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JUNE

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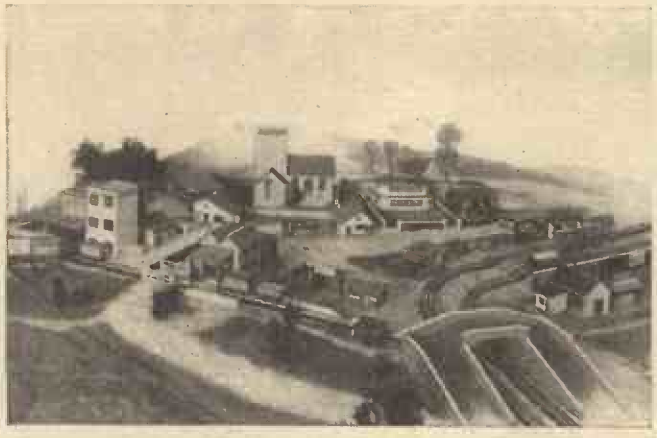

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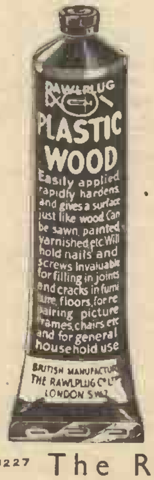

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Inland and Abroad 7s. 6d. per annum

Canada - - 7s. per annum

Editorial and Advertisement Offices: "Practical Mechanics," George Newnes Ltd. Tower House, Southampton Street, Strand, W.C.2.

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

Registered at the G.P.O. for transmission by Canadian Magazine Post.

PRACTICAL MECHANICS

VOL. V. JUNE, 1938. No. 57.

Fair Comment

By The Editor

Our Model Aircraft Contest

A LARGE number of entries for our £20 Cash Contest (many other prizes) for the Model Hawker Hurricane Competition have been promised, and elsewhere in this issue the competition rules are repeated and further instructions given on building the model. If you intend to compete you should notify me without delay on a postcard so that full details of the competition can be sent to you. It is expected that the competition will be held, as last year, at Brooklands. Issues containing the free double-sided full-size blueprint of the Hawker Hurricane are still obtainable, price 7½d. each.

The Practical Mechanics Handbook

DETAILS of our presentation offer of "The Practical Mechanics Handbook" were given in last month's issue, and, before it is too late, I recommend you to reserve a copy at once. This book contains valuable tables, formulæ, information on electro-plating, lathe work, workshop methods, filing, small tools, colouring metals, hardening and tempering, drills and drilling, screw cutting, mechanical drawing, how to obtain a patent, the micrometer and vernier, gear cutting, wire tables, metric conversion factors, drill gauge sizes, and a mass of other valuable material, which every mechanic requires. The tabular matter in the book alone will be found extremely useful. Much of the information I compiled for my own ready reference in answering readers' queries, and as the pile of information grew, it occurred to me that it would be useful if rearranged and published in book form. This I have now done and I place it before my readers in the belief that all of them would wish to avail themselves of this valuable work. Reserve yours to-day by complying with the simple conditions.

A Competition

I OFFER prizes of 3 guineas, 2 guineas and 1 guinea, for the best articles describing some original method evolved by the competitor, either of doing a particular job, for using up scrap material, or which describes some original process. This suggestion resulted from a letter I received from a reader who pointed out that many people in business have a large quantity of papers, cardboard containers, wood shavings, metal turning, and other waste material which they either have to burn or get rid of each week. He rightly points out that this is a terrific waste of material which, if treated properly and in sufficient quantity, could be turned to good account commercially, either as fuel, or remanufactured into useful goods. There are many processes, of course, for utilising waste material and reconverting it for further use. The material of which "horn"-rimmed spectacles are made is produced from scrap. The tin plate toys you buy, in many cases, are made from waste tins. The waste trade industry is, in fact, an important one, and very little material is actually wasted, but it may well be that our readers can evolve some other methods of converting waste profitably. It is of no use, for example, devising a process which renders the finished product more expensive than by making it from existing material. Above all, the method must be original. Entries should be sent to me addressed as above, not later than July 15th, marked "Process."

The Royal Aeronautical Society

NOW that the Hendon Air Pageant has been discontinued, air-minded people look forward each year to the Royal Aeronautical Society's Garden Party which, this year, was held at Fairey's Great West Aerodrome. I was greatly interested in the vast display of aeroplanes of all types, pre-war, war, and post-war, and particularly in the gliding. I was most fascinated by the flights made by the original Bleriot monoplane, the first aeroplane to cross the Channel in 1909. This frail-looking structure with its motor-cycle wheels, three-cylinder 35 h.p. engine, rubber cord suspension, and open-type fuselage took off, flew and landed equally as well as its modern rivals in spite of its 30 years of age. The old pre-war Deperdussin monoplane also flew well, and drew attention to the vast progress we have made in aircraft design. We now use retractable undercarriages, hydraulic chassis, enclosed fuselages, engines of 1,000 h.p. Our aeroplanes are capable of flying from one end of the globe to the other, and whereas the old Bleriot weighs only about 560 lbs., a modern aircraft weighs several tons and will carry enormous loads, either of merchandise or passengers. It is well that these old aeroplanes should be preserved so that we know the hazards which the pioneers such as Bleriot undertook, and who laid the foundations of the aircraft industry.

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How Engines Are Tested

A Brief Description of the Methods Generally Adopted in Tests of Steam and Internal Combustion Engines

ALTHOUGH in the case of a new, and somewhat untried, type of engine it is necessary to carry out various tests to find out what power it will develop under certain conditions, and what amount of steam or oil it consumes, as well as other information of a research nature, it is usual to put every engine, excepting the largest sizes, through ordinary commercial tests before it is despatched from the maker's works. This not only satisfies the builder as to its performance, but enables him to make any necessary adjustments with much less trouble and expense than might be necessary if carried out after the engine has been delivered and erected on site, which may be thousands of miles away.

Nature of Test

The nature of the test depends on the type of engine involved; whether a steam reciprocating engine, steam turbine, or an internal combustion engine using either gas, oil or petrol. Roughly speaking, apart from the tuning up and adjustment of valve settings, etc., the main objects of such a test are to find out the horse-power the engine will develop, the amount of steam, or other fuel, which it uses for each horse-power developed, and the governing efficiency.

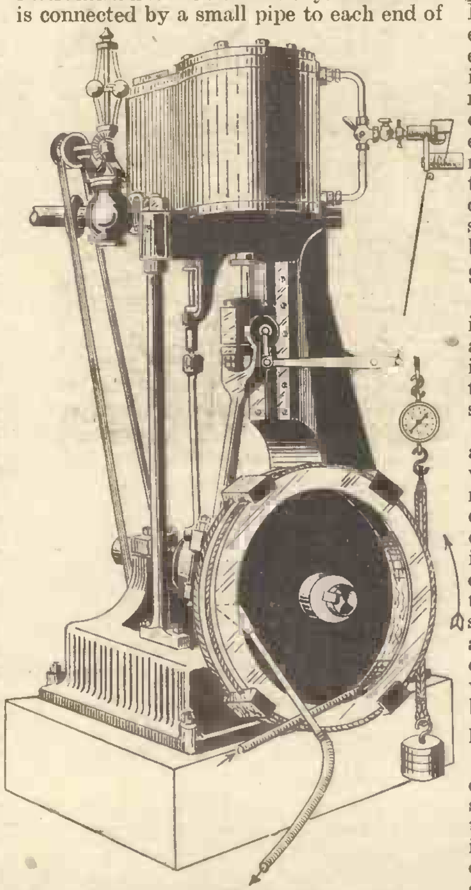
Take the case of a simple steam engine. The effective, or brake, horse-power which it will develop may be measured by one or other form of dynamometer, such as the simple rope brake for the smaller sizes, or a hydraulic dynamometer of the Froude type for the larger ones. In the former case, a brake wheel, or drum, with a hollow rim is mounted on or coupled to the crankshaft. Two ropes, joined together at the ends, are wrapped round the periphery of the drum, and held in place by wooden blocks. To one end of the ropes is attached a spring balance, while at the other end are suspended adjustable weights, the latter being arranged to act against the directional pull of the engine. To keep the brake wheel cool, water is fed into the hollow rim from one pipe, and, as the heat generated has to be carried away, a scoop fitted to another pipe draws the water off again.

Brake Horse-Power

One horse-power is the equivalent of 33,000 foot pounds of work done in one minute, so that by noting the diameter of the brake drum, the nett weight applied, and the speed in revolutions a minute, it is possible to calculate the brake horse-power quite easily. The formula is $\frac{W \times 2\pi R \times N}{33{,}000}$ where W is the nett weight, $2\pi R$ is the circumference of the drum, and N the number of revolutions a minute.

Another kind of rating often used is known as the indicated horse-power. This is the power actually developed inside the engine, and includes the power required to drive the engine itself, which is that much more than the brake horse-power. The ratio of these two is known as the mechanical efficiency, or the $\frac{\text{B.H.P.}}{\text{I.H.P.}}$

The indicated horse-power is found by using an instrument called an indicator—invented by James Watt—which produces a diagram on a piece of paper, or "card", mounted on the drum of the indicator. This instrument has a small steam cylinder which is connected by a small pipe to each end of



A small steam engine fitted with apparatus for "indicating" the steam cylinders and for obtaining the brake horse-power.

the engine cylinder, so that all variations taking place in the latter are instantaneously reproduced in the indicator cylinder. The piston in this operates a light mechanism which makes a metallic pencil trace out a diagram on the card showing the steam pressure throughout the stroke, and from which the mean steam pressure during the stroke is calculated. In order to make such pressures correspond exactly with the period of the stroke of the engine, the paper-carrying drum of the indicator is rotated by a cord attached to a reducing mechanism connected to the crosshead, or reciprocating part of the engine. A spring inside the indicator drum returns the drum back when the tension of the cord is relaxed. These indicator diagrams also show any fault in the valve setting, and enable such adjustments to be made.

Steam Test

The steam consumption test of the engine is best measured by condensing the steam as it exhausts from the engine and weighing it. If the engine is not of the condensing type the steam may be condensed in a separate condenser at atmospheric pressure.

The governing test is an important one, as should the governor fail to act properly when the load on the engine is suddenly removed, due to one cause or another, the engine would race and probably cause considerable damage. This is of particular importance in the case of steam turbines owing to the enormous speeds at which they run. The amount of momentary rise in speed on throwing off the full load is generally specified not to exceed about 7 per cent.; while the permanent, or settled, variation from full to no load should not be more than about 2½ per cent.

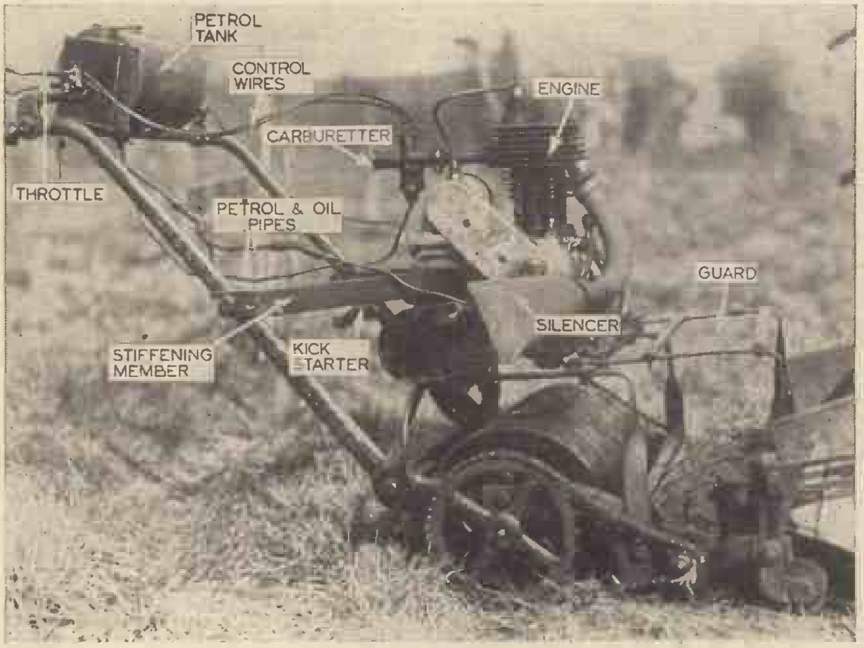
Power Developed

When the engine is direct coupled to an electric generator, as is mostly the case with steam turbines, the power developed can then be measured by the electrical output instead of by a dynamometer. In the case of ships driven by steam turbines the power developed by the turbines can be measured while running at sea by means of an instrument called a torsion meter, which is fitted to the propeller shaft, and gives this as "shaft horse-power". It is so called because the instrument measures the amount of torsion, or twist, in the shaft between the turbine and the propeller. One would hardly think that the big diameter shafts used in an Atlantic liner would actually twist under load, but, though very little, this twist can be accurately measured by a delicate instrument, and gives very useful information as to what power the engines are developing at any given time under varying conditions.

The testing of internal combustion engines includes the brake horse-power and governing features of the steam engine, but varies as to the fuel used in each case, while other features such as measurements of the cooling water used, its temperatures at inlet and outlet, the lubricating oil used, and so forth, are investigated. The duration of the tests may be anything from an hour to several hours, according to the size and importance of the plant, and the information required, while readings are taken at short regular intervals of all important items so as to check up and work out the final results.

Making a Motor Mower

By M. A. GISTER



This illustration shows the component parts of the motor mower.

DURING the summer the lawn has to be cut at least once a week and in showery weather when the grass grows thick and strong the task of valeting becomes irksome. Still more exacting is the problem of the man who owns or cares for a tennis lawn or bowling green, and as a matter of fact most sports grounds are now equipped with a motor mower. This lessens labour and greatly speeds up the job because while a hand-pushed mower usually has only 12-in. blades, a motor-driven one will have 20-in., or even more, and so does almost double the work for each run along the lawn.

The cost of a motor mower, however, is prohibitive to most private owners. There are many excellent makes on the market, with varied specifications, from popular to de luxe, at widely varying prices. Thus 16-in. commercial mowers range in price from £16 19s. 6d. to 25 guineas, while a de luxe machine with 20-in. blades costs no less than 43 guineas.

The Motor

Having a large lawn to care for I had learned to loathe the hand mower, and made several attempts to buy a second-hand motor mower at auction sales, but they all were too dear. I have now constructed my own motor lawn mower with 20-in. blades at a total out-of-pocket cost of *six guineas*; this is how it was done.

I was at a country auction sale one day when a 20-in. mower was put up for sale. It was intended for use by two men, or a man and a pony, and as there is very little demand for such I was able to buy it for 30s. It was in perfect condition and was said to have cost originally over 10 pounds, though I have no proof of this.

My next move was to buy the various parts required to build the power plant. This was done by visiting "motor-wreckers"—firms who buy second-hand cars and cycles and break them up—and junk shops. I was able to obtain all the parts required for £4 16s. They were so cheap because provided they were in working order, it did not matter whether the car or cycle from which they came was obsolete or not. The most important and expensive item was the actual engine. This was a $2\frac{1}{4}$ h.p. air-cooled J.A.P. motor-cycle engine, of early vintage, but in excellent condition, complete with carburetter and magneto—it cost me 30s.

The Author Tells in this Article how he was able to Build a Motor-driven Lawn Mower for the Moderate Price of Six Guineas

The next most expensive item was an old Triumph motor-cycle three-speed gear, complete with kick-starter, clutch, chain and sprockets. It was bolted to its original base-plate, and had to be cut out of the cycle frame with a hack-saw.

The other items will be described as we come to them; most of them were obtained at scrap price.

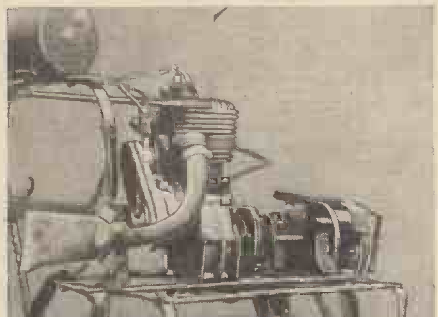
The Framework

The first step in building the motor was to erect a rigid frame-work to carry the engine and components. This was made of wrought-iron angle brackets, bent twice when red-hot at right angles to form a raised platform above the roller. The brackets were $1\frac{1}{4}$ in. wide and $\frac{5}{16}$ in. thick, and were firmly bolted to the frame of the mower, fore and after of the heavy roller. The brackets were connected at the front and rear by heavy cross-bars, of the same wrought iron. These were the actual engine carrying members, and the engine was held in position by four angle brackets, each 8 in. long, 1 in. wide and $\frac{5}{16}$ in. thick, which were bolted by two bolts to the cross-bars, and also to the crank-case of the engine.

In order to prevent all vibration two stiffening rods were also fitted, each was 17 in. by $1\frac{1}{2}$ in. by $\frac{5}{16}$ thick, they were bolted on each side of the upper part of the engine, and at the other end were bolted to the handles of the mower.

Flexible Drive

To guard against injury to the engine in case a stick or stone jammed the mower blades when working, it was necessary to fit a flexible drive. This was provided by removing the chain sprocket from the engine, and fitting in its place a flanged wheel, which it was thought would also drive a fan. In practice a fan was not found necessary, but the flanged wheel was obtained by taking a timing wheel from an Austin "7" and turning off the teeth in a lathe. The wheel was then drilled with three holes, and bolted to mount a flexible coupling, actually a universal joint taken from an obsolete air-cooled Rover "8" and was connected to the final chain drive by means of a Ford rear-axle shaft $8\frac{1}{2}$ in. long. The shaft was keyed and tapered at both ends, one of which was connected to the flexible coupling, and the other to the chain-sprocket drive of the mower. This would have been the original chain sprocket removed from the J.A.P. engine, but the pitch was not right for the Triumph chain drive to gear-box, so a Triumph engine sprocket was substituted. The mounting was provided by means of an end plate from a Morris commercial dynamo, which incorporates a ball-race for the thrust. It was bolted to the frame by two angle-plates similar to those already described.



A front view of the machine.

Mounting the Gear-Box

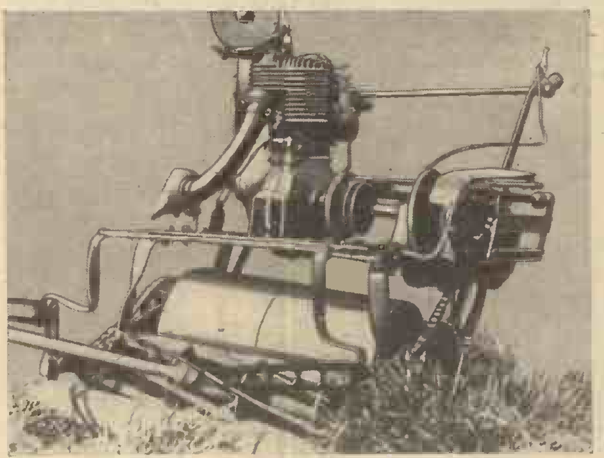
The next job was mounting the gear-box and kick-starter which had been removed from an old Triumph motor-cycle. It had to be cut out of the frame with a hack-saw, and the jagged ends were carefully filed down to make a neat finish. As this unit carries the kick-starter, and is likely to get rough usage on those occasions when the contraption kicks back but does not start; brackets were provided of exceptional strength. They were of wrought iron, $\frac{7}{16}$ in. thick and $1\frac{1}{2}$ in. wide. The forward item was roughly "S" shaped and was bolted to the engine-carrying frame. The rear bracket was a long curve (about twelve inches long), and bolted to the mower handle. The gear-box was attached to the base-plate by bolts fitted in an elongated hole which permitted easy adjustment of the driving chain. This was an old Triumph $\frac{5}{8}$ in. chain. A 1 in. pitch sprocket wheel with nine teeth was fitted to take the drive from the rollers, but here a difficulty occurred. When the machine was provisionally tried out, nothing happened. It was then realised that the rollers, as originally constructed to drive the mower, were pushed from behind by the handles. The drive was now delivered by the chain to the rollers direct, and so they had to be reversed, that is left-hand side changed to right-hand side.

The Chain Drive

The details of the chain drive should be quite clearly understood by a careful study of the illustrations showing the machine from each side and the front. The hand mower as originally supplied had two chains, one on each side, which took the drive from each half of the roller to the cutting knives. The roller itself is in two halves, and drove the knives by these chains as it turned when pushed along the ground. When rebuilt as a motor mower, the rollers were *reversed*, that is the left-hand side became the right-hand side. This right-hand side retained its original chain, which now serves to turn its half of the roller by means of power derived from the engine through the revolving blades.

The left-hand side is the engine and driving side, and is described thus. The primary drive from the engine to the counter-shaft is by means of the old Triumph $\frac{5}{8}$-in. chain, running on its original sprockets to the countershaft.

The final drive goes from the counter-shaft, over the roller to the revolving knives. This was done by means of the original mower chain, lengthened by the insertion of eight links so that the chain should be long enough to reach to the countershaft.



Three-quarter front view of the lawn mower with the chain guard in position.

Metal Guards

It was thought wise to protect the driving chains, and the knives by light metal guards, both to prevent clothing becoming entangled and as a safeguard against accident in case anybody stumbled and fell against either.

These guards were constructed of light iron, $\frac{3}{4}$ in. wide and $\frac{3}{16}$ in. thick. The guard over the chains is removed in the illustration but the guard over the knives is shown in position. Both are bolted into position, and are easily removable.

The grass-box was constructed quite simply by cutting out two thick wooden ends of $1\frac{1}{4}$-in. deal, and bending a piece of light sheet galvanised iron round the ends and screwing into position. This drops into the grass-box carrier fitted to the machine.

The fuel supply tanks and controls were bolted to the top bar of the handles, within easy reach. The petrol tank is an old circular motor-cycle tank holding about a gallon, and the oil tank is nothing more than a pint-size petrol tin joined up to the automatic pump of the engine.

Controls are provided by old-fashioned bowden wires from a primitive motor-cycle, having levers for both air and gas and placed close to the right-hand handle of the mower.

Testing Out

When tried out it was found that only first and second gears could be used. Top gear is much too fast for a walker, and except when the grass is thin the most useful gear is bottom.

The clutch is useful when turning or stopping, as the engine can be kept running when the machine is halted.

No silencer was fitted, but if the noise of the engine should prove annoying, any old motor-cycle exhaust box can be clamped on the outlet pipe and will quiet the noise with very little loss of power.

A Carbo-Dio Model Boat

THIS INGENIOUS SPEEDBOAT OBTAINS ITS MOTIVE POWER FROM CARBON DIOXIDE

MOST handymen have the necessary material on hand for making this ingenious carbo-dio speedboat. Spouting a stream of carbon dioxide from its boilers, this little speedboat will tear through the water in much the same manner as full-size craft.

Fuel

The fuel is obtainable from almost any chemist, and the construction involves very little work and a negligible outlay of cash.

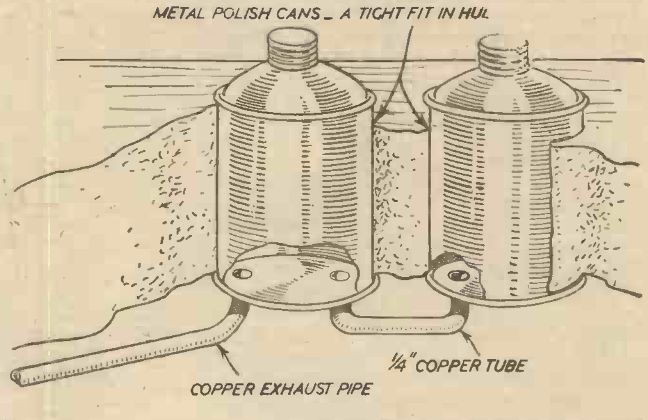
The shape of the body of the original model can be seen in the accompanying sketch, but the design of the hull may be left to individual taste. Balsa wood is the best material from which to form the hull.

The boilers consist of two small empty metal-polish tins with screw-on tops. Holes of a suitable size are cut in the body of the hull to seat the boilers. These should be cut so that the tins fit firmly into the hull.

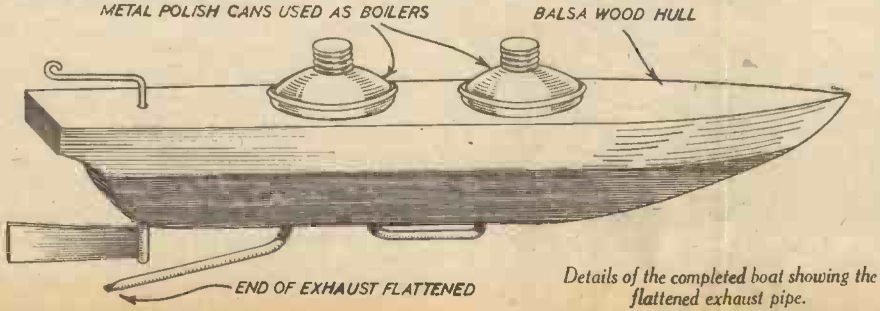
The two boilers are connected at the bottom with $\frac{1}{4}$-inch copper tubing, which is soldered firmly to prevent leaks. The exhaust, through which the carbon-dioxide escapes to give the boat its motive power is soldered to the bottom of the rear tin, and from there passes back under the hull of the boat.

The Exhaust Pipe

The end of the exhaust tube should be flattened. A little experiment will show the proper degree for highest speed.



How the two "boilers" are linked together.



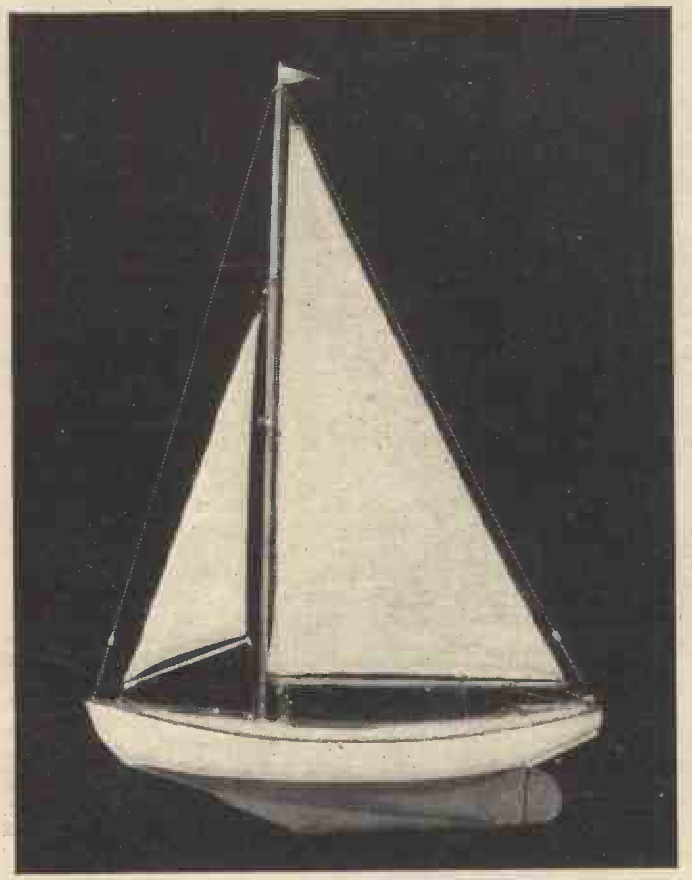
Details of the completed boat showing the flattened exhaust pipe.

Finally attach the rudder, which is made up from a piece of hard wire, with a strip of copper soldered to the bottom.

The boat is then completed and ready to fuel for a speedy cruise. Unscrew the tops of the boilers and drop a piece of carbon dioxide or dry ice into each. Screw on the tops and set the boat down in the water. Gas will begin to issue from the exhaust, and as the boilers get up "steam," the boat will glide through the water.

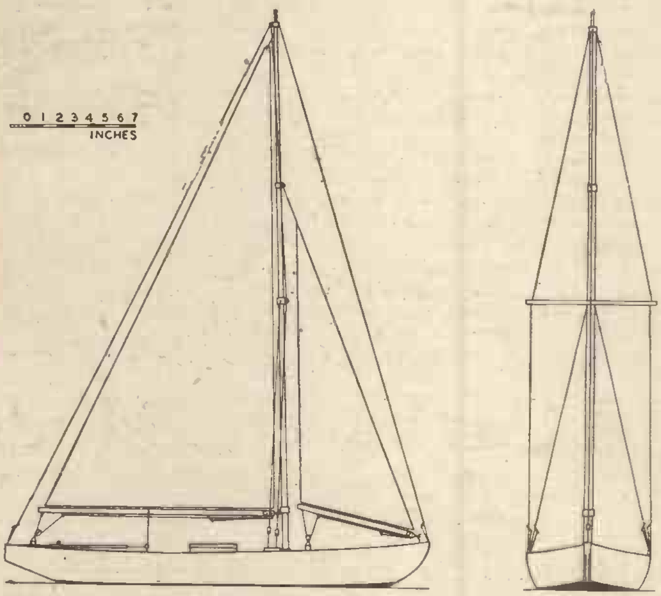
BUILDING A MODEL SLOOP

A Model Built On A System Similar To That Adopted By Full-Size Boat-Builders



Figs. 1 & 2.—(Left) The neat and trim lines of the model may be seen from this illustration of the finished sloop.

(Right) A side and front view showing construction.



THERE is much more satisfaction to be obtained from building a model yacht the same way that a full-size one is built than in just making one to look like a model but by methods which could never be applied on a large scale. What is more, the results are not only better from a sailing point of view, but they are also valuable as a means of studying the many problems of yacht construction.

The model sloop shown in Figs. 1 and 2 is built on an oak keel, with oak stem and stern post and aluminium frames. No steamed timbers are used because they are unnecessary and they would greatly complicate the process of building. The planking is of $\frac{1}{8}$-in. mahogany screw-fastened, and the deck of $\frac{1}{8}$-in. sycamore on oak beams. The mast is of deal and the booms of beech, and all the fittings are home-made of aluminium and brass.

Importance of Balance

The sailing qualities of a yacht depend upon the proper balance of the fore and after parts which are actually under water at any given angle of heel, and if this balance is disturbed by faulty design or inaccurate building it is a mistake to believe that it can be allowed for by the use of the rudder. In some cases the yacht can be persuaded to sail straight by adjustment of the steering gear, but only at the cost of a considerable loss of speed. It is therefore most important to take great care that the back-bone and frames are made correctly to the measurements given and that the lead keel is well cast from a good pattern and is drilled accurately and fixed true. There is no difficulty if the instructions are carefully followed, but short-cuts will inevitably lead to trouble.

The back-bone shown in Fig. 3 is the first job to tackle and each piece must be thoroughly trued up to size and squared up before assembly.

The Keel

Begin with the lead keel, shown in Fig. 4. Make a pattern for it from a piece of deal, giving it a very slight taper from the upper face downwards. This can be done easily by rubbing the sides on sandpaper on a flat surface, pressing the bottom harder than the upper face. The bolt-holes are drilled later and should be ignored in the pattern.

Now take a shallow wooden box a bit larger than the pattern and fill it gradually with damp sand. The sand must not be wet, but just damp enough to ram solid. Keep on pressing as each handful is added. When there is about an inch of firm sand all over the bottom of the box, stand the pattern on it, upper face upwards, and spread sand round it, ramming it firm with a piece of flat wood. Keep the upper face level by testing it with a spirit level. You will, of course, have arranged a hole in the upper surface into which a screw has already been driven and taken out again for the levelling. When the pattern is buried up to, but not over the upper face, re-insert the screw and very gently lift the pattern out. Melt the lead in a ladle, skim it and pour it into the mould from the lowest height possible. When the lead is completely cooled, dig out the casting and true it up with a file, lightly, or it will bend out of shape.

Now mark out and centre-punch the holes on the upper face and drill them at right angles to this face. Use an $\frac{1}{8}$-in. twist drill to clear 6 B.A. screwed brass rod. Then turn the keel over and enlarge the

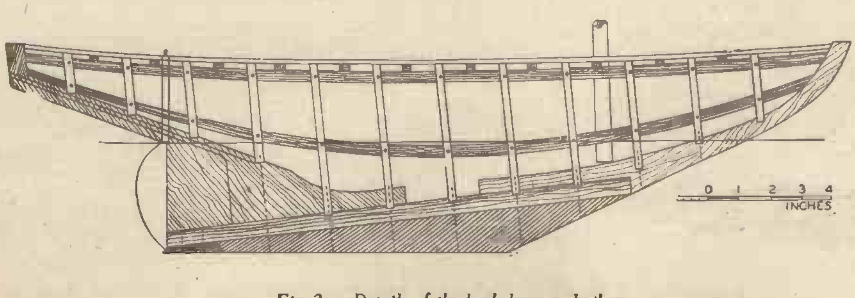


Fig. 3.—Details of the back-bone and ribs.

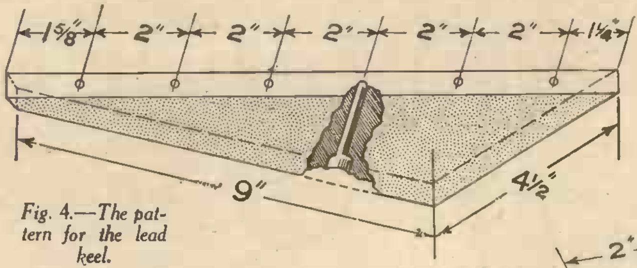


Fig. 4.—The pattern for the lead keel.

holes from the bottom to $\frac{1}{4}$ in. to a depth of $\frac{3}{16}$ in. The lead keel is now finished and should weigh 1 lb. 9$\frac{3}{4}$ oz.

