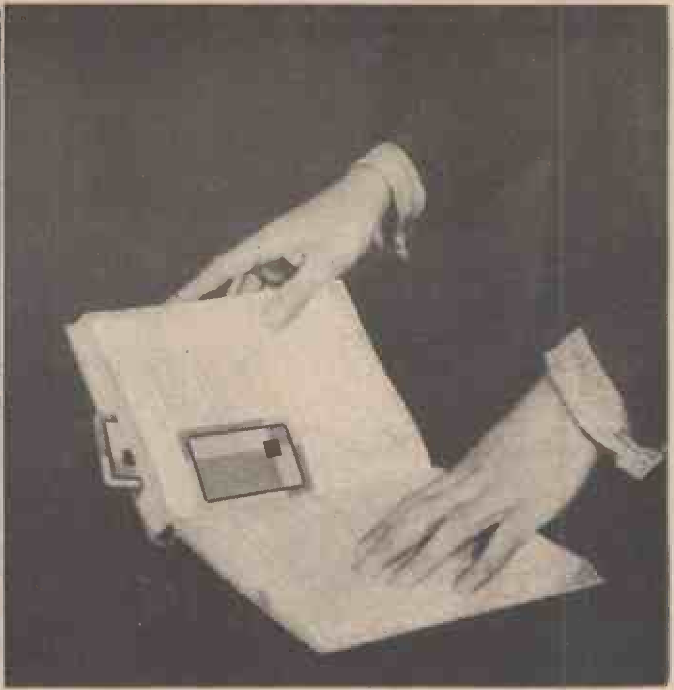


Fig. 1 (left).—Forcing a card by sleight of hand. The card to be forced is shown reversed for clearness. The cards are run from the left hand and the desired card brought gently into the spectator's fingers as he goes to take a card. Fig. 5 (right).—Forcing a word from a book. A card is placed by a spectator into the pages of a closed book. A duplicate card already placed in the desired page is then revealed by the performer opening the book at the pre-arranged page.

THE TECHNIQUE OF FORCING

Methods by Which a Conjuror Controls the Choice of the Audience to Suit his Needs

I HAVE already explained, in previous articles, one or two methods of forcing the choice of the audience so that, while apparently giving them a free selection, the performer actually makes sure that the choice will be made as he wishes. But the subject is so important that it deserves an article to itself.

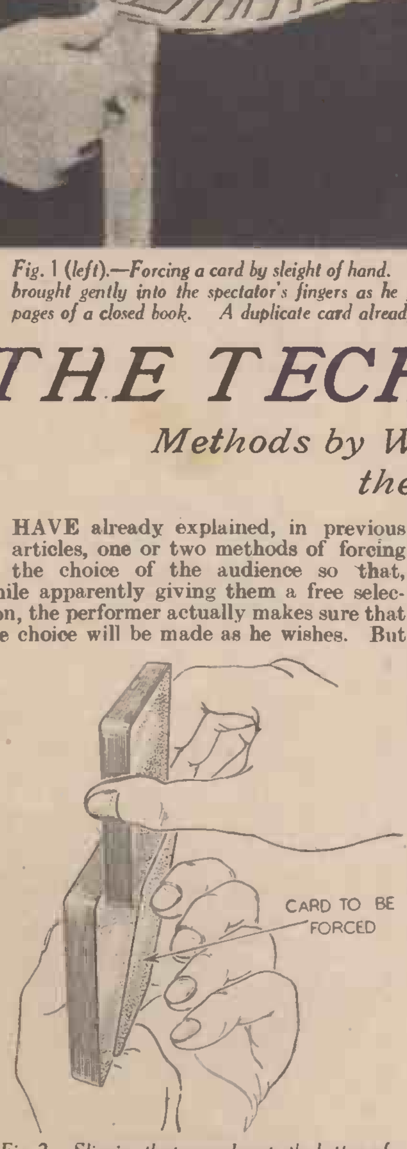


Fig. 2.—Slipping the top card on to the bottom of the pack.

Fig. 1 illustrates a stage in forcing a playing card by the sleight of hand method. This force is not easy, but it requires experience rather than skill. And it is so convincing that it is well worth while acquiring. In the picture the card to be forced has been reversed for the sake of clearness. The card in question is first shuffled to the top of the pack. The pack is then held as in Fig. 2 and cut. The top half of the pack is now laid slightly askew on the bottom portion as in Fig. 3 and the upper cards are fanned out towards the right. The card to be forced is kept carefully in view and the cards are run across from the left to the right, being pushed along from one hand to the other with the thumbs on top and the fingers underneath. The fan is offered to someone with the request that they take a card. As the spectator's hand approaches the pack the movement of the cards is regulated so that the card to be forced arrives at their finger-tips as they reach the pack.

The movements are all easy, but a good many trials will need to be made before you can be sure of forcing the card correctly every time. Do not worry if the person choosing the card realises that one particular card is being forced on him. Subtlety in making the force will come with practice.

Forcing From a Card Fan

Fig. 1 shows the card to be forced ready to be brought round as the spectator's hand comes forward. It is sometimes necessary, if the person taking the card is slow, gently to slide the required card into their fingers. Nine out of ten people will take the forced card without a thought. In making this, or indeed almost any force, it is wise to pick someone who looks as if he or she would rather not be asked to help.

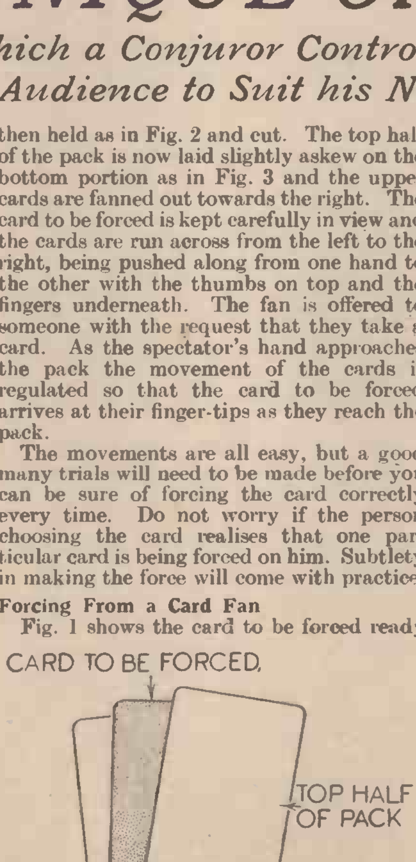


Fig. 3.—The top half placed slightly askew on the bottom half, with the card to be forced in the middle.

By Norman Hunter
(The Well-known Conjuror of "Maskelyne's Mysteries" Fame)
Further Articles on the Secrets of Conjuring will appear Regularly and Exclusively in this Journal

Such people will naturally be rather nervous and will not try to upset the show by deliberately taking some other card.

It will be appropriate now to give some ways of getting out of the difficulty if by chance the force should fail.

If you realise that the force has failed before a card has actually been taken, close the fan and start the force again. If a card other than the right one is actually taken, immediately ask the chooser not to look at it but to put it on top of the pack. You have meantime closed the fan and left the right card on top. Now pick up the two cards as one and put them aside. Later on, by again picking up the two cards together you can show the correct card as the one apparently chosen.

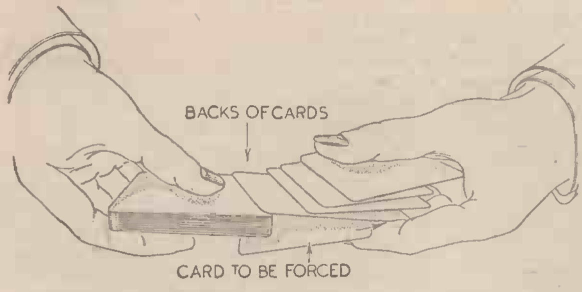


Fig. 4.—Showing how the chosen card is produced.

Wrong Card Chosen

Should the wrong card be chosen and seen, the best thing is to perform some other trick with it; a trick which does not call for the choosing of any particular card, then try the force again on someone else or employ an infallible force next time.

Whenever possible in performing a trick which depends upon a force, try to execute the force before beginning the trick, you are then free to alter the trick if the force fails—whereas, if you make the preliminary preparations for a trick, then do the force and it fails you are in a fix. Finally, as a last resort in such a case you can go through with the trick and when the chooser says that was not his card you say: "I don't wonder, you took the wrong one." This not only turns the laugh in your favour, but usually leaves the audience rather puzzled as to whether anything really has gone wrong at all.

Keeping to cards for the moment, here are some forces that are bound to succeed, though their effect is not so good as the first method.

Have the card on top of the pack and ask someone to insert a finger or the blade of a knife into the pack. Cut the pack where marked, holding it as shown in Fig. 2 and so slipping the top card on to the bottom half of the pack, where it is taken as the card at which the pack was cut.

Have the card on top of the pack and ask for a small number. Say five is called. Deal off five cards on to the table, face down, then pick up the pile so formed and show the bottom card. This, of course, is the card you want chosen and few people will tumble to the ruse.

Have the card to be chosen on the bottom of the pack. Spread the pack fanwise and ask someone to point to a card. Break the pack at the point indicated and draw the halves away from each other. As you do so, draw the bottom card away on to the underside of the top half. Turn the top half over and show the card as the one indicated. (See Fig. 4.)

Numbers and Letters

So far I have dealt with playing cards, but it will be apparent that cards bearing numbers, letters of the alphabet or names, may be forced in the same way. Now here is a very useful method of forcing a word in which the audience apparently are choosing quite at random.

A book is shown and a card taken from a pack. The spectator is asked to insert the card into the book, which is then opened. The number of pips on the card is then taken to indicate the position of the word to be used. For example if it is a nine, the ninth word is used.

Fig. 5 reveals the main secret. The card is forced by one of the methods already given or it may simply be picked up casually and handed to the spectator. A duplicate card has already been placed in the book and the corresponding word on that page has been written on a slate or elsewhere prepared for the trick.

In presenting the book for the card to be pushed in see that it is inserted nearer the top of the book than the one already there. Now open the book with the left hand and run through the pages, starting from the end of the book and the hidden card will come to light first. This will, naturally, be taken to be the one just placed in.

Fig. 6.—Three forcing devices. The metal arrow forces any number from 1 to 12. The teetotem can be made to stop at any number from 1 to 6 and the die, having no number 1 or 4, can throw only 2, 3, 5, or 6.

Selecting the Right Word

There are, of course, two pages at the opening and the problem of ensuring that the right word is taken can be solved in several ways. One way is to choose an opening where one page is taken up by an illustration. Another way is to find a page where the same word occurs in the same position on both pages; not a very difficult task if it does not matter what word is used. Yet another is to assume that the left-hand page, being the first one would naturally read, is to be chosen. Yet another way is to say: "Which page, this or that." Whichever word is chosen take the page that suits you.

Fig. 6 shows three devices for forcing numbers. The arrow is cut from sheet metal and is used in connection with a dial having the numbers 1 to 12 printed round like the face of a clock. The hand is put on to a projecting point in the centre of the dial and spun. The number at which it stops is the one to be used.

Examination of the hand reveals that in addition to the centre hole, there are twelve holes arranged round the centre. If the hand is put on to the dial by the centre it may stop anywhere when spun. If, however, it is hung on to the point by one of the twelve holes in the circle, it will stop with that hole towards the top of the dial. It is a simple matter to work out which hole to use to make the hand stop at any given number. The hole nearest the point will give 12 while that opposite will give 6. The rest of the holes will give the number opposite to their own positions on an imaginary clock face. Thus, if you hold the hand with the arrow pointing upwards and take the hole at the 3 o'clock position, the hand when spun on this hole will stop pointing to 9. Similarly, the seven o'clock position will stop the hand pointing to 1 and so on.

Fig. 7.—Counting to arrive at the desired packet by 2, 3, 5, or 6.

Revolving Hand

Another type of hand has a moveable disc in the centre, weighted at one point. The hand is spun on the dial by a central hole and always stops with the weighted part at the bottom. By turning the disc the hand can be arranged to stop at any given number. The best type of hand of this kind has a tiny spring stud on the moving disc which clicks over twelve little depressions and so enables the hand to be set without looking at it, by starting with the hand at 12 and counting the clicks. Each time the hand is removed from the dial the disc is returned to the 12 position ready to be set to any other number required.

This latter device is not primarily a forcing device, but is used as a separate trick. The clock dial is of plate glass with gilt numbers and the hand when spun is made to stop at any hour called out by the audience.

