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PRACTICAL MECHANICS

OCTOBER

6D.

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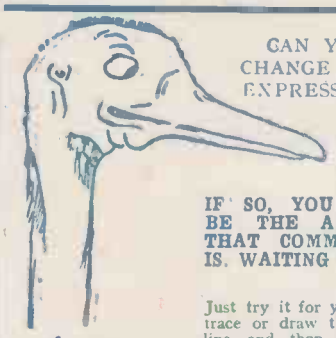

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Practical Mechanics

VOL. II. No. 13
OCTOBER
1934

Edited by F.J.CAMM

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

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

Notes, News and Views

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High-Voltage Electrical Discharge

IT is reported that in the high-voltage laboratory of the General Electric Company at Pittsfield, Mass., the engineers have produced electrical discharges of approximately a quarter of a million amperes at the enormous pressure of 150,000 volts in eight micro-seconds. Over 30,000,000 kilowatts were represented in a single discharge, and a copper wire, $\frac{1}{16}$ in. in diameter, was completely vaporised in the tiny fraction of a second required for the discharge.

New Cross-Channel Motor Ship

BUILT to the order of the Belgian Government for cross-Channel service, the new motor-ship, *Prince Baudouin*, recently completed her trial trip, when an average speed of 25·25 knots was obtained. The ship has an overall length of 370 ft. 8 in., a beam of 45 ft. 11 in., and a depth of 24 ft. 9 in. The propelling machinery consists of twelve-cylinder, two-stroke single-acting Diesel engines. The cylinder bore is 580 mm. and the piston stroke 840 mm., and each engine develops 7,500 h.p. at a speed of 258 r.p.m. The lighting, heating and ventilating of the ship, as well as cooking and water-heating, are carried out electrically, and for supplying the necessary power, four generators, each of 480 kW., are installed in the auxiliary engine-room. As is usual on cross-Channel ships, accommodation is provided for first- and second-class passengers, and this includes four restaurants, where 300 meals can be served simultaneously. There are five saloons equipped with sleeping-berths.

Latest French Submarine

FRANCE'S newest submarine, the *Conquérant*, which was launched recently, is 300 ft. long, and has a displacement of 1,500 tons. Her engines develop 7,000 h.p., giving the craft a speed of 20 knots on the surface and 10 knots when submerged. The armament consists of eleven 550 mm. torpedo tubes, one 100 mm. gun and two machine guns, and the submarine's range of action is 10,000 miles.

THE MONTH'S SCIENCE SIFTINGS

The new dry dock which was recently opened at Wallsend is 570 ft. long, and over 60,000 tons of concrete have been used in its construction. The dock gates are of the two-leaf solid steel type, each weighing 90 tons, and the walls are 12 ft. thick. The pumping plant, which has a capacity of 70,000 gallons a minute, can empty the dock in two hours.

A submarine lift has been designed by an Italian naval engineer. Placed in a well in the submarine, the lift consists of a cylinder large enough to accommodate a man, and when communication with the interior of the submarine is closed, the cylinder is allowed to rise to the surface. It can be opened from the interior, and by means of a winch the cylinder can be returned to the submarine.

What is stated to be the highest self-supporting tower in the United States has recently been erected by the General Electric Company at Denver. The tower, which is to be used for supporting an aerial, is 470 ft. high, 35 ft. square at the base, tapering to 2 ft. square at the top, and can withstand a wind velocity of 125 miles an hour.

According to a recent report, another aerodrome ship, the "Schwavenland," is to be put into service on the German Air Mail Service between Europe and South America. The ship will be stationed off the African coast and will be capable of taking three seaplanes on board at one time. It will launch by catapult a machine weighing 13 tons at a speed of ninety miles an hour, and will carry sufficient fuel for refuelling twenty aeroplanes.

A Rocket to the Moon

MAX COSYNS and Neree Van der Elst, the Belgian scientists, are contemplating an interesting experiment which is to take place during their next adventure into the stratosphere. A rocket weighing 2 lb. is to be released when the balloon reaches the stratosphere and will be shot upwards by a series of powder explosions. It is claimed that when fired at an altitude of 12 miles, the rocket, owing to the lower pressure, would travel at a greatly increased speed and would reach the moon in a few hours.

Steering Ships by Wireless

A NEW application of radio was recently demonstrated in Italy when Senator Marconi's yacht, *Elettra*, was navigated "blind-fold" to Sestri Levante by means of a "radio beacon" transmitted from a distance of about ten nautical miles. The transmitting instrument on land sends out micro-waves less than 50 cm. long, which are received by an instrument on the ship. A needle is caused to oscillate in front of a screen which is divided into two sections, one red and the other green. A loud speaker working in conjunction with the apparatus gives audible signals indicating "left" or "right." All that the navigator has to do is to steer the ship so as to maintain the needle in a central line between the red and green sections. The action of the wind and current is corrected automatically. It is claimed that the invention will prove invaluable for directing ships in foggy or stormy weather, and during extreme darkness at sea. The apparatus can also be used for directing aircraft.