The Back-bone

For the oak parts of the back-bone (Fig. 5) use oak planed to $\frac{1}{2}$-in. thickness. First cut out the oak $\frac{1}{2}$ in. wide and 15 in. long. On the bottom face, mark off 1$\frac{3}{4}$ in. from the end you chose for the bow and cut the slope. On the upper face, mark off the centre lines of the slots, 5 in number, 2 in. apart, and the first one 3 in. from the forward end. Cut the slots $\frac{1}{4}$ in. wide and $\frac{1}{16}$ in. deep. From the second slot to the fifth on each side cut the rabbet $\frac{1}{8}$ in. by $\frac{1}{8}$ in., but do not carry it beyond these slots at present, as you will have to make it lead into the rabbets cut in the stem and stern knee. Clamp the lead and oak keels together so that the sloping-forward ends are in line, and run the $\frac{1}{8}$-in. drill through the holes in the lead keel to drill the oak keel. This will drill all except the first hole at the fore end. For this, slip the lead keel forward 2 in., pass 6 B.A. rod through two holes in both keels, clamp up and drill the first hole in the oak keel through the first hole in the lead keel

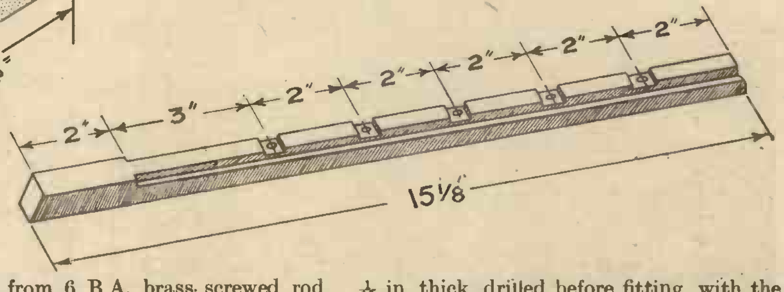


Fig. 5.—(Below) The oak parts of the back-bone.

to length from 6 B.A. brass screwed rod. Put on the bottom nuts after very thoroughly cleaning the threads on bolt and nut and moistening with soldering flux, for which killed acid is strongly recommended. Get the end of the rod flush with the bottom face of the nut and cover the whole with solder. If a fairly heavy bit is used, the solder will penetrate into the threaded joint and make a really firm job. Push the bolts up through the lead and oak keels together, but do not put on the upper washers and nuts yet.

The Ribs

Now comes the question of the ribs or frames which are so vital to the building of the ship. These used always to be either sawn from natural or grown crooks or steamed to shape from straight-grained timber. Crooks are difficult enough to get for full-sized yachts, and quite impossible for models. Steamed timbers are bothersome in small sizes, owing to the sharpness of the

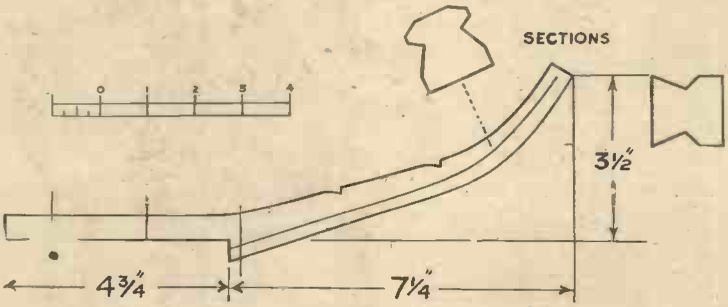


Fig. 6.—Constructional details of the stem.

The stem shown in Fig. 6 is also cut from $\frac{1}{2}$-in. planed oak. Mark out from the base line, erecting perpendiculars to give centre lines for the slots, and cut the slots with the bottom parallel to the base. Do not be upset by the fact that the third slot is not in a fair curve with those on either side, as this difficulty is overcome by special design of the third rib or frame. The rabbet runs off the stem just aft of the point where it joins the keel, still with the faces at 45 degrees inclination. The change to 90 degrees takes place on the keel.

The Stern

The only possible difficulty in the stern-knee (Fig. 7) is the rabbet. Aft, along the under-side of the counter, it is $\frac{1}{8}$ in. × $\frac{1}{8}$ in. at 90 degrees. As it turns down towards the keel it leans back a bit to take the ends of the planks instead of their edges. Remember that the slots are marked off from the horizontal water-line but parallel to the oak keel. Cut out the transom to the forward or larger measurement and file it to the requisite angle. Make the slot for the joint with the stern-knee a close fit.

The bolts which pass through the keel should next be prepared by cutting them

curves, and they are liable to split when the plank-fastenings are inserted, besides which they have a tendency to straighten out again, which is helped by the pull of the shrouds and the weight of the keel when sailing. The resulting change in the firm shape of the body is fatal to the sailing qualities of the ship as it reduces stability and completely upsets the balance of the lines.

Again, with wooden ribs, the planks must either be riveted to them or screwed

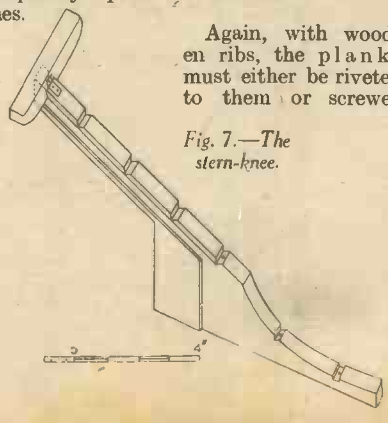


Fig. 7.—The stern-knee.

from the outside, necessitating the subsequent stopping of an immense number of holes.

The ribs of this model are of aluminium, $\frac{1}{16}$ in. thick, drilled before fitting, with the result that the screws can be put through from the inside and the planks are only pierced from the outside at their junction with the stem and transom. This saves hours of work and produces just as good results. The weight is just about the same and, owing to the system of ties introduced, the strength and rigidity are improved and well in excess of any possible requirements.

Cutting the Aluminium

First cut the aluminium into strips $\frac{1}{4}$ in. wide and 16 in. long; the pieces cut off the ends for the shorter ribs will be useful later. The strips will curl and bend and must be straightened out, one way being to squeeze them edgeways in the vice, working gradually from end to end. Mark the middle of each strip with a centre-punch and drill $\frac{1}{8}$-in. hole, smoothing off the burr with a fine file.

Each of the twelve ribs must have holes drilled $\frac{1}{16}$ in. diameter and $\frac{1}{8}$ in. apart all along the centre line except for $\frac{1}{4}$ in. on each side of the $\frac{1}{8}$-in. hole already drilled. It is quite easy to mark off and drill all these holes with a hand drill provided you keep the drill well oiled. Alternatively, it is not very difficult to make a punch to knock out six holes at a time, but the punch needs to be accurately made and tempered light straw. Fig. 8 shows one which works quite well with two blows from a hammer. I do not think it is worth

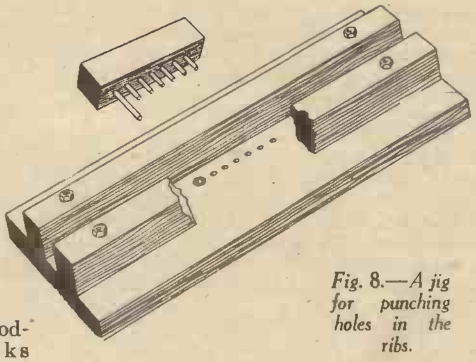
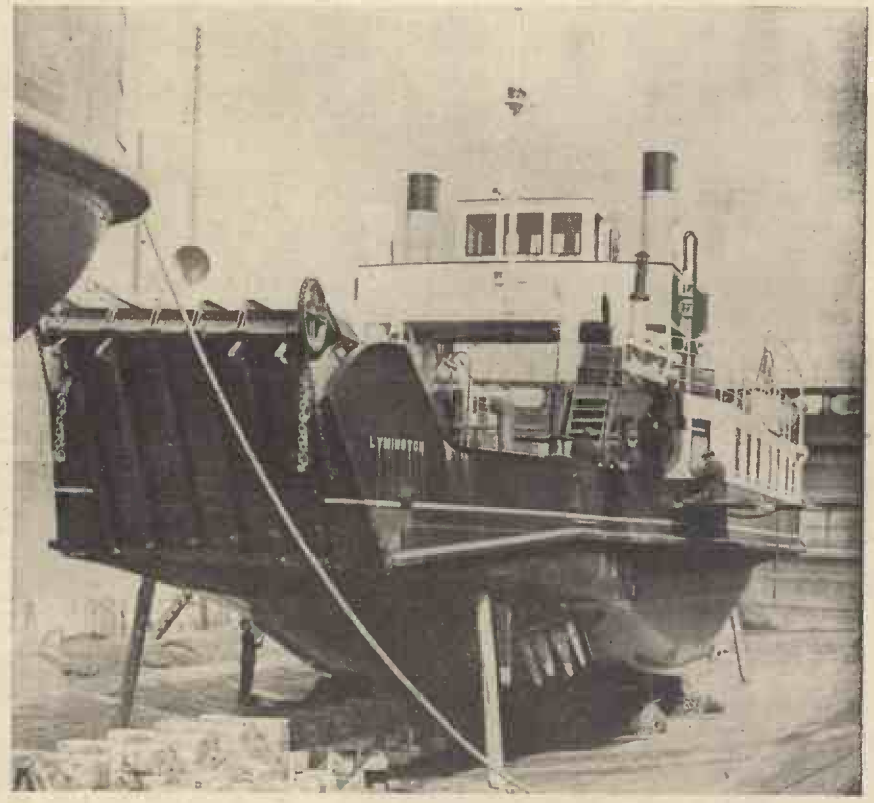


Fig. 8.—A jig for punching holes in the ribs.

while making a really elaborate punch and die for use in a press, as the simple punch and die illustrated works quite well enough. Or you can make a jig with guides, similar to the die illustrated but the other way up, and drill through this to save marking off. You drill one hole on each side of the centre hole and use this as a first guide by putting a $\frac{1}{16}$-in. spoke through the first hole in the jig and the hole you have drilled. Then remove the spoke, slide the rib forward and use the last hole drilled as guide hole for the spoke while you drill the next batch.

(*To be continued*)

A New System of Ship Propulsion



The new Southern Railway steamer "Lymington" is the first English boat to be fitted with the Voith-Schneider propeller.

THERE are several methods of propelling ships by mechanical means, such as paddle wheels, screws, and even by water jets as in some lifeboats. The most common of these nowadays is the screw propeller. For the first fifty years or so of steam propulsion paddle wheels were used, these being more suitable for the slow rotative speeds at which the early marine engines worked, as well as having other minor advantages. Many light draft river steamers are still driven by paddle wheels, in some cases there being a single wheel at the stern.

Inventor Amazed

The screw propeller, in its general form, works on the same principle as the screw thread of a bolt turning in a nut. The propeller is the equivalent of one, or more, threads, and the water in which it works corresponds to the nut. It is recorded that when Francis Petit Smith was experimenting with the first screw driven steam launch on the Paddington Canal in 1837 he used a screw made with two complete turns, or threads. Half of the screw got knocked off by accident while running, and the inventor was amazed to find that the boat went faster with the single turn.

About seven years ago a Viennese engineer, Herr Schneider, invented a new form of screw for ship propulsion. The essential feature of this is, to all intents and purposes, the principle of the single oar used for hundreds of years by the Chinese on their sampans. This oar is made to swivel on a pintle, or rowlock, at the stern, with the top end loosely secured by a rope to the deck. Other people do the same when handling a small boat with a single oar. In all these cases the feathering of the oar in a nearly vertical position propels the boat. To turn the boat to one side or the other, it is only necessary to give a push with the flat side of the oar to give the steering required.

The Voith-Schneider Propeller

In the Voith-Schneider propeller, so named after the inventor and the builder,

The Voith - Schneider System of Ship Propulsion by Means of a Screw Propeller Composed of Automatically Feathering Blades

J. M. Voith, from four to eight single blades of aerofil section are fixed vertically in a circular frame or rotating disc. The whole unit is driven round by the engine, through gearing, or by an electric motor. Inside the casing of the unit, which is suitably enclosed and runs in an oil bath, is the mechanism to produce the feathering action on the blades as they rotate in their orbit. Take the case of a four-bladed propeller. When the ship is travelling straight ahead, as in Fig. 1, the blade passing through the arc of the circle on the stern side is pushing the water aft, while the one diametrically opposite is pulling

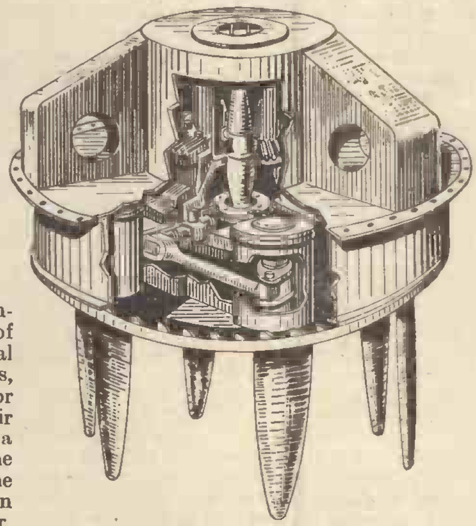


Fig. 5.—The Voith-Schneider propeller.

the water in the same direction. The other two blades are moving more or less in the direction the ship is travelling, so they are placed at a neutral angle producing neither thrust nor drag.

Method of Working

When going straight astern, as in Fig. 2, the blades passing through the front and

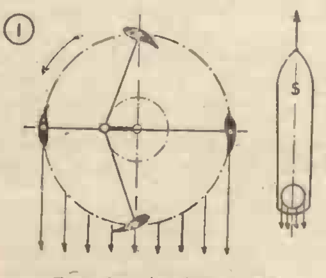


Fig. 1.—A ship travelling straight ahead.

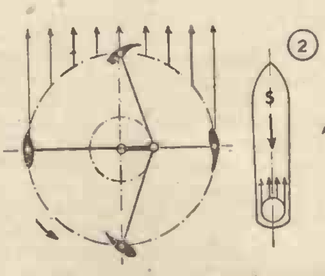


Fig. 2.—A ship going straight astern.

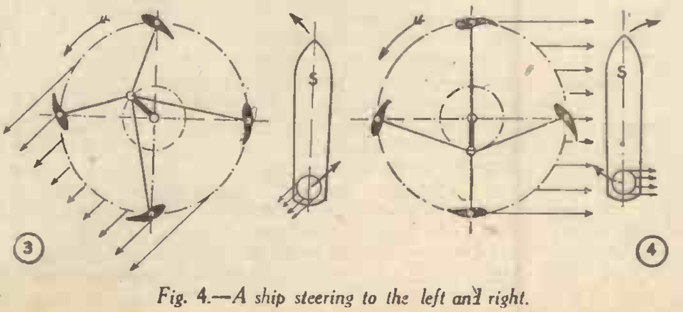


Fig. 4.—A ship steering to the left and right.

back arcs of the circle are moved to the reverse angle, and will produce a thrust on the water in a forward direction, making the ship go astern. When wishing to steer to either port or starboard, it is only necessary to set the blade angles to an intermediate position, giving a directed thrust to one side or the other, and corresponding to the amount of turning required, as shown in Fig. 3. With the thrust as shown in Fig. 4, the ship will swing right round with the bow turning as on a pivot, without any forward movement. In fact, with twin screws of this type, placed either both at the stern or one at each end, it is possible to move the ship along crabwise at right angles to the fore and aft axis. This manœuvre is very useful in the case of floating cranes, or for a ship getting alongside a pier or quay in restricted waters. The Southern Railway Co. has one ship of this type on the Lymington-Yarmouth (Isle of Wight) ferry service.

Other definite advantages of this propeller are that the speed of rotation can be maintained constant for all speeds of the ship, so that the engine can always be run at its maximum or most efficient power, no matter what the speed of the ship is, and with all the blades set to the neutral position there is no propulsion at all. Further, a

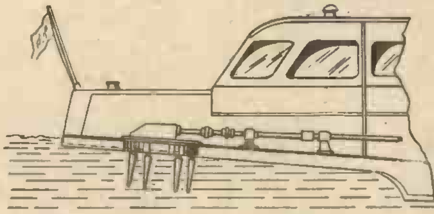


Fig. 6.—How the Voith-Schneider propeller is operated.

reversing gear is not necessary, which saves complication and cost. Both of these features are of particular advantage for internal combustion engines. Then again, no rudder is required, so that both propulsion and steering are obtained by a single mechanism.

Altering Angle of Blades

The method of altering the angle, or feathering, of the blades is by using an eccentric disc carrying a nodal point from which radiating arms connect up to the blades trunions, or axes. Two oil servo-motors, placed 90 degrees apart, are so arranged that the one affects the thrust in the athwartships direction, thereby steering the vessel, and the other determines the amount of thrust in the fore and aft direction, so controlling the speed. The first of these is connected to the steering wheel on the bridge, and the other to the speed lever. These two controls alone are capable of carrying out all the manœuvres of the ship by one man on the bridge and independently of the engine-room staff.

Steam tugs find this system most useful, as it enables them to exert maximum pulling power at slow speeds, while for ferry-boats the crabwise movement possible is very helpful in restricted waters, or with much other traffic about.

THE ALL-METAL LIGHT AEROPLANE

EVER since the early post-war years there have been attempts at building a simple, safe and practical aeroplane for the use of the man-in-the-street. Back in 1923 several "baby" machines, powered with modified motor-cycle engines of no more than 6 h.p., and as little as 3 h.p., were built. They flew and flew well in the hands of expert pilots, but it became apparent that they did not fulfil the dream of "everyman's aeroplane."

And so after a brief appearance these ultra-light 'planes were abandoned and gave place to the forerunner of the private owner's aircraft of to-day. But during the period of the latter's development there still have been spasmodic efforts at producing the low-priced, low-powered runabout of the air. From time to time some of the many difficulties that confronted the designer have been overcome. Continual research work in engine and airscrew design has increased reliability and efficiency, and additional knowledge of aerodynamics has yielded some remarkable improvements in performance, so that machines of low power have been built with extraordinary capabilities in regard to speed, range, controllability and economy of running. Yet in spite of these promising results, which have been by no means isolated to one specific design, the low-priced light aeroplane has so far been unobtainable.

Methods of Construction

The reason is to be found mainly in the methods of construction. Because of its light weight, reliability and ease of working, wood has been employed in the construction of airframes. Wing spars, and ribs, the fuselage with its longerons and struts—all have been made of wood and this necessitates a very large number of working operations. The material, in the first place, has to be very carefully selected for uniformity in grain and other qualities. There follows meticulous work in planning, cutting, drilling, assembling and gluing on elaborate jigs, and the attachments of sundry metal fittings. Finally there comes the attachment and doping of the fabric covering. This method of construction, obviously, takes time and requires highly skilled workers. An aeroplane built by such means is a "hand-made job," and is therefore an expensive job.

By

Professor A. M. LOW

People with little insight of the problems of aircraft construction, on examining an aeroplane of simple design will express surprise that so straightforward a structure should be relatively costly, especially when compared to the motor car with its far more intricate mechanism. It is all a matter of manufacturing methods.

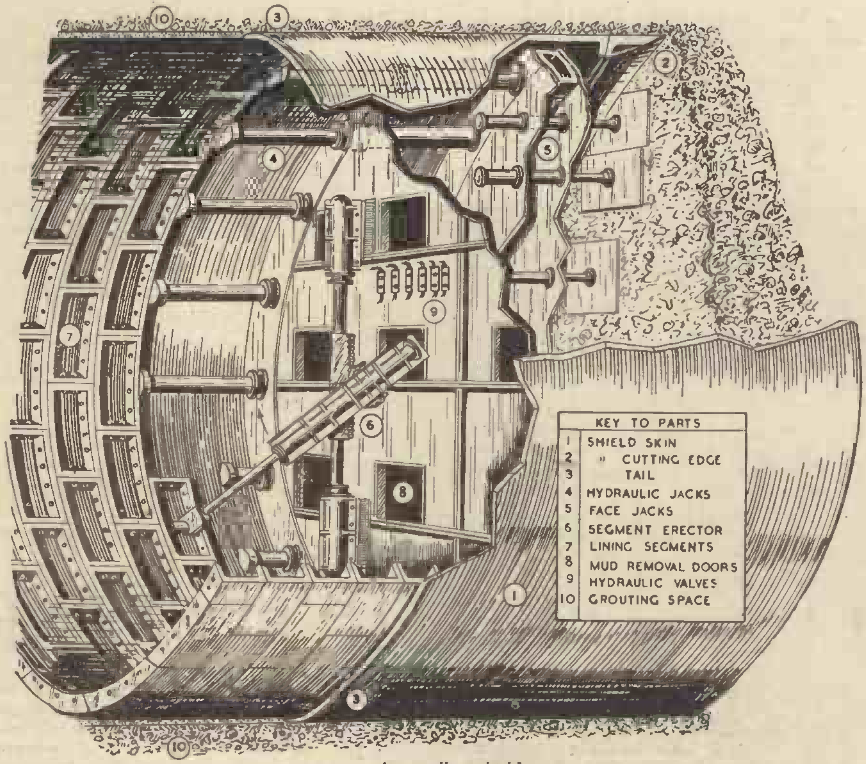
Metal in Place of Wood

And now that there is a definite and growing market for the truly economical, light aeroplane, aircraft constructors are borrowing ideas from the motor car industry. In place of wood, metal is being used. Instead of making such a part as a wing form-rib of slender strips of spruce and plywood, laboriously tacked, screwed and glued together, it is possible to employ a light but strong metal pressing, which by modern machinery, can be turned out by the hundred in a fraction of the time and at a fraction of the cost. Steel or high strength aluminium alloy tubes quickly and simply welded or riveted together can replace the spruce longerons used hitherto in building the fuselage. The covering used on the wings, controlling surfaces and fuselage can be made of special aluminium sheet instead of "doped" linen. Erection and trimming for maintenance is greatly facilitated.

In big commercial machines and fighting aircraft this change over to metal has been in progress for a number of years. Nowadays practically the whole construction of the modern bomber and many of the fighters is of aluminium alloy in the form of extruded sections built up from rolled and formed strip covered with what is known as Alclad sheet—a strong aluminium alloy coated on both sides with a thin layer of the highest purity aluminium. The protection afforded by the pure coating is of an electrolytic nature, the base alloy being fully preserved from attack, even when exposed by shearing. The use of this type of sheet has in fact made possible the stressed skin metal wing of the present day. It is estimated that seventy-four per cent. of the structural weight of the Mayo Composite Aircraft is composed of this sheet in various forms, whilst it is also employed largely in the Empire Flying Boats. In both these cases, of course, its resistance to salt water corrosion is of paramount importance.

Durability and Strength

The adoption of metal has been done to increase durability and strength, and to reduce fire risk as well as to simplify manufacture and erection. But it is only recently that the small light plane manufacturer has seriously considered metal—steel aluminium and aluminium alloys—as the solution of the problem of economical manufacture. An outstanding example is the C.W.A. Cygnet. This aeroplane is a cabin monoplane of 130 h.p. and is the first all-metal light aeroplane of British make. Without doubt this machine, and others now being planned, heralds a new phase in light aircraft building. As progress continues metal construction will be improved and simplified still further so that we shall ultimately have "everyman's" aeroplane which will be absolutely safe and strong, and as cheap and efficient as the modern "baby" car.



A tunnelling shield.

TUNNELLING MACHINES

Describing The Principal Machines Used For Large Tunnelling Operations

FOR the construction of railway and roadway tunnels, in sizes from, say, those of the London Underground Railways of about 12 ft. diameter in the running sections to the largest sizes reaching the 44-ft. diameter new Mersey Tunnel, some very large mechanical appliances are used.

The principal ones are known as the "Greathead" Shield, and the mechanical excavator. The former is a much improved form of a mechanically operated shield designed and used by Brunel in the construction of the Thames Tunnel in 1825-43.

Tube Tunnels

Where the ground traversed is of a dry and fairly solid nature, such as the London clay encountered whilst constructing most of the London Tubes, the work can be carried out without the use of compressed air chambers; but when working under rivers, or waterlogged soil, the excavator is necessary. The reason for this is that each foot in depth of water above the tunnel exerts a pressure of 0.434 lb. per square inch, causing the water to percolate more or less into the workings. By confining the men and the machines in a space filled with air compressed to a pressure sufficient to keep out the water, the conditions of working will be more, or less equivalent to that of dry ground.

The older timbering methods were cumbersome, not too stable and safe, besides being expensive. The Greathead shield not only supports the whole of the surrounding ground in a simple, safe and stable manner, occupying much less working space, but it also cuts its way through the soil, and the amount of manual labour is reduced, especially when mechanically operated tools can be used, such as pneumatic shovels.

The Shield

The shield is built up in position as a large steel cylinder of the diameter of the boring to be made, while its length is about three-quarters of the diameter. Its essential composite parts are the outer shell, or "skin," made of thick steel plates, a rigid internal structure capable of standing, not only the external pressure, but also the enormous thrust applied to it while pushing its way through the ground, and a number of hydraulic jacks arranged round the inside periphery as close to the skin as possible. At the front end of the shield is the cutting edge, which may take the simple form of the bevelled edge of the skin, or preferably made up of a series of pointed cast steel shoes bolted round the circle. A short length of the back end of the skin is called the "tail," and by partly overlapping the last ring of the tunnel lining as the work progresses, the alignment is more correctly maintained.

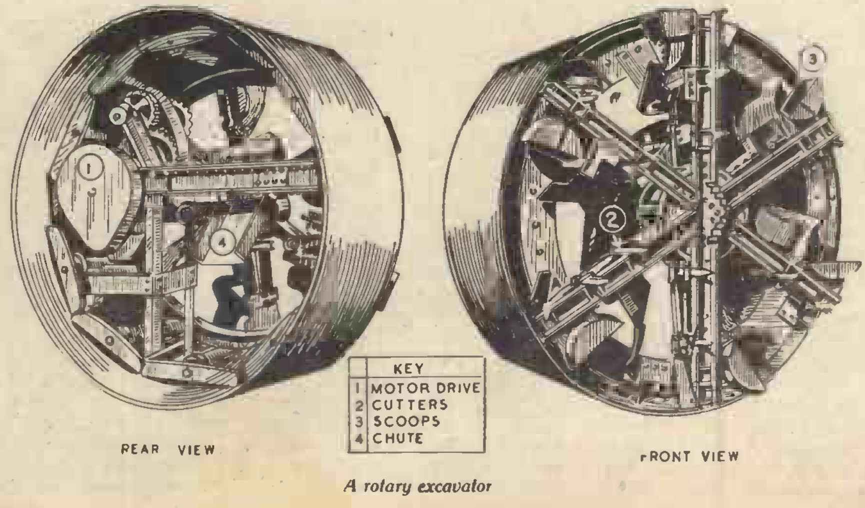
The internal structure of the largest sizes is divided up into compartments and platforms on which the miners can work, while holes are provided for the removal of the soil as it is excavated. Sometimes additional smaller jacks are provided for holding up the face of wet or loose ground to prevent its caving in while digging.

Mechanical Erectors

On the back of the larger shields are provided mechnical erectors for lifting into position the cast iron segments of the tunnel lining. A long arm rotating in a vertical plane, and mounted on a central pivot bracket, is moved round to the position required for each segment by hydraulic cylinders fitted with a rack and pinion gear, or sometimes with a chain rotating gear.

The main hydraulic jacks, for pushing the shield, work with a hydraulic pressure ranging from 1,500 to as much as 6,000 lb. per square inch, supplied from suitable pumps, with sometimes an accumulator. The total pressure exerted by these jacks in the case of the London Underground Railway is from 80 to 100 tons, while in the 30 ft. shield of the Rotherhithe Tunnel the total pressure possible was sometimes over 6,000 tons.

The method of operation is as follows. The ground in front of the shield is excavated to a depth slightly more than the width of one lining ring (from 18 to 30 in.); the shield is then pushed forward this distance by the jacks, the heads of the jacks resting against the flanged lining ring. The rams, or plungers, of the jacks are then withdrawn into the cylinders hydraulically, thereby leaving room for the erection of a



A rotary excavator

complete ring of the lining, which is done within the tail of the shield.

A "Cement Gun"

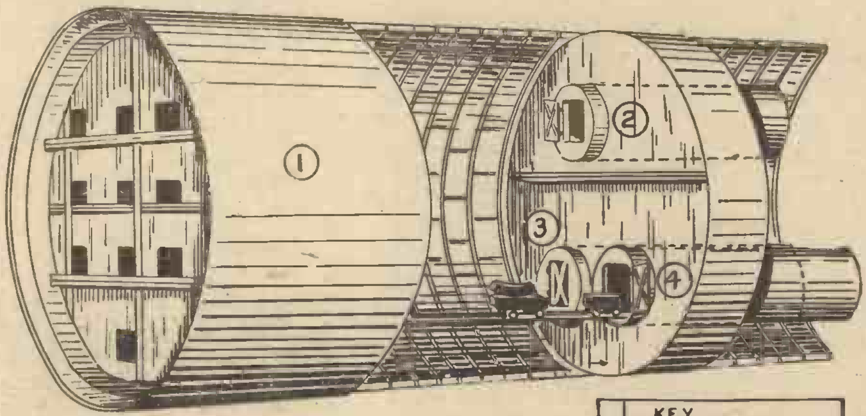
Should the shield tend to get off the correct line, or if it has to be diverted in any particular direction, say when travelling round a curve, or in an up or down direction, only those jacks which would force it that way are used. The complete cycle of operations as just described is then repeated for each length of lining ring, which is built up into place at each stage. As the tail of the shield leaves the last lining ring, a space is left between the lining and the bore, and this is grouted up by means of a "cement gun," which pumps liquid grouting through a hose pipe to fill it up.

As a rough idea of the rate of tunnelling, the machines on the running tunnels of the London Underground Railways do three 20-in. wide sections—or 5 ft.—every eight-hour shift, with a squad of eight men, or 15 ft. every twenty-four hours, working three shifts. The tunnelling of the stations, which are about 21 ft. diameter, is at the rate of two sections every eight-hour shift, or about ten feet per full day.

Compressed Air

When working under compressed air it is necessary to have air locks for both men and material. Three of these are usual, one for the men to pass in and out by; another for the material and trucks; while a third one forms an emergency lock in case of a sudden inflow of water or mud. The air pressure depends on the water conditions, and may range from 15 lb. to 40 lb. per square inch. Apart from the need of the locks to keep the air pressure confined to the space under operation, and avoid leaks, these are necessary to give the men time to raise the pressure gradually before going into the working chamber; and also to "decompress" them when they leave. Otherwise serious ill effects may be experienced.

For the construction of tunnels up to about 12 ft. in diameter, mechanical excavators are sometimes used. Inside the cylindrical shell of the shield is contained a rotary cutter. This has six radial arms, along which are mounted a number of cutting tools, while at the centre is a toothed triangular plate which breaks down the central core of the bore. Each arm also carries a small bucket which scoops up the soil as it is dug out and discharges it at the top of the machine into a chute which then diverts it on to a conveyor system to be carried away. The whole cutting mechanism is driven at slow speed by motor power with three or four reduction gears. A number of hydraulic jacks placed round the edge push the shield forward as the cutting progresses, the remaining operations being much the same as previously described.



	KEY
1	WORKING SHIELD
2	EMERGENCY AIRLOCK
3	MEN'S " "
4	MATERIALS " "

Tunnel shield and air lock.

When there is an appreciable amount of rock cutting, or very hard ground, pneumatically operated rock drills and other tools are used. For these purposes an air pressure of from 90 to 100 lb. per square inch is usual, and obtained from a separate compressor to that for the shield compressed air chamber.

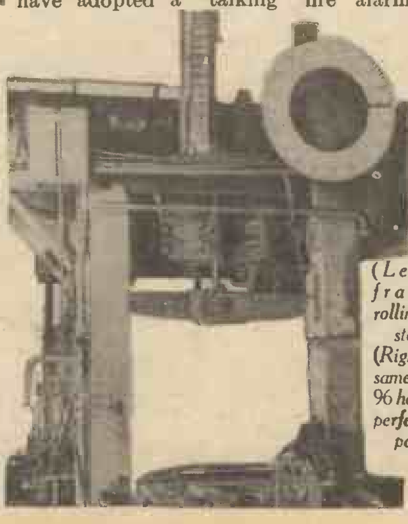
SCIENCE NOTES

A Gliding Record

MR. J. S. FOX by flying from Cambridge University Gliding Club at Huish, near Pewsey, Wilts, to Fowey Cornwall, a distance of 144 miles, has set up what is claimed to be a new British gliding distance record. Mr. Fox was flying a Rhonadler sail-plane and was in the air 6 hours.

"Talking" Fire Alarm

THE Harrow and Cardiff Fire Brigades have adopted a "talking" fire alarm system, the invention of Mr. W. Steljes, of Middlesex. It is the first of its kind in the world, and the inventor has spent over £2,000 in perfecting it. This ingenious alarm speaks its own name direct to the fire station, where it is relayed to various points of the building by means of loud speakers. For example, if the alarm were raised in the "Strand" the robot alarm repeats "Strand" and the firemen can immediately set out for their destination without delay. Fire Chief Anderson, of the Harrow Fire Brigade, states: "This is the biggest advance in fire-alarm signalling for many years. It saves vital minutes, is fool-proof, and is already increasing our efficiency."



(Left) The fractured rolling mill standard. (Right) The same standard 96 hours later, perfectly repaired.

A Remarkable Welding Feat

A REMARKABLE repair by scientific welding has recently been carried out to one of the standards of a big rolling mill—the plant that is used for producing the sheet steel from which motor vehicle bodies are made. The outstanding features of this repair are the tremendous strain to which the mill is subjected in use, and that 96 hours after the repair was started the mill was again on full production.