Faked Dice

The small dice shown in Fig. 6 is a faked one. It is not weighted, but the numbers 1 and 4 are missing, two of the other numbers being duplicated instead. Such a dice appears to be quite normal unless carefully examined, but when thrown it can only fall with 2, 3, 5, or 6 showing. The choice is thus limited to one of these figures.

The dice is used in conjunction with a trick such as the four ace trick, in which one packet of cards must be chosen out of four. Any four objects can, of course, be used. They are put in a row and the dice cast.

The object to be chosen is placed as shown in Fig. 7 and, by counting from one end or the other, the choice is made to fall on the correct article, whichever number is cast.

It will be seen from these diagrams that the number 1 is the only one which cannot be made to fall on the right packet, hence the reason for eliminating it from the dice.

The same force can also be executed in a different manner without the dice. Having laid out the four packets, you ask someone to name a number between 1 and 4. As only 2 or 3 fall between 1 and 4 the choice is virtually limited to these, and by counting from one end or the other the choice always falls on the required packet. The weakness of this method is that if someone by accident or design calls either 1 or 4 you have to re-iterate the proviso " between 1 and 4 " which is apt to reveal to the thinking members of the audience some part of the secret.

The Teetotem

The teetotem in Fig. 6 is also specially made to force any number from 1 to 6. The numbers are stamped at equal distances round the teetotem and there is a black dot near the point. The part which carries this dot can be rotated to bring the dot opposite any number at will. The movable portion is weighted opposite the dot so that whenever the teetotem is spun it always comes to rest with the dot uppermost. To force a given number it is only necessary secretly to turn the dot until it comes opposite the required number.

Fig. 8 shows a board divided into sixteen squares painted in various colours. Any colour decided upon when making the board, can be forced by asking for a number up to 16 and counting the squares, starting from the top left-hand corner. The final count of any number can be made to come on a square of the desired colour according to which edge of the board is held uppermost.

Coloured Squares

In Fig. 8 the squares shown solid black represent the colour to be forced, say red. The following table shows which edge of the board to start counting from to force red at any number :

To force	1	start	with edge	A
,,	2	,,	,,	D
,,	3	,,	,,	C
,,	4	,,	,,	B
,,	5	,,	,,	A
,,	6	,,	,,	A
,,	7	,,	,,	D
,,	8	,,	,,	B
,,	9	,,	,,	C
,,	10	,,	,,	C
,,	11	,,	,,	B
,,	12	,,	,,	D
,,	13	,,	,,	C
,,	14	,,	,,	B
,,	15	,,	,,	A
,,	16	,,	,,	D

It would, of course, be impossible to carry this list in one's head, so each edge of the board is marked with small figures to show at which numbers the red square will fall when counting from that edge. The numbers are shown in Fig. 8. It should be noted, particularly, that the counting is always from left to right along the first row, then back from right to left, then on from left to right, zigzag down the board.

The colours of the intermediate squares should be well mixed and there need not be the same number of each colour. Furthermore, two different shades of the forcing colour could be used to avoid any suspicion of special arrangement.

By preparing both sides of the board to force a different colour one board can be used twice in the same trick and so two different colours be apparently freely chosen. The numbers will be the same as long as the arrangement of forcing squares is reversed with the board. For instance, two identical boards could be made, one with red forcing squares and one with blue. If these were placed back to back with A edge to A edge

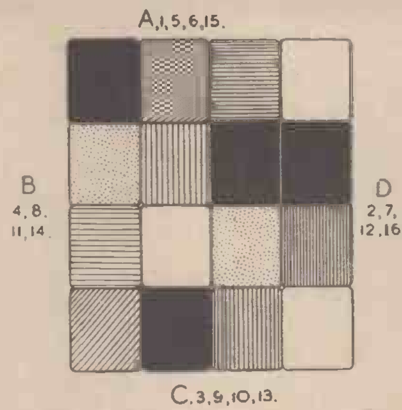


Fig. 8.—The solid black squares represent the colour to be forced.

the same numbers would force red on one side and blue on the other, starting from the same edges.

Forcing Names

Other methods of forcing names and numbers are as follows :

A bag with a partition down the centre. Counters or cards all bearing the same number are in one side. The empty side of the bag is shown and assorted cards dropped in. The other side of the bag is then offered for a card to be taken.

The audience are invited to call out names of well-known people while the performer writes them down. Actually, the performer writes the same name every time and that is the one he wishes to use. The papers are folded and offered for one to be chosen which must, of course, be the one arranged for.

A number of cards are shown and the different names on each are read out. Actually, all the cards bear the same name, but a different name is read as each card is picked up. The cards are then spread backs upwards for one to be taken.

Silk Handkerchiefs

Finally, here is a very subtle force of a colour with a changing bag, that is a bag with a secret partition down the centre.

Take four silk handkerchiefs, each of a different colour, say red, yellow, green, and blue. Into one side of the changing bag put three more handkerchiefs of the colour to be forced, say green.

Turn the bag inside out, showing the empty side. Put the handkerchiefs into the bag one at a time. The green silk goes in with the other green silks and the remaining three go into the empty side of the bag.

Offer the bag for a handkerchief to be chosen, but hold only the side containing the green silks open, keeping the other side closed. When the green silk has been taken out, move the partition over and shake out the three remaining silks. To the audience it seems impossible that the choice can have been other than straightforward, because the silks remaining after the choice are the silks of the other three colours.

COTSWOLD VILLAGE IN A GARDEN

THE landlord of the New Inn, Bourton-on-the-Water, Gloucestershire, Mr. C. A. Morris, has made a model of his own village in his garden.

The illustration shows part of it, including the village green with its war memorial cross, and in the foreground is one of Bourton's famous little bridges over the River Windrush. The model is one-ninth full size.

Remarkable features are the accuracy with which the Cotswold architecture involved has been reproduced, and the choice of trees and flowers of miniature proportions to suit the scale of the rest of the model.

A model village which Mr. Morris has built in his own garden.

An Automatic Self-feed Painting Machine

A Device which Saves the Wastage of Both Material and Time

Showing the aero automatic self-feed distempering machine in use, the original photograph of which was taken under practical working conditions.

THE old hand style of painting with pot and brush is now being replaced with that of the automatic self-feed painting machine, which eliminates the dipping of the brush as experienced with the old method of painting.

This new type of machine also does away with the spilling of paint when applied to the work, and it has been proved that more work can be done with this machine in a specified time than that of the old method.

Construction of the Machine

The machine itself consists of an outer container of pressed steel, which is constructed to hold air pressure, and an inner container of tinplate, to hold paint, varnish, enamel, etc. The air pressure is sealed in the machine by means of a lid made of pressed steel, which is slightly oval in shape, as is the hole of the container. On the upper edge of this lid is vulcanised a synthetic rubber joint and is held in position by means of a locking bar, which makes the joint between the lid and the container, thereby rendering the whole equipment airtight when assembled. The lid must be fitted in its correct position when assembled; this is easily done, as two positional lugs are fitted to the lid and these correspond to the two notches on the rim of the outer container.

Showing the paint container with the lid and its various fittings, such as the pressure gauge, handle, release valve, agitator, etc.

The lid is a complete unit, consisting of the pressure gauge, which is divided to give an indication of the pressure required to suit the various grades of materials used. An air release valve is fitted to bring the machine within the Factory Act Regulations, and release any excessive pressure within the machine, these being usually set to "blow off" at 45 to 50 lb. A filler cap is also fitted which, when unscrewed, gradually releases any pressure left in the machine, and by this means the internal container can be refilled without undoing the lid. An agitator lever is fitted to enable the material in the inner container to be stirred whilst the machine is in operation. A two-way header is attached to the top of the agitator lever, and on to each header is fitted a length of special reinforced tubing and a brush.

Operation

Pressure is obtained by means of the small hand-pumping unit which is attached to the side of the outer container and is constructed of brass tube and gunmetal fittings. It is fitted with a simple non-return valve at the outlet end. This type of pump operates on the same lines as that of a bicycle pump. The air supply pipe is led from this outlet to the top of the inner container to avoid penetration of material into this valve.

The inner or paint container is attached to the underside of the lid by means of a bayonet-joint fixture, thus making it easy to dismantle. The air pressure inside the machine when same is assembled passes into the inner container through the gap which is left round the top of same when it is fitted to the lid.

When assembling the machine, the inner container is first attached to the lid, and is then slightly tilted, and will pass easily into the outer container. The lid is then raised, still, of course, inside the outer container, and turned until the positional lugs fit into their notches. The locking bar is then placed into position and a butterfly screw is tightened until the lid is held securely inside the container and the rubber joint has rendered the machine airtight. Pressure is then raised inside the container by means of the hand pump.

Its Advantages

The material is then forced up through the metal tube which is fitted to the header, until it reaches either or both of the two valves attached to it. On opening these taps, the material is forced up through the rubber tubing into the brushes, but is arrested before passing into the brush head by the valve insert. The valve is opened by means of pressure of the finger on the little lever which protrudes from the brush handle, and the material flows right into the tips of the bristles via a special bag which acts as a leader, which is incorporated within the bristles of the brush head.

The complete equipment.

The flow of material to the work can be controlled very easily and accurately by means of the lever on the valve insert, and a much more even coating can, therefore, be applied.

One pumping is sufficient for several hours' working, as the pressure loss is only equal to the displacement of material used. Another great advantage obtained from this machine is that when using paints and varnishes of the quick-drying variety, which often contain a high percentage of spirit, evaporation losses are avoided, as the machine is entirely airtight.

Our Busy Inventors

By "Dynamo"

Mr. M. Metcalf holding a special device for fitting a shoe which he has invented. It is the result of 15 years' research on the art of walking. In comparison note the simple device in front of him which is already in use (see paragraph on page 516).

Headlights for Razors

SHAVING in the dark is not impossible, but it is not advisable, especially in the case of those who use a "cut-throat" razor. In fact, to effect a clean shave, a good light is indispensable. Headlights for electric razors are the latest convenience for the man who performs a daily surgical operation on his beard. A small electric lamp rides the shaver and throws a spotlight upon the pimples of the epidermis. When the human façade is thus illuminated, the result is a close shave, but not a dangerous one.

Torch Without a Battery

ANOTHER light has appeared on the horizon in the shape of an electric torch without a battery. The appliance is worked by its own spring-operated generator, which is wound up like a watch. It is asserted that this torch has no armature or brushes to get out of order.

Illuminated Truncheon

YET another invention is of a light nature. This is a policeman's truncheon with an electric torch at one end. The source from which I obtain this information does not state at which end the flashlight is situated. However, it does tell me that heavy cushioning protects the light when the stave comes in contact with hard heads. This "billy," as our American cousins call a truncheon, will enable a policeman or watchman to give a light blow.

Harness for Babies

WHEN His Majesty the Baby makes his royal progress in his triumphal car—the perambulator—he is subject to some restrictions. For example, he has to be securely fastened in his chariot. The harness usually employed for this purpose is generally of skeleton formation and includes a base strap round the body and two straps over the shoulders of the infant. The body strap has two metal rings for coupling up the base strap with the sides of the perambulator.

An inventor contends that such harness is inefficient. Firstly, he maintains that the restless child can easily wriggle out of it. And, secondly, he considers that it impedes the free movements of the youngster. Accordingly, he has designed safety harness which embodies a waistcoat-like arrangement and a separate waistbelt carrying safety rings and suspended from the lower edge of the waistcoat and waistbelt about the axis of the harness.

This harness will effectively encircle the youthful dictator.

Tongue Guards

DURING the month of April, this year, there have been patented in the United States no less than four inventions for tongue protection. However, this appears to have nothing to do with that human organ with is proverbially termed "the unruly member." The limited description of these appliances which has come to hand includes the word "carcass." It is obvious, therefore, that the protector in question relates to the meat trade and not to the tongue, which, according to high authority, "no man can tame."

In this connection I am moved to mention that the record of tongue protection seems to be held by a lady. She was Laena, a Greek lady, who, when tortured, is said to have bitten off her tongue, to guard herself against betraying her associates. This is to the credit of the fair sex, who are not famed for being able to keep a secret.

This is not the latest type of gas mask for use in air raids, but is a dust protector for use in dusty factories, or for work where the air is impure. It is one of the many safety devices produced by members of the Home Office Industrial Museum.

Cradle for Casks

I LEARN that to mature spirituous liquors and wines, the rolling of the barrel contributes to the ageing of the contents. Hence casks of intoxicants have been sent for a sea voyage, so that they could reel like a drunken man in the hold, while the vessel played pitch and toss.

To enable a cask to undertake the role of a cradle is the object of a device recently submitted to the British Patent Office. The invention shakes the contents as though they were a giant cocktail. And the sequel to this life of agitation is that the liquor becomes prematurely old.