War 'Plane with no Tail

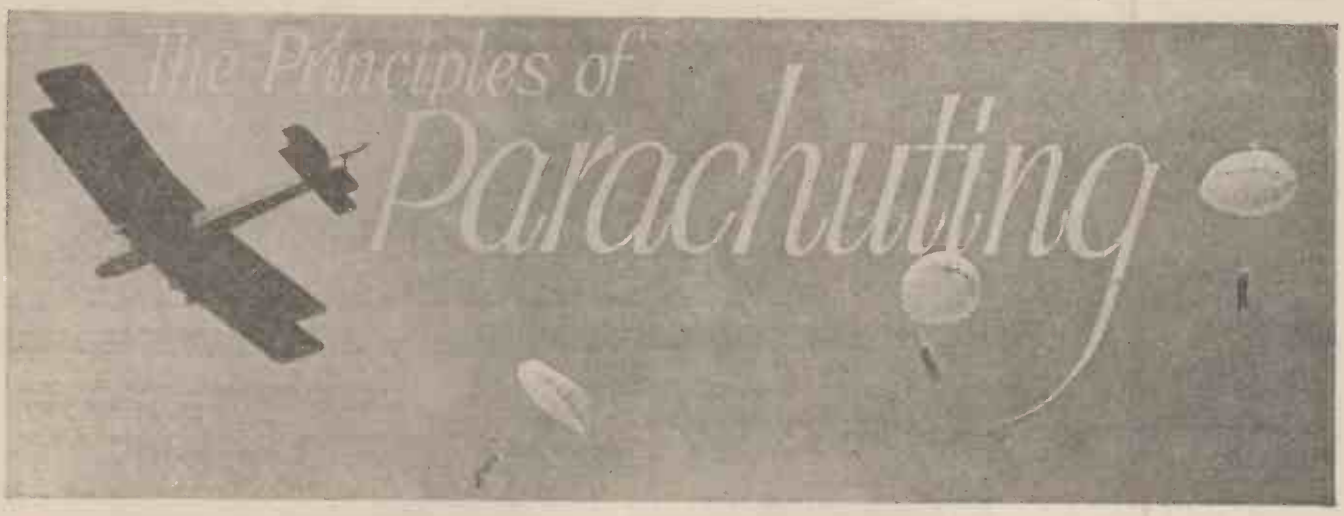
THE results of nearly ten years' pioneer work by an aircraft designer and his wife, Captain and Mrs. G. T. R. Hill, were shown at Westland Aircraft Works, Yeovil, to-day, when a new pterodactyl fighting 'plane was put through her paces.

The absence of a tail gives the gunner in the machine a greatly increased field of fire, and if adopted by the Air Ministry the pterodactyl is likely to be used in large numbers for the defence of London.

Captain Hill evolved the pterodactyl from a glider with the help of his wife, who sewed together the wing fabrics. He built the first pterodactyl on the lawn of his home.

The Healing of Wounds in Metal

OUR readers will be interested to know that the interesting article on page 573 of our issue for September entitled "The Healing of Wounds in Metal" dealt with actual work carried out by Messrs. Barimar Ltd., to whom we are indebted for permission to use the illustrations appearing in that article, and for the information on which the article was based.



SOME INTERESTING FACTS ABOUT THE LIFEBELTS OF THE AIR

By F. J. CAMM

WHAT the lifebelt is to the sailor, so is the parachute to those who fly. Thousands of pilots and their passengers have saved their lives by means of this simple device, made from silk and cord, and have thus qualified for membership of the most exclusive club in the world—the famous Caterpillar Club—whose entire membership consists of those who have saved their lives by means of parachutes. The badge of membership—a small gold device worn as a tiepin—is not a coveted insignia among airmen, for it is only in the extreme resort that a pilot abandons his aeroplane. As with the captain of a ship, so with a pilot, it is an unwritten law that he should do everything in his power to save his craft. The parachute is strapped to his back for use only when a crash is inevitable. It is not intended for use by the nervous pilot on every occasion when the aeroplane develops trouble, for in most cases of failure of the engine or some other part of the aeroplane it is possible for the pilot to glide until he finds a suitable landing place.

In warfare, for example, anti-aircraft gunfire may shoot away a portion of the wings or tail, and immediate resort to a parachute jump will ensure that in the ultimate crash the damage is confined to material and excludes a human life. The parachute, too, by skilful manipulation—drifting—may prevent the pilot becoming a "prisoner-of-war." It requires a good deal of pluck to jump into space, even from a crashing aeroplane, but the number of casualties arising from parachute jumping is practically negligible, and there has been practically no loss of life, the only instances being those of professional parachute jumpers who, in combining daring with their descents, have paid the penalty of spectacular showmanship with their lives.

The parachute is now a standard part of the equipment of all military aircraft, which are compelled under Air Ministry Regulations to carry parachute equipment of an approved type. All pilots are given instructions as to their use.

The parachute, strange to relate, was not originally introduced as a safety device, but as an added attraction to balloon ascents, which the public were invited to attend;

(Above.) Inside a parachute inspection department, showing the third folding stage in the inspection of the parachute. (Right.) This type of parachute is made attached to a coat, as shown.

Mr. J. Tranum, the famous parachutist, who has made many record-breaking jumps.

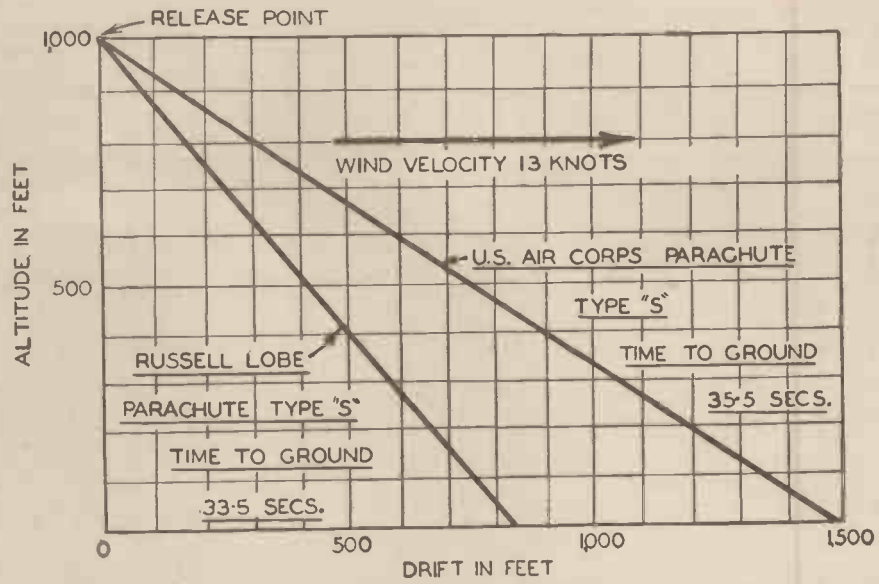
An exceptionally fine photograph, showing the first stage of the parachute jump as the parachutist leaves the aeroplane.

and to swell the gate money the spectacle of parachute descents was an added bait. There are, of course, to-day several professional parachutists who are performing yeoman service for aviation in demonstrating the ease and the safety with which a pilot or a passenger may leave an aeroplane.