The fracture was right through one of the main vertical standards—massive steel columns, measuring 19 ins. by 11 ins. The metal was 3½ ins. thick, and the crack was over 5 ft. long.

In these days, when steel is in such urgent demand, it is a serious matter for a rolling mill to cease production, and it was decided that the quickest as well as the most economical thing to do was to have the standard repaired by the scientific welding engineers, Barimar, Ltd. Two highly efficient welding machines were brought into action, and skilled operators worked them simultaneously. By working in relays, day and night, the repairs progressed without a break, until the work was finished. As a precaution against overload, the welders also reinforced the repaired standard.

Barimar gave a money-back guarantee with this repair and the owners saved some thousands of pounds which they would have lost if the rolls had been out of service for a long period waiting for a new standard.

STARGAZING FOR AMATEURS

By N. de Nully

A GUIDE FOR JUNE

On the 22nd, the Sun enters the sign Cancer (the Crab), marking the Summer Solstice and the official commencement of that season. It will also be the longest day of the year, with the Sun above the horizon for 16 hours 34 minutes; but there will be vertually no difference in the lengths of the two following days. In this connection it may be interesting to note that many almanacs style June 24 "Midsummer Day"—a relic of ancient Sun-worship at the Solstice. If this date is really the middle of our summer and each of the four seasons can be correctly regarded as of three months duration, summer must actually commence about May 9, more than six weeks before the Solstice. Autumn would correspondingly begin on August 8, Winter on November 7, and Spring on February 7; for easy reckoning the 1st of each month might be taken. In that case, March 21 would no longer denote the first day of Spring in the time-honoured way. Such a shift in the approximate calendar limitations of the seasons would probably be more in conformity with the average of the series of climatic changes experienced in the British Isles than the arbitary astronomical divisions. The latter could, however, be reconciled with the new arrangement by merely considering the Solstices and Equinoxes as marking the *middle*, not the commencement of each period. There is no true night in these latitudes during June, for the dip of the Sun below the horizon between sunset and sunrise does not exceed 18 degrees at the lowest position. Twilight will consequently merge into dawn during the next few weeks: thus temporarily depriving stargazing of much of its spectacular interest. Nevertheless, in fine weather, the Moon and the planet Venus will frequently be available, as well as the Sun and its spots by day. On the 28th, our satellite will be in perigee at its nearest to the Earth during 1938; but on that date it will be too near "new" to be observable. Meanwhile there will probably be many opportunities for lunar exploration at closer quarters than usual, both under morning and afternoon illumination.

The Planets

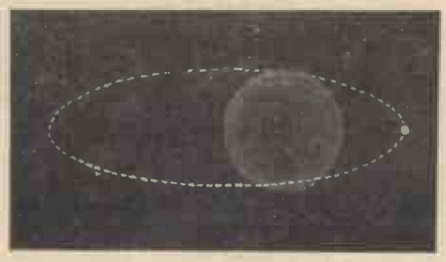
Mercury will reach superior conjunction exactly behind the Sun on the 22nd, and is therefore already lost in the glare of daylight. Venus may, however, be seen shining brightly in the twilight in the north-west until it sets at 11.30 p.m. The tiny disc, as viewed through a telescope, continues to present a gibbous aspect. Mars sets soon after 10 o'clock and is on the eve of passing out of sight as an "evening star." Jupiter and Saturn rise in the small hours; but the former will be doing so at about midnight at the end of the month, and Saturn an hour and a half later.

Meteors

There is apparently a stream of meteors in the heavens that manifest themselves in the early days of June as bright shooting stars or fireballs. They diverge from near the star Antares in the constellation Scorpius, which is now low in the southern sky. These meteors are sometimes very bright. On June 4, 1933, a fireball said to have been brighter than the Moon was seen in strong twilight from many places in the south of England. Similar appearances are likely to flash out from other quarters of the heavens.

The Stars

The light nights are dimming all but the leaders of the constellations shown on the monthly chart as being above the horizon at this time of the year. Although Auriga is now partly below the northern sky-line



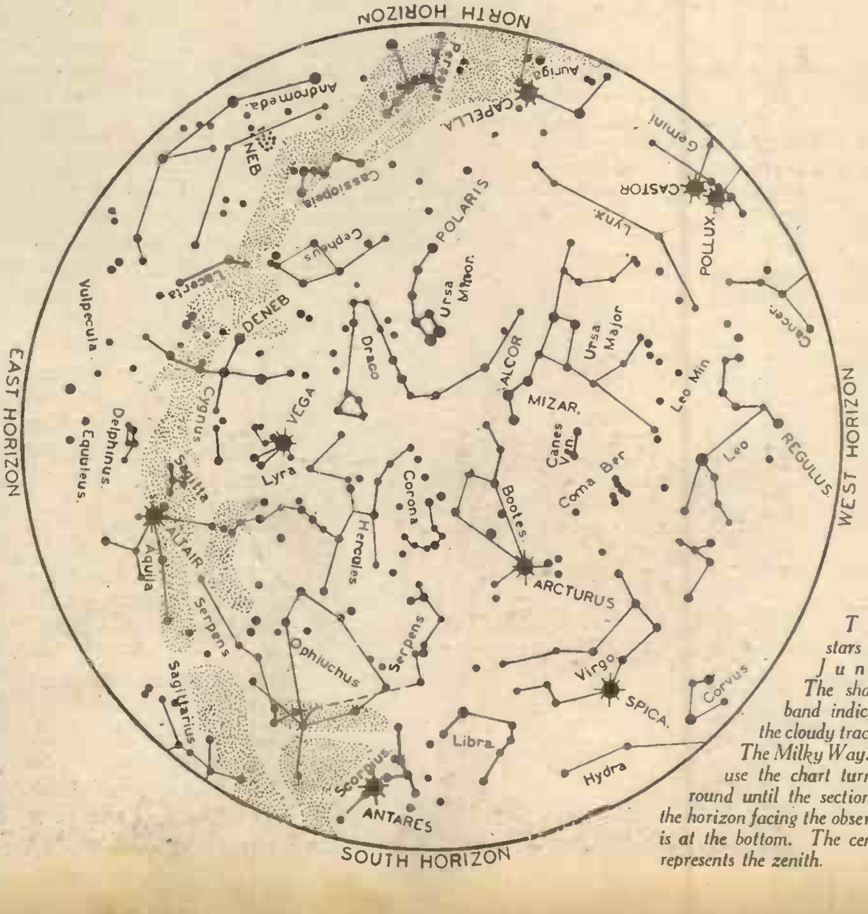
Diagrammatic drawing of the remarkable variable-star Epsilon Auriga. The dotted ellipse indicates the orbit of the smaller bright component round the huge dark one.

in the late evenings, further details concerning the remarkable variable binary star Epsilon in that group, may be given in extension of the short note last month. This unique stellar system comprises two components; one a comparatively cool colossal body enveloped in an almost non-luminous semi-transparent shell, which probably expands and contracts; the other a very much hotter and smaller brilliant sun revolving round the larger one in a highly eccentric orbit. The bigger sphere is not discernible visually, through even a giant telescope; but a great deal has been ascertained about it by the aid of the spectroscope and interferometer. Recent measurements confirm a prodigious diameter of 2,600,000,000 miles, which somewhat exceeds the earlier seemingly incredible estimate. The smaller brilliant star is easily visible to the naked eye and, though comparatively tiny, is 100,000,000 miles in diameter—120 times more than our Sun! Its temperature is at a white heat and it radiates 10,000 times as much light as our luminary. The periodic fading happens while it is passing behind the translucent periphery of the major component in a "grazing" eclipse. For six months after "first contact," the lustre of the smaller star gradually diminishes to half its usual brilliance. This partial obscuration continues for nearly a year. Return to normal takes place a little farther along the edge of the veiline disc at the same rate as the previous decline. At the opposite section of its orbit, the bright star moves in front of the invisible form of its mammoth partner, and, of course, no variation in its light occurs. The illustration gives a diagrammatic representation of the system as it is believed to exist, and shows how the fading is caused. Were it not so remote, it is possible that we might be able to discern the dull glow of the larger infra-red body.

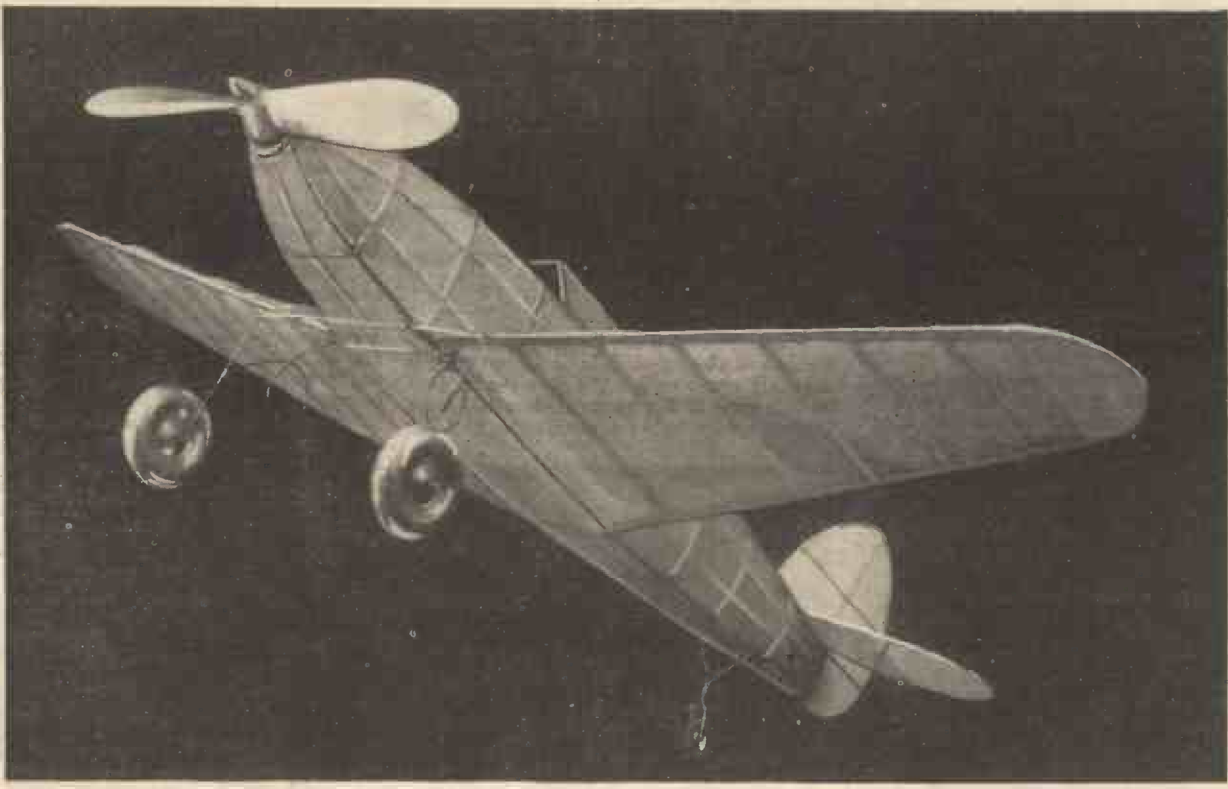
Notes

The Moon (except when a slender cres-

(*Continued on page 502*)



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



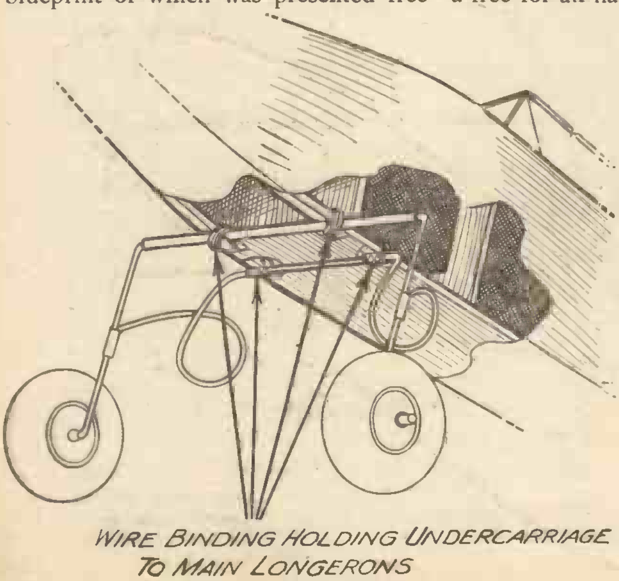
OUR GREAT NATIONAL MODEL AIRCRAFT COMPETITION!

Build this Flying Model of the Hawker Hurricane

FIRST PRIZE: £20 cash and many other Special Awards

The Hawker Hurricane

THE announcement in last month's issue of our National Aircraft Competition for flying models of the Hawker Hurricane, a full-size blueprint of which was presented free with every copy of last month's issue, has aroused enormous interest in model aircraft circles; for it is the second occasion on which this journal has been able to offer a substantial cash prize in a free-for-all national contest. We have received a large number of notifications from readers who intend to compete, and each of them will be informed of the time and place of the competition.



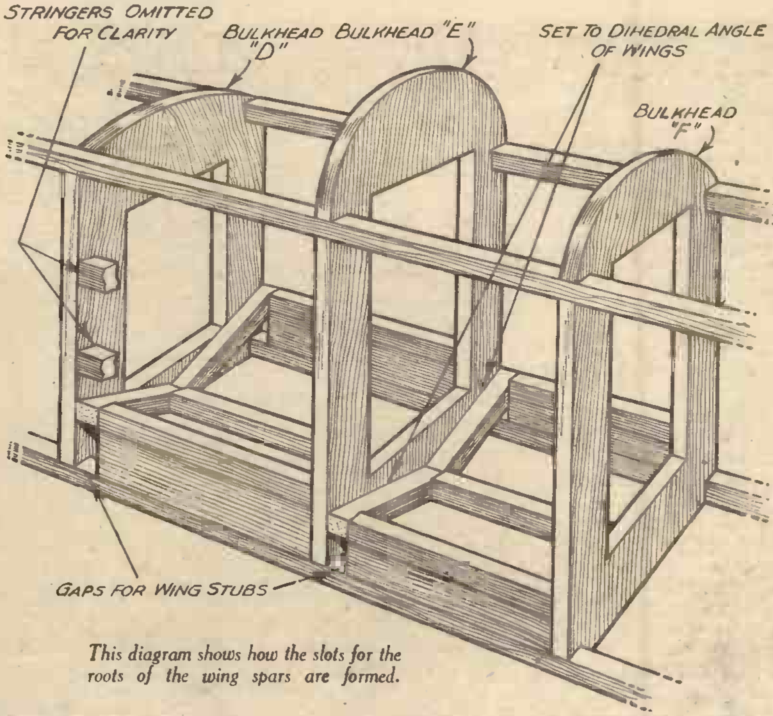
The chassis and its attachment.

Readers' Correspondence

I should like to answer various points which have been raised by correspondents, before proceeding with further constructional details of the model. In the first place one or two readers have apparently been confused by the fact that in the side elevation the wing is shown dotted and apparently has a negative angle of incidence. If readers will examine the photographs, however, they will see that that part of the fuselage is quite horizontal, and the wing automatically fits to its correct position. It does not need an angle of incidence, and if the bulkheads are correctly cut the fuselage will automatically take on the correct shape, and the wing its correct position.

The side elevational drawing is intended merely to supply the reader with a template for the various lengths of wood, and to indicate the position of the bulkheads. One or two readers have been unable to understand the nose assembly. In the blueprint 3-ply reinforcing pieces are shown, and as the nose terminates in a circle, readers cannot understand how to fit those reinforcing pieces.

Actually, I have found that they are not really necessary if spruce longerons are used. If, however, you are using balsa for the longerons, this strengthening of the nose is necessary, and it will be found that the very thin balsa 3-ply or the 1-millimetre ordinary 3-ply will bend easily into the form of a cone and spring into place where it should be glued.



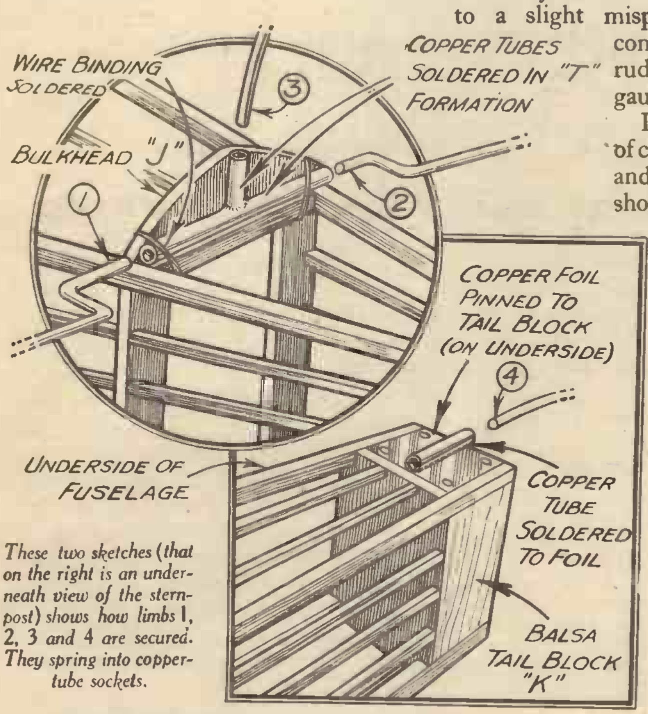
This diagram shows how the slots for the roots of the wing spars are formed.

The Nose Piece

Several readers have asked whether they can vary the construction and the material; they may without entailing disqualification. They must not alter the general form of the model nor the dimensions. It is obvious by inspecting the drawing of the nosepiece A, how the longerons are notched in. It is really impossible to make a mistake.

The Wings

One or two readers have raised queries about the wing construction. The plan view of the wing gives its exact outline, and the ribs should be most accurately cut to the lengths and curvature shown. When the ribs and spars are all cut the leading, trailing and main spars should be laid in position on the blueprint, and the slots in the ribs carefully cut until they fit over the various spars. The next stage is to fix rib A and rib H, which will automatically settle the taper of the wing. The other ribs should then all be slid along on the spars until the leading edge and trailing edge of each rib matches up with the outer edges of the leading and trailing spars.



These two sketches (that on the right is an underneath view of the sternpost) shows how limbs 1, 2, 3 and 4 are secured. They spring into copper-tube sockets.

Their position is shown very approximately on the plan view, but their final positions may vary a little. *It is important to work to the outline of the wing.*

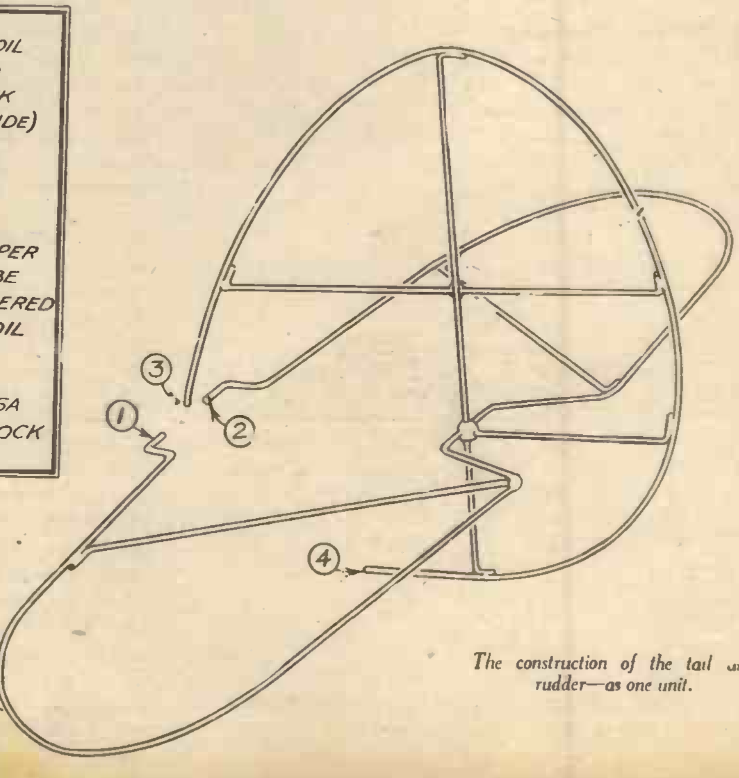
I hope that that has made this particular point clear. The slots in the ribs, of course, must be cut to suit the spars. The photographs should make these various points quite clear.

The Tail, etc.

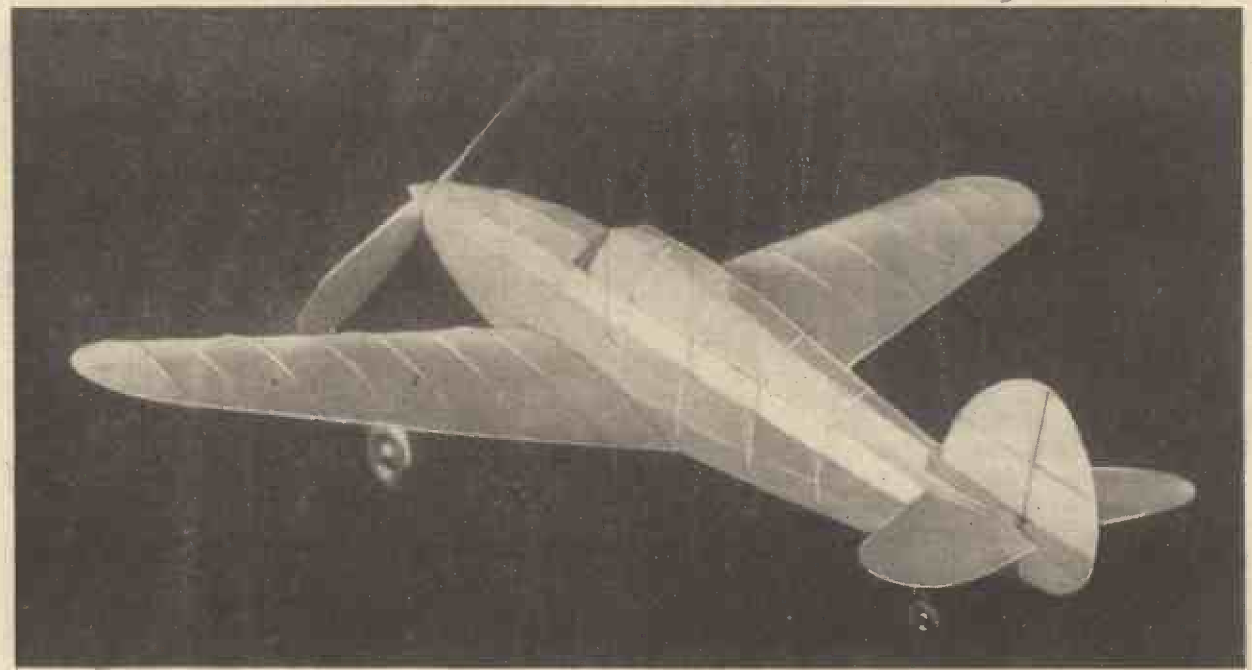
One or two readers wish to make a solid balsa tail or to use balsa framework construction; some wish to use round cane construction; they may do so if they wish. I wish to draw attention to a slight misprint in the list of components; the tail and rudder should be 20-gauge wire and not 22.

I have repeated the list of components this month and amplified it, and this should be followed. As mentioned last month, the position of the notches in the bulkheads will need adjustment according to each model. The overall height of the bulkheads and accurate notching will bring the model to the correct dimensions and form as shown.

Further illustrations in this issue show the details of the construction. It will be seen from the photographs and from the drawings, how the model is assembled. Complete but without elastic it weighs 5½ ounces although it is, of course, possible to save weight by using



The construction of the tail and rudder—as one unit.



Three-quarter rear view of the Hawker Hurricane.

balsa where I have used 3-ply. The method of attachment of the chassis is shown in one of the sketches, and I do not think that any special difficulty will be experienced in making or assembling that.

Securing the Wings

I briefly mentioned last month the method of attaching the wing and securing the dihedral angle. I found that if each wing is $\frac{3}{4}$ in. above the bottom edge of the fuselage, the model was quite stable laterally. The exact amount is not important.

One of the sketches shows how the slots were formed in the original model to take the wing roots or stubs, although the reader may choose any particular method of fixing the wings. That shown in the sketch is most convenient in that it ensures that the wing is rigidly held in place but easily knocked off in the event of a collision. It will be observed that hooks are attached to each stub, and the two wings are pulled into position by means of rubber bands, and these are attached in the following way. Bend a hook on the end of a long piece of piano wire, and pass this through the gaps in the fuselage provided for the wing stubs. Attach a strong rubber band of the requisite length to one of the hooks, and pass the other end of the band over the hook of the piano wire. Pull on the piece of piano wire and draw the band through the fuselage, securing the rubber band to the appropriate hook on the other half wing, and releasing the piano wire. Repeat for the second pair of hooks.

If you cannot obtain bands of the requisite strength use three or four 1-in. long bands as used for stationery purposes.

View of the Hawker Hurricane from above.

The Tail and Rudder

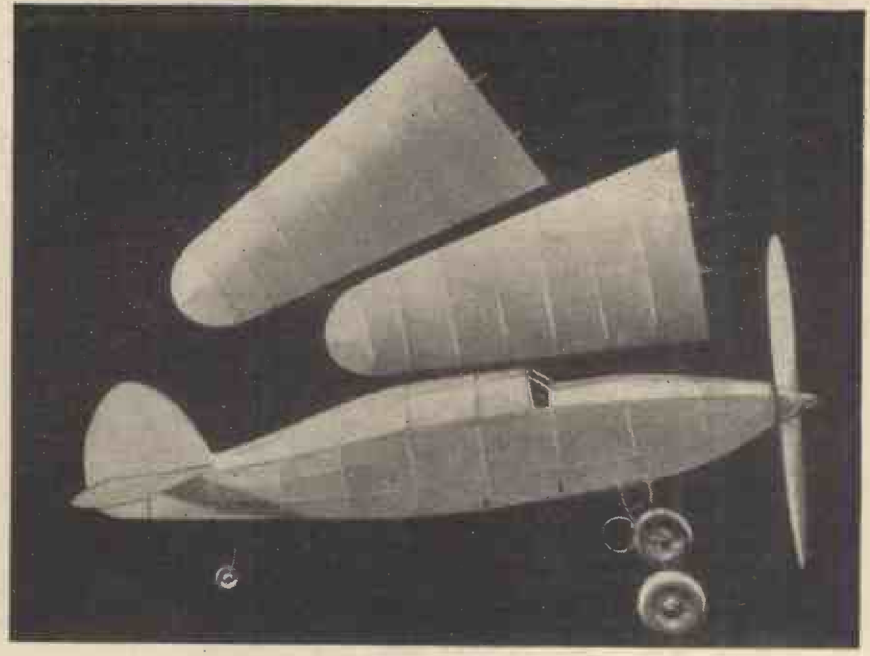
The tail and rudder unit is secured as shown in the three sketches. A T-piece made from copper tube is secured behind bulkhead J, by means of florist's wire binding, which is afterwards lightly soldered. This accommodates the two forward limbs of the tail, and also the downward extension of the rudder, whilst the bottom part of the rudder is secured underneath the balsa tail block J

RULES

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

LIST OF COMPONENTS FOR THE MODEL HAWKER HURRICANE

4 lengths of Silver Spruce 22 in. long × 1/8 in. square for longerons.
3 lengths of Silver Spruce 13 in. × 3/8 in. × 3/16 in. for main wing spars.
4 lengths of Silver Spruce 13 in. × 3/16 in. × 3/32 in. for leading and trailing edges.
6 ft. 6 in. of Spruce or balsa ribbing 1/4 in. × 1/16 in.
12 in. 3/32 in. round cane for wing tips.
4 ft. 6 in. of 1/16 in. three-ply for ribs. 3/4 in. in width (maximum chord of wing 6 3/4 in.).
2 ft. 6 in. of 1/8 in. Balsa 3/4 in. wide for ribs
4 small brass hooks for wing fasteners.
1 piece of Spruce or balsa 1/2 in. × 1 1/2 in. × 7/8 in. for sternpost.
1/8 in. Balsa Bulkheads :
1 piece 2 in. × 1 1/4 in.
1 piece 2 1/2 in. × 1 3/4 in.
1 piece 3 in. × 2 in.
1 piece 3 1/4 in. × 2 1/2 in.
3/32-in. three-ply Bulkheads :
1 piece 3 1/2 in. × 3 in.
1 piece 3 1/2 in. × 3 in.
1 piece 4 in. × 3 in.
1 piece 3 1/2 in. × 2 1/2 in.
Nosepiece:
1 piece 1/4 in. three-ply 2 3/4 in. square.
1 piece 1/8 in. three-ply 1 1/2 in. square.
12 lengths Balsa 21 in. long × 1/16 in. square for stringers.
4 yds. 20-gauge wire for tail, rudder and rear chassis.
6 in. of 1/8-in. Duralumin tubing for chassis.
6 in. of copper by-pass tubing for tail and rudder fixing.
2 yds. 18-gauge wire for chassis and propeller shaft.
6 yds. 1/4 in. strip elastic.
1 pair 2-in. disc wheels.
One 1-in. disc wheel.
6 ft. Jap Tissue 8 in. wide.
Dope, glue, pins, thread, etc.
One 10-in. airscrew.



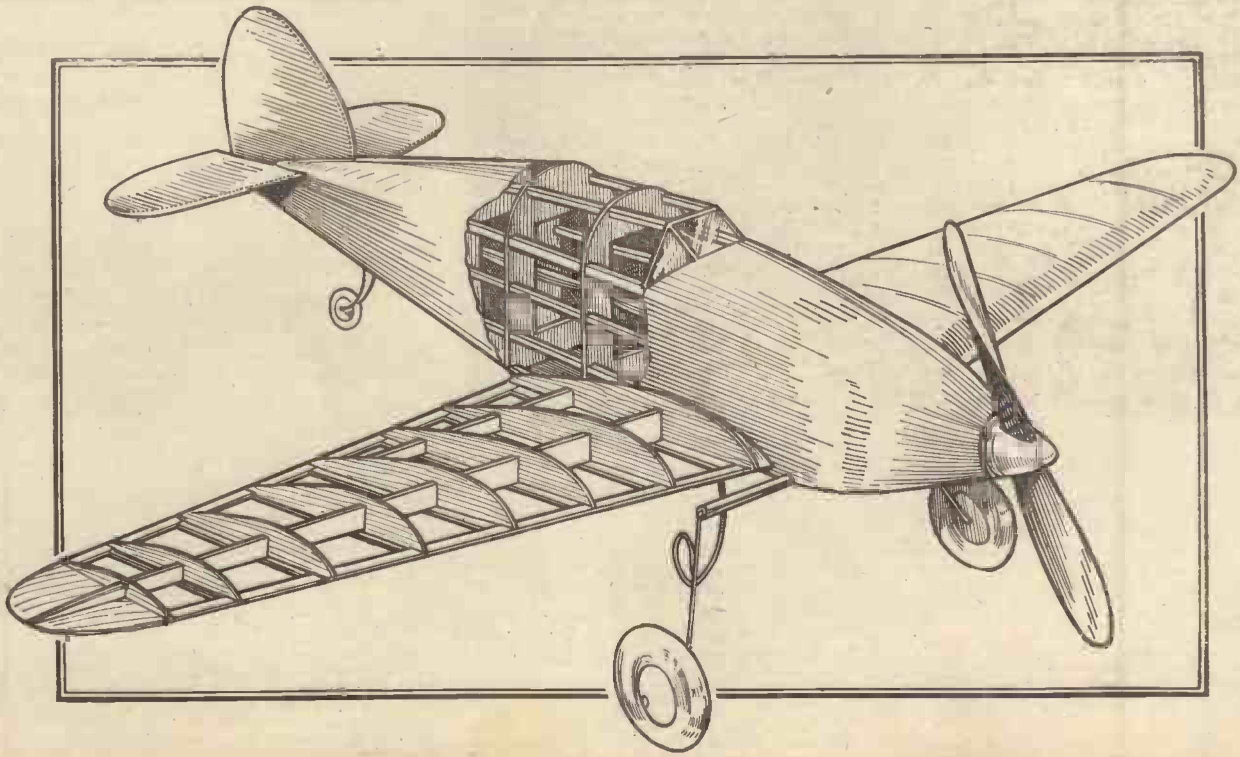
The Fuselage and two half wings of the Hawker Hurricane.

as shown by the inverted view of the rear of the fuselage. The various points are numbered for easy reference. It is very necessary to solder the tail to the rudder in such a position that the tail is horizontal. It must not have either a positive nor a negative angle, and it will be necessary to attach it to the fuselage and adjust the position of the soldered joint to ensure this. Any negative angle which is found to be necessary for longitudinal stability can be effected when the tail is covered, by bending up the tail flaps.

When satisfied that the tail is correct attach it to the fuselage and cover it, passing the paper over the fuselage and securing it to it, so that it fairs off into the fuselage curve.

I think that sufficient photographs, sketches and information have been given to enable even the beginner with the aid of the blueprint given last month, to complete a very successful flying model, and one which closely resembles its prototype.

Several advertisers are providing kits of parts, but it must be distinctly understood that factory-assembled models will not be permitted. F.J.C.



Cut-away sketch of the Hawker Hurricane.

NEW INVENTIONS

The following information is specially supplied to "Practical Mechanics," by Messrs. Hughes & Young (Est. 1829), Patent Agents, of 9 Warwick Court, High Holborn, London, W.C.1, who will be pleased to send readers, mentioning this paper, free of charge, a copy of their handbook, "How to Patent an Invention."