The contrivance stores as well as stirs. It furnishes a rack and rock for the alcoholic beverages.

Cruiser Cabin and Caravan

THOSE holiday-makers who enjoy an amphibious holiday—that is, one spent partly on land and partly on water—will hail with delight a combined boat and caravan, which has appeared in the offing.

This accommodating craft is of what is known as the cabin cruiser type. It includes a forward part provided with a cabin. This and the after part are so constructed and hinged at midships that, when the boat is transported on land on a trailer, the after part may be inverted upon the forward part. The cabin can then be used as a caravan, the entrance being through the cabin doors at the rear end of the folded structure.

One is reminded of the inverted boat at Yarmouth which was the improvised cottage of Ham Peggotty in "David Copperfield."

For the Amateur Gipsy

ANOTHER caravan, which will interest the amateur gipsy, is of the kind which is collapsible with a view to its being conveniently trailed and garaged. This obliging house on wheels differs from its predecessors in at least one respect. When the caravan is erected the collapsible struts are situated inside the caravan.

Equipped with this movable house, temporary nomads will be able to "fold their tents, like the Arabs," though they may not quite as "silently steal away."

Anti-building Plant

THERE is a war between the vegetable and the mineral worlds. Plants are sometimes the foes of buildings. It has been observed that certain plants, for example, couch or similar grass, in seeking water, force their roots even into thick, non-corrosive, protective coatings. At least they attack parts of the buildings, such as pipes, shielded with bitumen. Although the protective coating is not chemically altered by the penetrating plants, it is affirmed that there is a danger that the roots may wither and leave hollow spaces. And the surface is likely to be attacked by aggressive substances.

A German company has applied to the British Patent Office for a patent for a method of protecting buildings against attack by plants, particularly their roots. The process is designed to afford protection to structures made of metal, stone, stone-like substances, concrete, wood, etc. It consists in applying a thick, non-corrosive coat of bitumen or bituminous millboard and subsequently a coat containing phenol. The second coat repels and diverges the cell walls of the plants and their roots.

In addition, it is claimed for this invention that it prevents the buildings from emulating the chameleon and changing colour.

Ivy Mackintoshes

SPEAKING of plants which have an affinity for buildings, I feel moved to mention that climbing evergreen which mantles so many a village church tower. I refer to ivy—the jade plant that has lately been in the news owing to the fact that a queen expressed her dislike for it. Some folk think that ivy ought to be destroyed because it strangles trees and eats away the brick and stone of walls. But I gather from a botanical authority that far from injuring walls, ivy forms its best protection. It acts as a macintosh and it not only defends from rain, but it is an effective windscreen. The rain may vent all its fury on an ivy-clad wall, but few drops will bedew the brick or stone. Conscious of this fact, numbers of birds build their nests or shelter for the night in the ivy.

Teaching by Ear and Eye

FROM Wales, where the people have a great love of music, very appropriately comes a new method of teaching the pianoforte. It is the outcome of several years of class teaching experience. And the two gentlemen who are the authors of the system have had sufficient confidence in their idea to apply to the British Patent Office to protect the offspring of their brains.

The use of instruction books containing prints of a pianoforte keyboard, with a reproduction on a large scale of the vocal compass of the keyboard visible to all the students in the class, inspired the idea of the new method. The inventors came to the conclusion that much time, movement, and verbal explanation by the teacher could be avoided if attachment were made between the piano and the piano keyboard chart; and if it were done in such a manner that the chart would become an indicator of that which was being performed on the piano.

Entitled "Pianoforte Keyboard Electrical Indicator," this improved music-teaching apparatus comprises a representation of a keyboard in chart form. Each key of the chart is fitted with an indicator, means for controlling the indicator, and connected with the piano in such a way that the pressing down of a note on the piano is indicated on a corresponding note on the chart.

The piano and the chart could be electrically connected. And the keys could be illuminated by means of an electric bulb, placed behind, or in each key of the chart.

Thus the sound and position on the keyboard could be simultaneously noted by a class of pupils. The ear and the eye would co-operate in the acquirement of the art of pianoforte playing.

The latest anti-glare glasses as now being worn in Switzerland. The tinted section can be turned into different positions so as to protect from sun, sea or river glare.

The latest aid for prolonging life, so it is claimed by its inventor, Mr. Andre Knorr, a Geneva shoemaker, is a spring-heel. The lower portion of the heel of the shoe or boot is attached to the upper by means of small springs, all jars to the organs of the body as experienced by wearers of ordinary shoes are avoided by the wearers of a pair of shoes fitted with these heels.

Sack-filling Machine

A NEW sack-filling machine, for which a patent has been applied for in this country, not only has a sack-clip and a filling tube connected with a weighing device from which the sack is removed manually or automatically. It also has means for locking the weighing device, which means is released by the sack-clip when the latter is operated by the introduction of a sack to be filled.

Apropos of the invention of three Nottingham men for rapidly filling A.R.P. sandbags, announced recently, it is obvious that in case of war the sandbag will play a most important part. The yielding quality of the mass of tiny particles modifies the impact of the assailing missiles.

During the Great War, when the exploding maroon foretold an imminent raid, I myself used to run like a hare to a neighbouring brewery. My object was not to fortify my courage with liquid reinforcement, but to shelter beneath two or three floors of grain, which answered the purpose of sand.

I venture to add a further personal touch. The value of the union of a multitude of atoms moved my muse to indite the following ditty :—

THE SONG OF THE SAND

I'm but a grain of sand,
So very, very small;
And, by my little self,
I'm just no good at all.

But put me in a bag
With many, many more,
Then we will guard a trench
And help to win the war.

The Language of Smoke

SMOKE is usually regarded as a nuisance, but it can sometimes serve a useful purpose. There is a language of smoke. Victor Hugo says : "The thickness and colour of a line of smoke marks the whole difference between . . . hospitality and the tomb. A smoke mounting among the trees may be a symbol of all that is most charming in the world—a hearth at home; or a sign of that which is most awful—a conflagration."

At an aerodrome, a smoke-producing apparatus is used in wind-direction indicators. In apparatus of this type, oil is sprayed on an electrically heated plate, so as to be evaporated and condensed into fine drops. One of the chief difficulties is to ensure that the oil will be evaporated without either being ignited or producing a carbon deposit on the hot plate.

To overcome this difficulty, is one of the aims of an improved smoke-producing apparatus, for which a patent in this country has been applied. The new apparatus comprises means for projecting the oil in a fine spray with a high velocity on to the surface of the plate. The latter is swept by a current of air, whereby practically no carbon deposit is formed.

This appliance should effectively perform the role of a cat's-paw to show which way the wind is blowing.

MODEL AERO TOPICS

Current News from the World of Model Aviation

Mr. E. Chastenheuf, who for the last two years has been captain of the British Wakefield team, starting his machine during the recent elimination trials for the Wakefield International Cup at the Fairey Aircraft Co. aerodrome at Hayes

Lord Wakefield's Generous Gift

LORD WAKEFIELD has generously donated £250 to the S.M.A.E., to cover the expenses of organising the King Peter Cup gliding contests, and to meet the expenses of organisation. It will be remembered that Lord Wakefield recently gave £300 to the S.M.A.E. towards the expenses of sending the Wakefield team to America.

Cotebrook Rally

THE Rev. T. Boyard Webster is organising a competition at which all clubs may compete on equal terms, and at which the novice will have a good chance of award. There is a good flying ground and means for launching model hydroplanes. There will be no entrance fees and no prizes unless the competitors so wish. Further details from T. Boyard Webster, The Curatage, Cotebrook, Tarporley, Cheshire. The event takes place on August Bank Holiday.

Composite Model Petrol Planes

CAPT. S. T. GRANT, a member of the Bournemouth Aeroplane Club, has successfully built and flown a 7 ft. wing span petrol model of the composite type. He uses a rubber-driven plane for the secondary model, released by a time-controlled clockwork arrangement.

A 16-Mile Flight

DURING the Wakefield Elimination Trials at Fairey's Great West Aerodrome, one of the models flew out of sight and was retrieved 16 miles away. It was very little damaged.

Competitions

THE National Cup Competition takes place at Fairey's Aerodrome on August 6th, and the King Peter Cup Contest for model gliders from July 17th to the 23rd. The Hamley Challenge Trophy takes place on July 2nd, and the Women's Challenge Cup competition on August 6th. The Sir John Shelley Cup for power-driven models will be run off at Fairey's Great West Aerodrome on August 7th, on which day the Bowden International Trophy for power-driven models will also take place.

Hamley Bros., Ltd.

MESSRS. HAMLEY BROS., LTD., have developed the model aircraft side of their business, and they specialise in petrol motors and petrol models. A visit to their shop in Regent Street revealed that they are stocking Bunch Models, the Speed Demon Racing Car and the Sea Hornet Hydroplane, the former having been timed to do over 50 miles an hour round the pole, whilst the latter gives speed of 20 knots round a 50-ft. radius circle. They are also selling the Flying Star and the H.E.3, both having a specially designed Ohlsson 23 Motor. The H.E.3 is a semi-scale single-seat monoplane with the motor totally enclosed in a spun aluminium cowl. The Flying Star is a typical competition model, and both can be packed in a box 30 in. long. The Southern Star is powered with the Mighty Midget motor, and was the winner of the Bowden Trophy for 1938. They couple, with their selection of models of all types, an excellent "assistance while you build" service, for the designer of all four models is always available to answer queries. All motors sold are demonstrated for the customer if necessary.

Northern Ireland, Skybird Model Rally

THE third annual Skybird Rally was held at the Ards Airport. There were 29 entries, and the standard of the models was even better than last year. The judging was done by Captain E. W. Percival, the famous designer, who came over specially for the occasion. Tea was provided by the Marquess of Londonderry, and the Marchioness of Londonderry presented the prizes.

After the judging and presentation of the prizes, Captain Percival gave a flying display and took many people up for joy rides.

The Wakefield Team

AT the Wakefield elimination trials referred to earlier in these notes, the following team was selected to represent England. The contest this year will be held in America. The following is the British team:

1. F. Almond, North Kent M.A.C.	230.2
2. N. Lee, Halifax M.A.C.	220.1
3. R. Copland, Northern Heights M.F.C.	186.2
4. R. T. Parham, Edgware M.A.C.	180
5. L. Stott, Halifax	175
6. R. A. Hill, Bournemouth	171.5

The King Peter Cup Team

THE King Peter Cup Team results decided by the elimination trials is as follows:

1. R. E. Galbreath, of Blackheath	577.75
2. F. E. Wilson, Northern Heights M.F.C.	412.6
3. A. Cox, Northern Heights	385.8
4. A. C. Minion, Hayes M.A.C.	346.2
5. A. Tindall, Lancs. M.A.S.	325.7
6. G. F. Clifford, City (Birmingham) M.A.C.	307.9
7. A. A. Weston, Park M.A.L.	289.1
8. G. E. J. Reynolds, Surrey M.A.C.	286.5
9. H. Hill, Lancs. M.A.S.	284.4
10. G. W. Day, Northern Heights M.F.C.	278.3
11. W. G. Oliver (unattached)	270.85
12. H. N. Simmons, Blackheath	251.95

Dennis & Smith

MR. E. B. DENNIS tells me that he has taken over the business of Dennis and Smith upon the retirement of Mr. A. E. Smith, and is now operating from 395a, Romford Road, London, E.7. Telephone Maryland 3694. This company supplies lathes, bench and general workshop equipment, silver solders and brazing spelters, and engineering materials generally.

Winch Launch Glider Record

THE Winch Launch glider record by Mr. Mawby has been passed by the S.M.A.E. at 36 min. 31 secs.