The parachute was first introduced by Veranzio, an elderly but intrepid Venetian architect who, as long ago as 1617, practised descents from the top of a tower, with a square sail stretched by four rods of equal size, and having four cords attached to the four corners which were fastened to his body. In spite of the crudity of the device, it is recorded that Veranzio made several successful descents.

Parachutes were first introduced to the Royal Air Force in 1925, since when they have been compulsory. They have never been compulsory on civil machines, although many of the commercial air lines carry them as part of their standard equipment.

There are several differing designs of parachutes available, the most noteworthy being the Irvin, which is that adopted by the Royal Air Force, and the Russell.



A chart showing the method of test employed when comparing parachutes of widely different drift characteristics for speed of descent.

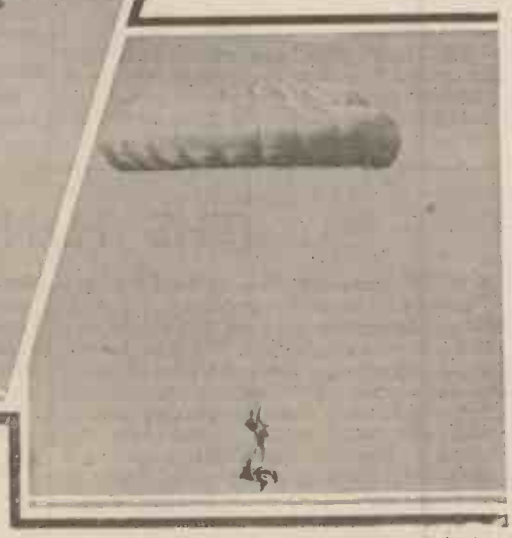
These are attached in groups of six to the harness attached to the waist and shoulders of the user. The harness is fixed to the body of the pilot, and the parachute itself is folded in a certain way, and strapped to his back. He virtually is sitting in a loop something similar to a child's swing, so that when he jumps and the parachute opens he is suspended from it. Part of the harness engirdles the thigh, then there is the loop of the swing in which he sits; there are the back straps which fasten round the waist and the upper part of the harness, to which the four groups of six rigging cords are attached.

In the Irvin pattern a pilot parachute 2 ft. in diameter is included. It is spring-operated by the parachutist and is used to withdraw the main parachute from the packing envelope. This latter is similar to an ordinary letter envelope. It has four flaps that open when required under the action of elastic in tension. The opening of this envelope is operated by means of a flexible cable rip-cord enclosed in a flexible metal tube. Pulling the cord

Vera Turl, a 20-year-old London girl, making a parachute descent at Brooklands.

The Irvin parachute is a flat circle of silk 24 ft. in diameter, with a 2-ft. circular vent in the centre, the purpose of which is to allow a certain amount of the air trapped when the parachute opens to escape and somewhat to relieve the shock to the parachutist when the parachute opens, and also to relieve the connecting cords to the harness of undue strain. When the parachute opens out it assumes an umbrella-like formation which, of course, causes a corresponding reduction in diameter—in point of fact, when open and loaded, the parachute is about 17 ft. in diameter. Equally spaced round the edge of the parachute are twenty-four rigging lines, each 16 ft. long.

Ralph le Peal, a veteran parachutist, in mid-air following a jump from a 'plane at the National Air Races at Chicago.



Mr. Harris making a jump during Sir Alan Cobham's Air Circus display at Somerset.

withdraws two pins which unlock the pack.

"Pull-off" or "Delayed" Drop

The question is often asked, which of the two jumps, viz., a "pull-off" or a "delayed" drop of 1,000 ft., produces the greatest strain on a parachute.

When making a pull-off with a parachute of the Russell type, the parachutist takes up a position on the wing of the 'plane, which is eased down to the minimum flying speed, the parachutist then rips his 'chute and waits for the 'chute to pull him away from the machine. The air-speed of the plane is usually about 50–70 m.p.h. whilst this operation is carried out.

On making a delayed drop, the parachutist jumps clear of the 'plane with the parachute intact, and increases his downward speed each second, attaining his maximum speed of 120 m.p.h. after about ten seconds, by which time he will have fallen 1,000 ft.

From the above figures it will be seen that the greatest strain is placed on the parachute when making a delayed drop, as the shock load increases proportionately to the speed at which the body is falling at the time of opening the parachute.

Everything used in the manufacture of a parachute is governed by A.I.D. Release Notes, being supplied by manufacturers who are officially appointed by the Air Ministry.

Therefore, when a parachute is sold, the maker issues a Release Note covering the completed article, guaranteeing that the parachute is made from first-class material, tested and only supplied by manufacturers approved by the Air Ministry.

The minimum breaking strain to which component parts of the Russell "Lobe" Parachute are subjected are as follows :—

Harness webbing . .	2,750 lb.
All-metal fittings . .	2,500 ,,
Silk thread for seaming .	8 ,,

Shroud lines. There are twenty-four of these. Each will take 400 lb.

The silk and duck are of the best quality obtainable, and the duck waterproofed before being made up.

To give some slight idea of the work entailed in the manufacture of this parachute. The canopy consists of about 70–100 yd. of silk (depending on the size of the 'chute). This is divided into 24 panels, each of which consist of 12 panels, making 288 panels altogether. These are joined by either quadruple or double rows of stitching.

The First Drop

All those who have made parachute descents agree that it is one of the most pleasant sensations imaginable once they have plucked up the courage to jump into space. Instead of experiencing what they anticipate, namely, a feeling of hurtling through the air with an acceleration due to gravity of 36 ft. per second, they experience a sensation of floating on nothing, and there is a pleasant yet almost eerie silence. Another surprising experience common to all parachutists is the remarkable speed at which the brain seems to function in the three seconds which is normally allowed before the rip-cord is pulled. Immediately after the jump you

H. E. Manning, a professional parachutist, taken aloft over the Curtiss Wright-Reynolds Airport, Chicago, a distance of 11,500 feet, leaped over the side, shooting head first at an average speed of 147 miles an hour. 1,000 feet from the ground the pilot 'chute broke free and then the big parachute, Manning floating safely to earth.