Artificial Linen

THE Victorian era was the Age of Starch. With his neck surrounded by a high fence of rigid collar, the man of fashion strutted with head elevated like the giraffe-necked women exhibited by the late Mr. Bertram Mills. In imitation of inflexible linen, the paper collar appeared on the scene. Next followed a facsimile made of celluloid or some similar composition. This, lustrous with a gloss which surpassed the polish of the genuine article, almost deceived the very elect—but not quite. The fabric, when bent round to the shape of the neck, had a vicious tendency to crack and to develop small folds.

Although, since those stiffnecked days, the freedom of the neck has been attained, the artificial collar still simulates its linen prototype. But owing to a recently patented process of manufacture, even when rolled up tightly, the imitation no longer exhibits cracks and troublesome folds.

This newly-devised collar is first stamped from the material of which it is composed. It is then folded and has applied to it a coating of a celluloid ester varnish. Then on the inner side are impressed one or more rows of indentations, which run parallel to the edge of the collar.

The result is an excellent reproduction of the linen original—a crack collar without a crack.

Photographer's Portable Studio

PHOTOGRAPHERS frequently have occasion to travel from place to place. For example, they may have to journey some distance to take a wedding group. In such a case, they have not always the facilities for controlling the lighting effects which they have in their properly equipped studios. When the rain descends and the wind is boisterous, great difficulty is experienced in securing a satisfactory photograph.

To obviate this disadvantage, a Frenchman has protected in this country a movable and collapsible tent. It is contended for this easily transported studio that it embodies the favourable conditions of the photographer's home studio. A supporting structure is covered with a jacket of transparent or translucent material which is flexible and not heavy. The larger part of one side of the tent consists of windows, and there are doors opening at the front and back. A single door curtain serves as a photographic background. This can be detachably fastened across either of the door openings.

Furnished with this portable tent, the photographer will be able to peg away.

Scorer for Darts

THE game of darts is rapidly becoming national. In the tranquil times of Queen Victoria, archery was a fashionable pastime. Now not only the frequenters of our village inns, but many other good folk are obsessed with the tiny hand-flung arrow

I am informed that, in this game, the usual method of scoring is that one of the spectators, with the aid of some mental arithmetic, jots down the score on a slate or blackboard. In a fast game, particularly upon what is known as a "clock-board," in which odd and even scores are made irregularly, it is quite a task to keep a clear reckoning. Sometimes heated arguments may arise as to the accuracy of the scoring.

In these circumstances, a new scoring board for darts should receive hospitality in those wayside hostelries which provide entertainment for man and beast. The device in question, which has been accepted by the British Patent Office, consists of a number of steel strips which are readily responsive to magnetic attraction, and there are one or more magnetised pointers to be placed on the strips. Columns of figures appear alongside the steel strips.

This convenient scoring board should prevent unpleasantly pointed remarks from emulating the darts.

Cinema Seat Indicator

EVERY week (so they say), 23 millions of people frequent the cinemas in our country. This is an enormous multitude to accommodate with seats, and tact and patience are required to deal with the waiting queues.

Ordinarily, in picture palaces, the usherettes and other attendants communicate verbally with the cashier and the public to intimate the number of seats vacant.

By the way, the post of an usherette is not a sinecure. She has to note and memorise the accommodation available. And, as many future husbands and wives have to be catered for, the number of vacant double seats has to be kept in mind.

To assist in the seating of the patrons, as the spectators are politely termed by the manager and his staff, an improved mechanical indicator has been patented in Great Britain. Placed before the cashier or at the entrance to the auditorium, this indicator enables the delivery of the tickets and the admission of the public to be regulated.

A closed box has at its front a number of slots lighted from the inside by an electric lamp fitted with a movable shutter. As the seats become occupied, the shutter is displaced along the slots and covers a corresponding number of slots. The checking meter may be connected to the different classes of seats vacant in each category.

Where this indicator is installed, the more or less patient patrons will scan with interest the recorded state of the house. And the wandering minstrels who entertain queues might appropriately sing that once popular melody, "The Vacant Chair."

Dummy Aircraft

THE cautious mother, who would not allow her son to enter the water until he could swim, was not as illogical as appears at first sight. The art of natation has been taught on dry land, as far as the actions of the limbs were concerned. The would-be swimmer lay prone on a kind of stool, while his arms and legs waggled like the antennæ of a gigantic insect.

On the same principle, a few years ago, there was devised a dummy aeroplane which enabled the prospective pilot to acquire some knowledge of the art of aviation without soaring towards the stratosphere.

The inventor of that particular device—a citizen of the United States—has developed his machine which is styled a "trainer." The dummy is mounted upon a universal support whereby it can be rotated, tilted and tipped in all the normal flying positions of an aeroplane. Means are also provided by which the response of the instruments can be imitated.

This machine makes possible the training of the pilot in all kinds of weather, and at a very much reduced cost compared with the same instruction given in actual flight.

However, the pupil, although he may thus on terra firma gain much knowledge, will never become a fully fledged airman until he has flapped his wings in cloudland.

Powdered Cork Tip

FOR many years the cork tip has prevented the cigarette from forming too close an attachment to the lip of the smoker. But this band of cork naturally adds to the cost of manufacture. I understand that at present it is customary to form the cork into blocks. These are cut into thin sheets, which are fixed to a backing paper by means of an adhesive. The cork has to be of high grade, and it is difficult to obtain cork of this quality.

To provide a cheaper and more efficient cork tip is the object of a recently patented invention. The new device comprises a strip of paper, to which finely powdered cork is stuck. In this process lacunæ, i.e. tiny gaps, are produced in the cork by applying the adhesive irregularly to the background.

This will make for an easier slip between the tip and the lip.

Non-Elusive Latchkey

THE latchkey is occasionally as elusive as the Scarlet Pimpernel. Arriving home in the very early morning, one hunts through the multitude of pockets which it is the privilege of man to possess. All in vain; the metal "Open Sesame" is missing.

To guard the benighted against a fruitless quest, an inventor has devised a latchkey which is integral with a dress watch. Of the Yale pattern and not bulky, this key is incorporated with the handle of the watch. The convivialist, therefore, has only to put his hand in a left waistcoat pocket to find the means of entry to his abode.

By the way, some years ago there was patented a latchkey with an electric bulb attached. If such bulb were embodied with the watch and latchkey, the owner could discover with ease what is sometimes as difficult to find as the latchkey. That is the aperture of the lock. For example, one reveller, arriving home contemporaneously with the milk, is alleged to have said, "I can see several holes, but I cannot get the key into one of them."

Gas-Masks and Eyeglasses

IN the Great War, there was much talk of frightfulness. If uncanny design suggestive of Klu-Klux-Klan were capable of frightening the enemy, then the average gas-mask would, like the head of Medusa, petrify the foe. That it should have windows for the eyes to look through is obviously necessary. These are usually of what I will term the porthole pattern. Consequently the patriotic lady or gentleman who attends gas-mask drills, ogles through goggles.

It appears that in the case of those people who wear spectacles, considerable difficulty is frequently experienced in donning a gas mask, owing to the close fitting of the mask. To overcome this drawback, there has been patented an arrangement which enables lenses to be embodied with the gas mask. Both, therefore, are put on together. Spectacles, pince-nez and any other description of optical lens can be incorporated.

This appliance will certainly be fitting, and in view of hostilities, will qualify the wearer to keep a good look-out.

DYNAMO.

BUILDING A 1-C.C. ENGINE

Further Constructional Details of the First 1-c.c. Engine to be Described.

By W. H. Deller

Part V

Details of the Piston

(Complete Sets of Blue Prints are now available at 5s. per Set)

THE piston shell is turned from $\frac{5}{8}$ in. dia. "non-shrink" tool steel. Although $\frac{1}{2}$ in. dia. material would clean up easily to size, its use might prevent a good surface hardness being obtained after heat-treatment. This is accounted for by the fact that the metal immediately below the scale is rendered low in carbon while being worked into bars.

Chuck the bar, face and rough turn to $\frac{15}{32}$ in. dia. for a distance of $\frac{3}{4}$ in. Centre drill and drill $\frac{21}{64}$ in. dia. to a depth of $\frac{33}{64}$ in. to the point of the drill and flat bottom drill to the same depth. Face the bottom of the hole to increase the depth to $\frac{17}{32}$ in. and chamfer out at the back to $\frac{3}{8}$ in. dia. × $\frac{3}{32}$ in. width. Tap out with $\frac{3}{8}$ dia. × 26 thd. taps allowing to plug tap to cut clear into the chamfer. Finish turn the outside dia. to .4385 in. after polishing to a fine finish. Counterbore the mouth of the tapped hole to .420 in. dia. × $\frac{3}{16}$ in. deep and chamfer the front at 45 degrees to leave the bottom of the skirt with an almost sharp edge. Cut-off to leave piston shell $\frac{5}{8}$ in. long when finished, making an allowance for facing the head, should be a good fit in the bore of the cylinder, so as to slide freely but without any apparent slackness. On no account must the piston be lapped into the cylinder or the fit will be too slack when the lapping compound is cleaned off.

The Gudgeon Pin Adapter

Make this part from duralumin. First turn the bar to $\frac{3}{8}$ in. dia. and screw to suit the thread in the shell. The front end is faced and turned down to the core dia. of the thread for a distance of $\frac{3}{32}$ in. Centre drill, and drill a $\frac{1}{4}$ in. dia. centre hole and counterbore the mouth of the hole to $\frac{19}{64}$ in. dia. to a depth of $\frac{3}{32}$ in. Part off to $\frac{11}{32}$ in. length overall, chamfering the end of the thread before completely severing.

Screw the adapter into the piston tightly with the reduced end against the underside of the head. Drill $\frac{1}{16}$ in. dia. holes through the hole in the shell. Remove the adapter and open out the $\frac{1}{16}$ in. holes with a pin-drill to $\frac{3}{32}$ in. dia. and ream right through both holes to $\frac{7}{64}$ in. dia. Square out the $\frac{1}{4}$ in. centre hole, taking precautions to see that the sides are at right angles with the reamed hole.

The Gudgeon Pin and Retaining Pin

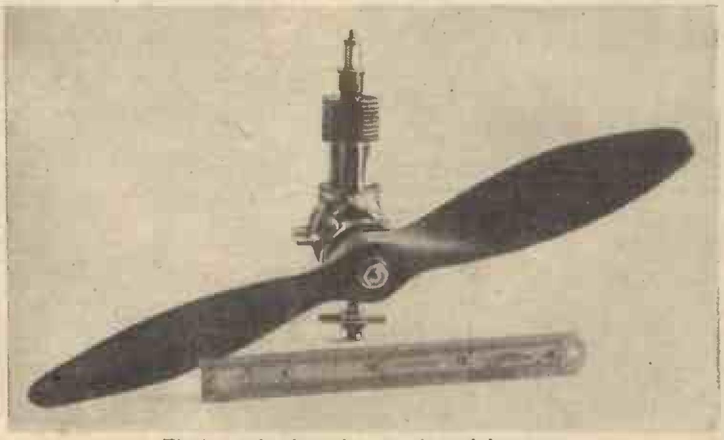
The gudgeon pin is a piece of $\frac{7}{64}$ in. dia. silver steel drilled with a central $\frac{1}{16}$ in. dia. hole. This is faced to a length equal to the core dia. of the adapter thread and the ends radiused or chamfered so that the pin will clear the thread in the shell. Harden and temper the pin to a light straw colour and finish with a high polish. The retaining pin is a short piece of $\frac{1}{16}$ in dia. soft aluminium wire which is lightly riveted over at each end into the countersinks, in the mouth of the pin holes in the shell, after final assembly.

For the connecting rod a short piece of duralumin bar is required. Use the same dia. material as that from which the drain plug was made.

First Operation

Cut a piece of bar $1\frac{3}{8}$ in. long and face both ends to reduce length to $1\frac{9}{32}$ in. Machine or file a flat along the whole length of one side $\frac{5}{16}$ in. wide. Remove the metal on the opposite side to produce a flat piece exactly $\frac{7}{32}$ in. in thickness and parallel.

Mark out a centre line on one of the flat faces. On this centre line and $\frac{1}{8}$ in. away from one end, mark and centre punch for drilling a hole $\frac{13}{64}$ in. dia. Mark and punch for a $\frac{1}{8}$ drilled hole at a centre distance of exactly 1 in. Drill the holes and ream $\frac{9}{64}$ and $\frac{7}{32}$ dia. respectively.



The 4-in. ruler shows the minute size of the engine.

Second Operation

Turn a shouldered peg in the chuck from $\frac{1}{2}$ in. dia. mild steel, reduce the dia. to $\frac{7}{32}$ in. to suit the large hole in the con. rod blank, for a distance of $\frac{7}{16}$ in. leaving with a square corner. Turn the front of the peg down and screw No. 4 B.A. or nearest thread, leaving $\frac{3}{16}$ in. of $\frac{7}{32}$ in. dia. Mount the blank on the peg and secure with a nut and washer.

Face away round the hole to leave a $\frac{9}{32}$ in. dia. boss $\frac{1}{16}$ in. high and continue facing to the same depth to within $\frac{1}{8}$ in. of the edge of the $\frac{7}{64}$ in. dia. hole. Reverse on the peg and repeat the process on the opposite side of the blank.

Third Operation

Next reduce the peg to $\frac{9}{64}$ in. dia. and turn the small-end boss on both sides to $\frac{7}{32}$ in. dia. to such a depth as to pick up the faces previously surfaced. It should be noted that the tool used in both instances should have a small round nose to leave a fillet where the bosses join the faced portion.

Mark out and profile file the rod leaving a good radius in the corners. End mill the sides to "H" section leaving the web and flanges $\frac{1}{32}$ in. in thickness. Notice should be taken of the fact that on one side the big-end boss requires spot facing, or facing on a peg in the lathe, to reduce the thickness to .195 in. Cut a central cross slot $\frac{1}{32}$ in. wide and reaching almost to the centre, in the small-end boss for the admission of oil to the gudgeon pin.

The Con. Rod Bushes

Both bushes are made from silver steel $\frac{1}{4}$ in. in dia. After drilling and reaming, the small-end bush is turned to .141 in. dia. leaving with a good smooth finish. File the centre slot $\frac{1}{32}$ in. wide $\frac{3}{32}$ in. deep before parting off cleanly. The big-end bush is made exactly the same length as the boss in which it fits, one end being slightly radiused to suit the crank pin.

Carefully harden both bushes and temper to a light straw colour. Press the bushes into the rod with care, applying a little oil to the surfaces before so doing. See that the slot in the small-end bush is in such a position as to line up with that in the rod. Also note that the chamfered side of the big-end bush should be at the same side as the lowest boss when in position. Stone off any slight projection of the bushes above the faces of the bosses and lap both bushes to size. See that the gudgeon-pin and crank-pin work freely but without apparent shake in their respective bushes after the lapping is completed.

Assembling the Piston

Now that the rod is finished the piston may be assembled. Remove the gudgeon-pin adaptor from the shell and well oil, with thin lubricant, the gudgeon-pin and the bearing surface of the small-end bush.

Before passing the pin through the adaptor and small-end bush it should be noted which side of the adapter, or rather which hole in the adapter, comes under the baffle on the top of the piston when screwed home. This is important as the longest boss on the big-end must come on the same side as the baffle on the piston and rod assembly. Having arranged the parts in this manner pass the gudgeon-pin through the adaptor and con. rod and screw the shell home.

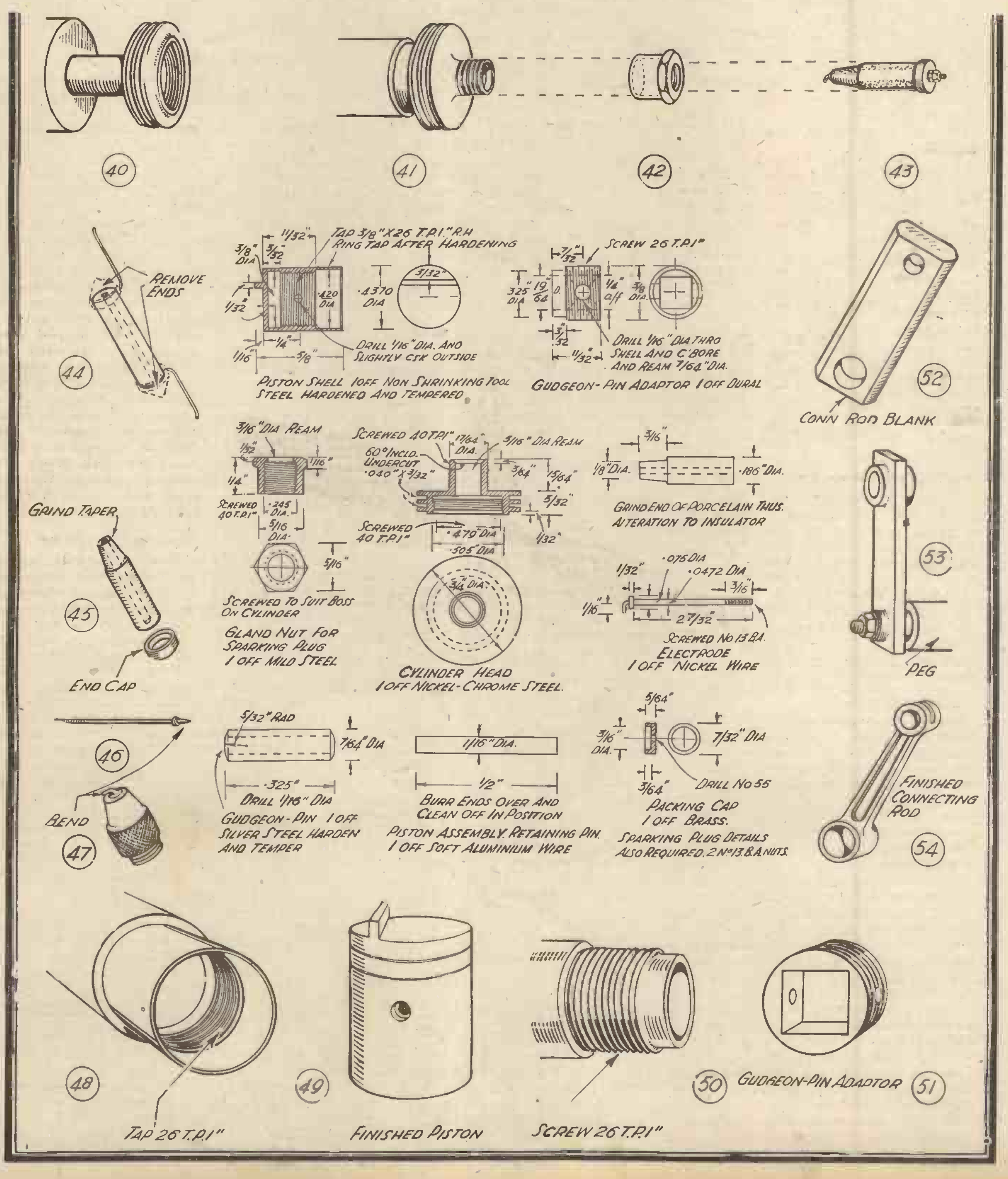
The retaining-pin may be either hand riveted or spun over in position. If the former method is decided upon, form a small countersunk head by burring up the end of the aluminium wire in a split block first of all. Cut off the surplus wire to leave a rivet $\frac{15}{32}$ in. in length and pass through the piston and gudgeon-pin, lightly riveting over on the opposite side to fill the countersink.

If the spinning method is adopted cut off the wire and clean up at each end to leave a piece $\frac{1}{2}$ in. long. Hold this in a true chuck or collet in the lathe and drill a $\frac{1}{32}$ in. dia. hole down each end to a depth of $\frac{1}{16}$ in. The ends of the wire, when in position, are spun out into the countersinks with a tool like a blunt countersinking drill. The angle formed by the end of the spinning tool should, however, be greater than 90 degrees, nearer to 120 degrees in fact.

Whichever method is adopted care needs to be taken to prevent distorting the piston. Clean off the ends of the riveted wire flush with the surface of the piston, and lightly lap again, by hand.

THE 1c.c. TWO STROKE PETROL ENGINE

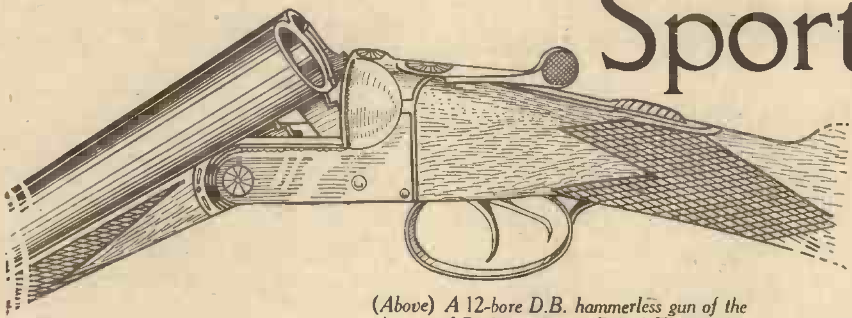
Stage-by-Stage Constructional Details

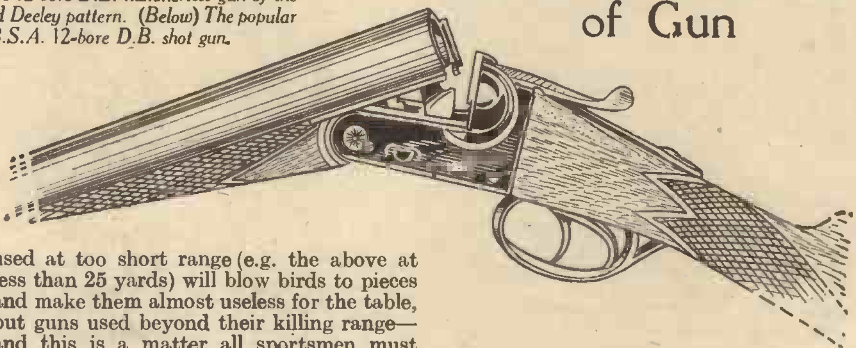


The Mechanics of the Sporting Gun

By ERIC HARDY, F.Z.S.

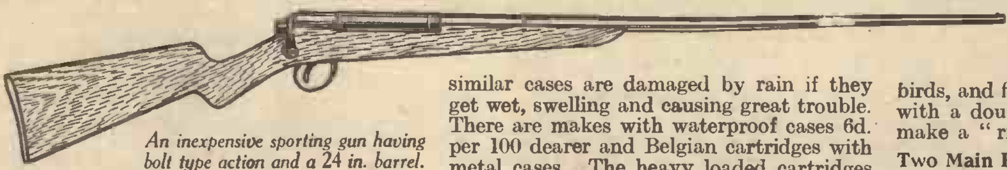
Some Helpful Hints for the Would-be Sportsman's Choice of Gun





(Above) A 12-bore D.B. hammerless gun of the Anson and Deeley pattern. (Below) The popular B.S.A. 12-bore D.B. shot gun.

THE man who knows the basic principles of sporting guns and rifles may yet have a lot to learn before he can confidently make a choice from the many patterns of weapons, for his own particular type of shooting. There is a big difference from our schooldays' target practice with an air-gun firing pellets, to the days when we hold a big heavy 8-bore gun in our hands, and firing the special BB shot for long distance with such a powerful weapon, bringing down a goose from say 80 or 100 yards. One may understand the purpose of the walnut stock to absorb some of the shock from the kick of a gun against one's shoulder, of the trigger, the hammerless ejector which is an essential of most modern guns, the difference between the single bullet-firing rifle used in deer-stalking and young rook-shooting at May rookeries, to the cartridge (with its many, scattering pellets) firing sporting gun used against wildfowl, pheasant, partridge, pigeon, rabbits and hares.



An inexpensive sporting gun having bolt type action and a 24 in. barrel.

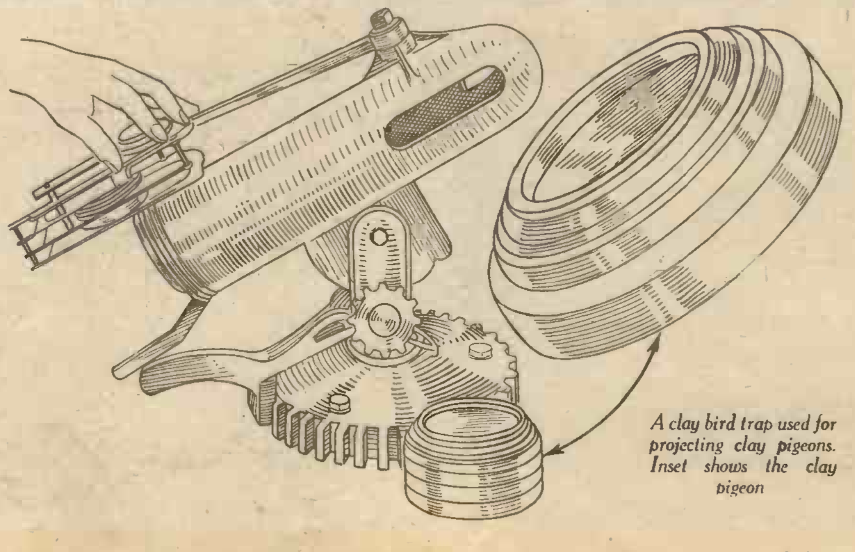
Rough Shooting

For the ordinary rough shooter who shoots rabbits, etc, he will find an inexpensive gun like a .22 repeating shot-gun satisfactory. This type of gun will take fifteen short or ten long cartridges at one loading, the ejector and reloading action being carried out by a simple sliding fore-end which enables one to shoot and reload without actually lowering the rifle from the shoulder. This is an advantage where it is necessary to take snap shots. It has the danger, however, of making a "gun" over-confident and his aim is less skilful, for even if he misses with his first shot, he has time for another, whereas the man with a single shot who has to reload each time is forced to take more accurate aim if he wants his target.

Probably the best all round gun for a sportsman is a double-barrel 12-bore with cartridges having 2¾ in. cases of 33 grains powder and 1½ oz. shot No. 4 chilled. A bigger gun like an 8 bore is very heavy and tiring to carry and such long shots are not always coming one's way to make its use worth while except on some good geese haunts on the estuaries. A powerful gun used at too short range (e.g. the above at less than 25 yards) will blow birds to pieces and make them almost useless for the table, but guns used beyond their killing range—and this is a matter all sportsmen must learn sooner or later—merely "prick" the birds or animals (a 16-bore would probably not kill one duck in 10 at 60 yards), and the wounded creatures may even escape your retrieving dog, for winged birds can always run well, and winged duck can dive. One of the great troubles with many cartridges is that their cardboard or similar cases are damaged by rain if they get wet, swelling and causing great trouble. There are makes with waterproof cases 6d. per 100 dearer and Belgian cartridges with metal cases. The heavy loaded cartridges are reserved for long range shots and are most used for geese, but in addition to the standard game cartridges there are high velocity, quick-firing cartridges; in fact there are loads designed for every style and class of shooting. The best place for a beginner to learn to shoot is not amongst the wild birds, where he will merely maim then until he discovers the range of his gun, but at the clay pigeon shoots of some gun club where clay, saucer-shaped objects are flung into the air at various angles by a powerful spring release, the "gun" standing on a spot to try and score a hit : in a "skeet" there is a projector on either side of the gun, and the "pigeons" take all sorts of surprise angles like flying birds, and fired at alternately, give the man with a double barrelled gun the chance to make a "right and left" hit in succession

Two Main Principles

Let us return to the mechanics of the sporting gun, however. At first glance one admires the engraving on the lock plates, the trigger bow, etc., and one examines the graining of the stock to see if it is of well-seasoned wood. However, these are merely accessories, for the sporting gun is con-

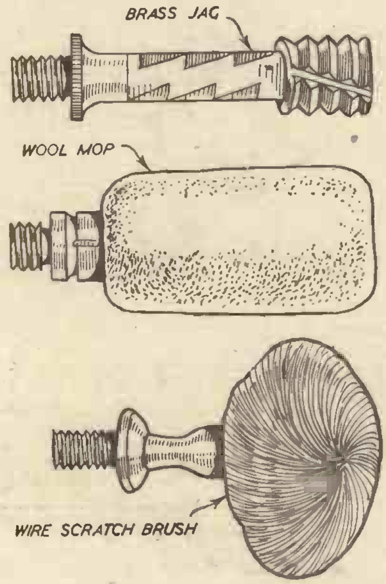


A clay bird trap used for projecting clay pigeons. Inset shows the clay pigeon structed on two main principles—to kill efficiently and to be safe to the user. The greatest danger lies in the breach or firing chamber of the gun, which has to resist nine-tenths of the force of the explosion. In a 12-bore gun, for example, the pressure in the breach may safely range around three tons per square inch with the use of standard game cartridges, but an error in loading or some other trouble might increase this strain and the result be a burst barrel, a rare but not unknown event. Another point is that the faster the velocity of the cartridge, the stronger must be the breach to withstand this pressure. Thus a gun able to withstand a pressure of 6 tons per square inch from a standard cartridge, might burst if a high-velocity cartridge puts this strain upon it. The overheating of the powder charge through resting a time in the gun breach made hot with repeated discharges during good sport, or some overstrong primer, might make an ordinary standard cartridge fire far quicker than usual.

Trigger Pull

The weight and quality of the trigger pull is another feature the expert notices in his gun. Say, for instance, the average 12-bore shotgun weighs six-and-a-half pounds, a trigger-pull of $3\frac{1}{2}$ lb. would thus prove excellent for efficient shooting, because the weight of the gun is a steadying factor, counterbalancing the force exerted against the trigger. But the same amount of pull exerted on a much lighter gun such as a .410 bore, weighing only $4\frac{1}{2}$ lb., would spoil nearly every shot, making the shooter drag down his gun barrel and thus fire below the target, or swinging his gun at a moving bird, it might easily put him off his swing.

For general shooting, however, a young beginner is better advised to start with a light gun such as a 28-bore which fires nine-sixteenths of an oz. of shot, in preference to the above-mentioned .410-bore (or "four-ten") light gun, which fires $2\frac{1}{2}$-in. cartridges with $\frac{3}{8}$-oz. charges. These small bores are quite good for killing rabbits, wood-pigeons and rats. The big difference between these two guns is that the .410-bore has not the 40 yards killing range of the 28-bore, while the latter's cartridges are about 3/6 per 100 cheaper than those for 12, 16, and 20-bores. Of course, the type of shot as well as gun, is of importance. At ranges of twenty to thirty yards the small shot is apt to make too much mess of rabbits and pigeons by reason of its scattered pellets, but a gun-expert would use No. 6 shot for a .410 under such conditions: in other words, when shooting for the table you want to shoot your animals "clean", and the same applies if you wish to sell them to the game dealers who pay higher prices for clean stuff. For that type of light gun, Nos. 5, $5\frac{1}{2}$, or 6 shot would do cleaner work on rabbits than 8 or 9 small shot sizes. With these smaller gauged gun barrels, however, there is a much greater chance of the purchaser of a cheap gun obtaining one with badly bored barrels, giving poor shooting. It is upon the accuracy of barrel-boring that strong and even pellet distribution, and regular shooting results depend. A badly bored barrel may cause overloading of the bore, balling of the shot and excessive recoil. The proper length for a shotgun barrel is 40 diameters. The amateur sportsman should start his shooting with light guns and work up to the heavy 12-bores, and so on, rather than make the 12-bore his first gun and then later try a light gun for small work, for his strength of trigger pull, and the much thinner grasp of the light gun, would no doubt trouble him.



A cleaning outfit for guns.

NEW CAR FOR THE LAND RECORD

Details of the Car in Which John Cobb will Attempt to Beat the Land Speed Record held by Capt. Eyston.