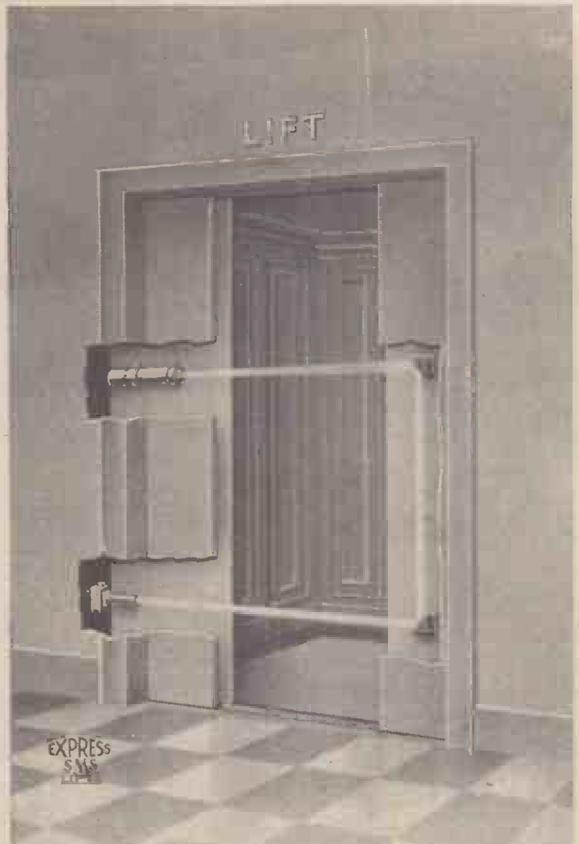
The Area Representation Scheme

THE constitution of the S.M.A.E. provides for a President, Chairman, Vice-Chairman, Treasurer, General Secretary, Press Secretary, Competition Secretary, Technical Secretary, Fellows' Representative, and one area delegate or proxy area delegate from each of the areas to be specified. Each must be elected annually. All affiliated clubs in such specified areas shall hold group meetings, at a time mutually agreed upon by themselves, fully to discuss all matters concerning council meetings.

Each club must send two members to the group meetings if possible, and the club secretary should preferably be one of these representatives. Area groups shall elect a suitable and responsible delegate to represent them at all council meetings. All area delegates shall receive their instructions at the group meetings, and shall vote only as instructed by the group of clubs they represent. The voting powers of delegates shall be proportional to the number of clubs each delegate represents, and delegates shall submit a signed statement of the voting results in his area to the S.M.A.E. Secretary before each council meeting.

MODERN

Describing the Highly Complicated the Modern High-speed



The "Express-S.M.S." saferay system. It is applicable to lifts incorporating automatic push button control and fitted with doors operated by electric or pneumatic power.

A MODERN high-speed electric passenger lift is a highly complicated and ingenious mechanism, the outcome of extensive research and experiment by many lift engineers over a period of years.

The essential parts of a lift are :—

(*a*) The car in which passengers are conveyed from floor to floor.
(*b*) The counterweight.
(*c*) The electric motor which may be associated with some form of speed reduction gearing and which provides the power for raising and lowering the car.
(*d*) The controller. This is the brain of the lift and determines when the motor should start, stop, reverse, accelerate, or decelerate and when the brake should be applied or released, in accordance with the operation of a starting switch or push buttons in the car or on the landings.
(*e*) Landing entrances.
(*f*) The guides.
(*g*) The ropes.
(*h*) The numerous safety devices which safeguard the passengers.

Let us consider these parts in detail.

The Car

This is the most obvious part of the lift so far as the passengers are concerned and is usually of more or less elaborate design, in accordance with the style of the building in which the lift is installed.

The car entrance or entrances are closed by a collapsible gate or by sliding doors. The entrance gate, when closed, operates a small switch, which can often be seen just above the top of the gate and outside the car. This is a safety switch and ensures that the lift cannot be set in motion until the gate is properly closed. If the lift is of the automatic type, it may be found that the floor moves slightly as the passenger enters. The slight movement of the floor under the passenger's weight operates another switch, which gives him complete control of the direction of travel and prevents the car from being called away by a passenger on another floor or landing.

The fittings to be found in the car depend upon the type of control. If the lift is in charge of an attendant, a switch will be provided for his use and an indicator which shows the floors from which calls have been made by intending passengers.

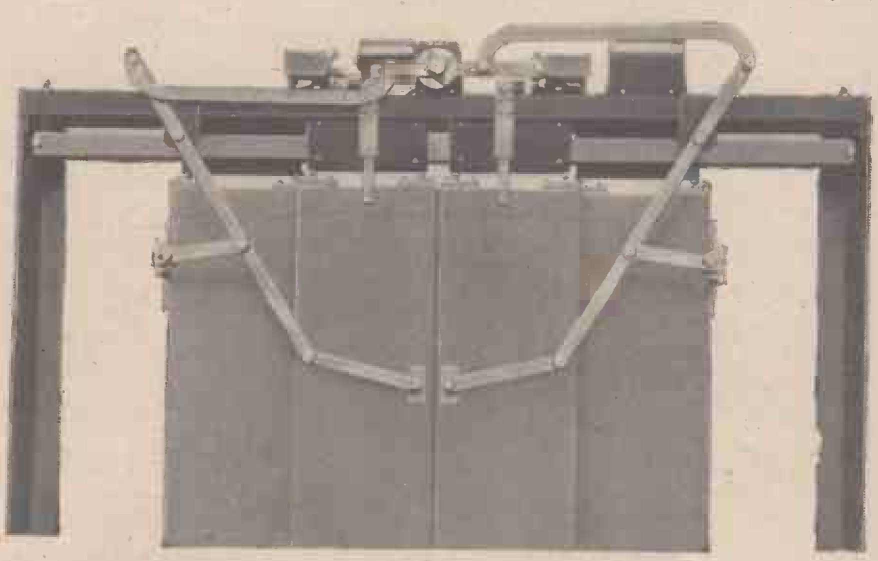
The car control station. In this instance the lift is attendant controlled, a flush-type carswitch being fitted.

If the lift is automatically controlled, a series of buttons will be found, each of which will be marked to correspond with one of the floors and it is only necessary to press the appropriate button momentarily for the lift to proceed there immediately. A further button marked "Stop" is only for use in case of emergency.

In some cases a luminous indicating device inside the car shows the floor at which the car is standing or which it is passing.

Outside and beneath the car is a safety gear, which is designed to arrest the descent of the car and hold it securely to the guides should the lifting ropes break or in the event of the car overspeeding.

A number of switches fixed on top of the car enables the controller to determine the



"Express S.M.S." harmonic electric operator applied to four-piece two-way doors. The doors are shown closed.

LIFTS-PART II

and Ingenious Mechanism of Electric Passenger Lift

position of the car at any time and to stop it correctly at the desired floor level.

Current is carried to these switches by flexible cables, which hang from beneath the car and connect to a terminal box fitted halfway up the lift well.

Typical arrangement of gearless variable voltage passenger lift.

The outside car fittings can usually be seen when the lift is installed in a staircase.

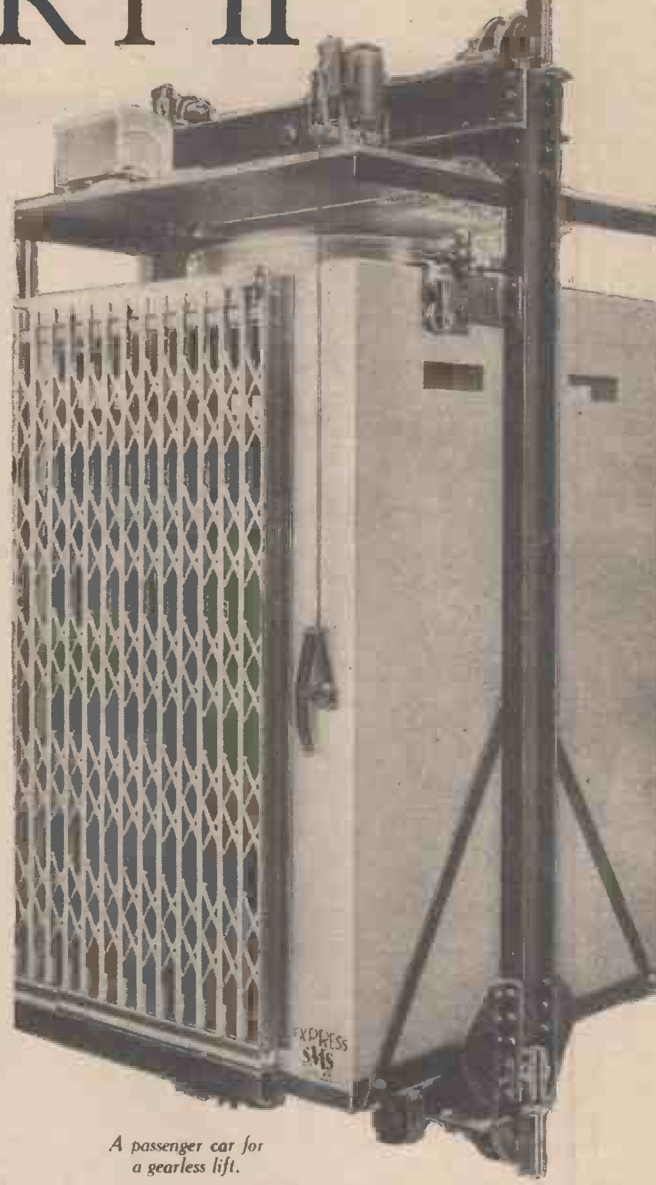
Counterweight

This is a balancing weight rather heavier than the empty car, and is suspended on the opposite ends of the lifting ropes. It enables the lift to be operated by a much smaller h.p. motor than would be required were the car unbalanced.

Motor

The electric motor shown in the illustration, is of the gearless type and is used for high-speed lifts. The current is obtained from a separate motor generator set and the speed of the lift motor can be varied between wide limits, so that the motion of the car can be accelerated and decelerated correctly without uncomfortable results to the passengers.

The fastest lift speed usually employed in this country is in the region of 500 f.p.m. This may sound a very high speed, but actually it is only just over 5½ miles per hour.



A passenger car for a gearless lift.

Controller

The controller is an assembly of switches which apply or cut off current to the motor and brake as required to control the motion of the lift. The controller may be comparatively simple or amazingly complex, as when all lifts in a complete " bank " are electrically interconnected. There are literally dozens of forms of lift control which it would be impossible to describe in the space at our disposal, so we propose to consider one form of control only, e.g. a completely automatic system known as 2 B.C. (two-button collector) control.

For this form of control two push buttons are provided on each landing marked " Up " and " Down." At terminal floors, of course, only one button is required. In the car one push button is provided for each floor served by the lift.

Imagine the car stationary at the ground-floor level and a number of passengers on various higher floors, some pressing " Up " buttons and some " Down " buttons. As soon as any button is pressed the car starts off in the upward direction and answers all " Up " calls. On this journey it will not stop to answer any " Down " calls.

If any " Up " calls are registered after the car has started it will stop in answer to them, unless it has already passed the floor from which such calls are made. When the car has answered the last call in the upward direction it will reverse and proceed to answer all downward calls in a similar manner. It will be seen that all calls are stored in the system until answered, and by this means the best possible service is given. Such a lift may be said to give an " omnibus service," as compared with the " taxi service " given by an ordinary push-button lift, which answers only one call at a time.

Landing Entrances

The lift entrances are usually protected either by collapsible gates, sliding doors, or hinged doors. Whatever type is used, a mechanical lock is fitted, which is operated by the car itself, so that the gate cannot be opened unless the car is at the landing.

An electric switch is also fitted which ensures that the car cannot move away unless the gate is closed. The moment the car leaves the landing the gate is automatically locked.

Sometimes landing gates or doors are operated by electric power. In such cases an application of the well-known "electric eye" principle can be fitted, so that if the light beam is intercepted by a passenger, the doors cannot close or, if in the act of closing, will re-open.

At the side of the entrance will be found a push button, which will either signal the attendant or bring the lift automatically. When two buttons are fitted marked respectively "Up" and "Down," a passenger wishing to go up would press the "Up" button and vice versa.

Various forms of luminous signals may also be seen showing the position of the lift and its direction of travel, or possibly such signs as "Lift in Use," "Lift Coming," "Lift Here," etc.

Guides

The guides form a very important part of the lift and provide a smooth running surface for the car and counterweight and confine them to a truly vertical path, so that they cannot meet with any obstruction in the lift well. Upon the perfection of the running surfaces of the guides and the accuracy of their erection depends the smoothness of motion which is so characteristic of modern lifts.

Ropes

The lifting ropes are made of high-tensile steel wire, and not less than four ropes are normally used, any one of which is capable of supporting a fully loaded car with a factor of safety of three or more to one.

Safety Devices

Some of these have been mentioned above, but we summarise below all the safety devices normally to be met with. They may be regarded as falling into one of two categories, electrical or mechanical.

Electrical safety devices are provided as follows :—

1. To prevent the lift from moving if any landing door is open.

2. To prevent the lift from moving if the car gate is open and there is a passenger in the car.

3. To prevent the car from being controlled from any landing while it contains a passenger. (This does not apply in the special case of collector control described above.)

4. To stop the car automatically at terminal floors.

5. To cut off the electric supply at the mains in the event of the automatic stops referred to under No. 4 failing.

6. To stop the lift motor in the event of the car safety gear operating.

7. To stop the lift when the "Stop" button is pressed.

8. To prevent the lift from being restarted after a failure of the supply mains unless the engineer in charge has re-set the main switch.