The photograph shows Manning nearing the ground after his spectacular leap at the International Air Races at Chicago.

find yourself in a position facing the ground—an ideal position for opening the parachute by means of the rip-cord ; there follows a slight swish and slight jar as the 'chute stretches itself open under air pressure.

Landing

After the 'chute is safely opened, the next move is to concentrate on landing. Pilots are instructed that they must not stiffen their muscles, but make contact with the ground limply, and if possible to sink to the knees gently, allowing the resistance of the 'chute to break the fall. It is very seldom that even a bruise results from landing. Everything, of course, depends upon the careful packing of the parachute, so that it may open freely. The extreme safety of parachuting has brought into being the profession of parachuting, and there are many who are now engaged making daily descents with Russell and other parachutes. Most of these are making at least two or three delayed jumps and one pull-off daily.

Control

It is possible, of course, within certain limits, for the occupant of a parachute somewhat to control his descent. The speed of descent, which is largely dependent, of course, on atmospheric conditions, averages about 20 ft. per second on the surface type, which is equivalent to jumping from a 7-ft. wall. On the training type the speed of descent is only 17 ft. per second. By careful manipulation the rate of descent can be varied by what is known as "spilling" the air. In this operation, the occupant, by pulling on some of the rigging cords, can allow some of the air inside the parachute to escape. This will accelerate, according to the amount of air spilt, the rate of descent. When reasonably near the ground he can allow the parachute to assume its normal shape and slow up his descent in preparation for contact with the ground.

It is interesting to note that lives have been saved by means of parachutes from jumps made as low as 100 ft.

The graph shows the results obtained when parachutes were dropped from a 'plane at the same instant. Two-hundred pound-weights were used on each parachute. The actual distance of drift was measured from a mark over which the parachutes were released, to point of contact with the ground. The distance of drift for the Air Service parachute (seat type) was found to be 1,475 ft. and for the Russell "Lobe" parachute (seat type) 825 ft. The time from release to ground for the Air Service parachute was 35·5 secs. and for the Russell "Lobe" parachute 33·5 secs. The altitude at time of release was 1,000 ft., with wind velocity of 13 knots. Dividing time down into altitude gives a vertical speed of descent of 28·2 ft. per sec. for the Air Service Parachute and 29·9 ft. per sec. for the Russell "Lobe" parachute. Dividing the time down into the distance of actual travel as shown above, *i.e.*, the distance between point of release and point of contact with ground gives an air speed of 50·2 ft. per sec. for the Air Service parachute and 38·9 ft. per sec. for the Russell "Lobe" Parachute.

THE MAN THAT DEFIES GRAVITY

SOME years ago there entered into the arena of the *Nouveau-Cirque* at Paris a performer carrying on the tip of one of his fingers a small box which kept turning slowly round and round whilst balanced on one corner. He lifted the box from his finger and set it down on another corner, with the same result. What was the secret ? The box contained a well and accurately made gyroscopic top, spinning at a high velocity.

The apparatus shown in the diagram was then introduced to the audience, viz., a high steel mast supported by wire stays and

containing at its summit a large steel cup. In this cup, *rested* (not fixed) a ball joined, as in an ordinary gyroscopic top, by means of a free bearing to the axis of the large gyroscopic disc. To this was fitted an upper framework which could be grasped by the performer and in which he could sit. To this framework was fitted a geared driving apparatus by means of which he could impart a high speed of rotation to the heavy disc. When the performer first entered the framework, the apparatus was supported upright by means of a rope fastened to the ring shown in the top of the framework. Pedalling gradually faster and faster, he set the disc spinning at a high velocity, the rope and catch were then removed and this great human-driven gyroscope went through all the evolutions that an ordinary toy gyroscope performs.

Truly a thrilling performance, when one considers that the mast was some 35 ft. high.

"Cold" Light

Examining a picture by ultra-violet ray. The light penetrates the top coating of paint and discloses the original. This is possible, as the ancient artists used a mineral base for their paint, whereas the modern artist uses an organic foundation.

FLUORESCENCE AND PHOSPHORESCENCE

A well-known example of what is sometimes called "cold" light—to distinguish it from the light given off by a heated body—is to be seen in the curious luminescent rays emitted by certain insects, such as fireflies and glow-worms, and by various kinds of jelly fish.

Examining precious stones with micro-photography, which shows details of its structure, the purity or otherwise of the stone.

STRICTLY speaking, the rays given off by various insects, such as glow-worms, fireflies, etc., are the result of definite chemical reactions which are deliberately controlled by the animal concerned.

Fluorescence, on the other hand, is not accompanied by any chemical change in the substance producing it, nor is the allied effect of phosphorescence. On this footing, a clear distinction can be drawn between the "cold" light due to organic and inorganic processes.

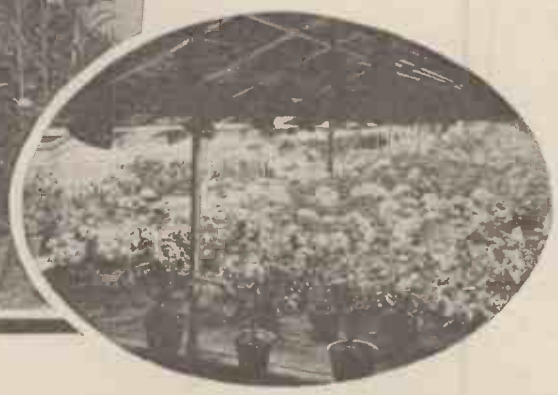
In true fluorescence—as in phosphorescence—the light given off must come from light which has been received. It is true that the emitted light is always lower in wavelength than the incident light, but it is not generated spontaneously, as it is by the glow-worm or firefly. The process is, in fact, one in which light is transformed, but not generated.