IN August next, John Cobb, the famous racing motorist is taking a car of revolutionary design to America to make an attempt on the world's land speed record. The car is expected to do six miles a minute, and is shaped like a huge slug. Cobb will sit right in front of the car with the engines behind him The huge car weighs just over three tons and has two 12-cylinder Napier engines each developing nearly 1,500 horse power. Although the body is 30 ft. long it weighs only 500 lb. The whole body can be detached in a few minutes and must be taken off in order to get at the wheels, tyres and various tanks

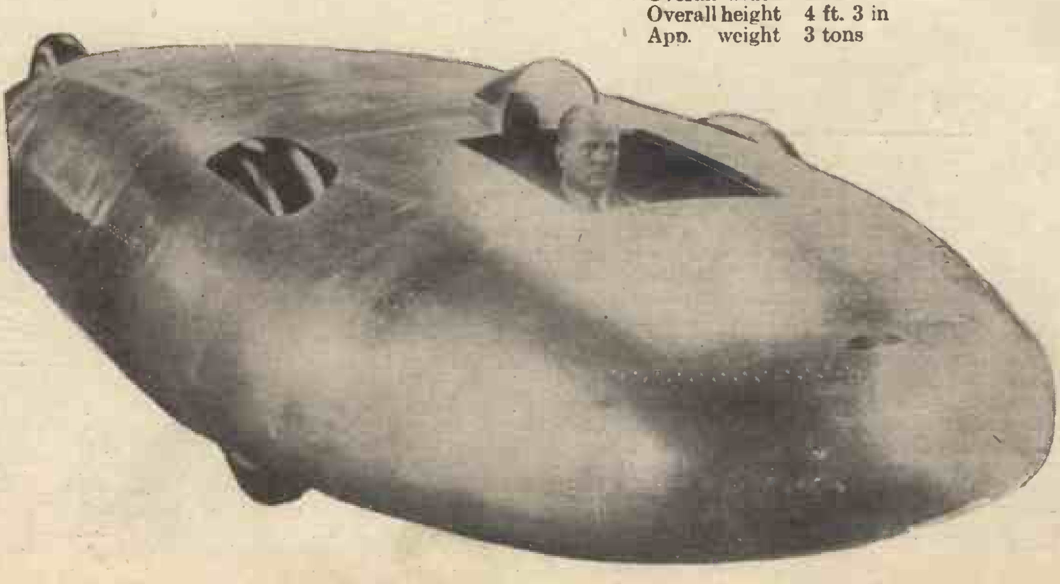
The Chassis

The chassis is made of aluminium and is formed by a single box-section girder, and the two enormous 12-cylinder engines are slung on cantilevers on each side of it. The front wheels are driven by the rear engine and the back wheels by the front engine. They will be controlled by Cobb through two separate clutches, a single inter-connected throttle and two three-speed gear boxes controlled by a single gear lever

In the absence of a radiator the engine will be cooled by a 75-gallon tank of ice, and after each run this will be refilled

Specification

Engines ...	Two Napier 12-cylinder, $5\frac{1}{2}$ in. bore, $5\frac{1}{8}$ in. stroke, 23.936 c.c., 1,250 h.p.
Rear axle ...	Bevel driven.
Tyre size ...	44 in.
Fuel tank ...	18 gallon.
Gear box ...	Three speeds, top gear ratio 1.35 to 1.
Water tank...	75 gallon.
Track ...	5 ft. 6 in. front: 3ft. 6 in. rear.
Oil tank ...	15 gallon.
Wheelbase ...	13 ft. 6 in
Overall length	28 ft. 8 in
Overall width	8 ft.
Overall height	4 ft. 3 in
App. weight	3 tons



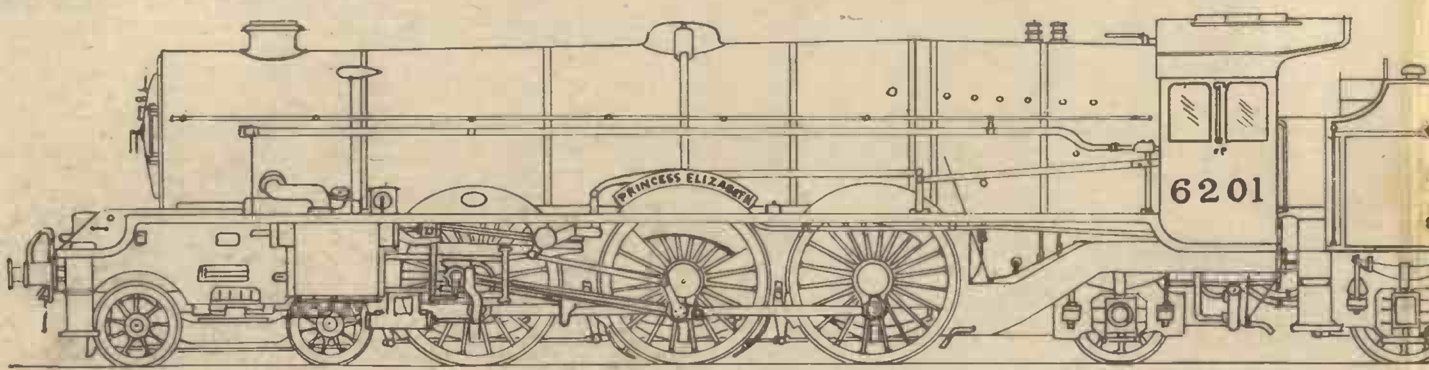
Mr. John Cobb in the cockpit of his new car. When the car is in motion a conning tower fits over his head. It is stated that the car is capable of a speed of 6 miles a minute.

PROGRESS OF THE BRITISH STEA[M] LOCOMOTIVE—PART V

The Fifth Instalment Of This Series Covers The Period From 1927-1937

Fowler's 4-6-0 "Royal Scot," L.M.S.R., 1927

Although not illustrated in this series, we cannot pass on without a mention of the famous "little English train"—as Americans call it—the L.M.S. "Royal Scot." This train gained world fame through its visit to the Chicago World Fair in 1932, and, after this exhibition, throughout its long journey across the great American continent and back, it did not develop a single mechanical defect—a fine achievement for a British train.



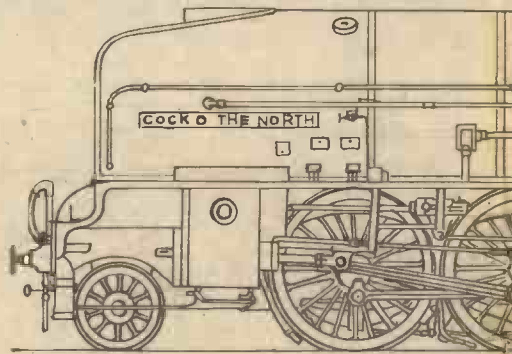
The L.M.S. locomotive "Princess Elizabeth." This type hauls the "Royal Scot" and the "Night Scot" from London

Stanier's 4-6-2 "Princess Elizabeth," L.M.S.R., 1933

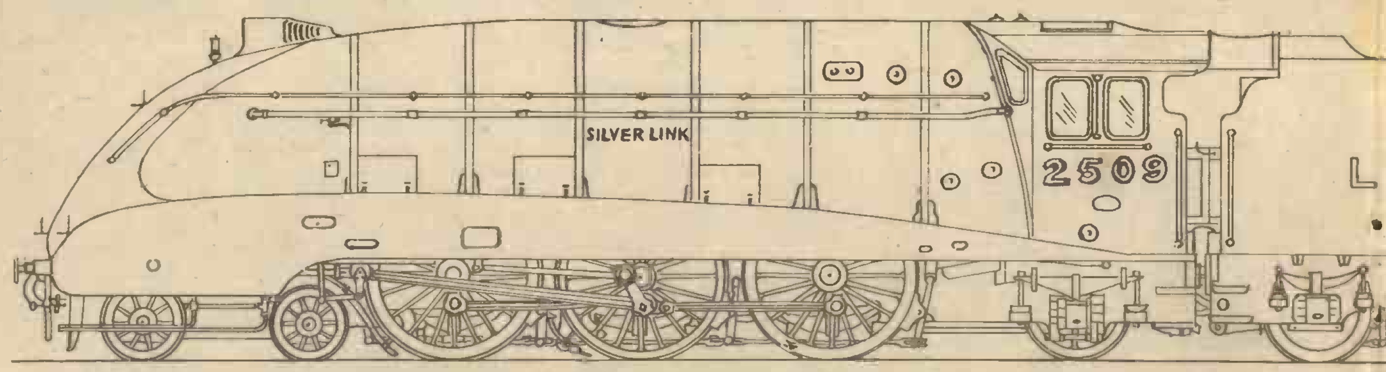
In 1932 Mr. W. A. Stanier became chief mechanical engineer of the London Midland and Scottish Railway, and having previously been second in command at Swindon, he brought with him those individualistic ideas in locomotive design so apparent in G.W.R. locomotive stock—tapered boilers, high working pressures, long valve travels—and these were transferred to L.M.S. metals. Deciding to go one better than Churchward or Collett, he designed a locomotive with the cylinders, motion, and driving wheels of a 4-6-0 "King," gave it a longer boiler and mounted it on a 4-6-2 wheel base, making it a "Pacific." Thus the L.M.S. "Pacifics" and G.W.R. "Kings" have the same tractive effort, but the former with 45 sq. ft. of fire-grate are the better equipped for long-distance steaming at high speed. Under test the "Princess Elizabeth" ran over the 401½ miles from London to Glasgow non-stop in just under 6 hours. This was in November, 1936, and the next day on the return the train averaged 70 miles an hour from start to finish—a remarkable performance, including as it did both Beattock and Shap Summits.

Gresley's 2-8-2 "Cock o' the North," L.N.E.R., 1934

After studying French developments, Sir Nigel Gresley of the London & North Eastern Railway decided to make a similar experiment here. An engine with a bigger boiler than a "Pacific" was needed for the very steep and difficult main line of the L.N.E.R. on the East Coast and in Scotland, and in order that it might have sufficient adhesion to take up the power developed in three 21-in. by 26-in. cylinders, an engine with four axles coupled instead of three was designed. So came the first British eight-coupled express passenger design. To keep the engine within the limits of existing turntables, the leading end was fitted with a two-wheeled pony truck instead of a bogie, giving the 2-8-2 "Mikado" arrangement, instead of 4-8-2. Like the French Chapelon engines, the L.N.E.R. 2-8-2's have larger steam pipes, double blast pipes and double chimneys, and "Cock o' The North" has poppet-valves instead of piston-valves. On a test journey this remarkable locomotive hauled 650 tons up the long 1 in 200 and 1 in 178 to Stoke Summitt without the speed falling below 60 miles an hour, developing a horse-power on the run of over 3,000.



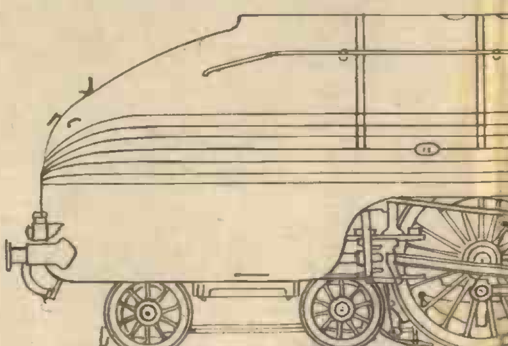
The L.N.E.R.



The L.N.E.R. locomotive "Silver Link," designed by Sir Nigel Gresley and built in 1935. It was the first fully streamlined train built in Great Britain, and was

Gresley's "Silver Link," L.N.E.R., 1935

1935 saw the first fully streamlined train on British metals, named "Silver Jubilee" in honour of the 25 years of King George

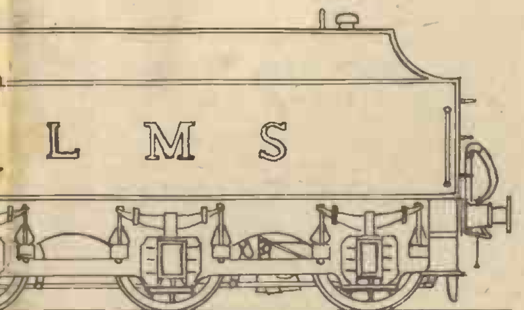


The L.M.S. 4-6-2

M

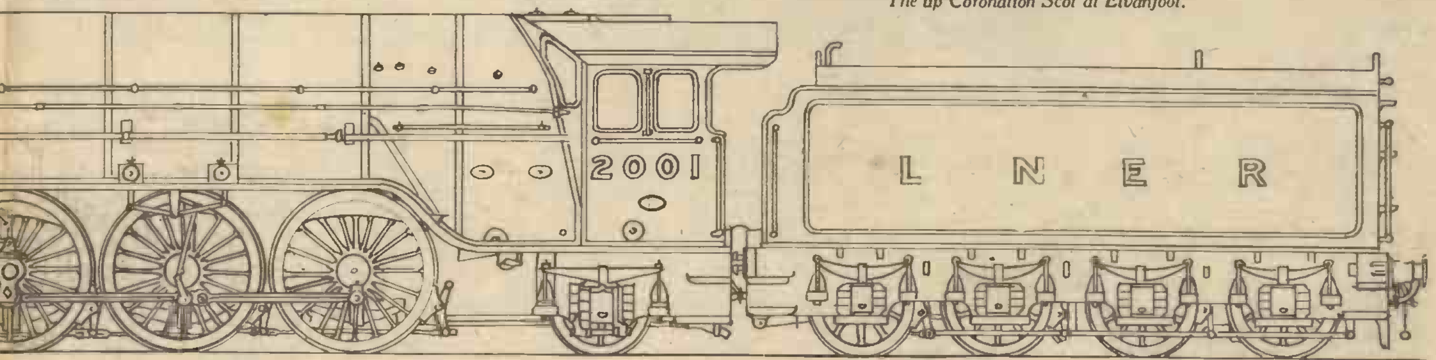
The elevations which illustrate this article are all to the same scale, $3\frac{1}{2}$ mm. to the foot and are suitable for 16-mm. gauge railways. Detailed drawings are available for those readers interested.

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

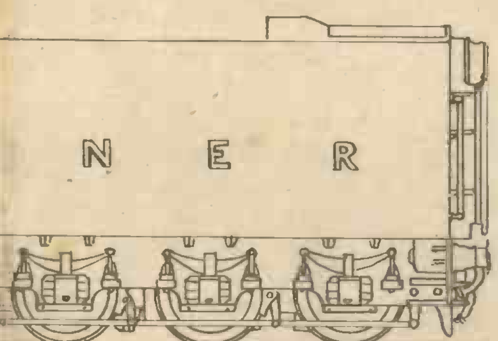


to Scotland.

The up Coronation Scot at Elvanfoot.



locomotive " Cock o' the North," which was the first 8-coupled locomotive built for express passenger service in Great Britain.



noted for its maximum speed of 112½ m.p.h

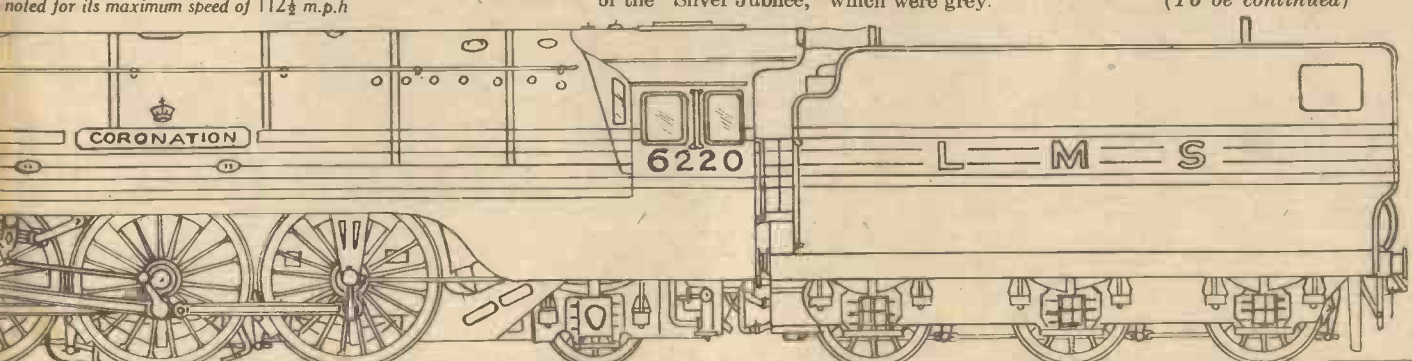
the Fifth's reign. This vision of grey and silver, such as had never been seen before in this country, made a remarkable trial run. The streamlined locomotive "Silver Link" actually maintained an average speed of 100 miles an hour for 43 miles, twice touching 112½, and for 70 miles continuously the average was a shade under 92. The more recently introduced blue "Coronation" streamliner has the same point-to-point schedule as the "Silver Jubilee," but stops at York, and with its 72 miles an hour booking between London and York, is the fastest train in the British Empire. About 30 of these highly successful L.N.E.R. streamlined "Pacifics" are in service, all of them painted blue, including the four engines of the "Silver Jubilee," which were grey.

Stanier's "Coronation" 4-6-2, L.M.S.R., 1937

Three high speed streamlined trains came into service in King George VI's coronation year. The L.N.E.R. "Coronation" six-hour service, London to Edinburgh; the L.N.E.R. "West Riding Ltd." between King's Cross, Leeds and Bradford, and the "Coronation Scot" of the L.M.S. The "Coronation Scot" runs daily between Euston and Glasgow in 6½ hours each way, leaving ample time for absolute punctuality.

"Coronation" is based in design on the previous "Pacifics," but has a larger firebox, with 50 sq. ft. of foregrate, and a larger superheater, to ensure a constant and ample supply of dry steam for continuous high-speed running.

(To be continued)



2 locomotive " Coronation." This type of locomotive is used for hauling the " Coronation Scot " train between London and Glasgow.

MODEL AERO TOPICS

CURRENT NEWS FROM THE WORLD OF MODEL AVIATION

BY F. J. C.

Winding a rubber motored model with the aid of a winder made from a bench grinder, at a recent meeting of the Kingston and District Model Flying Club on Wimbledon Common. The practice of stretching the rubber whilst winding originated in America, and is being adopted in this country. It is claimed that a much greater number of turns can be placed on the rubber skein in this way.

From New Zealand

MR. J. B. ROSS, of Mandeville, Southland, New Zealand, tells me that the Gore Model Aero Club was recently formed, and they have already been promised two silver cups—one for petrol model competitions, and the other for rubber-powered competitions. A new note is struck in that these cups will be competed for weekly whilst indoor club meetings will be held monthly.

The N. Kent Model Aircraft Society

MR. T. WICKENS, of 73 Burnell Avenue, Wickham, Kent, has sent me the rules for the Roberts Cup Competition. The cup was presented by Mr. C. H. Roberts, principal of the College of Aeronautical Engineering, Chelsea. The Competition is intended entirely for model flying boats, and it will be held on Sunday, June 26th, at Dansom Park, Bexleyheath, where on the same date the Lady Shelley Seaplane, and White Flying Boat Competitions, are also being held. The rules of the Robert Competition stipulate an enclosed rubber drive, minimum cross sectional area of hull to be equal to the overhaul length of model squared and divided by 50, the body or bodies, fuselage or hull, constituting the main flotation support. The minimum wing area is to be 150 square inches and the minimum wing loading 1 ounce for every 50 square ins. the average time of three flights to count (from release of model). The models must rise from the water unassisted, and a flotation test of 30 seconds will precede the flying test of each model. Bonus marks of 10 per cent. of the duration will be added to flights over 20 seconds when the model alights on the water. Clubs affiliated to the S.M.A.E. may enter for 1s., Juniors 6d., non-members 2s. 6d., and Juniors 1s. The winner of the 1937 contest was H. White. This should prove a most interesting competition in view of the rules and it should produce some well-designed machines.

Good Elastic

I HAVE recently tested a sample of the elastic supplied by Caton, Ltd., 1 Mermaid Court, Borough, London, S.E.1, which is sold by most dealers in sealed boxes. A dozen yards of $\frac{1}{8}$th in strip costs 8d., $\frac{3}{16}$th in. strip 10d., and $\frac{1}{4}$in. strip 1s. They are all $\frac{1}{30}$th of an inch thick and there is a proportionate reduction in cost for quantities of 36 yards and 72 yards. It can also be purchased by weight. Using a good lubricant I found that this elastic is most durable and the skein of it which I used is still unbroken after being in use for a total flying time of over 3 hours. The model is capable of consistent flights of 2 minutes, so this means that after 90 flights the rubber is still in use. It seems good for many more flights, and seems to exert the same torque as when new.

Insurance

MR. DUDLEY SHIP, of National Provincial Bank Chambers, 44 Holdenhurst Road, Bournemouth, tells me that his policy of insurance against third-party claims for damage caused by petrol-driven models, has been designed especially for members of S.M.A.E. clubs, and not for the general public. He points out that his policy is completely free from all restrictions, and although the premium is 7s. 6d. and thus dearer than some other policies, many additional benefits are conferred. If the club is affiliated to the Society of Model Aeronautical Engineers, power-driven machines may only be flown in accordance with their regulations. In other cases, I am informed, it is the intention to stipulate the following conditions :

No power driven (petrol, steam, etc.) model shall be flown over public open spaces.

No person under 18 shall be allowed to fly a petrol (power) model unless under the control of an adult.

The model shall carry a mechanical timing device, fitted to the ignition system, limiting the engine's run to two minutes. It shall be tested before each flight and shall be so designed that the model cannot be flown unless the time switch is brought into action.

No machine shall be flown with a bent or otherwise defective air-screw.

Machines must be set to fly a circular course.

It is very desirable for all clubs, and even individuals to take out a policy, for the sum is small and it relieves clubs of responsibility. I learn that the Manchester City Council may by the time this paragraph sees print, have approved the recommendation of the parks committee, that the flying of model aeroplanes in the public parks and recreation grounds be prohibited unless a special permit has been obtained. It was explained that the regulation will not apply in the case of small toy models. The committee stated that it was of the opinion that many of the larger models were dangerous.

The Brown Junior

THE Model Aircraft Stores of Bournemouth state that they have been appointed sole distributors in the British Isles and the I.F.S. for Brown Junior Models. The model B. costs £5 17s. 6d., the model C. £4 18s. 6d., model D. £3 17s. 6d., and the Model M. (Marine), costs £4 15s. All engines are complete and include propeller or flywheel according to type.

S.M.A.E. Notes

MY readers are no doubt aware of my views on the fuselage formula adopted by the S.M.A.E. which I have disliked from the moment it was adopted many years ago. This formula is based upon the length of the fuselage and the rule originally was so ambiguously framed that it did not stipulate that fuselages must be covered. The inevitable result of the rule, as I predicted many years ago, was that it produced what I might call a type of model, all of which look as if they have emerged from the same mould. Irrespective of the wing area or the weight of your model your fuselage has to be to those proportions, and it must be at least 12 years ago when I first suggested that the correct formula should be based on wing area. I am gratified therefore, to know that at a recent international conference it was proposed " that the present F.A.I. formula was unsatisfactory, and that this formula should be altered. The cross section of the fuselage to be based on the surface of the wing."

(*Continued on page* 514)

THE SECRETS OF CARD CONJURING

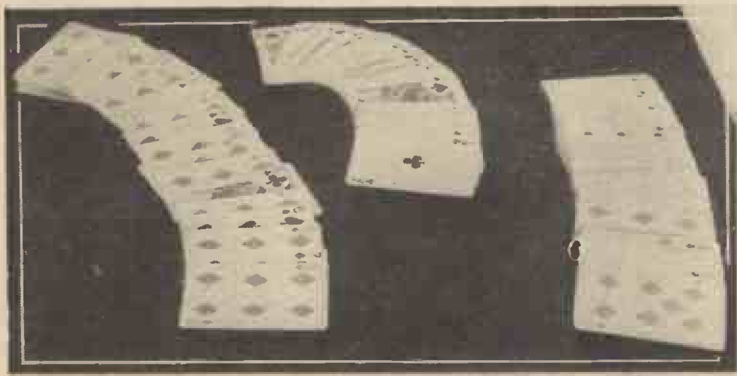


Fig. 1.—*Forcing packs. Left to right: Alternate cards alike. All cards alike. A group of identical cards in the centre of the packs.*

Some Apparatus and Devices which make Card Tricks Possible Without Sleight of Hand

THE majority of card tricks consist, broadly speaking, of getting a spectator to choose a card and then producing that card in some striking or unexpected manner. The chosen card may be made to vanish first, or it may be destroyed and then reproduced, or several cards may be chosen and make their appearance either from the pack or elsewhere. But, whatever the effect, the first essential is that the spectator should pick the card the conjurer wants him to pick.

This is known as forcing. There are several methods of forcing a card which depend on sleight of hand and are more or less difficult. There are also a variety of ways of getting a pre-determined card or cards chosen without the need for skill. Most of these are by the use of special packs of cards known as forcing packs.

Forcing Packs

In Fig. 1 is illustrated three types of forcing pack. The simplest of all is a pack consisting of the same card repeated some fifty times. This is illustrated in the centre of Fig. 1. This pack consists almost entirely of Jacks of Spades, but there are a few indifferent cards on the bottom so that the conjurer may allow these to be seen and so keep the audience unsuspicious of the special nature of the pack.

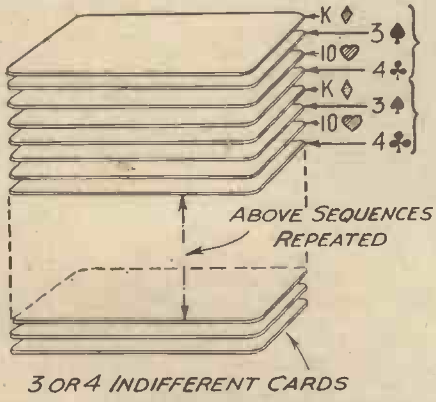


Fig. 2.—A four-card forcing pack. This pack may be cut anywhere and will always give the same four cards.

To use such a pack is simply a matter of spreading the cards in a fan—face downwards, of course—and asking someone to take a card. No difficulty need be experienced in preventing the few indifferent cards at the bottom from being taken, and the choice is bound to fall on the Jack of Spades.

A modification of this pack is illustrated on the right of Fig. 1. Here the Six of Diamonds is the card to be forced, and there is a packet of about fifteen Sixes of Diamonds in the centre of the pack, the rest of the cards being ordinary and varied. It does not need any great display of skill to ensure, when spreading the cards for selection, that a card is chosen from the central fifteen. In fact, only these cards need be spread out, the rest of the pack being kept together at each end and gripped tightly with the fingers. This pack is in some ways better than the all alike pack, as the presence of the comparatively small number of identical cards is easily concealed.

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

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

Cards the Same

Now we take a step farther and make up a pack in which every other card is the same. Reference to the left-hand pack in Fig. 1 will show a pack in which every alternate card is a Six of Diamonds. To the ordinary observer, if he is not allowed too long to study the cards, such a pack appears to be an ordinary well-shuffled pack. To force the Six of Diamonds, or whatever card is selected for forcing, a member of the audience is asked to cut the pack anywhere he pleases. The conjurer takes the top part of the pack and glances at the bottom card. If this happens to be the Six of Diamonds he displays it as the card cut. If it is not a Six of Diamonds, he knows that the top card of the lower portion must be; and this is, then, the card he uses.

"Vanishing" Cards

The next step is a pack made up of three or four cards repeated. The composition of such a pack is shown in Fig. 2, a few indifferent cards being placed on the bottom so that they may casually be shown to create the idea of an ordinary pack. It does not matter where this four-kind pack is cut, four cards taken at the cut, either from the top or bottom half, or even two from each, are bound to be the four cards of which the pack is composed.

Next on our list of devices for card

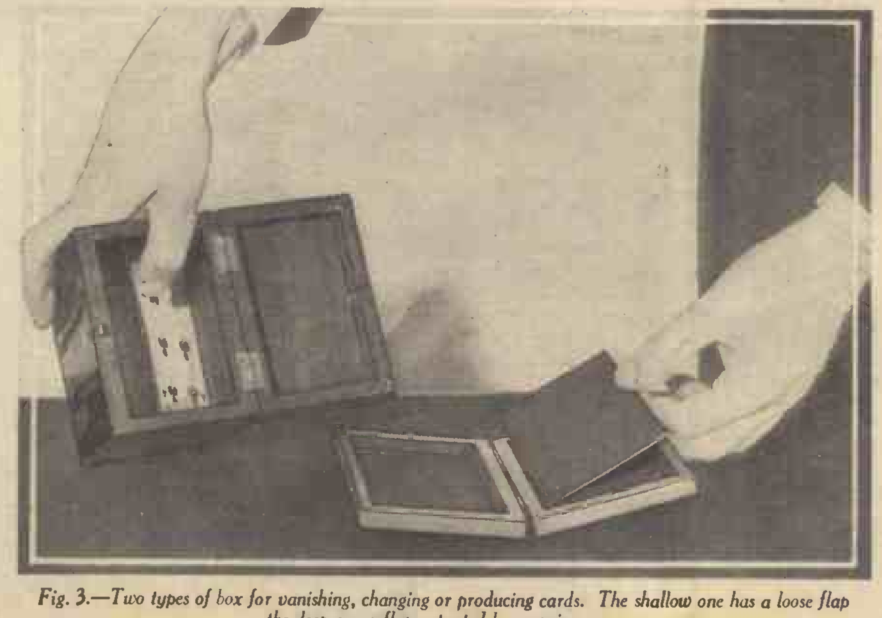


Fig. 3.—Two types of box for vanishing, changing or producing cards. The shallow one has a loose flap the deep one a flap actuated by a spring.

conjuring we have some methods for "vanishing" or otherwise disposing of the chosen card. In Fig. 3 are illustrated two types of box for this purpose. The shallow box shown in the front of the photograph is hinged box and lid like a book, both box and lid being exactly the same depth and both painted or polished all over the outside so that the box looks the same whichever way up it may be placed on the table. The inside of the box is painted dead black, and there is a loosely fitting flap of thin wood or metal, also painted dead black, on both sides. The box is just large enough to take a card and deep enough when closed to accommodate a whole pack. It is a good idea to have the pack in the box at the start of the performance, as this gives a reasonable excuse for the presence of the box.

To "vanish" a card the box is empty at the start, apart from the loose flap. The card is placed in the box, the flap being for the moment resting in the bottom of the lower part. The lid is closed and the box is turned completely over in passing it from hand to hand or in placing it on the table. The flap then falls into the other part of the box, and when the lid is next raised the card will seemingly have vanished, being actually covered with the black flap.

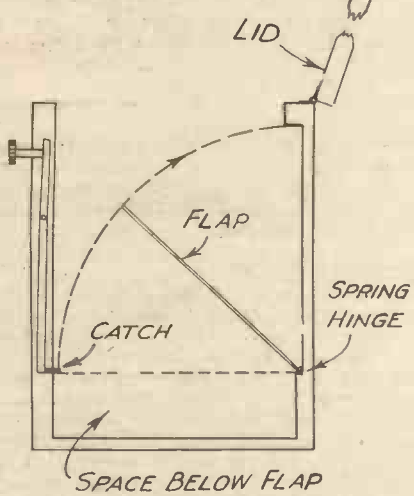


Fig. 5.—Left Another form of sprung flap card box.

Faked Boxes

The same box will, of course, produce a card by simply having the card under the flap to start with. It will also change one card to another by having the card into which the change is to take place already under the flap. The card to be changed is placed in the box, which is closed and reversed as before. On opening the box the second card is revealed in place of the first The box may usefully be employed, apart from "vanishing" or producing a chosen card, either to cause the chosen card to change to some other card or to change an indifferent card into the one chosen. For example, a card having been chosen and the choice forced on, say, the Ace of Clubs, the performer may have the card returned to the pack, make some passes, and produce from the bottom of the pack some other card; for instance, the Ten of Hearts. He announces this as the chosen card and puts it into the box, which he closes. He then asks the chooser of the card to verify that his card is in the box. Naturally, the spectator refuses to do anything of the kind and insists that it is not his card that is in the box. After working up the situation until the audience demand to be shown the card, the conjurer calmly opens the box, when, unless he has forgotten to reverse it first, it is found to contain the correct chosen card—or, at least, a duplicate of it.

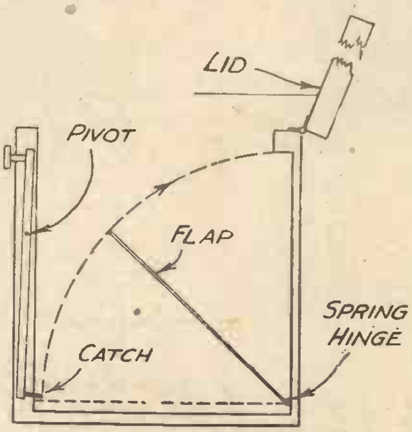


Fig. 4.—A section of a sprung flap card box.

Other Uses for the Box

Further uses of the box will suggest themselves to the student of magic. A card may be turned to confetti, or a chosen card may change to a slip of paper bearing a message telling where the card is to be found. Or the card may be transformed into a strip of ribbon with the correct number of pips of the proper suit painted in a row upon it. There are almost endless ways of varying the effect.

The other box, illustrated in Fig. 3, is fitted with a spring flap. The box is a little deeper than the width of a card and normally the spring keeps the flap pressed against the back of the box. It may be depressed until it forms a false bottom. in which position it is held by a small catch. Pressure on the little knob seen on the front of the box releases the flap, which flies up against the back, thus concealing any flat object placed in the box and revealing a card or cards, or similar flat articles, hidden beneath the flap. Fig. 4 will further explain the working of the box.

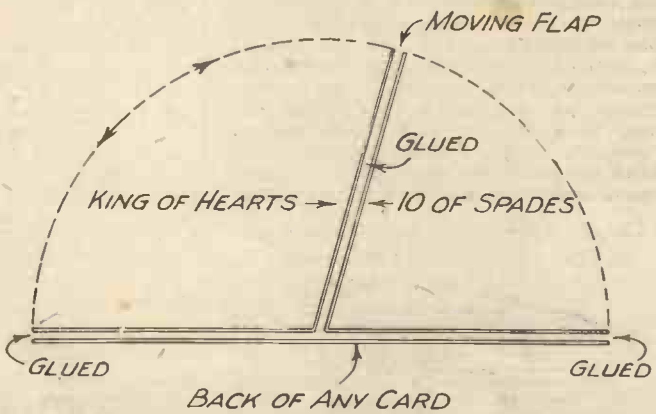


Fig. 7. — (Right) A section of a flap-changing card.

It should be noted that in this box the catch which releases the spring flap is not operated by closing the lid. It could be made to do so, but this would not be an advantage, as it would not then be possible to open the box, once it was closed, without letting the flap fly up. Thus the box could not then be used to hold a pack or two packs of cards for use in the tricks.

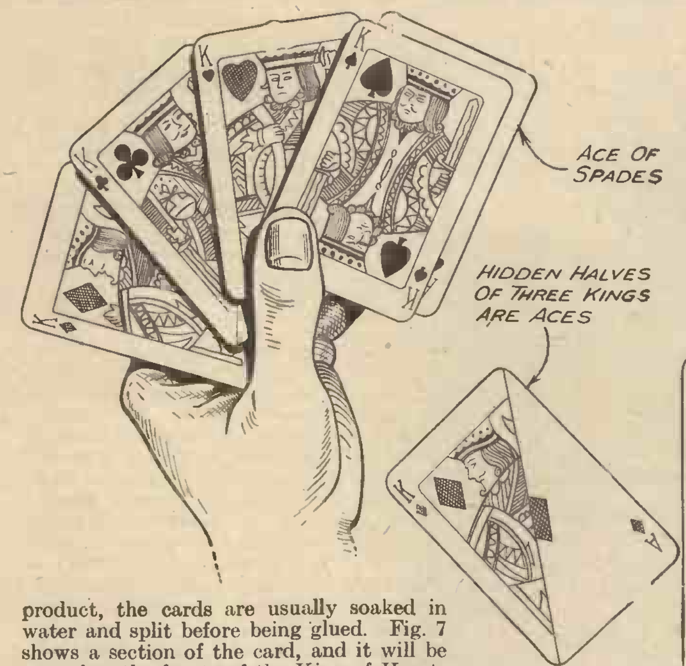
Fig. 5 shows a section of another box planned on similar lines, but with a space beneath the flap so that the card may be changed to a few sweets or a flower, or some other article.