9. To prevent the landing gates from being opened while the car is passing and not actually stopping at a landing.

Mechanical safety devices are provided as follows :—

(*a*) Car safety gear to bring the descending car to rest in the event of the lifting ropes breaking or the lift overspeeding. Occasionally a safety gear is fitted also to the counterweight.

(*b*) The brake. The brake is applied automatically when the current is cut off, whether due to the action of the controller or to failure of the electric supply.

(*c*) All landing doors are mechanically locked unless the car is standing at the landing.

(*d*) Buffers are provided in the pit.

AROUND THE TRADE

Novelties Now On The Market

"Delta" Home Cinemas

NEAT and compact in design with a high-grade finish, the "Delta" home cinemas are remarkable value for money. They are made by the Delta (Nottm.) Manufacturing Co., 46 High Pavement, Nottingham. The firm market a hand-driven model at 25s. and motor-driven model for £3 17s. 6d. Both types of machine are adapted for use with the old type 9.5 mm. film as well as the latest type, and both are practically silent running. The hand-driven model is extremely reliable and will give years of trouble-free service. Standard equipment of the machine includes lamp, rewind handle and a 60-ft. spool. A spare lamp costs 2s. 6d. extra. It is attractive in appearance as all steel parts are highly chromium-plated.

The motor-driven model has a multi-commutator type motor, and all bearings are grease packed to ensure easy and efficient running. The cinematograph mechanism is of the double-claw type, and the high-power lamp in conjunction with the super grade lens gives an exceptionally bright and sharp picture, whilst flicker is reduced to the very minimum by the specially designed shutter. The mechanism runs on phosphor bronze bearings with lubricating pads, which obviates the necessity of further lubrication after leaving the works. The motor is of the universal type for A.C. and D.C. mains, 200/250 volts. A 300-ft. spool is supplied with this machine, which is adapted for the use of 30, 60, and 300-ft. films.

The Clarity Magnifier

THE magnifiers shown on this page are something absolutely new for philatelists. They are made of a new unbreakable, non-inflammable and extremely light plastic composition incorporating a plastic lens. They are only one-sixth the weight of a similar size glass magnifier, and can be carried in the pocket without fear of breakage or dangerous splinters. They do not distort and magnification is of a high degree. Each magnifier is already focused so that no adjustment whatever is necessary.

There are three sizes, the price of each being 2s. 6d.

Win £5

MULTI-MODELS, LTD., have produced a bogie but they haven't yet found a name for it. So they invite readers to make suggestions, and by way of encouragement they will award £5 to the sender of the most appropriate name. The second best will get a £2 10s. credit to be spent at their showroom, and the third a £1 credit.

Closing date is August 8th. *Every entry*

Showing the three types of clarity-magnifiers.

must be made on the form included with each pair of bogies. Prizewinners will be notified at once and results published in the September issue of this magazine.

These bogies are of the latest L.M.S. type, suitable for L.M.S., G.W.R., S.R. and many L.N.E.R. coaches—brass die-castings, oxidised, and requiring no painting; needle bearings for precision running; "00" gauge, 4 mm. scale.

Send off your order now—the bogies are ready for immediate delivery—and you will receive with each pair a free entrance form giving you a chance of winning £5 in cash, or a valuable credit voucher. Please quote P/1 when ordering.

BRITISH HALL-MARKS

(*Continued from page 526*)

exactly the same dates, and here you have the first of the secrets of the successful antique dealer—who must recognise every date.

The second point to memorise is that all letters from the year 1559 are contained in a shield, and that these shields do not vary from the earliest period until 1737, the shield being of the Saxon type with a straight top, straight sides and a straight point. (Before this date the shield followed the shape of the letter.)

Seventeen-thirty-seven is an important date to remember, and for the rest of this cycle—that is, from 1737 to 1755—the shield is indented at the sides. No other shield has this peculiar indentation and the cycle letters after this period are contained in a straight sides shield with a curved point.

The cycle letters commencing with the year 1776 are contained in a similar shield, but the letters are in small black characters.

Duty Mark 1784-1890

There is another important date to bear in mind in connection with this cycle—the year 1784 with the letter I or K, for at this time a duty mark of the King's head was introduced, and all series of marks afterwards included the King's or Queen's head until the year 1890, so that now one has five distinct and easily memorised points to bear in mind :

1.—All the letters are contained in Saxon shields until the year 1737.

2.—From 1696 the letters A, F, Q, L, and V divided the cycles into five-year periods, so that whenever you see the letter L you will know that this is ten years after, i.e. 1716 or 1736, etc.

3.—Wherever you see indented sides to the shield the piece belongs to a cycle commencing in 1736-7.

4.—Wherever you see old English letters without the head of the king it must be before the year 1776.

5.—Wherever you see the King's head the date must have been after 1784.

With these points borne well in mind it is perfectly easy to trace any particular mark.

Fig. 1.—Half model of the "Great Britain"—one of the ancient models—which is the work of Mr. J. Johnson, of London.

A MASTERPIECE OF MODELLING

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

Some Wonderful Modelling Work at the World's Fair

IT would require many issues of PRACTICAL MECHANICS to give even a brief description of every one of the hundreds of models that are on show at the New York World's Fair. Every international exhibition makes use of models in some form, either scale or formalised, and in an exhibition where the World of To-morrow is the theme of themes, they are very useful.

Not only does modelling enable a much more extensive display to be shown in a small space, but it also saves expensive transport across continents and seas, a boon where huge locomotives and machinery are in question, and as far as ships are concerned the exhibition of the prototype would be impossible, but in model form it is more comprehensive and just as effective.

Model Ships

The Maritime Trade section of the British Exhibit is devoted entirely to shipping and the main feature of this is the wonderful set of wall panels illustrating the progress of steam transport across the North Atlantic. The models are built in half-section, and there are the *Sirius*, the first ship to cross from England to America under its own steam and the *Great Western*, which made her crossing at practically the same time, from Bristol, there only being a matter of six hours between the two ships.

Then comes the *Great Britain*, that famous ship with six masts and one funnel, designed by Brunel—the first screw steamer to cross the Atlantic—and also the pioneer Cunarder, *Britannia*, which made her maiden voyage in 1840.

But the centre piece of all these models is a wonderful half-model, nearly thirty feet long of the new Cunard White Star vessel R.M.S. *Queen Elizabeth*. This is certainly a masterpiece in construction—the largest ship model ever made by British workmen, and it occupied three and a half months in building.

The "Queen Elizabeth"

The beauty of its finish is the result of careful planning and skilled workmanship.

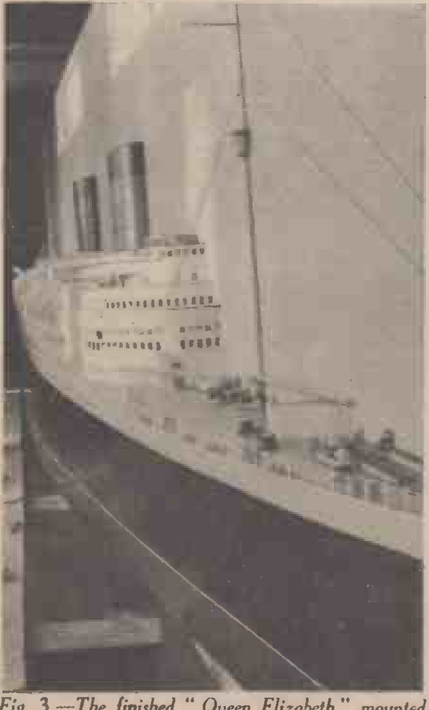


Fig. 3.—The finished "Queen Elizabeth" mounted on her backboard of sea and sky.

Fig 2.—Work on the huge hull of the "Queen Elizabeth" at Northampton.

Fig. 4.—Life-like view of a corner of the cabin class lounge model, showing the great gilded clock surround, which was reproduced photographically from drawings of the real model.

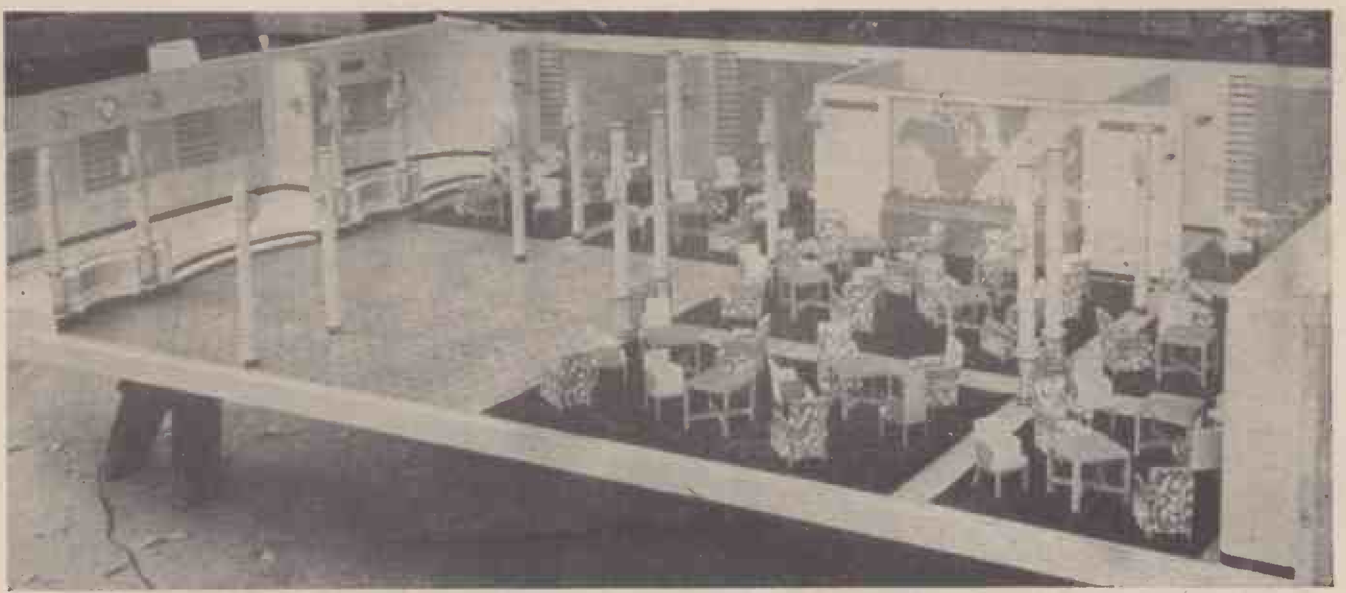


Fig. 7.—The Tourist Lounge, in cyclamen, parchment and green, with oak parquet flooring and silver bronze fittings.

Nothing could be left to chance. The drawings were scaled down from actual blueprints of the *Queen Elizabeth* herself, and while the huge hull was being carved and prepared for the paint-shop, the hundreds of small fittings, metal and wooden, were apportioned out to the model makers, so that when the time came, all the work would be ready for assembling together. Between twenty and thirty coats of paint and varnish were applied to the hull to bring it from the bare wood up to a smooth, shining surface able to stand years of exhibition in varying climates.

Fig. 5.—The Tourist Lounge—at work on the small jardinière, filled with minute flowers to match the colour scheme of the room.

Progress of comfort and luxury in oc an travel is further illustrated by the series of model rooms, to the large scale of 1 inch to 1 foot, which are to be seen just below the huge half-model of the *Queen Elizabeth*. There are five in all, cabin class restaurant, cabin class lounge, tourist lounge, tourist swimming pool and one of the cabin suites, and each one is ingeniously wired up to the *Queen Elizabeth* hull, so that a visitor pressing a button on the indicator rail, not only sees the room in question, but lights appear in the hull of the half-model, showing its position on the ship.

Figs. 5 and 7 show the tourist lounge in sheep-skin rawhide with silver bronzed jointings. The colour scheme is parchment walls, with cyclamen chairs, and deep cyclamen carpet with green markings. All light fittings are in silver bronze and the flooring is oak parquet. This attractive room is fitted with Thermolux glass windows, and its particular feature is the map of the world carried out in decorative glass.

The Swimming Pool

Fig. 6 is of the tourist swimming pool, which, in my experience of shipboard pools, is the most striking I have seen, even though it is only in model form as yet. The interior of the pool and its immediate surrounds were carried out in a delicate light-brown tile, with green tiled outer surrounds. The columns and pilasters were in Venetian mosaic, and all the rails and metal embellishments in Venetian bronze, with its peculiar metallic green tint, harmonising well with the green-grey walls. The water in the pool was produced by specially made ripple glass. The colourful cartoons in vivid blues and greens on the outer walls were reproduced in miniature by photography, and each one has a nautical interest of some kind—a ship, a dolphin, even the tiny shrimp, has been introduced into the design.