Fluorescence owes its name to the fact that it was first observed in connection with the native mineral called Fluor-spar, though nowadays it is known to be a property shared by a great variety of substances. This is not apparent under normal conditions because the fluorescent effect is so feeble that it is usually masked by the brighter "exciting" light. But nearly every substance exhibits it to a greater or less degree when subjected to the action of ultra-violet light—or X-rays—in a darkened room.

"Afterglow"

It is commonly said that fluorescence lasts only as long as the light which causes it, whilst phosphorescence persists after the exciting rays have been withdrawn. This, however, is only partly true, because although phosphorescence is more definitely an after-effect—due, one might say, to a delayed action—fluorescence is seldom so instantaneous as to be free from some degree of "afterglow." Most fluorescent substances are, in fact, also phosphorescent, and it is often extremely difficult to distinguish between the two.

The well-known physicist, Lenard, found that the peculiar lag in time associated with phosphorescence is sometimes caused by small metallic particles or "impurities" in an otherwise purely fluorescent crystal such as calcium sulphide. If the impurities are removed, the crystal reacts instantaneously, fluorescing only so long as it is subjected to an exciting ray.

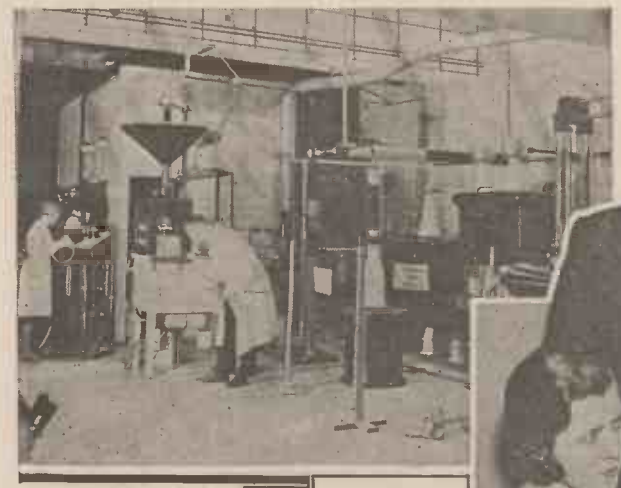


Flowers are brought to perfection, and fruit ripened very rapidly by means of electrical rays.

This is, of course, exactly what is required from the fluorescent screen used in a cathode ray television receiver, where any excessive afterglow will "blur" the received picture. Great pains must therefore be taken to free the Willemite crystals (used in preparing the viewing screen) from every trace of impurity.

For cathode-ray work it is particularly important to use a fluorescent coating which is capable of giving a "brilliant" response

(Above.) Where words have been deleted from rare manuscripts of an earlier century they can now be deciphered by means of a compound binocular microscope and a special process of illumination. (Right.) An ultra-violet ray machine being used to discover a forged document.



Above.) The laboratory where the experiments with the cold cathode rays are being made. On the right the high-tension apparatus is to be seen where the 250,000 volts electric current is generated, which is used for the production of the cold cathode rays. On the left, is seen the apparatus for producing the cold cathode rays. The experiments are being made under a cover of a plate of crystal lead, because the rays may hurt the persons which are experimenting on them.

(Right). Demonstrating the "hand torch" sunlight ray.

to the impact of the electron stream. Willemite or zinc silicate is found to give very good results for anode voltages up to 500. But it must be chemically pure, otherwise it is liable to vary considerably, both in brilliance and colour. With higher anode voltages, of the order of 1,000, zinc sulphide and calcium tungstate may be used for the fluorescent screen to give clear-cut reproduction, free from blur or after-glow.

Cathode Ray Television

Although interest at the moment is largely centred on the subject of fluorescence because of its new importance in cathode ray television, it has other useful fields of application, particularly for testing the purity and chemical composition of food and various industrial products.

In making an analysis, the substance to be tested is exposed to ultra-violet light, and the colour and degree of the resulting fluorescence are then noted and compared with that given by a sample of known purity and composition. Alternatively a strip of filter-paper is soaked in the dye—or other liquid under test—and subjected to a ray of ultra-violet light. The capillary action of the filter paper produces "zones" of fluorescence, which can readily be compared with those produced by the genuine article.

Fluorescence also plays a useful part in the microscopic examination of animal and vegetable substances. The microtome sections cut through the stalks of plants show a characteristic and beautiful luminescence when subjected to ultra-violet light. The same effect is also produced by the cellular structure of fruits, and by the "rings" formed in the trunk of a tree.

In food analysis, milk shows a yellow fluorescence, whilst that of flour is blue. The presence of boracic acid and other preservatives can also be detected by the characteristic colourings given off under the action of ultra-violet light. A fluorescent test will similarly distinguish the edible from the poisonous varieties of mushroom.

Detecting Forged Documents

Forged documents are detected by slight variations in the otherwise uniform fluorescence of the surface of the paper or parchment where an erasure has been made, whilst the "faking" of rare postage stamps is at once shown up, particularly if any alteration has been made to an existing postmark or if fresh gum has been added to the back of the stamp. In the same way renovations to an old painting are clearly made evident by the varying fluorescence of the original pigment as contrasted with the new, whilst the subsequent addition of a forged signature also becomes palpable when exposed to ultra-violet light. The different fluorescence of old and modern paints and inks is quickly recognised by the skilled eye.

A very striking demonstration can be given of the effect of human fluorescence. The light from a mercury-vapour lamp is first passed through a filter of blackened glass, and the emerging beam of invisible or ultra-violet light is then directed from the stage of a music hall on to the audience. Under these conditions, dress materials show a fluorescent colouring which is quite different from that normally seen—depending upon the texture of the material and the chemicals used in dyeing it. But the most startling result is that the eyes and teeth of the audience shine out in brilliant blue. Curiously enough artificial teeth appear dead black.