Trick or mechanical cards are another form of conjuring device often employed to good effect. Fig. 6 shows several different types.

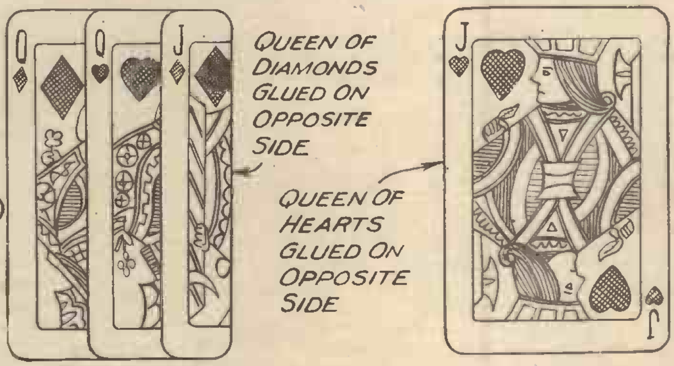
Fig. 6.—Trick cards. Left to right: The flap changing card. A target to produce a card. A half and half card for changes and, extreme right, a trick balancing card.

The Flap Card

First, there is the flap card. This is illustrated in the bottom left-hand corner. It is made from three cards, two of them scored across the centre and then all glued together so that a moving flap is formed which, according to its position, will show the card as either of two varieties. To avoid undesirable thickness in the finished



Figs. 8 and 9.—(Left) The arrangement of cards for the Kings and Aces trick. (Below) The cards for the Queens and and Knaves trick.



product, the cards are usually soaked in water and split before being glued. Fig. 7 shows a section of the card, and it will be seen that the fronts of the King of Hearts and Ten of Spades are needed and the back portion of any indifferent card. Such cards are sold by conjuring shops quite cheaply and are fitted with elastic hinges, so that the change from one card to another is made by simply releasing the flap. This has certain advantages, but also certain limitations. For instance, the flap must be moved over and held down before the change can be shown, and the change will only work one way—say, from Ten of Spades to King of Hearts, not vice versa. With the non-elastic flap card the change can be made to work either way; but, on the other hand, not being instantaneous, it must be covered by passing the hand over the card.

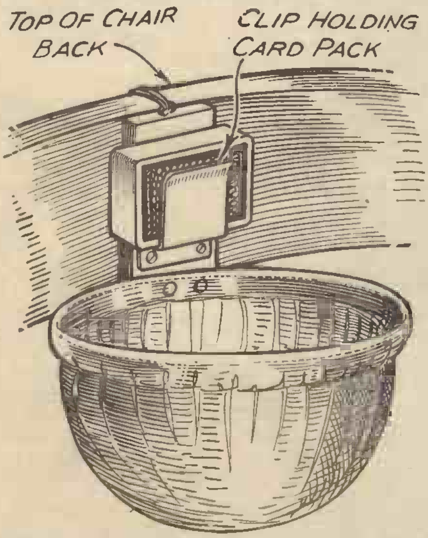


Fig. 10.—A "servante" for changing a pack of cards.

A Good Shot

The target shown in the centre of Fig. 6 is an elaboration of the flap card. In this case the card is glued in the centre of a cardboard target and the side visible when the flap is held down is painted to match the target. The target can be shown on both sides with the flap held down by the thumb. A wave of the hand and there is the card in the centre of the target. Just a matter of releasing the flap and letting it fly up, when the card becomes visible. Needless to say, in this case the flap must work on an elastic. A good effect in which the target could be used would be to have a card chosen and force the card on the target, place it in one of the boxes, and ask someone to hold the box. Another spectator is given a toy pop-gun and asked to stand at one side of the stage while the performer stands on the other side holding the target. The person holding the box with the card in stands between. At a given signal the pop-gun is fired and the card appears on the target. The box, on being opened, is either found empty or containing a slip of paper with the words "Good shot" instead of the card. If the box used is the spring flap type, the person holding it may open it himself, the spring having been released by the performer on giving it to him. If it is a box with a space beneath the flap, the message "Good shot" may be amplified into "Good shot, here's your prize" and be accompanied by either a cigar or some nuts as the conventional reward for accurate shooting. On the score of expense, the cigar would naturally be either very inferior or else chocolate.

Fig. 11.—Rising cards. The cards are drawn up from the back of the pack by a fine thread wound on a tiny spring drum strapped to the conjurer's forearm.

The card seen in Fig. 6 supporting a wineglass is made by scoring any card vertically down the centre and gluing one half to the back of another card. Such a card, with the flap held against the front card, may be shown both sides and yet, with the flap secretly opened, immediately be used for such surprising balancing feats as the one illustrated.

Half and Half Card

The half and half card lying flat on the table in Fig. 6 is made by cutting a card across diagonally and gluing one half of it over one half of another card. A simple but effective trick with several such cards is to cause, say, the four Kings to change to the four Aces. Three of the Kings are cut and each is glued over one of the aces. There are thus three half-and-half cards, half King half Ace, one whole Ace and one whole King. The cards are arranged as shown in Fig. 8, with the King parts of the trick cards showing and on the front first a whole ace, and on top of that a whole King. Having shown the fan as four Kings, close it, turn it upside down with the backs of the cards to the audience. Draw off the front card, which is the whole King, and place it at the back. Fan the cards again and they will appear as four aces, the whole King and the three Half Kings being hidden.

Fig. 9 shows a development of the half and half idea. In this case four cards are shown; say, two Queens and two Jacks. They are dropped into a hat or other receptacle and the two Queens are openly taken out. A moment later the hat is shown to be empty. The two Jacks have apparently gone off after the Queens. All four cards—or, rather, duplicates—may then be produced together in a card box or other apparatus.

Two prepared cards only are required for this little trick. One card is made by cutting portions of two Queens and a Jack and fitting them on to the back of a duplicate of one of the Queens, as shown in Fig. 9. The other card is a second Jack glued back to back on a duplicate of the other Queen, shown on the triple fake card. The cards are first shown as in Fig. 9, and appear as two Queens and two Jacks. They are dropped into a hat and both are taken out separately, each being shown on its reverse side as a Queen. The audience naturally assume that the two Jacks have been left in the hat. Quite a number of effective

(*Continued on page 512*)

INTRODUCING—

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

SOLDERING AND HEATING TORCH

AN ingenious heating and soldering torch, known as the "Ricofor" which has no working parts and dispenses with pumping has recently been placed on the market. It is small and neat in design, measuring 8 in. by 2 in. by 1 in., and can be slipped into the pocket quite easily. Briefly, it is composed of a heater and carburettor, both of which contain a wick soaked in spirit. They are connected to a twin collar ring, wherein they can turn and slide. It costs 17s. 6d.

Showing the heating and soldering torch in use and method of construction

COMING OF AGE

FOUNDED in 1917, the Technological Institute of Great Britain this year celebrate their coming of age. Since its inception the Institute has enabled upwards of 25,000 men to embark upon careers in engineering through the medium of correspondence training. The tutorial service of the T.I.G.B. embraces the various branches of engineering and allied technology. These are covered most thoroughly as may be judged from the fact that the Institute operates over 200 courses—the widest choice of engineering courses in the world. Readers should write to them at Temple Bar House, London, E.C.4, for their book—"The Engineer's Guide to Success"—containing 174 pages, which will be sent post free.

ELECTRIC ERASING MACHINE

WITH the aid of this machine, ink lines are erased from tracing linen or paper in a fraction of the time taken by hand. The plug-in eraser, which is rapidly revolved by the motor, rubs out the unwanted lines without damaging or burning the drawing surface.

The ball-bearing, universal motor is suitable for A.C. or D.C. currents from 25 to 60 cycles and may be obtained for 110 to 200 volt working. Careful design has eliminated vibration and noise, whilst a current of air circulating round the windings keeps the motor cool and free from dust. The complete machine, which weighs only 2 lbs., is well balanced and costs £3 17s. 6d., complete with six spare erasers.

"PRACTICAL PAINTING HINTS"

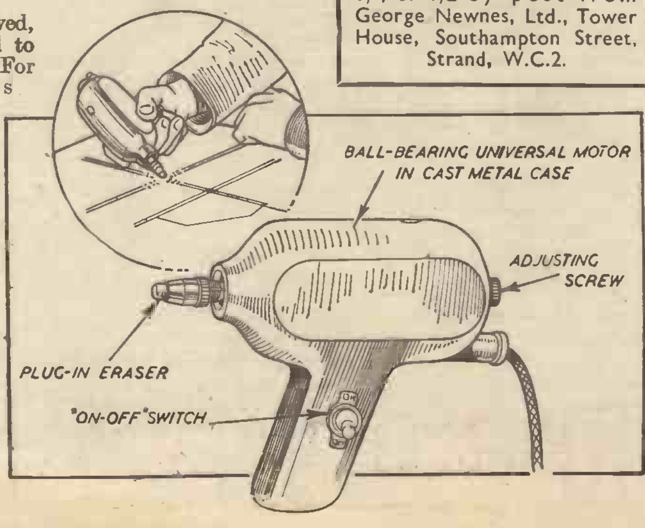
UNDER the above heading, The Rawlplug Co., Ltd., Rawlplug House, Cromwell Road, London, S.W.7, are issuing an attractive 48-page booklet that should prove extremely interesting to all handymen. Containing many illustrations, it deals with brushes and their treatment, various methods of removing paint, removing wallpaper, stopping cracks, etc.

There are, of course, many jobs where it is best to employ a professional painter, but for those who like painting, the book is a mine of information. Readers wishing to obtain a copy of this booklet should write to the above address, mentioning "Practical Mechanics," and they will receive a copy free of charge.

A POCKET AERIAL

AN aerial, which when closed is similar in size and shape to a fountain pen, is now being marketed for 2s. 6d. (postage 6d. extra). For the reception of local stations it is only necessary to insert the plug end of the aerial in the aerial socket of the set. For distant stations, however, the cap should be unscrewed and the aerial extended up to a maximum length of 14 ft. The device consists of a black vulcanite tube fitted with a pocket clip, and having a red terminal screwed on at one end. Inside the tube is a thin coiled spring, one end of which is connected to the base of the tube and the other end to the terminal. When the terminal is unscrewed, the spring will extend to a distance of 14 ft. For good reception it is advisable when using the pocket aerial to see that the receiver also has a good earth connection.

An aerial similar to a fountain pen in size and shape which can be carried about in the waistcoat pocket.



An electric erasing machine fitted with a universal motor which can be obtained for 110 to 200 volt working.

A LIGHT SENSITIVE CELL

A CELL which is extremely sensitive to light, known as the "Detectaray," is now on the market for the reasonable price of only 5s. The device consists of a selenium cell mounted in a small plug similar to the standard electric 5-amp two-pin plug. It may be included in an electrical circuit, and by using relays can be made to carry out many remarkable operations. An electric light may be switched on by a person passing through a doorway, burglar alarms may be fitted up, model railway points and signals may be operated by a passing train, etc. An illustrated leaflet is supplied with the cell, giving details of three simple circuits in which the "Detectaray" may be incorporated.

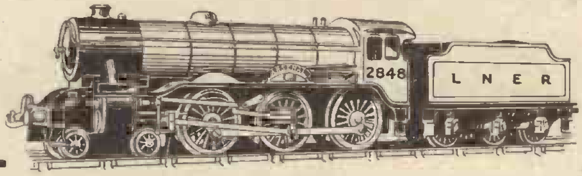
A UNIVERSAL RECEIVER

RADIO fans will no doubt be interested in a neat and compact 5-valve A.C./D.C. portable receiver which is being marketed at £4 15s. Known as the "Lucille," it is housed in a Fabrickoid case measuring 12 in. x 7½ in. x 6 in. The set is supplied in many attractive colours including black, brown, blue, green, red, and grey and weighs only 6 lbs.

The portable is fitted with an electro-dynamic moving coil speaker, has a self-contained aerial and a fully illuminated calibrated scale dial. It covers both medium (200-550 metres) and long waves (900-2,000 metres) and will receive English and a number of foreign stations.

Under test it gave very satisfactory results, the London stations coming in with considerable volume.

JUNE MODEL BULLETIN



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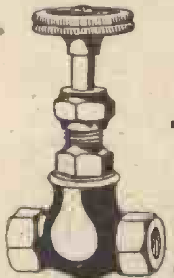

Remember we have an expert staff at Northampton to deal with your model enquiries, so don't hesitate to write to us!

NEW "B" LIST

Readers who have been waiting for our new Stationary Engine and Castings List No. 12 will be interested to know it is now brought up-to-date and reprinted in two sections.

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MASTERS OF MECHANICS

No. 34. The Life-History and Career Of Matthew Murray, Engineer, Of Leeds, Locomotive Builder and Pioneer Of Steam Power.

UNTIL the last decade or so the name of Matthew Murray was a comparatively unknown one in the history of engineering. A line or two served to sum up the career of this inventive genius who not only very greatly assisted in the development of the steam engine and locomotive, but who also founded an engineering industry rivalling that of Watt and Boulton at Birmingham.

Happily, however, Murray is now coming into his own again in the record of engineering achievement. In consequence of the engineering industry which he set up at Leeds he has been given the honourable title of "Father of Leeds Engineering," a commemorative tablet to him having been erected in that noted city within recent times.

So far as we can tell, Matthew Murray was born at Newcastle-on-Tyne. The exact date of his birth is unknown, but there is little doubt that he was born in the year 1765.

Practically nothing is known of his earliest days, with the exception of the fact that, as a lad, he was apprenticed to a blacksmith in his native town and that he married before the completion of his apprenticeship.

Just before his term of service was ended, he moved to Stockton-on-Tees and at the end of his apprenticeship worked as a journeyman mechanic in a small foundry there.

Trade Bad

Trade was bad, however, and Murray, now having a family to keep, cast anxiously around for a better avenue of employment. Leeds at this time was coming into the news as a progressive neighbourhood and as a city in which efforts were being made to introduce machinery into its mills. Thinking, therefore, that he might find a chance of bettering himself in that town, Murray, in 1787, set off to walk to Leeds, a distance of 60 miles, leaving his family behind and taking with him merely a bundle of clothes and his own small kit of tools.

At Leeds he came in contact with John Marshall, a flax manufacturer who had a water-driven mill outside the town. Marshall gave Murray employment as a handyman whose main duty it was to do odd jobs here and there and to patch up the continually failing machinery of the mill.

Marshall seems to have been quick to recognise the great abilities of his new employee, for within a year or so he made Murray his chief mechanic and also subsequently presented him with the sum of £20 in cash as a reward for certain improvements which he had suggested.

Feeling now that he had obtained a grip on the ladder of a successful career, Murray at once sent for his wife and family and, with them, settled down in Leeds, taking a cottage on the moors skirting the town.

In 1790 Marshall decided to take his works nearer the town, feeling then that his old water mill had become inadequate for his expanding business. In partnership with a man called Benyon he erected a mill at Holbeck, near Leeds, which at first he equipped with a waterwheel driven by a Savery steam pumping engine. Three years later, however, he discarded water-power altogether, installing a steam engine made by Boulton and Watt, of Birmingham, which at once he placed in charge of Murray, who was now his right-hand man.

His First Patent

Murray, by this time, had taken out his first patent which was for a machine for spinning flax, and this was followed after a year or two by another patent for a similar machine.

The commemorative tablet to Murray which was unveiled at Leeds in 1929.

In all, Murray remained in Marshall and Benyon's employment for twelve years. To him much of the consolidation of the firm's business was due, and he made a reputation for himself as a clever, inventive mechanic which was the envy of many.

About 1795, Murray left the works of John Marshall and entered into a partnership with one David Wood, a local engineer, establishing a machine shop and foundry at Holbeck, Leeds. Soon afterwards they were joined by a third party, a James Fenton, and afterwards by another individual, William Lister, who, however, appears to have been entirely a sleeping partner.

Murray's firm made rapid progress. Murray himself was the practical man of the concern, Fenton finding most of the capital and Wood attending to the routine designing of the firm's products.

A new building was very quickly rendered necessary. The firm took a new site in Water Lane, Leeds, and here, amongst other buildings, they erected what for years was known as the "Round Factory" on account of the circular shape of the engineering foundry of the works.

Here, associated with his famous "Round Foundry," Matthew Murray spent the remainder of his life, which yearly became more and more productive in mechanical creations. He devoted nearly the whole of his energies to improving the steam engine and to converting it into a perfectly reliable, satisfactory and serviceable source of power.

Improving the Steam Engine

Many were the improvements which Murray devised for the steam engine. He simplified steam engine construction by fixing the cylinder in a horizontal position and by devising an improved means of connection between the piston rod and the flywheel shaft. In 1799, he devised a self-acting means of regulating the intensity of the fire beneath the boiler of an engine, thus controlling, automatically the amount of steam available for the pistons of his engines.

Murray also brought out the principle of the "D" slide-valve, in which all the valves open into one valve box. This principle, which has been used in one form or another ever since, seems to have been regarded by Murray merely as a trivial invention, for he made little of it.

For the purpose of obtaining perfectly steam-tight joints at the valve surfaces of his engines, Murray invented and used a metal-planing machine. Other inventors, as, for instance, Fox, of Derby, devised similar machines at a later date and have unreasonably been credited with their invention in place of Murray.

In addition to his inventions relating to stationary or mill-driving engines, Murray devoted much of his time to building locomotives on the lines laid down by Trevithick, the celebrated Cornish engineer, who made the first practical locomotive.

John Blenkinsop, the manager of Brandling's Colliery, at Middleton, near Leeds, had in 1811 invented and patented a system of truck haulage on iron rails. Blenkinsop, however, was not a practical steam engineer. Thus he was unable to produce any type of locomotive to run on his rails for the purpose of drawing the coal-laden trucks

A Problem Solved

It was Matthew Murray who solved the problem for Blenkinsop by building, in 1812, four locomotives for his use. Murray utilised the high-pressure steam system of Trevithick's pioneer locomotive, but in place of the single piston which the latter had employed, he provided two cylinders which drove cranks set at right angles to each other. By this simple means Murray solved the problem of making a steam locomotive start from any piston position.

Murray's first locomotive which he made for the Blenkinsop colliery was given the name of "Prince Regent." It was first used on the colliery "tramway" on 24th June, 1812, and it proved to be an immediate success, being capable of putting forth a power some five times as great as Trevithick's locomotive could produce.

Since the Blenkinsop railroad was the first working steam railway to be erected in the world, it follows that Murray must have the credit of being the world's first builder of a practical railway locomotive. How often, however, do we hear that oft-repeated error to the effect that George Stephenson made the first practical locomotive?

Murray's locomotives were the first to be successful on any railway. Murray, therefore, after Trevithick, was *the* pioneer of locomotives, not merely in this country, but also in the world.

Matthew Murray appears also in another rôle—that of a pioneer of central heating. In his house at Holbeck, near Leeds, he designed and installed a system of heating by means of steam pipes running from a central boiler. In consequence of this then novel system, the house was nicknamed "Steam Hall" and, as "Holbeck Lodge," it stands to this

Gas-Lighting

Gas-lighting was another innovation which received considerable attention from Murray. He was the first to devise a practical plant for the manufacture of coal gas and to light a factory with the gas. It was, indeed, owing to the pioneer system of gas-production devised by Murray that the Leeds City Council afterwards took upon itself the duty of providing a public supply of gas.

Murray figures to some extent as a pioneer of the gas engine, although, so far as can be ascertained, he never attempted to construct such an engine. However, during his later life he wrote of a principle which had occurred to him whereby an "explosion engine" might be contrived, the principle of which was "to drop, by drops, a bituminous or inflammable substance on a red-hot plate at the bottom of a cylinder." At the same instant air admitted to the cylinder would cause the vapour from each drop to explode, thus forcing up the piston.

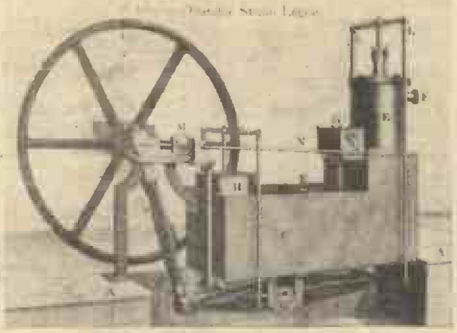
Murray, too, was a pioneer of the hydraulic press. He invented and patented a form of press for packing cloths by hydraulic power, the patent being granted to him in 1814. A pioneer in smoke consumption to avoid atmospheric pollution from factories, in the manufacture of various types of machine tools and in the mechanical forging of steel and iron, Murray attracted the attention of all the practical engineers of his time, who, for the most part, were only too ready to acknowledge the benefits which his work had bestowed upon the engineering community and upon engine users generally.

Not so, however, Messrs. Boulton and Watt, of Soho, Birmingham, the so-called "pioneers" of steam power. Throughout Murray's career, the Boulton-Watt firm displayed an intense jealousy and antipathy to him, as, previously, it had done to almost every other engineer and steam pioneer of note.

Avoided the Limelight

Murray, unlike the gallery-playing Watt, never sought the limelight. He was contented to proceed on his own path in life, finding his happiness in the realisation of work well done. Amiable and good-natured, Murray permitted one of Boulton and Watt's representatives, William Murdoch, to roam unrestricted over his Holbeck works, entertaining him at "Steam Hall" for a week with every courtesy and respect. Judge, therefore, the feeling of the more simple Murray when later he paid a visit to the Watt-Boulton Birmingham foundry and was peremptorily refused admission to it on the grounds that it was a rule that the foundry should never be shown to "any persons in the trade."

But more than this. The Watt-Boulton organisation, as they had villified and ground down other steam engine pioneers in the past, attempted to put the same tactics into operation against Murray. They contested the validity of his patents, they sent spies to obtain employment in



A contemporary illustraton of a small inverted beam engine devised by Murray in the year 1805.

Murray's factory in order to seek out and report his individual methods of production and—meaner at that time than anything else—the Watt-Boulton firm, immediately after Murdoch's visit to Murray's factory at Leeds, instructed their legal representative to buy up a large plot of land adjoining the latter in order to prevent extension of the Murray works.

Boulton and Watt had to pay dearly for their land and they were unable to acquire all of it. The plot, however, which they did purchase remained for many years a monument to their jealousy, laying, as a writer on the subject once said, "disused, except for the deposit of dead dogs and other rubbish, for over half a century."

Tablet To His Memory

Matthew Murray's energetic career came to an end with his death on 20th February, 1826, at the comparatively early age of 60 years. He was buried in the near-by churchyard at Holbeck, Leeds, a cast-iron obelisk being erected over his grave.

The memory of Murray and his pioneer achievements seem to have faded out of men's minds until the coming of the railway centenaries a few years ago. Then interest in Matthew Murray was revived. His long-forgotten grave was sought out, tidied up, and its huge iron obelisk renovated. By public subscription a bronze tablet enumerating very briefly the life record of Murray was purchased and unveiled at Leeds, a belated tribute to this "Father of Leeds Engineering."

Yet in a prominent position in the same industrial city stands a massive statue of James Watt, the head of a firm which did so much to attempt to drive Murray out of business. Truly, indeed, has Mr. George Bernard Shaw said somewhere that "Lies appear as history for two or three centuries until all interest in any important event falls flat."

STARGAZING for AMATEURS

(*Continued from page* 481)

cent), and the planets Venus and Mercury, are best observed telescopically with a solar diagonal or wedge-prism eyepiece. These devices reduce the glare and facilitate the detection of delicate markings.

* * *

The existence of twin meteors is inferred from the simultaneous appearance of small numbers of close double trails impressed on photographic plates. It is estimated that 3 per cent. of the meteors seen by the naked eye are probably real pairs; though the nature of their physical connection is not yet established.

* * *

Based upon spectroscopic observations of the extragalactic nebulae, carried out by means of the 100-inch Hooker reflector at Mt. Wilson, California, Dr. Hubble reduces the minimum permissible time-span of the universe to between 750 and 1,500 million years. This is less than the age of the Earth as deduced from geological and other considerations. Dr. Hubble is, however, apparently not quite certain about it; for, in a book of his recently published, he remarks that "we seem to face, as once before in the days of Copernicus, a choice between a small finite universe and one infinitely large—plus a new principle of Nature."

* * *

An objection to the modern theory of the origin of the planets as the result of an encounter between the Sun and a wandering star, has lately been raised. It is contended that the quantity of solar filament that would be required to be drawn from the atmospheres of the colliding suns, would not only be insufficient to account for the number and combined bulk of all the known planets, but would be far richer in hydrogen and helium than the material of which they are composed. Moreover, as all the planets would be produced at the same point of contact, they would almost certainly have had intersecting orbits which, with the exception of the asteroids (explainable by the hypothesis of an exploded world) is not the case. Further, a grazing approach of two suns is regarded as more likely to result in the "capture" of the smaller by the larger resulting in a binary system, than either an actual impact or the formation of detached planets.

A NEW TYPE OF RAILROAD TANK

A New Development of Road-Rail Transport

The new edible-oil tank connected to a motor, and ready for transport by road.

AN interesting demonstration took place at Euston Station recently of a new type of railroad tank built by the L.M.S. Railway Company in conjunction with Messrs. R. A. Dyson, of Liverpool, for the conveyance of edible oils in bulk between the refineries and factories of Lever Bros. and Unilever, Ltd.

The rail wagons, which are being constructed at the Railway Company's Derby Carriage and Wagon Works, have a six-wheeled underframe of 18-tons carrying capacity, with a special runway on which two Dyson road-rail trailers are run and firmly secured by binding chains and ratchet-type wheel scotches, etc.

The rail vehicles are fully fitted for working on fast freight trains, and their leading dimensions and carrying capacity are as follows:—

Dimensions

Length over headstocks, 30 ft.
Length over landing platform, 32 ft. 2½ in.
Length over buffers, 33 ft. 5 in.
Wheelbase, 19 ft. (outer wheels).
Size of journal, 10 in. by 5 in.

Carrying Capacity

Two road trailers, unladen weight, 8 tons. Edible oil, 10 tons. Total, 18 tons. Tare, 16 tons 10 cwt.

Road Trailers

The road-rail trailers are of the single axle type, equipped with single 36 in. by 8 in. Dunlop tyres at the rear, and the standard 6-ton Scammel retractable forecarriage, being so designed that a mechanical horse is able to back them on or draw them off the road vehicle at end loading docks.

Dyson-Marenbon patent rail wheels are fitted to the trailer hubs, in addition to which auxiliary rail wheels are fitted just behind the retractable forecarriage.

Before loading or unloading, the rail vehicle is secured to the permanent way by rail clips to prevent upending, and hinged landing plates bridge the gap between the end of the loading dock and the wagon and between vehicle and vehicle, thus allowing several wagons in a line to be loaded at one time.

The road trailers are backed on to the rail vehicles one at a time by a mechanical horse and the rear rail wheels engage with the guides on the wagon, automatically guiding the trailer into its assigned position and elevating it slightly so that the weight is taken off the pneumatic tyres and the retractable forecarriage.

Two oil tanks on a specially constructed six-wheeled truck for transport by rail.

Auxiliary Wheels

The auxiliary wheels guide the front of the trailer into position so that when the tractor is uncoupled the front of the trailer comes to rest on the auxiliary rail wheels, the trailer forecarriage being just slightly clear of the platform. Adjustable scotches are then screwed into position against the rail wheels and holding down chains fitted as a safety device. The trailer is then firmly secured, lateral movement being prevented by the guides and any movement along the rail track by the scotches. Special spring deadening jacks are then screwed into position, and damp out any vibration in the trailer springs.

This positive location of the trailers on the carrying truck is essential, so that the trailers should not rest on their pneumatic tyres, otherwise it would be almost impossible to lash them down securely and any tyre deflation whilst the vehicle was in transit would result in the lashings becoming loose and the trailers possibly coming adrift, with serious consequences.

Oil-Heating System

The oils are loaded warm, and owing to their delicate nature close control of the temperature during transport is important since it must not be allowed to fall below a specified minimum value, nor rise above a given maximum. For this reason, not only has it been necessary to provide exceptionally good insulation, but also to install heating equipment in the form of a hot water circulating system, which was considered to be the only safe method.

A 24-32-volt electrical supply is the source of heat, and this is applied to the oils through the medium of the water circulating system within each tank, embodying an immersion heater loaded to 1,800 watts at 30 volts.

The electricity is generated by a Stone's "Tonum" generator of the field-regulated type, driven from one of the rail-truck axles, and having an output of 3.6 k.w. Connection between the electrical equipment on the truck, and the immersion heaters on the road tanks, is by means of jumper cables, terminating in "Niphan" plugs, which engage with sockets on the truck, a dummy socket being provided on each road chassis for housing the plug when the tanks are travelling on the road or returning empty on the rail truck. All the cables on the trucks and the road tanks are run in conduits, with special connection boxes.

Glass-lined Tanks

Temperature regulation, varying according to the type of oil being carried, is by means of a British Thermostat Company's K.5 M. thermostat operating in conjunction with a special low-voltage "Sunvic" vacuum control switch. Access to the electrical gear and circulating system is obtained through readily removable covers specially designed to reduce heat loss to a minimum.

The trailer tanks are glass lined to ensure perfect hygiene and are "Pfaudler" products manufactured by Enamelled Metal Products Corporation (1933), Ltd. These are cylindrical with dished ends, the internal dimensions being 4 ft. 6 in. diameter, 12 ft. 3 in. straight side, 13 ft. 9 in. overall length, with a capacity of 1,250 imperial gallons, i.e. 5 tons. The fittings include a 16-in. manhole, 3-in. outlet cock, vacuum release valve, and sundry fittings in connection with the internal heating pipes. The tanks have been insulated with 4 in. of Alfol covered by 18-gauge aluminium sheets.

The tank mounting is somewhat ingenious, the tank sitting on wooden cradles carried on chassis cross members attached to the underside of the chassis frame, the underside of the tank being actually level with the underside of the chassis frame. The tank is then held in position by means of four holding down straps, the outer ones of which are considered to be master straps, these being 3 in. wide by ½ in. section, the two centre or secondary straps being 3 in. wide by ¼ in. section. Special means of adjustment are incorporated in the master straps, situated above the centre line of the tank, so that adjustment by means of the usual screwed end is not relied upon. The master straps also carry the lashing rings, which are held in cast steel brackets riveted and welded to the straps.

Constructional Details

All the straps are connected together by means of stabilising bolts and in addition the front master strap is fitted with a special strut member connected to the chassis frame.

The trailer back axle is of special design on account of there being two different load lines—through the centre of the pneumatic tyre when travelling on the road and through the centre of the rail wheel when carried on rail. The rear rail wheels are steel castings, 18½ in. in diameter, bolted to a flange on the front of the hub, and on the outside of the pneumatic-tyred road wheels. They have been designed with apertures, permitting access to the studs securing the pneumatic-tyred road wheels so that these can be tightened and generally serviced without removing the rail wheel.

The auxiliary rail wheels are carried on special pressed steel brackets adequately braced. The brackets on the near and off side of the trailer are connected by means of a stabilising tube in order to form a very rigid structure. The rail wheels themselves are steel castings, the spindle being cast integral with the wheel.

Ingenuity has again been displayed in the design of the special spring deadening jacks which are fitted to the rear axle and which are screwed down when the trailer is in the correct position on the rail truck. Hand wheels at the rear of the tank force a series of steel balls round a bent tube. These balls impinge on a piston-shaped jack, the stem of which protrudes into the tube. As the rear handle is operated it pushes the balls along the tube and forces the jack down. In this simple manner "remote control" is obtained as well as very easy operation.

Careful attention has been paid to the braking layout, and in addition to the ordinary mechanical means of operation, Clayton-Dewandre double-acting vacuum brake gear has been fitted.

It may happen in service that the trailers arrive at the loading dock the wrong way round for coupling to the tractor, and in this case they are hauled off the truck backwards. The power braking has therefore been arranged so that the brake coupling on the tractor can be coupled to the back of the trailer, and the trailer brakes power operated even when it is being hauled backwards.