Cabin Class Lounge

The most ambitious of the model rooms was the lofty cabin class lounge, a view of which is seen in Fig. 4. The walls are of cluster maple, with enrichments in fou delicate shades of leather, and cellulose gilded metal work. The art work, pictures, etc., were carried out by the artist who is doing the actual work on the ship, and special features of this room include the ornamental cornices carved and gilded and the wonderful floodlighting effect from the concealed lamps in various parts of the room, also the gilded clock surround (which you will see in the picture). This model clock was reproduced photographically from the artists drawing, and built up to give the necessary relief in gesso. The luxurious-looking carpet is in a neutral brown, and the upholstery of the chairs, in various shades of dull blue and yellow.

Congratulations to the Department of Overseas Trade for this splendid idea of displaying British shipping progress, and to Mr. Misha Black the architect in charge of the arrangements for this exhibit, which is certainly an excellent example to the world of Britain's modelling skill.

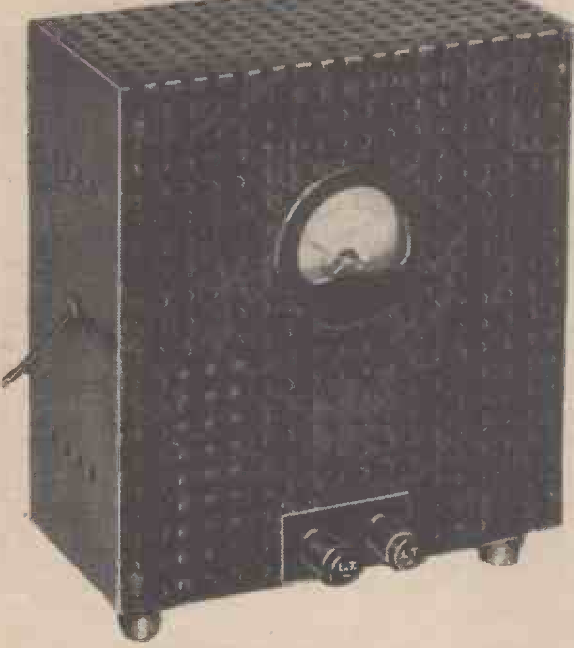
The model of the *Queen Elizabeth* and rooms, were the work of Bassett-Lowke, Ltd., of Northampton, and the ancient models the work of J. Johnson of London.

Fig. 6.—The Tourist Swimming Pool—a high spot of the " Queen Elizabeth "—with predominating colours of pale green, pale brown and Venetian bronze. Feature of this pool is the set of colourful cartoons in nautical style on the outer walls.

"PRACTICAL MECHANICS" WIRELESS EXPERIMENTER

THE P.M. BATTERY CHARGER

Details of a Powerful Accumulator charger Incorporating a Special Valve Rectifier. An Output up to 30 Volts at over 1 amp is Available



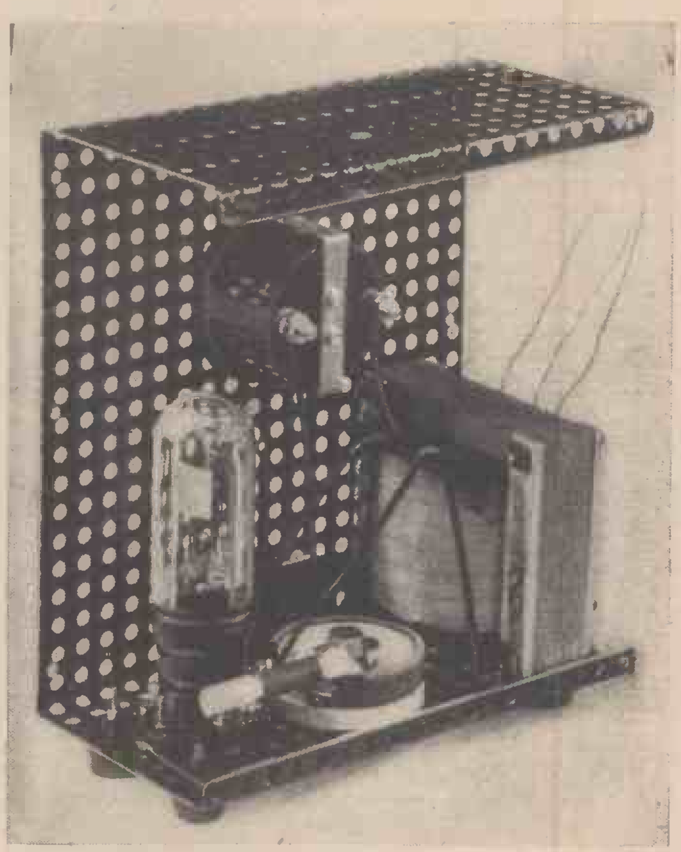


Fig. 1.—(Above) Showing the neat and compact arrangement of the completed charger.

Fig. 2.—(Right) A view of the internal section, showing the arrangement and wiring of the component parts.

MANY amateurs now use simple trickle chargers for keeping their accumulators in good condition, but the main drawback with this type of charger is the small current output. It is often found necessary to leave the cell on charge for such a long period that listening has to be curtailed, or a visit paid to the charging station to have the cell put into use more rapidly. It is possible, however, to make a charger which will deliver the full current required for normal charging rates with standard accumulators and such a unit is the subject of this article. It will also be found of value to the motorist as it may be used for car battery charging purposes. As designed, the charger may be stood on a bench—rubber feet being provided, or it may be hung on the wall, for which purpose keyhole slots are cut in the back. The circuit is shown in Fig. 5, from which it will be seen that the main requirements are a transformer, regulating resistances, ammeter, and the valve. In addition to these, two output terminals and a suitable mounting block are called for, together with a valveholder and connecting wires.

Containing Case

The components in our model were assembled in a metal case consisting of a metal sheet bent to form the back and two sides, whilst a sheet of perforated iron was used for the front and top and bottom. This enables the components to be mounted on the lower perforated side and perfect ventilation is thereby provided. Any similar form of assembly may be adopted, but it is important to ensure that air may pass freely from bottom to top as the valve gives off a considerable heat. For the same reason the transformer and valve should be well separated, whilst the meter should be placed at a fair distance from the valve.

To enable the current output to be regulated we have adopted a combined resistance feed, a fixed component of 5 ohms being joined in series with a variable rheostat of 6 ohms, and this acts as a safeguard and will prevent the valve from being overrun, whilst permitting the current to be reduced when required.

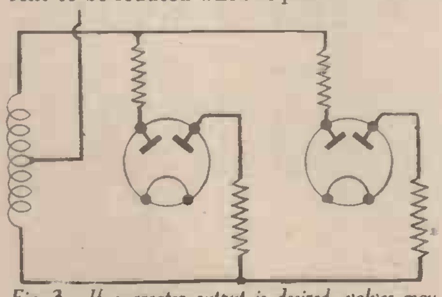


Fig. 3.—If a greater output is desired, valves may be paralleled, but then a separate 5-ohm resistance must be joined-in each anode lead as shown here.

Construction

The mains transformer must be capable of delivering 1.8 volts at 2.8 amps for the heater of the valve, and the secondary should be capable of delivering 30+30 volts at 1.3 amps. The component specified has been thoroughly tried and tested and will run without overheating and is in all other respects perfectly suitable for this charger. The variable resistance is adjusted by means of a screwdriver, and a hole in the top of our case was enlarged so that a long driver may be placed down through the case and the necessary adjustments made. This is a safeguard which will prevent the control from being inadvertently adjusted unknown to the user, which might result in some unforeseen accident. No live parts are accessible in the design, the mains leads being taken out through a rubber grommet at one side and insulated terminals with non-removable heads being used for the output.

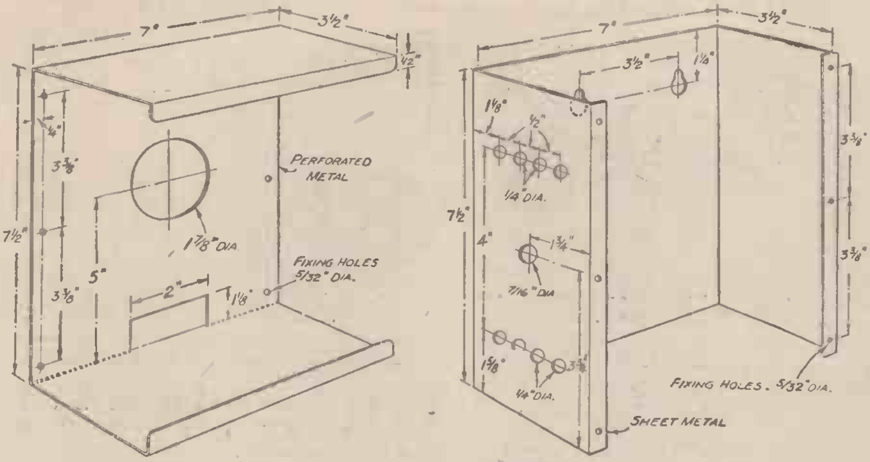


Fig. 4.—Details of the metal containing case.

The parts should be wired as shown in the wiring diagram, using stout leads where additional wire is required, and cutting off the output leads from the transformer to reach comfortably to the valveholder, etc. Note carefully the connections to the ammeter, and be careful to connect the thick secondary leads to the filaments. To prevent the mains leads from being pulled away from the contacts inside, a knot may be tied in the flex before it is passed through the grommet and this will take the strain. Alternatively, if a wooden back is fitted for simplicity the wire may be anchored by attaching a small ebonite or wooden bridge over the flex. A switch has not been included in the circuit as it is assumed that the charger will be connected to a mains socket of the type having a switch mounted for it, and thus it will only be used as required. The complication of a separate switch is not called for, and by switching off direct at the mains plug there will be no risk of danger due to the fact that a length of live mains lead may be left permanently in circuit in such a place as a garage.

Greater Outputs

Where it is desired to obtain a greater output another valve may be included in parallel with the existing valve, but to ensure that each valve delivers an equivalent load, and to avoid overrunning one valve due to differences in characteristics, a 5-ohm fixed resistance should be included in each anode lead as shown in Fig. 3. The same type of resistance as is already used in the output circuit (Bulgin type A.R.5) should be used.

To use the charger, simply connect to the mains, join the accumulator to the L.T. terminals, set the variable resistance to maximum (all in) and switch on. With a screwdriver adjust the variable resistance until the current indication on the meter rises to approximately 1.25 amps. If, of course, the cell is to be left unattended for some considerable time and it is feared that it will be damaged due to over-charging, the rate may be reduced by a simple adjustment of the resistance.

Owing to the type of rectifier employed, this unit is much more flexible as regards its applications than many other simple inexpensive chargers. For instance, it is ideal for the radio amateur, the car owner, or the electrician who wishes to start a charging station in a small way. It must be appreciated that the output is quite safe for use with a single two-volt cell, a six- or twelve-volt car battery, or, say, twelve two-volt cells in series.

When ordering the mains transformer specify voltage of mains supply so that the makers can provide correct primary winding.

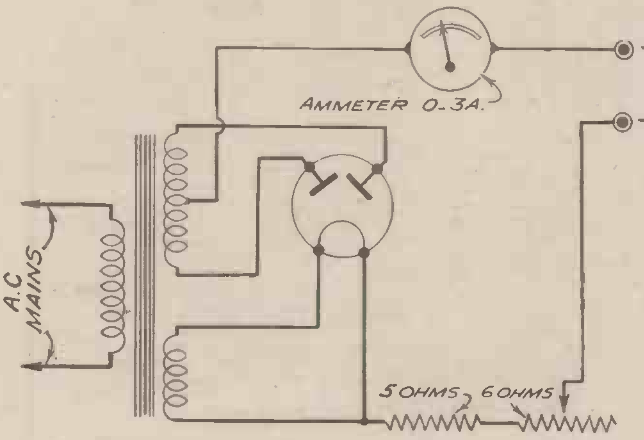


Fig. 5.—Theoretical circuit of the charger.