VETERANS OF THE AIRWAY

ONE of the pioneer airmen of Imperial Airways, Captain F. Dismore, has just completed twenty-one years as an aeroplane pilot, while the total mileage flown by eight of the veteran pilots of the Company—Captains Dismore, Jones, Horsey, Rogers, Youell, Wilcockson, Perry and Walters—has now reached a figure of approximately 7,000,000 miles.

It was in August, 1913, that Captain Dismore gained his certificate of proficiency, and he has been flying aeroplanes ever since, handling machines of all types and sizes. He was at the Central Flying School, Upavon, in the days before there was any special flying corps uniform, and the soldiers, sailors, and mariners who were drafted to the school wore so many different uniforms—including kilts—that Upavon was often referred to, jokingly, as "the Zoo." Among those who were at the Central Flying School, while Captain Dismore was learning to pilot an aeroplane, were Lord Trenchard and the late Air Vice-Marshal Sir Sefton Brancker. At that time, however, military aircraft were in such an early stage of development that sceptics were heard to declare that "only birds and fools took to flying."

In the early days of the Great War Captain Dismore carried out scouting flights over the North Sea in search of enemy submarines; after which he saw much active service, fighting against enemy aircraft in Belgium, and being decorated by the King of the Belgians with the Order of Leopold. He also acted as a flying instructor.

When hostilities ceased and civil aviation began, Captain Dismore flew on the first commercial services to the Continent, and he has been a pilot of air-liners ever since.

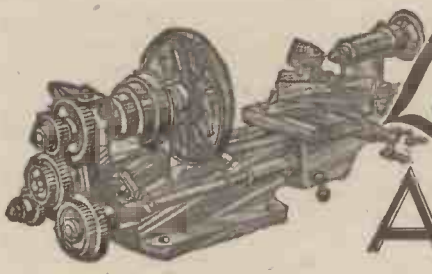
Twenty-one years ago Captain Dismore was flying a pioneer type of biplane which was like a big box-kite, being driven by a single 50-h.p. engine and carrying a pilot and one passenger. To-day he flies as commander of an air-liner of Imperial Airways which is driven by four engines developing 2,200 horse-power and carries thirty-nine passengers and a crew of four.

Approximately 1,000,000 miles have now been flown by Captain O. P. Jones, who has the honour, on several occasions, of piloting Imperial Airways craft which have carried the Prince of Wales as passenger. Captain Jones learnt to fly in 1917, and piloted many different types of aircraft in the Royal Air Force. Then, on resigning, he conducted a joy-riding concern; while for a time he was with Mr. A. J. (now Sir Alan) Cobham; after which he flew for the Instone Air Line, subsequently joining Imperial Airways. On one occasion, piloting a big four-engined air-liner up to Scotland for demonstration flights, Captain Jones took up more than 3,000 passengers in three days.

Captain Youell, who has now flown more than 800,000 miles, became apprenticed when he was fifteen years of age to an early flying school at the Hendon aerodrome, his first job being to mend punctures in aero-tyres and replace missing spokes in aeroplane wheels. When he was sixteen, he learned to fly one of the school biplanes. In 1918 he was in France on active service, seeing a considerable amount of aerial fighting. When peace came he went with a joy-riding concern to Sweden, carrying out flights 150 miles north of the Arctic Circle. On returning to England he began flying on the Continental air-lines, becoming, in due course, one of the pilots of Imperial Airways.

Captain Wilcockson, who joined the R.A.F. in 1917, completed nearly 600 hours of military flying before demobilisation in 1919. For some months he acted as a pilot on the pioneer service which carried mails by air from Folkestone to our Army of Occupation at Cologne. Then he became associated with the Handley-Page Company, conducting early test-work with slotted-wing aeroplanes, and remaining with them until joining Imperial Airways.

The log-books of three others of these veterans—Captains Horsey, Perry and Walters—show that they have flown hundreds of thousands of miles along our airways with passengers, mails and freight, Captain Walters having the distinction of having obtained the first master air pilot's certificate issued by the Air Ministry. This represents a new category for British commercial airmen, the requirements for securing it being such that only pilots of exceptional flying experience, both by night and day, can hope to obtain one.



Lathe Work for AMATEURS

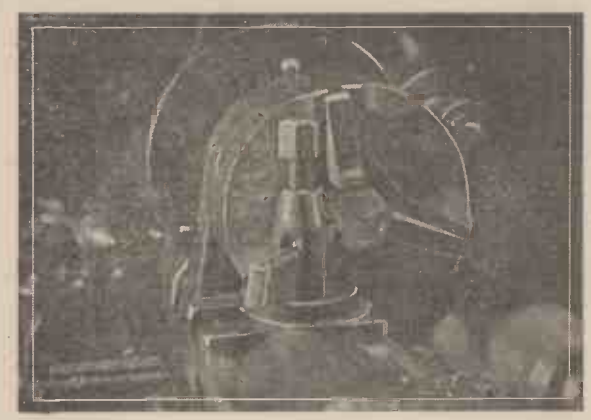
TYPES OF TOOL-BITS

By W. H. DELLER

THE advantages that are to be had in employing tools of the holder type are many. In the first place the "tool-bits" for use in these holders are of "high-speed" steel and are supplied in a hardened condition throughout their entire length. By reason of the fact that the squared hole in the holder is drifted through at an angle in relation to the base, top rake is automatically given to the "tool-bits" when secured in position. Further to this the "bits" are cut off at each end to an acute angle which at first sight seems excessive, but when in the holder and the length of the tool shank always remains constant. Also there is no comparison between the amount of work that can be done between grindings when using "high-speed" steel tools as against those of ordinary carbon tool-steel. The particular type of holders referred to range from shank sizes of ½ in. × ⅝ in. suitable for lathes using normal tools ½ in. in thickness. The bits or cutters for use in this size are ⅜ in. square. Other sizes correspondingly deeper in section take tools increasing in the size of the square by ⅛ in. in proportion to the size of the holder shank.