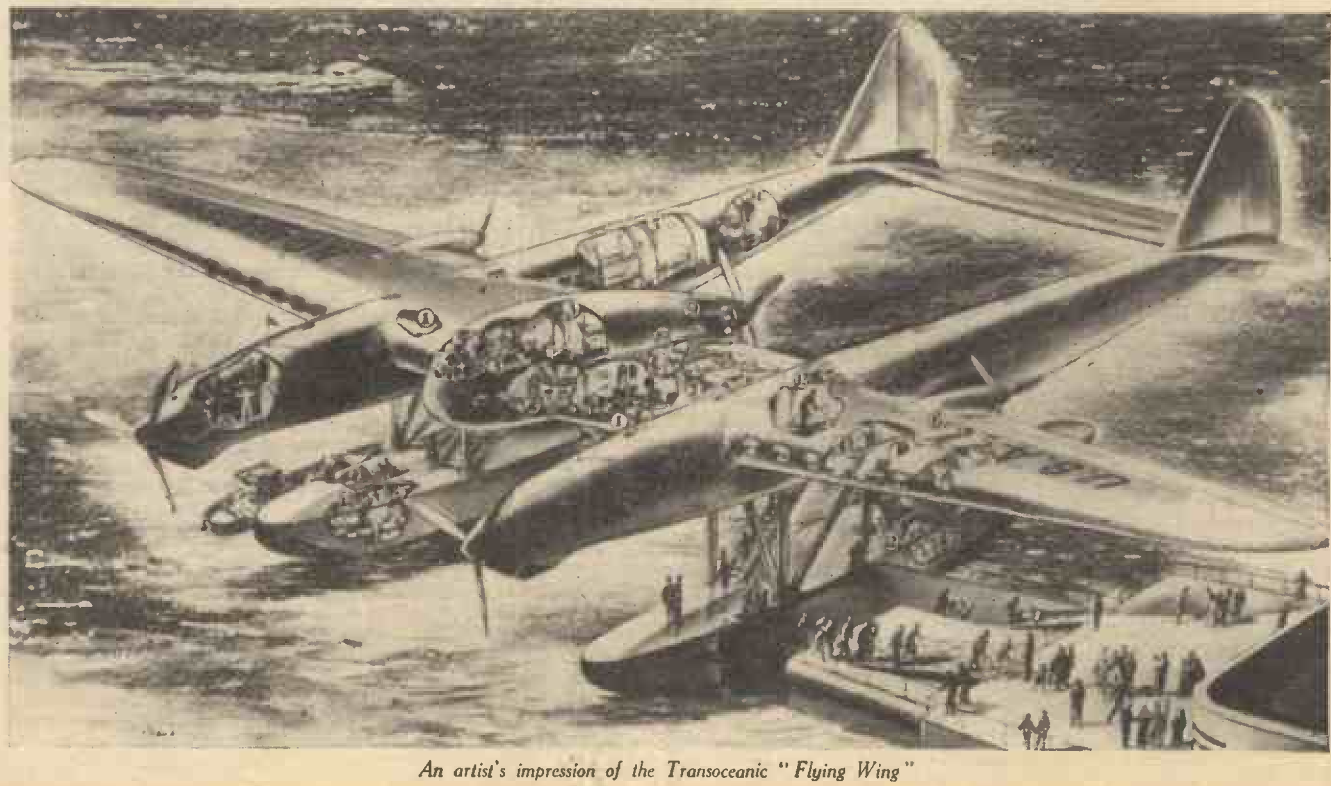
A TRANSOCEANIC "FLYING WING"

Details Of A New American Air Liner

ON this page is shown an artist's impression of the super clipper being built by the Seversky Aircraft Corporation at Farmingdale, Long Island, New York, U.S.A., for the Transoceanic flying service. It is designed to carry a payload of 43,000 lb. and to accommodate 120 passengers with all the comforts of a luxury ocean liner. It has a cruising range of over 5,000 miles, and a minimum cruising speed of 250 miles an hour, and is supercharged to permit flying at high altitudes. One of the unusual features of this latest air liner is that passengers are housed in the 250-ft. wing, which affords particularly spacious accommodation. Attached to the wing are two large fuselages, or "outriggers," which house retractable landing pontoons and support the tail surfaces.

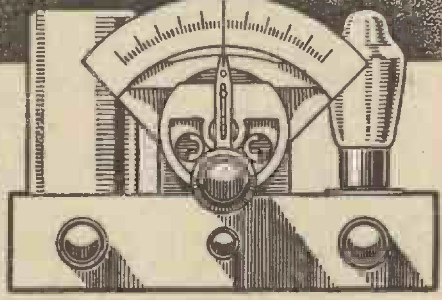
The hydraulic mechanism of the pontoons performs the dual functions of a retractable device and shock absorber, so that the big craft will be able to weather the seas that would be disastrous to the conventional flying boat.

In time of national emergency the super clipper can be transformed into a "dreadnought of the air," that can carry ten 2,000-lb. bombs over a range of 12,000 miles at a top speed of 300 miles an hour. The parts of the plane are : (1) dining saloon and promenade; (2) cocktail lounge and observation deck; (3) control bridge and officers' quarters; (4, 5, 6, 7) staterooms; (8) starboard forward engine compartment; (9) centre aft engine compartment; (10) galley; (11) crew quarters; (12) cargo space; (13) landing foyer.



An artist's impression of the Transoceanic "Flying Wing"

The PRACTICAL MECHANICS WIRELESS EXPERIMENTER



THE P.M. 1938 ALL-WAVE THREE

A Simple Three-valve Battery Operated All-Wave Receiver Using Separate Coils for the Broadcast and the Short Waves.

THE present tendency for all-wave reception has resulted in a demand for simple receivers which will provide the alternative of short-wave reception when conditions permit. As every listener knows, however, conditions are often so bad that it is impossible, even with the most powerful receiver to obtain clear signals from long distances, but there are dozens of short-wave stations near at home where good signals may be obtained at all times. There is little doubt that the addition of short-wave tuning to a broadcast receiver tremendously increases the value of such a receiver and will enable good entertainment to be obtained at all times. We have described several of these all-wave sets from time to time, but so far the majority have included special all-wave coils which have incorporated a self-contained wave-change switch. There are, however, certain advantages to be gained by removing tuning in the aerial circuit on the short-waves, and this enables a really efficient H.F. stage to be employed. A short-wave choke or fixed resistor must be included in the aerial circuit and this sometimes introduces switching difficulties. In response to many requests for a simple S.G. Three (by which the average listener recognises the S.G., Detector and Output circuit), we have produced this all-wave three-valver, adopting the chassis form of construction with additional simplification for the beginner to avoid difficulty in wiring the switch unit and coils.

The Circuit

Dealing with the receiver from the technical point of view, therefore, we have an H.F. pentode in the first stage, a triode valve as leaky-grid detector and a pentode in the output stage. Incidentally the suppressor grid is not shown in the theoretical circuit, but this is internally connected and will not affect the wiring or design. Alternative aerial sockets are provided so that a fixed condenser of low capacity may be included when desired, and the aerial lead is taken to one section of the multi-switch. This selects the long and medium-wave coils or the short-wave choke for short-wave reception. The grid of the first valve is also joined to the switch to complete the wave-change operation. Coupling between the H.F. and detector stages is by means of the tuned-anode system and the third section of the switch is included here. The screen of the H.F. pentode is connected to a potentiometer so that an accurate adjustment of the screen potential may be made, but the bias on the valve is fixed and is obtained by the lead marked G.B.—.

An L.F. transformer is employed for the L.F. coupling and this is parallel-fed, with a resistance connected across the secondary to act in the dual function of tone-corrector and stabiliser. A further device serving the two functions is joined between the anode of the output valve and the earth line. A refinement not often found in a battery-operated receiver is an 8 mfd. electrolytic condenser connected across the H.T. supply and this will be found to offer adequate smoothing on the short waves to prevent various forms of instability. It will be noted from the theoretical diagram that certain leads are screened, and these are provided in the chassis as supplied.

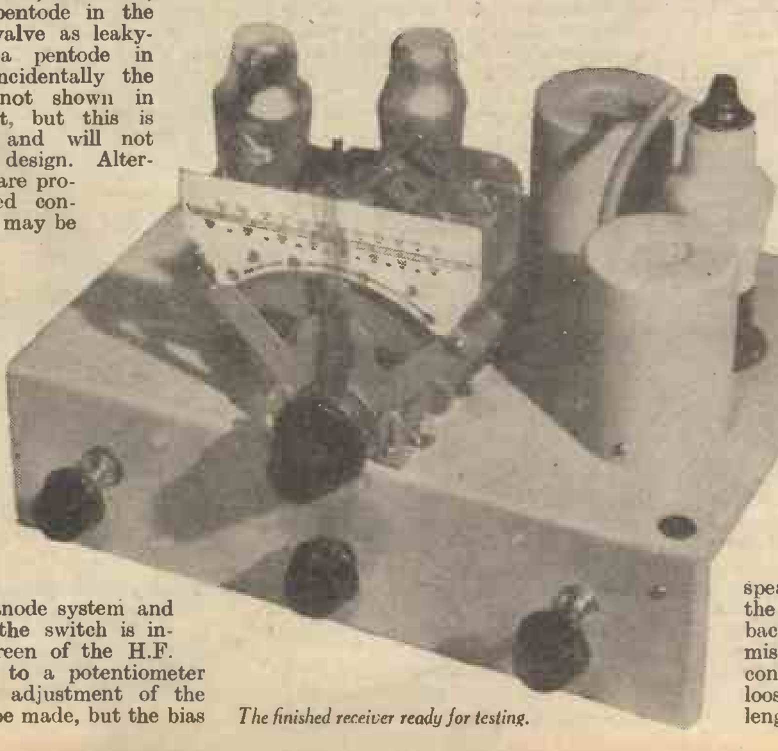
Constructional Work

The chassis is of the steel type, cadmium plated, and to simplify matters we have arranged for the manufacturers to supply this with the switch unit, the broadcast, and the short-wave coils ready mounted, and wired, and this will assist in construction. The first part of the constructional work consists of mounting the various chassis parts, the aerial-earth socket strips, reaction condenser, H.F. potentiometer and ganged condenser. Before mounting the latter component, remove the trimmers from the top of it. The remaining components which are attached to the chassis are fixed by means of bolts and nuts, but before mounting the L.F. transformer we suggest that leads are attached to the terminals, together with the fixed resistor across the secondary terminals. If this is not done, some difficulty will be experienced in obtaining access to the terminals.

At two points on the underside of the chassis there will be seen soldering lugs marked "M.C." and these are earthing points which must be in good contact with the chassis. Consequently, before placing the lugs into position, the plated chassis surface should be cleaned and scraped so that a really good connection will be obtained after the nuts have been locked up tight. The final connection from chassis to the earth terminal is obtained from the bolt holding the small trimmer in position close to the earth terminal.

Wiring

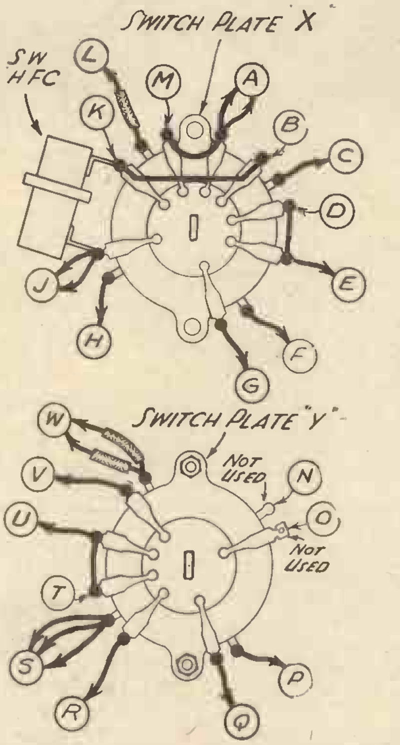
It will thus be seen that the constructional work is of quite a simple nature, and all that remains is to complete the wiring. For the earth connections mentioned a bare wire should be run as shown in the wiring diagram and then the various points and components may easily be soldered to this wire at the respective points — avoiding thereby long leads and awkward connections. As the receiver is to be used for short-wave reception all connections should be soldered if possible, as this will avoid background noises which might arise should a connection become slightly loose. The vibration from the speaker, or even from traffic passing the house, may easily cause serious background noises which might be mistaken for atmospherics, if a connection is in the slightest degree loose. For connection to the batteries, lengths of flex, or one of the pro-



The finished receiver ready for testing.

prietary battery-cords should be used. They should be provided with the wander plugs and spade ends mentioned in the list of parts, and to simplify identification of the various leads they may be made from different coloured flex. These leads are brought through a hole near the L.F. transformer and if desired a rubber grommet may be fitted in this hole, or the leads may be wrapped with a piece of insulated tape in order to prevent the edge of the chassis cutting through the flex and thus introducing a short-circuit.

The condensers and resistances which are specified have wire ends and these, with one exception, must be cut down so that they just reach from one point to another, the requisite length being measured by placing the component in position and cutting off the ends to suit. The exception is the 25,000 ohm resistor joined from one side of the potentiometer to the H.T. lead which has its anchoring point on the centre-terminal of the third valveholder. In this case a short length of wire will have to be connected to one end of the resistor and to prevent this from coming into contact with any earthed point a length of insulated sleeving should be slipped over it or it should be wrapped with insulated tape.



This diagram shows the wiring points on the two switch units, viewed from the rear of the chassis.

Removing the Trimmers

It has been previously mentioned that the trimmers on the ganged condenser should be removed. This should be done in the following manner. On top of the condenser will be found a slotted tubular nut over a flexible plate on top of each section of the condenser. The nuts should be removed and the flexible plates bent upwards to their fullest extent, so that there is no risk of the plate shorting on the threaded bolt which is left projecting. If the mica is removed, it is still more important to guard against short-circuiting, and thus care should be taken to bend the top plate to such a position that there is no trimming capacity and no risk of short-circuiting. A further important point is that the screening sleeves which are used over certain wires must be effectively earthed if they are to fulfil their function of screening. Therefore, a piece of bare connecting wire should be wrapped two or three times round the sleeving, and the soldering iron, carrying a good drop of solder, should be allowed to run over it so that a really sound joint is made. If the iron is not hot enough, it will have to be left in position for some time, and this might result in the internal insulation being burnt away. Therefore, use a really hot iron, well tinned, and make certain that the sleeving and binding wire are thoroughly cleaned.

Testing the Set

A good aerial and earth are necessary, and as the receiver is used for short-wave reception the aerial should not be too large, and the earth should be really efficient. In most cases it will be found that a medium length of aerial wire—not exceeding 50 ft. in length will be sufficient, and for best results a short vertical wire is often preferable. A total length of 10 or 15 ft. will in most cases give adequate range and will avoid the trouble of directional reception, whilst it will also ensure that no selectivity difficulties will arise even within a few miles of a powerful B.B.C. station. The earth should preferably be of the buried plate type, or a chemical earth which may be relied upon to give a low-resistance path. If a water pipe has to be used, try to connect to the pipe which enters the ground, not the one which feeds an upstairs tank. Beyond these points the receiver may be connected up, using the following H.T. and G.B. voltages. The H.T. plug should be inserted into the negative socket on the H.T. battery and the H.T.+2 plug in the 120-volt socket. The H.T.+1 plug should then be inserted for preliminary tests in the 80-volt socket, but it may be found later that a different voltage will give better results.

The G.B. + plug should be inserted into the positive socket on the G.B. battery and the negative plug into the 4·5-volt socket. An increase in signal strength will be obtained if this voltage is reduced, as it will result in an increase in the efficiency of the H.F. stage. On the other hand, however, it will increase the anode current of the output valve, which it also feeds, and this will result in the H.T. battery becoming discharged quicker. Consequently, when the receiver has been adjusted and results obtained, the G.B. negative plug should be moved to the highest socket consistent with clear signals and good sensitivity. Connect the L.T. spades to the positive and negative terminals on the accumulator, and the set is ready for test.

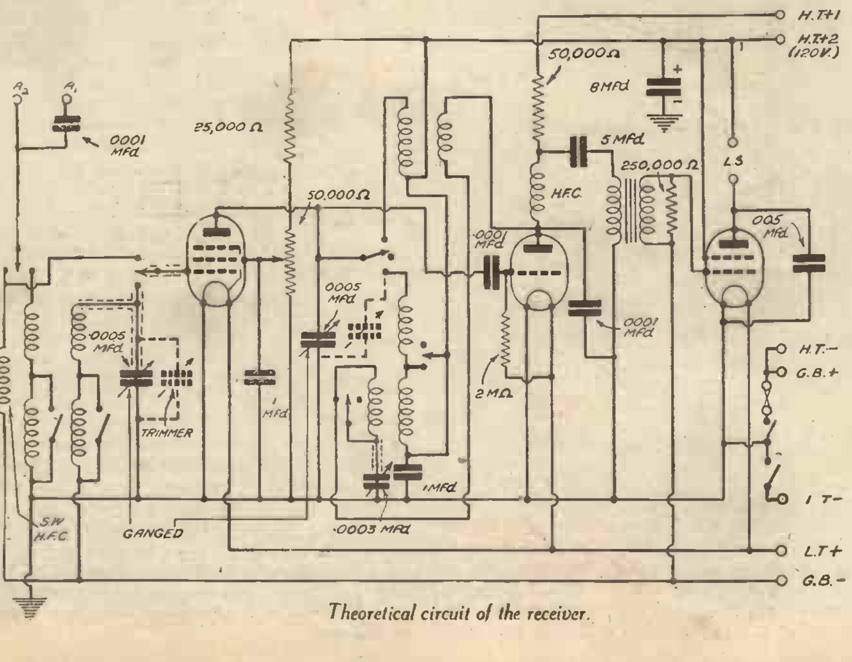
Trimming Adjustments

On the right of the chassis will be found a small trimmer, with a similar one at the rear, and these will trim the coils for the medium and long waves only. Turn the reaction control (centre lower knob) as far as it will go in an anti-clockwise direction and turn the set on by turning the left-hand control clockwise. The first part of the movement will switch the set on and the volume control which is operated by the same knob will then be at minimum. Further rotation will result in a build up in the strength of the signal, and if oscillation takes place (with the centre knob still at zero) the bias voltage should be adjusted to a higher value. If you cannot cure it by this adjustment it will indicate that the wiring is incorrect or that interaction is taking place, but if carried out exactly in accordance with the wiring diagram the set should be perfectly stable throughout all the wavebands covered, with the volume control at maximum.

Turn the tuning knob until the local station is heard, and this should be possible even with the trimmers well out of adjustment. As soon as it has been located, turn up the volume a little more and then commence to adjust the two trimmers. Use a long pointed implement for this purpose to remove any hand-capacity effects, and it will be found that there is quite a critical setting which gives sharp tuning and it should hold at all parts of the tuning scale. Swing the tuning control backwards and forwards whilst making this adjustment, and keep the volume as weak as possible so that the slightest changes are more easily noted.

The Short Waves

On the short waves the trimmers are out of circuit and therefore once they have been adjusted for the medium and long waves they should not be touched again. To receive distant stations the reaction control



Theoretical circuit of the receiver.

may be used and it should be found on this set that there is a gradual build-up in volume as this control is rotated clockwise, and the set should not burst into oscillation until the control is nearly at maximum. It should then be a smooth falling into oscillation which should cease immediately the control movement is reversed. If there is an overlap—that is, the oscillation does not cease until the knob has been turned a long way back, the voltage applied to H.T.1 should be adjusted. A position should be found where the action of this control is just as smooth as the volume control and by this means long-distance stations may be brought up to comfortable volume and short-wave stations will be tuned in quite easily.

The three ranges covered by the set are from 18 to 52 metres, 200 to 550 metres, and 900 to 2,100 metres. The total H.T. consumption is approximately 10 milliamps, although, as already mentioned, this will depend upon the voltage applied to the G.B. negative lead. It should be noted, incidentally, that the positions of the wave-ranges are tuned-in in the following order:—the short waves will be found when the wave-change switch is turned as far as possible in a clockwise direction, and the long waves when the switch is turned anti-clockwise. Medium waves are in the mid-way position.

LIST OF COMPONENTS

One metal chassis, drilled and fitted with coils, switch and two trimmers (Peto-Scott).
One 2-gang Bar type ·0005 mfd. variable condenser (C1 and C2) (Polar).
One S.M. drive, horizontal, type S.L.11 (with degree dial) (J.B.).
One microfuse and holder, 100 mA. (Micro-fuse).
One socket strip, E, A1, A2 (Clix).
One potentiometer with switch (3-point), 50,000 ohm, VM 36 (R2) (Bulgin).
One L.F. transformer, "Senator" (Bulgin).
One all-wave H.F. choke, H.F. 15 (Bulgin).
One reaction condenser "Dilecon," ·0003 mfd. (C3) (J.B.).

FIXED CONDENSERS

One T.C.C. 8 mfd. "F.W." 150-vol. (C11) (T.C.C.).
One ·005 mfd., type 451 (C10) (T.C.C.).
Two ·0001 mfd., type 451 (C7 and C9) (T.C.C.).
Two ·1 mfd., type 341 (C5 and C6) (T.C.C.).
One 0·5 mfd., type 341 (C8) (T.C.C.).

RESISTANCES

One 2 meg. ½-watt (R3) (Erie).
One 25,000 1-watt (R1) (Erie).
One 250,000 ½-watt (R5) (Erie).
One 50,000 1-watt (R4) (Erie).

VALVEHOLDERS

One 4-pin chassis-mounting valveholder
One 5-pin chassis-mounting valveholder
One 7-pin chassis-mounting valveholder
} standard (Clix) type.

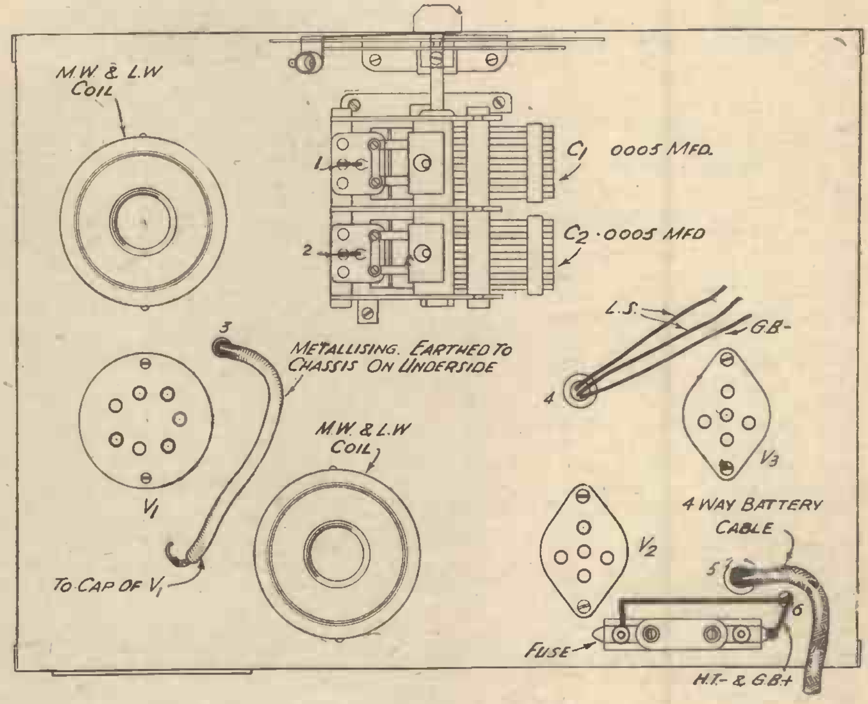
VALVES

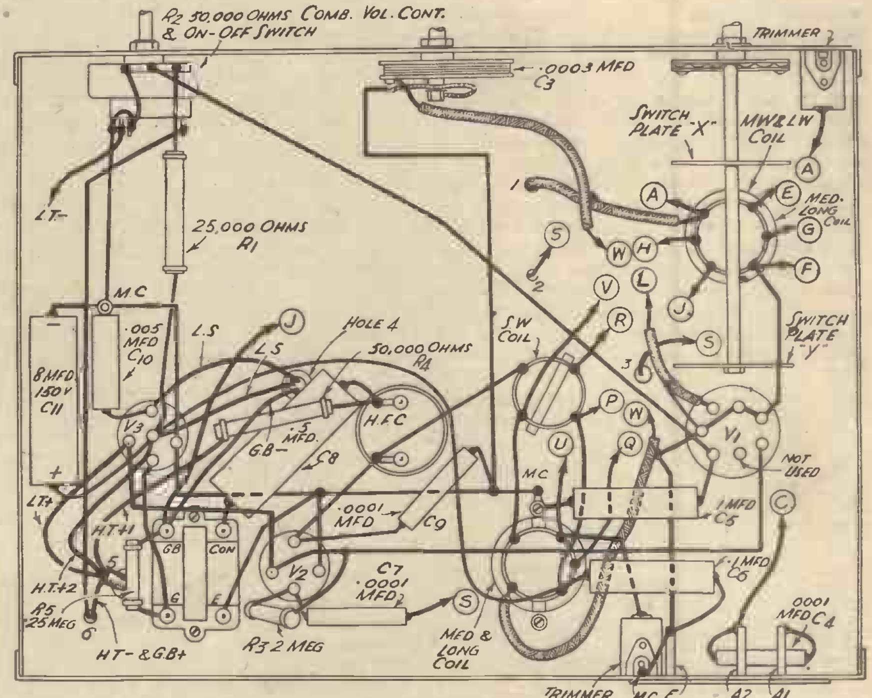
One 220 H.P.T. (V1) (Cossor).
One 210 Det. metallised (V2) (Cossor).
One 210 V.P.T. (V3) (Cossor).

PLUGS
H.T. –, H.T. + 1, H.T. + 2
G.B. +, G.B. –
SPADES
L.T. +, L.T. –
} (Clix.)

One speaker (Stentorian Junior) (W.B.).
One H.T. battery, 120-volt (Exide).
One bias battery, 9-volt (Exide).
One accumulator, 2-volt (Exide).

WIRING DIAGRAMS OF THE P.M. 1938 ALL-WAVE THREE





M.C = CONNECTIONS TO METAL CHASSIS

TRADE NOTES

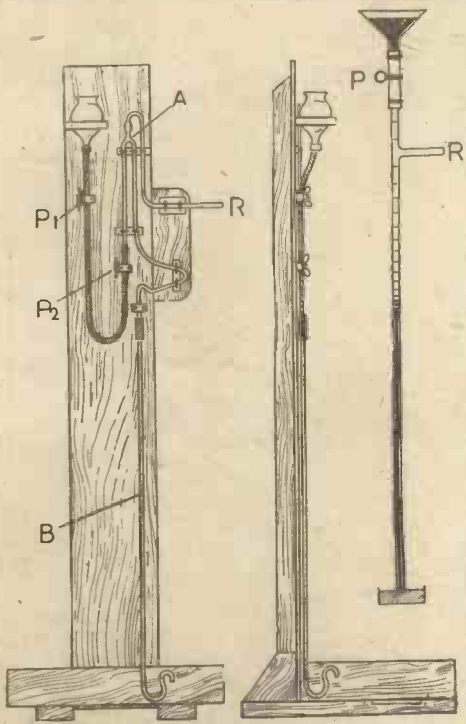
MODEL RAILWAY BOOKLET

HAMBLING'S, 10 Cecil Court, Charing Cross Road, W.C.2, have recently issued an interesting booklet, price 6d., on "00" gauge model railways. It contains 60 pages and is profusely illustrated. Interesting facts are given on the various miniature scales and gauges, together with practical notes on track and electric control systems. Every type of accessory which helps to add realism to a model railway are listed. Sensitive control of engines and rolling stock is obtained by specially designed reversing controllers that give a full range of speed control.

The Shenphone mains unit at £3 10s. 6d. is recommended as being specially designed to operate "00" gauge models. It incorporates an automatic circuit breaking device which dispenses with fuses, etc. Directly a "short" on the track occurs the breaker will disconnect the circuit, and when the "short" is repaired it will automatically reconnect. A complete range of standard locomotive parts is shown, and Hambling's will quote readers for a complete kit of parts, or any separate parts for any type of locomotive, past or present. Interested readers should pay a visit to the above address where Mr. Hambling will be only too pleased to help them in planning their layout, and show them over his comprehensive range of locomotives, accessories, etc.

MAKING GEISSLER

The First Article
Easy Stages How
Own



Figs. 1 & 2.—(Right) the pump in its simple form. (Left) An improved pump.

HOW much science owes to the production of a void can never be estimated, for upon it lies the whole structure of our modern conception of matter; but in introducing the reader to the fascinating behaviour of electrons flying through space, it is not with ideas of probing the proton, but to satisfy an aesthetic appeal which will be more than instructive. Vacuum tubes are extremely beautiful and their construction will add something to the home experimenter's accomplishments of which he can well be proud. Moreover, the range of experiment is vastly increased and no longer need he look into a glass bulb, a Geissler tube or a valve as into a forbidden world, but he will be in the happy position of designing his own "test-tube aurora" and in what manner he likes. That vacuum technology is an art beset with difficulties is not denied, but the aim of these articles is to initiate the reader by easy stages, and to see his results improve as his skill increases.

Experimental Possibilities

With the pump presently to be described, one should have no difficulty in making small Geissler tubes of various shapes. Later, when more skill is acquired, tubes can be made four or five feet long, but it is usual to condense this into decorative turns, zig-zags and loops. With a little more skill in glass blowing, jacketed tubes can be produced containing fluorescent solutions. Various gases introduced into the pumping system before sealing off produce colourful and spectacular effects as do various vapours judiciously handled. At a high degree of vacuum, tubes containing fluorescent minerals, as dolomite, calcite, etc., held in a glass claw give brilliant colours when subjected to the bombardment of cathode rays. At this pressure X-rays are generated.

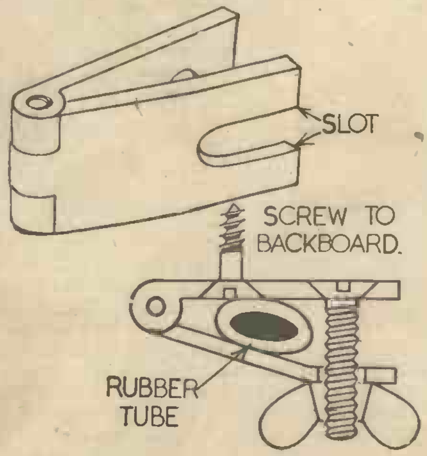


Fig. 5.—Pinchcocks can be made from steel flap hinges.

The Discharge in Vacuo

For testing the degree of rarefaction obtainable in a vacuum system, gauges are used; the two best known ones being the McLeod and the spark gauge. The McLeod gauge does not concern us at present as it is a complicated piece of apparatus, but the spark gauge merely consists in observing the character of the electric discharge in whatever tube is being exhausted. In the following description of these characteristic changes, the colours mentioned are those visible when air is being evacuated. Assuming a tube to be ready for exhaustion, an induction coil connected to the electrodes, and the pump started, we note that the bright blue snappy spark of atmospheric pressure modifies to silent violet-coloured streamers which, in a little while, assume a pinkish tinge and take the form of a single light stream or column. This broadens out until it fills the tubes. In this state it is called the positive column and possesses its maximum brightness and electrical conductivity and is at the pressure used for Geissler tubes.

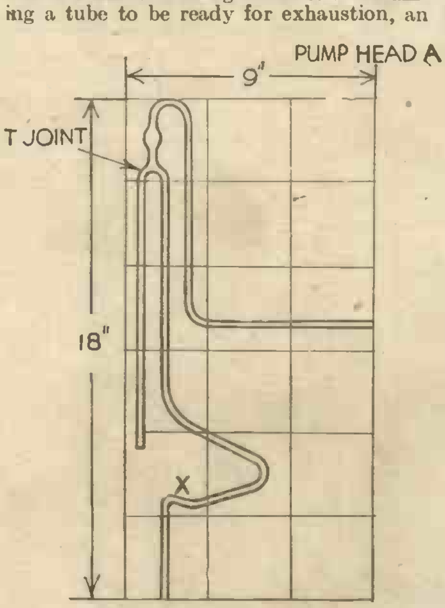


Fig. 3.—Details of the pump head.

Pushing the exhaustion further, the discharge turns bluish-white and begins to split up into striations, a dark space being visible a little distance from the cathode. This is called the *Faraday dark space.* At lower pressure the striations get larger and more distinct, and seem to retreat towards the anode, the *Faraday dark space* getting bigger. It will be noticed by this time that the cathode is shrouded in a blue luminous envelope separated by a second dark space of uniform thickness. This is the *Crookes dark space*, and as pressure gets still lower it increases in size until it fills the whole tube, the *Faraday dark space* and stria having dwindled away to practically nothing.

The walls of the tube are now fluorescing a brilliant green if soda glass is used, or bright blue in the case of lead glass. The size of the *Crookes dark space*, or its distance from the cathode glow, is the surest indication of the degree of vacuum obtained in small discharge tubes, and the experimenter will soon learn to recognise the various phases and to judge how evacuation is proceeding. As the resistance of the tube has increased since the *positive column* began to split up, it will be apparent that if exhaustion goes any further than the fluorescing stage it will be impossible to force a discharge through, and except by using a powerful induction coil the tube becomes virtually an insulator.

Materials

Assuming the reader to possess an induction coil the materials for the experiments are inexpensive, the most expensive item being mercury, of which at least 2 lbs. will be needed. The coil can be any size up to 2 in. spark. Glass tubing is sold by weight at about one and sixpence a pound and in lengths of five or six feet. They are called "canes" in the trade, and are obtainable from chemical warehousemen, or scientific instrument makers. We will need half a pound each of two sizes in soft soda glass, 2.5 mm. and 6 mm. bore, with walls of 1 mm. or more in thickness. A

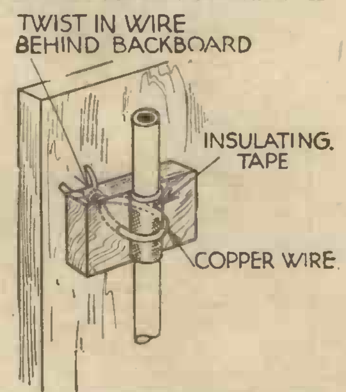


Fig. 4.—How the pump head is held in place by copper wire.

reservoir or bulb-funnel should be obtained having a wide neck and a capacity of about 200 c.cm., also some thick rubber tubing five feet in length and a bore 2 to 3 mm. Plywood and strips of deal will be needed for the pump backboard and tray. For the rest some scraps of aluminium sheet of thin gauge for electrodes, copper wire, flap hinges, screws, nails, etc., most of which will be found in the scrap box.