LIST OF COMPONENTS for the BATTERY CHARGER

- 1 mains transformer, with secondaries: 1.8 v. 2.8 A., 30+30 volts 1.3 A (T. W. Thompson and Co.) (12s. 6d.).
- 1 Argon rectifying valve, Type A.831 (General Electric Co.) (10s. 6d.).
- 1 ammeter (0-3 amps.) (Premier Supply Stores) (5s. 9d.).
- 1 terminal mounting block (Belling Lee) (6d.).
- 2 terminals (L.T.—, L.T.+) (Belling-Lee) (9d.).
- 1 6-ohm variable resistance (Heayberd) (2s.).
- 1 4-pin valveholder (VH.19) (Bulgin) (6d.).
- 1 10-watt 5-ohm resistance (A.R.5) (Bulgin) (1s.).

Wood for baseboard, connecting wire, perforated zinc for cover, screws, etc.

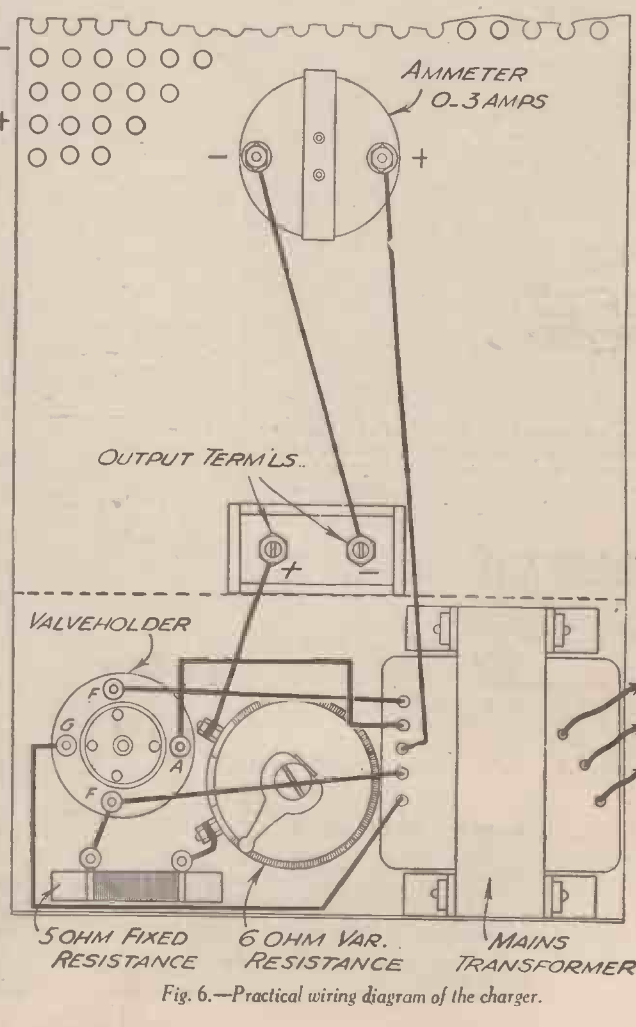


Fig. 6.—Practical wiring diagram of the charger.

"MOTILUS" PEEPS INTO THE MODEL WORLD

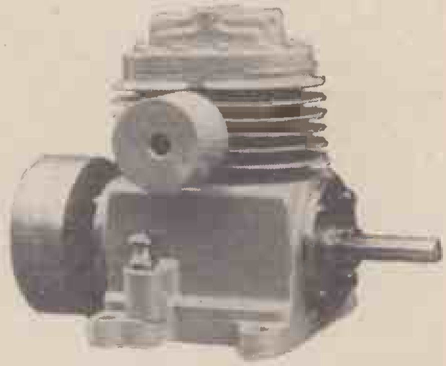
Our Model Fan has Been as Busy with his Camera as ever, and this Month has "Snapped" a Fine Variety of New Developments in the Model World.

Model of the Hampton Ferry of the Southern Railway.

JUST now the fighting forces of Britain seem very much to the fore, and in model making there are many ship enthusiasts who have transferred their affections from the mercantile marine to the navy and are making waterline models of Britain's latest warships. Naturally, this wave of enthusiasm has stimulated an interest and demand for finished models of the fleet—and of the fighting navies of other nations. So here you will see I have "caught" a professional craftsman engaged in the making of warship models. This work requires hours and hours of training and practice, and requires exceeding skill to achieve the right "atmosphere" and fineness of detail in the grey monotone of a light cruiser, destroyer or submarine, perhaps only 6 in. long.

Hampton Ferry

From the Navy let us proceed to transport by sea and by rail, for the model illustrated here combines both—the Hampton Ferry of the Southern Railway. This service, inaugurated by the S.R. in 1936, is run by the three sister ships *Twickenham, Hampton* and *Shepperton Ferry*, named after the well-known ferries of the Thames Valley, and is the first means of railway communication between Great Britain and the continent of Europe by which passengers can travel to and fro *without changing trains*. Great Britain has been the pioneer of this class of vessel. The first train ferry in the world was the *Leviathan*, built in 1849 and used for ferrying trains across the Firth of Forth until 1890 when the famous Forth Bridge was completed. So it was a bright idea to send this model of Britain's most up-to-date Channel ferry to the New York World's Fair, showing our American cousins who contemplate coming to England the advantage of a night route to Paris. The complete ferry did not lend itself to modelling, so Mr. C. Grasemann, the enterprising Public Relations Officer of the Southern Railway, in consultation with Mr. W. J. Bassett-Lowke, effected an excellent compromise by reproducing a portion of the ferry to a much larger scale. The scale is ½-inch to the foot, giving the model an overall length of 2 feet 6 inches, and illustrating in detail the main features of the service. You will see in the picture the docking bridge and deck fittings, the track by which the sleeping cars are run on to the ferry, the manner in which they are housed and the details of the cars themselves.

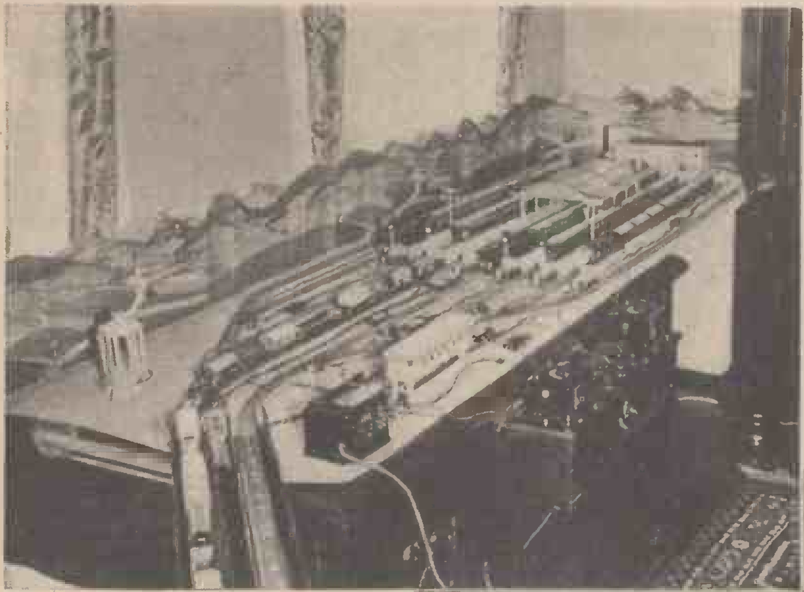


Two engines made by Stuart Turner, Ltd. (Left) "The Sirius." (Above) "The Compressor."

"OO" Gauge Layout

From the continent there comes to me

(Left) At work on waterline models of Britain's latest warships. (Right) Schoolboys interested in a model of the Belgian liner "Baudouinville."



A 00 gauge layout.

a most interesting picture of a layout in gauge "OO," the gauge which we all like to look at now, even if we are not owners. It is a bird's eye view of a main line terminus with the central control board in the foreground. What strikes me most about this picture is the excellent realism of the scenery which forms the background for the railway. It is a pity really that the curtains in the room are visible, as I'm afraid they take away from the view, but no doubt the owner is limited in his house room and must use one of the "best rooms" for his hobby. Never-the-less, English "OO" gauge owners might take a leaf out of this continental enthusiast's book, and set about making some good railway scenery. If I had the time and the energy —*and* the railway—I feel sure I should experiment with a photographic background for mine, but as I haven't I am handing this idea—free of charge—to my readers!

Stuart Models

Accepting an invitation from Mr. H. Sanderson, secretary and director of Stuart Turner, Ltd., to visit their works at Henley, recently, I spent a most interesting afternoon there, but without my camera!

Although the making of Stuart models is not such an important part of the business as the making of their marine engine and lighting plants, Messrs. Stuart Turner, Ltd. have a special department devoted to their model horizontal and vertical engines, dynamos, and also engine and boiler fittings and parts.

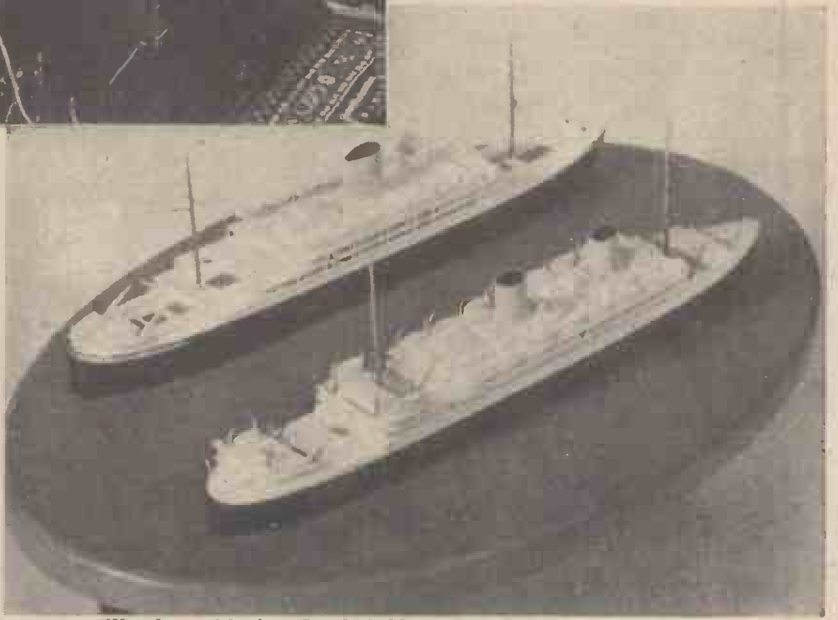
A walk round the factory convinces the most critical model maker that all their work is done with care and accuracy and is in brief a good British engineering job.

Several new lines have been introduced recently, including the Twin Cylinder "Sirius" and the Stuart Compressor or Vacuum Pump. In the "Sirius" particular attention has been given to the design of the valve gear and steam passages, with the result that the engine develops great power with a surprisingly low steam consumption. Messrs. Stuart Turner's own tests show that .4 b.h.p. is developed at 2,800 r.p.m. at a steam pressure of 50 lbs., steam very moderately superheated. Castings, machined sets and finished engines of both the "Sirius" and the "Compressor" are available.

A new model 0 gauge locomotive—the L.M.S. "Victory."

Waterline Models

A comparison of ships by waterline models is always a good method because the onlooker can so quickly grasp the essential differences in the lines and construction of the whole ship, whereas on the vessels themselves it is so difficult to take the "long view." On this page is shown two Royal Mail liners, the *Andes*, which has only recently been launched, and makes her maiden voyage to South Africa in September, and the *Alcantara*, built as a motor ship but recently converted to steam turbines. The new *Andes*, which has a single funnel will be one of the most luxurious and best appointed British ships ever built and will uphold British shipping prestige in Southern Seas. She will follow the regular South American route of Royal Mail steamers.



Waterline models of two Royal Mail liners, the "Andes" and the "Alcantara."

Model of Motor Ship

The Belgian liner *Baudouinville*, the new motor ship, which is shortly to be engaged in the service between Antwerp and the Belgian Congo, makes an attractive model as will be seen from the illustration. This vessel has a most attractive colour scheme—grey and two shades of rust red, one anti-fouling and the other anti-corrosive. The sidelights in a realistic shade of sea green complete the scheme. This *Baudouinville* model—there was another shipyard in its earlier stages—was built to the continental metric scale of 1/50th which corresponds most nearly with the English scale of 1/48th (¼-inch scale), and the feature of the ship was the awnings which screen practically the whole of the deck space.

I was in Bassett-Lowke's London shop in High Holborn the other week and I see they have now added a new 5XP model to keep the *Conqueror* company. This new gauge "O" model is of the L.M.S. *Victory* No. 5712, and several improvements and modifications have been added.

I also saw when I was there, an inexpensive set of parts they have just introduced for building a destroyer. It comprises finished hull complete with decking, electric power unit and dry battery, propeller shaft, stern tube, steering gear and all deck parts.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 552, 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.