As regards the actual grinding of the tools, the side and front clearances should be ground on the side of the wheel as hollow-grinding on these faces is undesirable. For general work if these clearances are made within a degree either way of 9 degrees they will be found satisfactory. The side rake on the top of the tool can be from 15 to 25 degrees sloping away from the cutting edges. This face can be hollow ground. For the sake of durability the side rake is made less for harder materials. Brass tools may to advantage be made with increased side and front clearances, but the top and side rake must be absent if "digging in" is to be avoided. In other words, a flat-topped tool is essential. To avoid alteration in the shape of tools from time to time a half-dozen tools can be ground up at both ends to cover requirements.

It is proposed to deal with the various lathe operations in turn, and therefore it is thought best to cover the individual tooling requirements at each stage rather than compile a table of tool shapes. In this way it is hoped to impart the necessary practical knowledge to the reader to enable him to perform such operations in an efficient manner. To make clear the points dealt with, the text will be supported with photographic illustrations, and at the conclusion of the series the whole of the operations will, as far as possible, be embodied in an article next month describing the actual machining of a complete job.



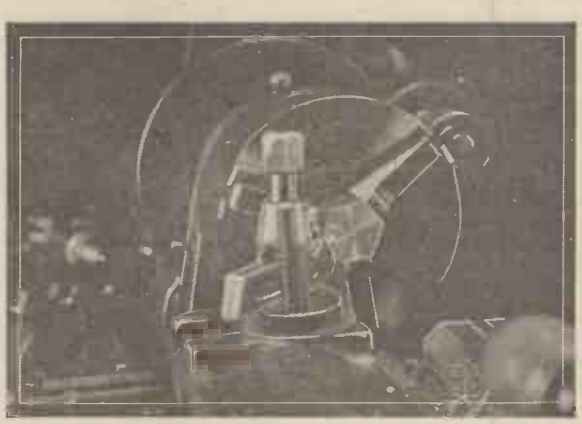


Fig. 1 (left).—Facing up a piece of mild steel, and Fig. 2 (right).—If the tool is too low a pip will be left on the work in the centre.

gives approximately the correct amount of front clearance to the tool.

Different makes of "tool-bits" vary as to the shape of the ends. Some of them are cut in the manner described square with the normal top face of the tool, others cut them diagonally so as to provide something approaching both front and back clearance, and in several instances the ends are roughed out to shape. Thus it will be seen that the steel comprising the tool can be used until too short for the holding screw to grip it. A different-shaped tool may be ground at either end, and the hardness of the steel remains the same throughout the life of the tool. With initial grinding and subsequent resharpenings it is only necessary to remove very little actual material,

These holders are made in types in which the cutter lies straight or offset in a right or left hand direction in relation to the shank. While holders are to be had in which the cutter can swivel on the shank, the line of the top of the cutter is in this type parallel with the top of the shank.

General Work

For general work the straight type is as good as any; provision can be made by grinding the cutting face of the tool at an angle to the centre line of the shank, so as to allow the shank to swivel in the desired direction for clearance purposes, and yet maintain the cutting face square with the work, as for instance in the manner of a right or left hand knife tool.

Facing the Chuck

In Fig. 1 a piece of mild steel is being faced. Set the material fairly close in to the jaws of the chuck. The tool-bit is held in the holder so that a short length is projecting. Clamp the tool holder at an angle of about 45 degrees with the work and so that the highest point of the tool is approximately central. Move the tool away from the centre and feed into the work lightly by moving the top slide feed back to the centre when the tool should finish

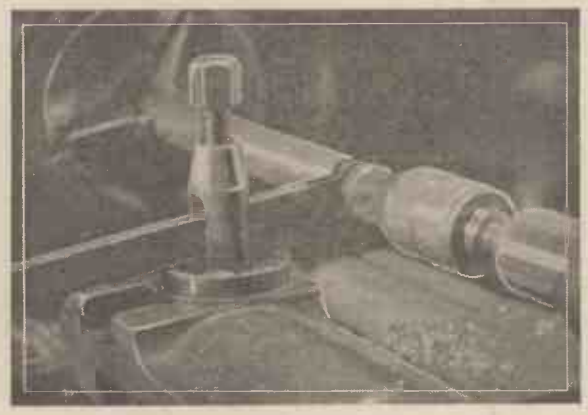


Fig. 3 (left). — Showing the tool holder adjusted too flat in relation to the facing cut, and Fig. 4 (right).—A method of centring bright bar so that it will run truly.

exactly central, that is, leaving no projection. Proceed then to face outwards as in Fig. 1, note that the face is being left flat from the centre. If the tool is too low a pip will be left on the work in the centre (see Fig. 2); whereas if too high it will be impossible to reach the centre with the tool.

The result of having the tool holder too flat in relation to the facing cut is seen in Fig. 3. This is caused by the side clearance rubbing against the metal being removed and pushing the cutter out of the way, leaving a hollow in the centre. This would not happen if the feeding was done in an opposite direction, from outside to centre, but the tendency is then, under a heavy cut, for the nose of the tool to cut all round, forming a groove in the material as it feeds in. The direction of thrust is such that it tends to swivel the tool and increase the depth of the facing cut and may result in scrapped work. The tool used in this instance is a right hand turning tool which feeds towards the left, normally producing a right hand shoulder. With a rocker bar or "Yankee" type tool post as shown the tool setting is a simple matter. With a plate or box type "tool post" requiring packing beneath the tool to adjust the height, fine adjustment can be made by sliding the tool-bit in or out of the holder slightly.

With regard to the tool shape the profile is such that the left hand or cutting face is parallel with the shank, the front being ground to form an angle of 60 degrees to 70 degrees with the opposite face and the point given a small radius. Previous remarks as to rake angles apply in this instance. Finish will be governed by the rate of feed and size of radius at the point. Stone the point of the tool and take a fine finishing cut, using a slow feed with soapy water as a lubricant to produce a mirror-like finish in steel.

The aim is to secure the necessary degree of finish from the tool direct, as this is more accurate than polishing.

Centring

Before work can be performed between the centres it is, of course, necessary to centre up the ends of the work. This is a drilling operation. A small hole is drilled central in the end of the bar and countersunk at an included angle of 60 degrees to match the lathe centre. Unless the centre hole is accurate as regards angle and the small hole continues deeper than the countersink the hole will wear or be otherwise unsatisfactory. For this reason a combination centre-drill is recommended.