The Pump

This particular design is called the Sprengel and has the merits of simplicity,

AND VACUUM TUBES

of a Short Series, which Describes in the Home Experimenter Can Make his "Test-Tube Aurora"

a high degree of exhaustion, and is semi-automatic in operation. The pump in its simple form is shown in Fig. 1, and consists essentially of a barometric column of small bore with a reservoir at the top. The flow of mercury is controlled by a pinchcock, P, under which and sticking out at the side is a tube R, to which the vessel to be exhausted is sealed. When working, the mercury falls in little drops which form pistons driving out the air before them; when exhaustion is complete the mercury stands in the column at nearly barometer height (76 cms.), the droplets falling smartly with metallic clicks. The capacity of the foregoing pump in its bare form to produce a good degree of rarefaction is limited by causes inherent in its operation and design.

The improved pump, Fig. 2, removes these defects. The construction is as follows :—

The reservoir is held in a ring of stout wood fastened to the backboard and is connected to the pump head by a piece of rubber tube two feet in total length. The pump head A. is in a single piece, that is, all joints are fused, and its particular shape

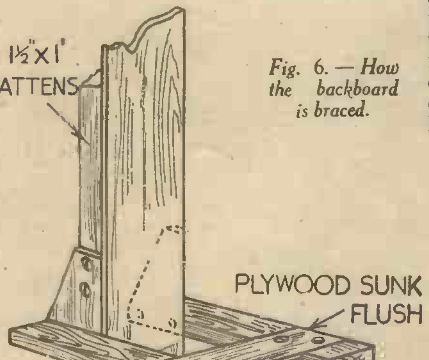


Fig. 6. — How the backboard is braced.

is shown in Fig. 3, which is squared up to scale so that it can be re-drawn full size and so facilitate the shaping. The pump head is fastened to the backboard at the places shown, being held off by pieces of plywood looped through with copper wire as in Fig. 4. The barometer tube B is 30½ in. long, the spout portion being an extra 4½ in. This long tube is fastened to the pump head by a 2-inch piece of rubber tube fitting tightly and should be smeared with vaseline or glycerine to make sure that it is airtight. As the barometer tube hangs quite freely it mitigates the danger of breakage due to accidental knocks. It is also an arrangement that makes the pump more manageable to erect. Two pinch-cocks—P 1 : P 2—are fitted to the rubber tube leading from the reservoir to the pump head and are fixed within an inch or so to the positions shown. Pinchcocks can be bought, but effective ones can be made from steel flap hinges shaped as in Fig. 5, with a bolt and wing nut, the whole unit being screwed to the backboard through one of the existing screw holes. Thus, if one wishes to take away the rubber tube, all one needs to do is to loosen off the wing nut and throw back the hinge. The backboard stands upright on the floor and is a piece of simple carpentry, the height being 4 ft. 6 in., and width 7 in. It is braced by two pieces of deal running up the back to within 3 in. of the top, and at the base is fixed to the feet by brackets of plywood. Fig. 6 makes the construction self-explanatory. The result should be a solid job standing firmly. Resting on the feet and under the barometer tube is a tray of plywood. This should be 18 in. long, 13 in. wide and 3 in. deep, and see that any cracks are filled with plastic wood before staining. This tray should on no account be omitted, for I know of no other pastime so exasperating as chasing globules of mercury all over the floor.

Simple Glassblowing and the Blowpipe

As a glass nozzle is needed for the bunsen blowpipe we will take this opportunity of describing one or two elementary operations in glassblowing. Take a length of the 2.5 mm. bore glass tube and with a triangular file make a scratch about 6 inches from the end, and, with the scratch uppermost and thumbs at either side, bend the ends downwards; the tube will break cleanly. Over an ordinary bunsen burner heat a sufficient length of this 6-inch tube

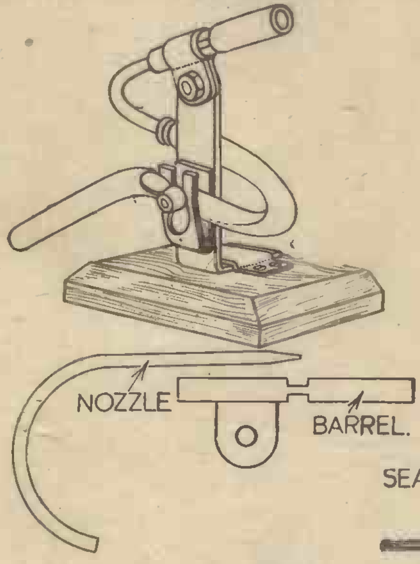


Fig. 7.—An easily constructed blowpipe.

near one end to bend into a semi-circle of 1 in. radius. If the tube is rotated between finger and thumb and moved backwards and forwards through the flame, one should have no difficulty in getting an even heat to make a perfect bend. When cool, take the tube in both hands, hold the centre over the flame and rotate. As the glass gets soft, care should be taken that one side does not gain on the other or it will spiral. A little practice will soon teach the experimenter how to rotate both hands at equal speed. When soft, draw out the tube into a spindle or narrow bore tube. Cut this tube in the middle and keep on taking off little lengths until there is an opening of 1 mm. We now have a tube with a turn-back at one end and a nozzle at the other. It will be used as part of the bunsen blowpipe. Before we can tackle other glassblowing jobs it is necessary that we have a blowpipe, and that described below will deal with small bore tubes with thick walls, and tubes up to 15 mm. with thin walls. Take a piece of brass tube 2½ in. long by 3-mm. bore and file two square holes in the centre and at opposite sides, as in Fig. 7. Clearing these holes a stout tinplate clamp is fastened round the barrel of the blowpipe and is fixed by a nut and bolt to an upright with an L. shaped base. The upright, which is 3 in. high, is fixed to a heavy wooden block by slipping the angle foot under a tinplate strap. This allows the blowpipe to be disconnected easily from the wood block for use as a hand torch. A pinchcock, as already described, is fastened to the side of the upright. Slip a piece of rubber tube about a foot long through the pinchcock, loop it round the upright, squeeze the end over the turn-back of the glass nozzle and insert this into the barrel with a little paper packing. If the glass tube will not fit or is too tight, drill the barrel out up to the air holes until it slides in easily. The blowpipe can now be connected to a gas cock with a length of ordinary flexible tube. Tilting the barrel to about 25°, the flame, when full on, should be 3½ to 4 in. long and have a slight upward drift, and by pushing the nozzle in or pulling it back, the best flame with the greatest heating power will be found. It should be the usual non-luminous bunsen flame, but much more forceful without being too noisy.

Making the Pump Head

For further and more ambitious glass-blowing operations, we will need one or two simple tools such as a wedge-shaped piece of copper plate let into a handle. A camel-hair brush shank with the ferrule intact is as good as anything, and allows a rapid twirling between finger and thumb. This is called a bordering tool, as it is used for opening out the ends of tubes. A pair of forceps or long tweezers are useful for holding short lengths of glass or wire in the flame, and some cotton wool will be needed for annealing purposes. Other tools will be described as we need them.

(*Continued on page 513*)

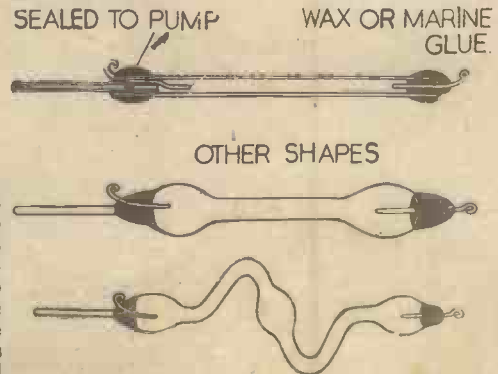


Fig. 8.—Simple Geissler tubes.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 515, 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.

AN ELECTRIC GAS LIGHTER

"WHAT gauge and type of wire is most suitable for the filament in an electric gas lighter, using (a) a single cell, and (b) a three-cell dry battery." (L. P. Lewisham, S.E.13.)

FOR a single cell use ¼ in. of No. 40 platinum wire; and for three cells use 2¼ in. of the same gauge.

Use as large a dry battery as possible, with thick leads.

REDUCING SPEED OF A MOTOR

"I HAVE in use a motor 200 volts, 50 cycles and 0.9 amps, and wish to reduce the running speed to about half. The motor is used to drive a fan." (O.N., Torquay.)

THE easiest and cheapest way to drop the fan speed is to put a 100-watt lamp in series. The resistance should be made with 14 ft. of No. 38 nickel chrome wire of good quality. On load, this will drop the speed by half approximately.

ORCHID GROWING

"CAN you describe the method now known as the 'tube system' used in orchid growing. If so, where can I obtain the necessary equipment. (2) What solution is used in which Aga and Japanese seaweed is employed to grow orchid seeds. (J. W., Yorks.)

1. BY your mention of the "tube system" of orchid growing, you refer, we think, to what is technically known as the "pure culture method" of raising orchids from seeds. This is really a laboratory method, despite the fact that it is now employed considerably by many firms of orchid raisers. The method is a difficult, and, in unskilled hands, an uncertain one.

It consists in placing in glass tubes or flasks the orchid seeds which it is desired to germinate, together with the mycelia (or filaments) of certain specific moulds which have been specially cultured for this purpose. The tubes are then "incubated," i.e. kept at a definite temperature for some weeks, until the seeds germinate and develop into seedlings capable of being handled by normal methods.

For supplies of the above orchid "tubes" and culture media, you should make inquiry to Messrs. Bees, Ltd., Horticulturists, Liverpool, or Messrs. Sutton & Sons, Ltd., Seed Merchants, Reading.

2. Some orchid culturists make use of a weak aqueous solution of agar-agar for moistening the germinating seeds of various species, but this is by no means essential. You will, however, be able to procure full instructions for the "tube" method of raising orchid seedlings from the firm which supplies you with the necessary equipment and culture medium.

A NEW TYPE OF TIN OPENER

"I HAVE devised a new kind of tin-opener and would like to know if you think it fit subject matter for a patent." (R. F., Yorkshire.)

THE improved device for opening lever lid tins is thought to be novel, and forms fit subject matter for protection by letters patent, but it is not considered to have any commercial possibilities. The additional cost of making and fitting the device to the lid would militate against its adoption by manufacturers. We advise you not to incur any expense either in putting the invention into a more practicable form or in protecting it, since the probability of getting manufacturers to interest themselves in the inventions are too remote.

STAINING ELECTRIC LIGHT BULBS

"HOW can I make a stain suitable for staining electric light bulbs? I wish to stain them blue to obtain a daylight effect.

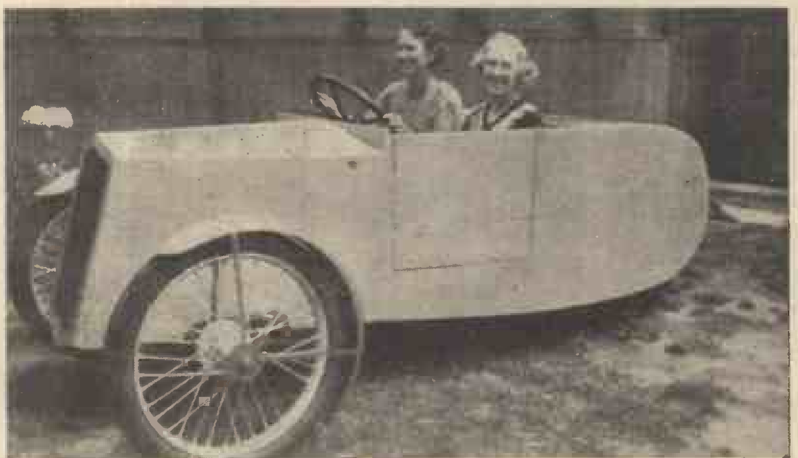
"What 'brine' is used for making artificial ice, and how much would be required to freeze ½ pint of water?" (K. D., Highbridge.)

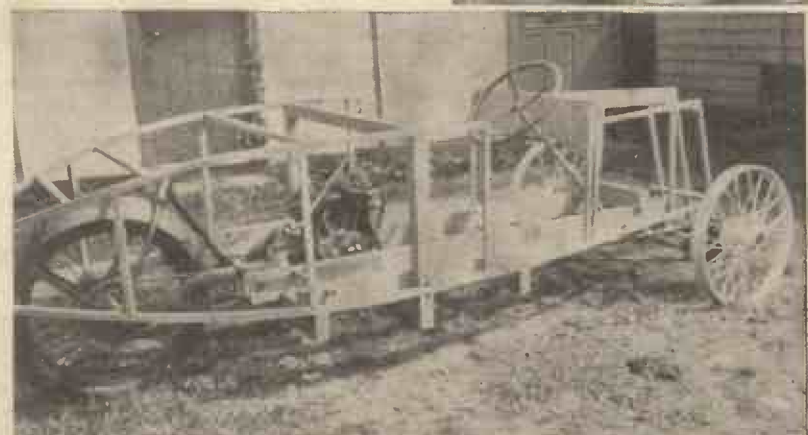
1. THERE is no really satisfactory stain for electric light bulbs, the reason for this being that the heat of the lamp quickly chars the "vehicle" or medium in which the stain is incorporated, and thus turns it black. For low wattage lamps you could use a stain made by adding a little blue dyestuff to celluloid or spirit varnish, but this would quickly deteriorate.

For the higher wattage lamps, there is nothing better than an ordinary water. colour, which may be mixed with a little sodium silicate or lime paste to give it a greater adhering power. Although this will not constitute a true stain and will tend to flake off, it will not char under the influence of heat and, when judiciously applied, will give an approximation to the daylight-blue effect which you aim at.

2. The "brine" employed in commercial ice production is either a saturated solution of common salt or a strong solution of calcium chloride, the latter being employed when greater degrees of cold are aimed at.

It is quite impossible to state how much of this "brine" would be required to freeze half a pint of water, for that depends upon the apparatus in which the brine is used. You will realise, of course, that the brine does not freeze the water of its own accord. All the brine does is to act as a carrier of cold, if we may put it that way. The brine is itself strongly cooled by various methods and, in its cooled condition it is circulated





(Left) the framework and (right) the "Practical Mechanics" £20 car built by Mr. G. W. Bright, of Melbourne. Constructional details of this efficient little runabout were given in our issues dated March to July, 1936, inclusive. It was designed by Mr. F. J. Camm.

around other materials, as, for instance, water contained in vessels, which require to be refrigerated. The brine is used for this purpose simply because it does not freeze until a very low temperature is reached. Hence it is able to "conduct cold" in a very efficient manner.

APPLYING FOR A PATENT

"I HAVE invented a number of appliances and wish to patent them, but I am ignorant as to my method of procedure. Perhaps you can help me?"

AN application for patent in Great Britain must be accompanied with either a provisional specification or a complete specification. The provisional specification must describe the nature of the invention for which protection is sought, it need not be accompanied by drawings. If a full patent is desired, a complete specification, fully describing the invention and accompanied by drawings, if capable of being illustrated, must be filed within 12 months (or 13 months with fine) from the date of application. This course is advisable if the invention has not been reduced to practice and it is desired to obtain protection at the least possible cost. It also allows time for you to obtain financial assistance in working out your invention or ascertaining if it is likely to be commercially successful. Alternatively an application for patent can be filed with a complete specification in the first instance which has the advantage of obtaining the result of the official search for novelty at an earlier date, since no official search for novelty is made until a complete specification is filed.

As you are presumably unacquainted with the patent laws in this country, we advise you to obtain professional assistance.

As a general rule firms in this country will not take up the manufacture of an invention until after the result of the official search is known, and then on a royalty basis, but in some cases will buy an invention outright.

With respect to the shutter release for cameras, it is not thought, apart from any question of novelty, to have sufficient subject matter or invention to support a valid patent. It is further doubted if the invention is likely to be commercially successful as the whole trend of modern practice is to reduce the bulk of the camera to the smallest dimensions possible.

REWINDING A MOTOR

"I WISH to rewind a vacuum cleaner motor which has burnt out. It is rated at 240-250 volts A.C./D.C., 50 cycles, and it is to be used on A.C." (A. H., Newcastle-on-Tyne.)

THIS armature is wound as for low voltages, and is considered as a 26-slot armature with 26 com. segments. This means that two coils are put into each slot. Use the same gauge of wire, or if you can get in the same number of turns a size smaller, fill each slot to its maximum. Imagine the first coil put in the first slot at right angles to the brush line; the start of this coil goes to the first bar under the right-hand brush, and the end to the next brush. The start of the second coil is connected to the end of the first, and is wound in the same slot, and the end connected to the third bar.

MAKING AN ARC LAMP

"CAN you tell me how to construct a ultra-violet ray tungsten arc lamp outfit to operate on A.C. mains?" (W. E. R., Sunderland.)

IF you require D.C. from your mains, a large type rectifier will be required and this to operate at 60 volts and 10 amps will cost in the region of £20. We advise you to make up an arc resistance of about 20 ohms, and use this in series with the lamp. Arcs may be obtained from Messrs. Leslie Dixon & Co.

DEPTH CHARGES

1. "CAN you tell me how to make depth charges for a model destroyer? I propose making the cases of celluloid with small holes cut out and covered with tissue paper, so that water can penetrate to the contents.

2. "Where can I obtain sodium and potassium?" (W. H., Hants.)

1. THERE is nothing which, of itself, will actually explode when brought into contact with water. Perhaps, therefore, the simplest way to obtain the effect you require would be to fill your celluloid cases with calcium carbide, which, on contact with water, would immediately generate acetylene gas.

You might, also, fill your celluloid cases with metallic sodium, although, in this instance, you should make the cases very small and not employ more than a very small lump of sodium for each charge. Sodium decomposes water violently and produces a stream of hydrogen gas. The use of sodium is not free from danger and, therefore, great caution should be taken.

Another alternative is to fill your celluloid "depth charge" cases with calcium phosphide. This material, on contact with water, generates hydrogen phosphide, a gas which is spontaneously inflammable and which will take fire on reaching the surface of the water. Hydrogen phosphide, unfortunately, has an abominable smell resembling rotten fish. Furthermore, it is poisonous.

2. You can purchase the metals you name through any retail branch of Boots the Chemists or, direct, from Messrs. Harrington Brothers, Ltd., Oliver's Yard, City Road, London, E.C.1. Sodium is fairly cheap, but potassium is expensive.

HEAT-PROOF TRI-COLOUR

1. "WHAT is the quickest method of producing a heat or semi-heat proof tri-colour design upon a small wood surface?

2. "What metal, or treated metal, resists the chemical action of mercury?

3. "Where can I obtain the finest bore copper or brass seamless tubing?

4. "What is a suitable recipe for flexible wire enamel?" (B. G., St. Annes-on-Sea.)

1. IN many instances similar to the one you quote, the design would be mechanically printed in three colours on thin paper and this would then be cut up and glued to the wood surfaces. It is also possible to print directly upon smooth wood, but the method is expensive. Your local printers, however, or one of the many Manchester printing firms, as, for instance, Messrs. Corner & Whittle, Bridge Street, Manchester, would supply particulars.

Alternatively, we suggest that you use a stencil, accurately cut, and having the design repeated many times. This could be used in conjunction with a paint spray or brush and would enable the necessary work to be turned out fairly quickly. An ordinary synthetic enamel paint of suitable colour should possess all the properties which you require. It would also have the advantage of rapid drying.

2. No metal will resist completely the amalgamating and corroding action of mercury. Mercury actually dissolves some metals and it will even corrode glass when kept in contact with it for a long time. Of the common metals, those containing iron are the most immune from mercury attack, and, without knowing the purpose for which you require a mercury-proofed metal,

we would suggest the use of cast or sheet iron, bearing three substantial coatings of clear, hard varnish. The "soft" metals, such as lead, zinc, gold, cadmium, antimony, and, most particularly, aluminium, should never be brought into contact with mercury.

3. We think you will be able to obtain your requirements from Messrs. J. Smith and Sons (Clerkenwell), Ltd., 45-52 St. John's Square, Clerkenwell, London, E.C.1.

4. Dissolve scrap celluloid in amyl acetate or in a mixture of 2 parts amyl acetate and 1 part acetone until a liquid of "paint consistency" has been obtained. Grind into this the very finely powdered pigment until the requisite "body" of colour has been obtained. Finally, add a few drops (not more than twenty per pint) of castor oil in order to add flexibility to the enamel coating.

This enamel, painted on metal will give a glossy surface. To dull its gloss, increase the proportion of acetone in the enamel.

THE SECRETS OF CARD CONJURING

(Continued from page 497)

and very easy card tricks can be worked out on these lines.

Using Two Packs

From what I have said of trick forcing packs and trick cards, it will be evident that very often a conjurer requires to use two or more different packs during his performance. To do this openly would be to invite suspicion that the packs were specially prepared, each for a particular trick; so some means has to be used to change one pack for another secretly.

A very simple piece of apparatus is known as the card servante. It is shown in Fig. 10 attached to the back of a chair, where its presence is hidden by a cloth or large handkerchief thrown over the chair back, or a chair with a solid back is used. The servante consists of a bag of cloth on a metal frame. Just above the bag is a clip capable of holding a pack of cards. The whole affair is tied to the top rail of the chair with tapes attached to the servante. Or a spring clip or screw clamp may be used.

In use the servante is prepared by placing in the clip the pack for which that previously used is to be changed. Holding the visible pack in the right hand, the conjurer lifts the chair forward. His right hand goes behind the top of the chair for this purpose, and it is the work of a moment to drop the pack into the bag and take the other one out of the clip. Or, again, the exchange may be effected under cover of taking a length of ribbon or a handkerchief off the back of the chair for use in the trick.

A Simple Change

Another simple change is illustrated in Fig. 11. A crumpled handkerchief lies on the table concealing one pack. The pack already used is placed on the table beside the handkerchief and the handkerchief flipped over to cover the pack just put down and expose the previously hidden pack. As long as the table is not too near the audience and the conjurer arranges matters so that he stands in front of the table while putting down the pack, this movement is quite undetectable, the more so because the audience will not be expecting it.

Our last example is a quite dramatic version of the trick known as The Rising Cards, said by conjurers to be the trick of which the greatest number of different versions exists. The total number is some hundreds, and the cards are made to rise from glass tumblers, closed boxes, envelopes, special stands, frames, bouquets of flowers, fans, backs of chairs, plates, and all sorts of other objects.

In this case the pack is held in one hand and the other hand is raised a couple of feet or so above it. The chosen cards are called for and fly out of the pack straight up to the finger tips of the hand above.

The Spring Drum

The secret lies in a tiny spring drum strapped to the right forearm and hidden by the performer's coat sleeve, although in Fig. 11 I have purposely strapped it nearer to my wrist to make it clear in the photograph. Wound in the drum, which is the sort of thing used for spring tape measures, is a length of fine black thread. A ring is worn on one of the fingers of the right hand, and this ring has a tiny eyelet soldered to the edge. The thread from the drum passes through this eyelet as shown in the photograph. The free end of the thread is tied to a tiny button and the button is smeared with wax.

The working of the trick is simple. The cards need not even be forced. Three or four cards are freely chosen and returned to the pack. For this purpose the pack is cut into two. In bringing the halves together the conjurer puts the top half underneath the original lower half, so that the cards, which were returned on top of the lower half, are now on top of the whole pack, or, as the pack is held facing the audience, at the back. He has only to remember the order in which the persons returned their cards. He need not know what the cards are.

Holding the pack in his left hand, conjurer presses the waxed button against the back card. He then raises his right hand. The thread will be drawn out of the drum. The pack is gripped firmly with the left hand.

Performing the Trick

The magician now turns to the person who was the *last* to return his card and asks him to call for it. As soon as he names it the grip of the left hand is relaxed and the thread draws the card up to the right hand. The waxed button is detached and the card laid down, the button being then attached to the next card under cover of showing the hands empty and the procedure repeated with the other chosen cards.

I have had this trick photographed against a light background in order to show the thread. In practice, of course, a dark, though not necessarily black, background would be used. If performing in evening dress, the conjurer must take care not to let the thread pass in front of his shirt front. The trick should not be performed at too close quarters. On a platform it is perfectly safe and at one end of a reasonably large room there is no likelihood of the thread being seen. Do not make the mistake of having the lights dim. This will not help to conceal the thread to any practical extent. It will only suggest to the audience that there is something to be hidden and, looking for it, they may possibly discover it. Avoid, however, in this, and indeed in all conjuring tricks, having light directly behind you.

The next article will deal with the very attractive range of tricks possible with flowers.

MAKING GEISSLER AND VACUUM TUBES

(*Continued from page* 509)

Having drawn up to scale the diagram of the pump head, we can proceed with the bending, which should be done over an ordinary bunsen burner. Use a length of 2.5 mm. tube and do not cut it until all four bends are complete. Lay the piece over the diagram from time to time and rectify any deformations. This piece can be put aside whilst the second is being prepared. The next piece is a tube 18 in. long of the same bore, and, using the blowpipe, soften one end and, when quite soft, stick a piece of waste glass to it and draw out into a fine tube or spindle. Open this spindle at the extreme end by cutting, and round the edges in a small flame, as this will be used in the mouth for blowing. The other end of the tube should now be closed with a short piece of plugged rubber tube. Heat a patch of glass 1½ in. from the shoulder of the spindle and slightly compress it as it rotates, and, if there is a tendency for the tube to corrugate, remove the piece from the flame and give a gentle puff through the spindle. When a good thick patch of glass has been collected, remove from the flame and, holding the tube horizontally, blow steadily and rotate. The result should be a symmetrical bulb. Cut the spindle away, leaving ¾ in. to 1 in. of tube between the bulb and the cut end. This cut end can now be heated and opened slightly with the bordering tool, and kept warm over a small spirit or gas flame, as it will be needed presently. We now come to a most important stage: the making of a T-joint. A little preparation is needed before we tackle this because we cannot do it in this case by manipulation of the pieces in our hands as they are too unwieldy, so the blowpipe must go to the job. Plug up one of the openings of our first piece, and from the other opening lead a rubber tube long enough for the end to be held in the mouth. It should be laid on a table with the top bend jutting over about 3 in. and the whole weighted down with anything heavy. Using the blowpipe as a hand torch, direct the flame on to the apex of the bend and, when a patch about ⅜ in. long is hot, blow steadily, but only just sufficient to raise a small bump or hillock on top of the bend. On the extreme tip of this bump direct the flame and soften only a tiny disc; puff strongly and a hole will blow out. Piece number two should be taken from the spirit flame and the blowpipe diverted on to the openings of both pieces and, when nearly white-hot, place them together. To finish off, go round the joint patch by patch until it is firmly welded and of fairly good appearance. Now lay aside the blowpipe and wrap the joint while still hot in cotton wool and leave to cool. This will anneal it and ease any strains. When cool, bend the added tube to shape as on the diagram. This completes the pump head.

The barometer tube is made from a piece of 2.5 mm. tube 35 in. long, and one end is bent to form a spout, leaving the straight portion 30½ in. long. The pump can now be assembled as in Fig. 2. Pieces of insulating tape wrapped round the tubes enable the copper wire to grip better.

Testing the Pump

When the pump is complete, open both pinchcocks and pour some mercury into the reservoir until it rises in the glass limb above P2. Close the first pinchcock P1 and pour in the rest of the mercury. Take the blowpipe and seal up the end of tube R, and place a beaker or cup under the fall-tube spout. Turning the first pinchcock on carefully, the mercury rises in the glass limb to the pump head, where it breaks over the gentle bend in drops and forms pistons which drive out the air down the pump head and through the fall tube into the atmosphere, the mercury falling into the beaker. As rarefaction proceeds, the mercury pistons compress the residual air into smaller space, and it falls a greater distance before being cushioned on air. As this proceeds, the mercury falls like a stone through the vacuous space and reaches the bent portion of the pump head, which is called the "crook." Here the mercury slows up and is caught on the slight turn up at X, and each little piston seems to halt here until the arrival of the next, when it is swung over into the fall tube. Thus no air can escape back into the pump because it is locked on the lower side of the crook, and even at the highest degree of vacuum the pump is still carrying out minute bubbles of gas. However, a limit is set by any water vapour present, and the fact that air may be carried into the pump from the reservoir. The degree of rarefaction to be expected of this pump is about 0.000152 mm. of mercury, which is more than that needed for the most vacuous of our tubes. Needless to say, one should keep a wary eye on the reservoir, for should it run empty the next few seconds will be interesting, in that the pressure of the atmosphere will cause the mercury to fly all over the pump conduits and end in a fracture of one or more parts. As the supply of mercury to the pump is controlled by pinchcock P1, it will be seen that when exhaustion is nearly complete the mercury tends to leave a vacuous space under this pinchcock and, as it falls in a thin stream from the reservoir, it delivers up most of the entangled air. After using the pump, and when all parts are at atmospheric pressure again, the pinchcock P2 should be closed and P1 opened. This allows the imprisoned air to escape through the reservoir, after which P1 is closed and P2 opened, and the pump is ready for the next exhaustion.

Making a Simple Geissler Tube

Take a 6 in. piece of the 6 mm. tube and see that it is clean inside; if it isn't, use a "pull through" of copper wire and a small piece of clean rag. Cut two strips of aluminium sheet about ¼ in. wide and 1½ in. long and loop one end of each. These electrodes are fastened into the tube with marine glue or a good quality sealing wax. A short length of the 2 mm. tube is included at one end, as this is to be fixed to the pump. The sealing compound should be liberally applied and the whole smoothed off on the outside over a flame. Taking the finished tube in the right hand and the blowpipe in the left, direct the flame on the end R of the pump and bring the small tube of the Geissler also within the flame. When its two openings show a bright red head on the edges, press them together lightly and wrap the joint immediately in cotton wool. Fig. 8 shows the idea.

Connect up the induction coil and exhaust. The result should be pleasing, thought not of a high degree of vacuum, as no organic sealing compound is quite air-tight. In opening the pump again, see that there is no mercury resting in the crook, for the sudden inrush of air will cause a fracture, and it is best in such circumstances as these to crack the place where the Geissler is sealed by a sudden application of the blowpipe. The air will enter slowly and the hole can then be cut square with a scratch from the file.

MODEL AERO TOPICS

(Continued from page 494)

Other Proposals

OTHER matters raised at the conference concerned a programme of contests in each country to be submitted to the F.A.I. for ratification in order that the dates of various international contests should not clash. It was proposed to centralise all technical data, ideas, and information, so as to offer these to all countries; that international uniform rules for planes and gliders should be insisted upon; that commercial interests should be obtained to bring down prices to a uniform level.

Competition Dates

July 24th.	Bowden International Trophy.
July 20th-25th.	King Peter's Cup.
July 31st.	Wakefield International Trophy.
Aug. 7th.	Competition for Wakefield Models.
Aug. 15th-16th.	President of the French Republic's Cup. This competition is for gliders and planes.
Sept. 4th.	Grand Prix Belge Competition for gliders to be held in the South of Belgium.
Sept. 11th.	International Cup.

AN error, we are informed, occurs in the S.M.A.E. handbook dealing with the Lady Shelley Seaplane Competition. Rule 6 should read "the nearest to 45 seconds" and not "average duration of three flights."

International Records

THE S.M.A.E. had received the following list of international records :—

Category A.—Aeroplanes Rubber Driven, Hand Launched.
M. Bequignat, May 3rd, 1936, 1m. 2s.
M. Fargeas, May 31st, 1936, 1m. 58s.
M. Vincre, Aug. 9th, 1936, 2m. $21\frac{2}{5}$s.
M. Gabriel Robert, Sept. 13th, 1936, 7m. $36\frac{1}{5}$s.

Category B.—Aeroplanes R.O.G.
M. Fargeas, May 31st, 1936, 1m. 43s.
M. George Dubois, Aug. 15th, 1936, 8m. 25s.
M. Desnoes, June 13th, 1937, 14m. $30\frac{1}{5}$s.

Seaplanes.—Duration.
M. Vincre, July 26th, 1936, 49s.

Gliders.
M. Robert Poulain, Aug. 15th, 1936, 3m. $38\frac{2}{5}$s.

The various classes to which model aeroplanes and gliders must conform to claim international records are to be found on pages 29 to 31 of the S.M.A.E. handbook. These handbooks can be obtained price 4d. from any affiliated club secretary or from Mr. Cosh, 35 Maple Crescent, Sidcup, Kent, at 5d. each, post free.

The Gamage Cup Competition

THE following is the result of the Gamage Cup Competition, held on April 3rd, and recently announced.

1, S. Pederson, Wembley, 231.6s.
2, N. Blacklock, Wembley, 150s.
3, A. A. Judge, T.M.A.C., 136.86s.
4, R. Copland, Northern Heights, 131.6s.
5. A. Wilson, Hayes Dist., 115.3s.
6, C. G. Martin, Romford, 104.9s.

Pilcher Cup Results

This competition was held on April 17th.

1, J. A. Leadbetter, Southport, 186.9s.
2, R. Smith, North Kent, 115.76s.
3, E. Chasteneuf, Blackheath, 111.68s.
4, R. Copland, Northern Heights, 101.36s.
5, A. Tintdall, Lancs., 95.5s.
6. H. Holbrook, Lancs., 84.25s

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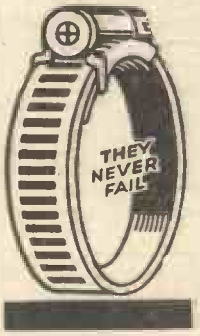

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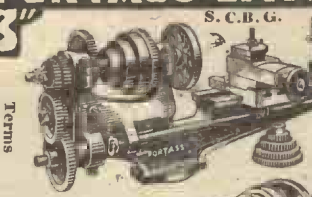

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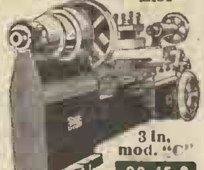

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