"SEA-MAT"

"CAN you give me any information of sea-fir. I think it is a kind of seaweed."—J. B. (Lewes).

THE seaweed you refer to is more commonly known as "sea-mat." To zoologists it is known as *flustra foliacea*. It is a member of a genus of polyzoa of the order *Infundibulata* and the family *flustradae*. There are many of these sea-mats, and they all take the form of woven, or net-like masses of foliage, greenish-brown in colour, which are generally found at the entrances to harbours. The word *flustra* itself is derived from the Saxon, *flustrian*, to weave, and describes the characteristics of this genus of seaweeds.

Flustra foliacea is the commonest sea-mat. Its leaves are about four inches long, rounded at their ends and supplied with marginal spines. Under the low-powers of the microscope, such leaves provide much interest.

BLEACHING BY SULPHUR

"I AM studying bleaching by sulphur and wondered if you could recommend a book which deals with this subject."—W. E. S. (Berks).

THERE is no book devoted exclusively to sulphur bleaching which, as you probably know, is a process reserved for the bleaching of woollen fabrics. Any of the following volumes, however, will be found to describe bleaching processes using sulphites, sulphurous acid, etc.: A. B. Steven, "Textile Bleaching," 1922 (3s.); J. M. Matthews, "Bleaching and Related Processes," 1921 (42s.); J. M. Matthews, "Bleaching of Textile Fabrics," (52s.); Trotman and Trotman, "Bleaching, Dyeing and Chemical Technology of Fibres" (30s.).

HYDROCHLORIC ACID

(1) "WOULD you, please, let me know if hydrochloric acid (HCl) is formed when hydrogen and chlorine are mixed through water.

"(2) If this is the case would you please furnish me with a description of the apparatus necessary for preparing hydrochloric acid by this means.

"(3) Are there any precautions that must be taken during the preparation, and is chlorine highly inflammable or not?"—J. G. (Glasgow).

(1), (2) HYDROCHLORIC ACID is not formed in appreciable quantities when hydrogen and chlorine are bubbled through water. If the dry gases, however, are mixed and exposed to diffused light, chemical combination proceeds slowly and, after a few days, the smell of chlorine may be detected in a cylinder of hydrogen and chlorine. If, however, the mixed gases are exposed to sunlight, the light of an electric arc, burning magnesium or any other light-source rich in ultra-violet rays, the chlorine and the hydrogen will combine together immediately and with great explosive violence, forming gaseous hydrochloric acid. It is dangerous to experiment with mixtures of hydrogen and chlorine in sunlight.

(3) Chlorine is not an inflammable gas. It is, however, highly corrosive and possesses a peculiar suffocating smell which greatly affects the mucous membranes of the throat and nose, causing all the symptoms of a severe cold. Chlorine gas should not be breathed in any quantity.

MAKING DENTAL PLATES

"CAN you tell me the name of the composition used by dental mechanics for repairing and making dental plates?"—G. M. (Yorks).

DENTAL plates are normally made from a variety of vulcanised rubber of special composition. It is really impossible for an amateur to make this material at home since its preparation necessitates the employment of special carefully controlled furnaces. For a similar reason, it is not practicable for an individual, unless specially trained and possessing the necessary apparatus, to effect repairs to dental plates. You can, however, purchase "dental vulcanite" for denture making from any wholesale and manufacturing dental firm, as, for instance: The Amalgamated Dental Co., Ltd., 5-12 Broad Street, Golden Square, London, W.1; The Dental Manufacturing Co., Ltd., 17 Newman Street, London, W.1; Vulcan Dental Manufacturing Co., Ltd., 9a The Village, Old Charlton, London, S.E.7.

IMPROVED ELECTRIC PLUG

"I HAVE devised an electric point which can be fitted in bathrooms to facilitate the use of an electric razor. Do you think it is novel and worth patenting?"—F. R. S. (Salisbury).

THE improved electrical plug is novel as far as we know and forms fit subject matter for protection by letters patent. To ascertain if the idea is really novel, it would be necessary to make a search amongst prior patent specifications dealing with the matter. As the cost of such a search is a relatively expensive matter, it would probably be less expensive to file an application for patent with a complete specification, and so obtain the result of the official search which is only made after filing a complete specification.

An alternative and less expensive way of obtaining protection is to file an application for patent with a provisional specification which gives protection for about twelve months, during which time it should be possible to ascertain if the invention is likely to prove commercially successful, and also if the idea is broadly novel from interested manufacturers.

LIQUID AIR

"I WISH to carry out some experiments with liquid air and would like to know: (1) "Where it can be obtained.

(2) "The approximate price for small quantities.

(3) "Is it possible to keep it for more than two days?

(4) "Can it be made at home?"—R. T. (Grantham).

(1) LIQUID air or oxygen is now a commercial commodity and can be procured from The British Oxygen Co., Ltd., Edmonton, London.

(2) The approximate price of liquid air is 7s. 6d. per litre, plus loan charges on a suitable container. It can be sent by rail (passenger train) under certain conditions.

(3) It is not possible to keep liquid air in its container for more than four days at the outside.

(4) To make liquid air at home you would require a portable air liquefier and an air compressor, both of which are costly articles, but which can be obtained from the above-mentioned firm.

A BOMBING GAME

"I ENCLOSE herewith design for a new game which I have invented and would like some advice regarding it.

"I have called it 'Air-raid,' and, as the name implies, the object is to bomb or destroy buildings, etc., in your opponent's territory. It involves a high degree of skill, and an element of chance; all movements and particulars are given on separate sheets, also enclosed. Has it any commercial value and is it worth patenting?"—F. S. (Liverpool).

THE improved game is ingenious, and if properly marketed should have commercial value. It is not possible to patent a game where the only material product is a printed sheet as in the present case.

Protection may, however, be obtained by registering the design of the board for playing the game, and for any pieces if of a novel shape. Rules or instructions for playing the game would be copyrighted on publication in printed form. The actual Government fee for registering a design in a single class is 10s. An application for registration of a design must be made on a stamped form and accompanied by three identical representations or specimens of the design.

Goods are classified for registration according to the material or predominating material of which they are composed.

It is not possible to give even an approximate cash value, as this depends wholly on the way it is marketed. It is unlikely that any manufacturer would pay any large cash sum for such a game, and is more likely, if interested, to agree to pay a small royalty depending on the cost. A fair royalty would be 5 per cent. to 10 per cent. of the selling price. A likely firm to be interested is Messrs. John Jacques & Son, Ltd., 37-39 Kirby Street, E.C.1.

CHLORINE FROM SEA SALT

(1) "WOULD you, please, tell me how to obtain dry chlorine from sea salt?

(2) "Is this the simplest and cheapest way of obtaining chlorine apart from hydrochloric acid?

(3) "Has bright sunlight any effect on chlorine?"—D. P. (Glasgow).

YOU may obtain chlorine gas from sea salt (or common salt) by electrolysing a strong solution of it, using carbon electrodes. Chlorine gas will be evolved at the positive electrode. This, however, is not a particularly cheap or convenient way of obtaining chlorine on a small scale.

For laboratory purposes, you will probably find it better to make chlorine by gently heating a mixture of sea salt (or common salt) with manganese dioxide and concentrated sulphuric acid. Chlorine will be liberated abundantly from this warm mixture. In order to dry the gas, lead it through a tube containing a small quantity of fused calcium chloride.

Experiments with chlorine should be conducted out of doors. The gas has an extremely irritant effect on the mucous membranes of throat and nose and is dangerous if breathed in any quantity.

Bright sunlight has no effect on chlorine gas.

BACILLUS CULTURE

"CAN you give me any details regarding the preparation of culture media for bacillus tuberculosis and for bacillus tetani?" G. M. (Chester).

B. TETANI is best cultured in a 4 per cent. solution of gelatine containing a little glucose. B. tuberculosis grows best in a medium comprising a 4 per cent. solution of gelatine containing 4 per cent. of glycerine. It will also grow readily in a "broth" composed of diluted meat extract thickened with gelatine and containing a little milk.

The best-known bacteriological supply firm is Messrs. Flatters & Garnet, Ltd., 309 Oxford Road, Manchester. Catalogues are issued by this firm, but we fear that you will not be able to obtain cultures of pathogenic organisms, such as the above-mentioned bacilli unless you can prove that you are an individual authorised to receive them.

VENTILATING SYSTEM

"I SHOULD be grateful for your advice on the practicability of my idea for a combined heating and ventilating system. The object is to introduce fresh air into a room which is heated by steam or hot water radiators without lowering the temperature." —T. B. (Surrey).

THE improved ventilating and heating system is probably novel, but it is a little doubtful if any patent of any commercial value could be obtained for the invention. It is not thought to have sufficient subject matter to support a valid patent since the broad idea of fluid jacketing is old. Unless fresh air is introduced it is not thought to have any advantage over an unjacketed radiator, and the introduction of air cooler than the room would of necessity lower the normal temperature. The invention is not thought to have sufficient commercial value to warrant the expense of attempting to patent it.

CHARGING BATTERIES

"I HAVE a 12-volt lighting plant and a rheostat or variable resistance. Intending to charge my wireless batteries through this resistance I find that the minimum charge rate is about 16 amps., which is far too high: Could you please tell me the proper gauge of wire to use in rewinding the resistance to charge at say from ½ amp. up to 10 amps. It has a 2-inch former and 3½-inch straight travel. Could you, please, tell me if enclosed diagram is the proper way to connect batteries charged at different rates?"—A. L. (Co. Antrim).

YOUR wiring circuit is quite wrong. You must connect up with a resistance in each battery circuit, so that the current in each circuit is not less than ½ amp. and 1 amp and 2 amp. This means that you must have three circuits in parallel with a resistance in each. To reduce to ½ amp. you will require about 20 feet of No. 22 resistance wire which will be too much for your former. We advise you to use lamps as resistances and put one 6-watt lamp in circuit when only ½ amp. is required.

BUY, EXCHANGE OR SELL

TOOLS—*Continued*

120 Combined Engineers & Woodworkers Vices, a most useful tool in any workshop, 6" Jaws, opens 4½". Clearance price, 4/9 each; honestly worth double. —Below.

500 Woodworkers Vices, 4" Jaws, clear 2/9 each.—Below.

85 Machine Vices for Drilling or Milling Machine. Robust design, Width of Jaws 2¾", opens 3⅞", very cheap to clear, 3/3 each, below.

150 S.A.E. Split Dies, 2" Diam. cutting ⅞"; ¾"; 1", clear 2/- each.—Below.

48 Split Dies, 2" & 2½" Diam., ½" to 1" Whit & B.S.F., 2/9 each, subject unsold.

J. BURKE, 30 TRIPPET LANE, SHEFFIELD, 1

TOOLS—*Continued*

1" Round Dies, Screwing ¼"; 5/16"; ⅜"; 7/16"; ½"; Whit., B.S.F.; or Brass 26 Threads; or American Fine. S.A.E. for Yankee Cars, Set of Five Dies 2/9; Four Sets 10/-; Best Quality 1" Die-Stocks, all Steel unbreakable with Hardened adjusting Screws, 1/9 each.—Below.

4,000 Taps, same sizes and threads as Dies, 2/9 set, four sets 10/-.—Below.

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Fine Emery Wheels, 1/16" to ⅜" thick, ¾" hole; 2½" to 4" diam., extremely useful for Grinding Drills, Small Tools. Special selection, 2/6 per doz.—Below.

250 Gross Genuine Tungsten Hack-Saw Blades, 8", 9", 10", 12", 14" to 32" teeth; ½" wide; a few gross 12" ⅝" wide. These are very slightly stock soiled, but guaranteed serviceable, 8/6 gross. Three gross lots, 22/6. Power Blades, 12" by 1", 2/6; 14", 3/6 doz., subject unsold.—Below.

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Small Taps in all above sizes. Taper; Second or Plugs, ⅛" to ¼", Whit. ,B.S.F. Also 0 to 6 B.A. 4d. each; 3/- doz.; 9/32" and 5/16" 6d. each. Please note we have no stock of M.E. 40 Thread Taps.—Below.

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⅜" to ¾" **Silver Steel,** 4 lb., 2" to 4" long.
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12 Drills, 1/16" to ⅜". Carbon.
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Ditto, B.S.F. 26 threads of S.A.E.
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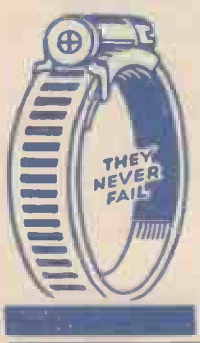

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