A method of centring bright bar so that it will run truly is shown in Fig. 4. The bar is held in the chuck with a fair amount projecting. When the work is revolving it is pushed true and steadied by the vee-ended bar held in the tool-post while centre drilling. After drilling both ends it is preferable to rough out the job in the chuck. Set the tool for centre height as in Fig. 5.

Steady the end of the bar with the back-centre, using oil to lubricate the point of the centre. The same tool as that described for facing can be used for "roughing out." By using the method of centring described, it is only necessary to leave a minimum amount above the maximum diameter of the finished job. As a proof of this, the cut being taken in Fig. 6 is cleaning up the bar, with a reduction of only ·004 in. in diameter.

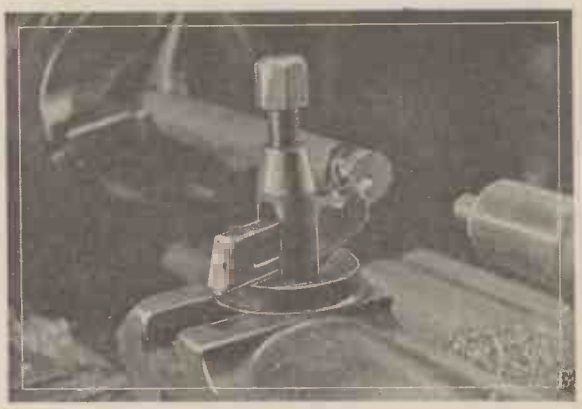


Fig. 5 (left).—Setting the tool for centre height, and Fig. 6 (right) showing a cut being taken which is cleaning up the bar with a reduction of only ·004 in. in diameter.

A PHOTOGRAPHIC PAGEANT FROM THE AIR

PYRAMIDS and temples amid gleaming sands! Vistas of mountains, forests, lakes and rivers! Glittering "air-scapes," high in the sky, formed by majestic banks of cloud! Wild life seen from a bird's-eye point of view! It is a new world, now, which dawns for modern travellers—a world viewed not from motorcars or trains, or from the promenade decks of liners, but from the saloons of big aircraft flying thousands of feet above land and sea.

An exhibition of photographs which forms a fascinating pictorial pageant of the 16,000 miles of air-lines which now connect England with India and the East, and stretch across Africa from Cairo to Cape Town, has been arranged by Imperial Airways; and the interest of these aerial views is enhanced greatly by a remarkable series of long-range infra-red photographs taken from Imperial Airways craft by a photographer of *The Times*, and included in the exhibition by courtesy of that newspaper.

The Exhibition is on view in a number of cities throughout the Provinces. Entrance is free.

In one's mind's eye, moving from picture to picture in this wonderful collection, one realises what it means to operate—as Imperial Airways are now doing—a regular weekly air service through three continents, and over twenty-three different countries.

You see the great four-engined air-liner "Helena" leaving the London air-port on the first stage of an air journey across the Empire. Paris appears below. Europe passes away beneath. And then you see the big flying-boat "Sylvanus" above the Mediterranean, with all its coastal and island beauties.

Now comes Cairo, with pyramids and golden sands, and all the mystery of a mighty past. On you fly in fancy above the desert to Baghdad, with the gold-covered minarets of the El Khadimain mosque gleaming in the brilliant sun. After which you catch a fascinating glimpse of that marvellous Arch of Ctesiphon, relic of the Palace of the Parthian Kings.

On, devouring distance, along the Persian Gulf with its sheikhs, pearl-fishers and camels—on to Gwadar and Karachi. Nowadays five days only from London by flying mail.

On still your "magic carpet" bears you in unflagging flight—on across India to New Delhi; away eastward to Calcutta and over the jungles to Rangoon; and then on still farther east to Singapore, which is now within eight and a half days of London by flying-boat and 'plane. Scene after scene is recorded—photographically—sometimes from the air and sometimes from the ground.

You not only look down, from above, upon a world in miniature. You are shown pictures of the control-cabins of the great modern air-liners; of the engines which drive them so smoothly through the air; and of the air-ports and wireless and meteorological equipment which now permit our British air services to fly with a reliability of just on 100 per cent.

Particularly fascinating are one's pictorial impressions of a flight across Africa. The desert lies behind and you approach the big game lands, looking down from aloft on herds of elephants and other animals of the wild. Hills, mountains, and rolling plains alternate with forests, lakes, and rivers. The pageant of a mighty continent passes before your eyes.

It is of thrills such as these, and many others, that air voyages across the Empire are composed—and one can enjoy them all nowadays, not as a result of toilsome and weary earth travel, but swiftly and without fatigue by the speed and luxury of the flying mail.

A young enthusiast sailing one of the many models that are made by the well-known firm of Messrs. Bassett-Lowke, Ltd.

HOW BRIDGES ARE BUILT

(*Concluded from page 544, September, 1934, issue*)

Fig. 19.—A fine view of a suspension bridge. The Chelsea Bridge over the Thames.

SPLENDID examples of reinforced concrete arch bridges are shown by Figs. 21 and 22, the former being Southwark Bridge in reinforced concrete, and the latter Hampton Court Bridge, which is of reinforced concrete with good architectural effects produced by the addition of stone and brickwork. Both these bridges were designed structurally by well-known engineers, and architecturally by well-known architects.

Bridges constructed on a Combination of Principles

It will readily be understood that two or more of the principles explained above can be adopted in the design of one bridge. The suspended span of a cantilever bridge may be a large steel-framed girder. The bridges on the embankment of a river may be of girder construction, and that over the river of steel-framed arch construction. A combination of reinforced concrete and steel is used. It may be mentioned that we have many timber-framed bridges in England, many having been constructed by the Great Western Railway, especially in Cornwall.

Foundations of Bridges

The foundations for bridges cause considerable anxiety to engineers. Those on land do not usually present much difficulty, and ordinary building principles are used. Those under water are much more difficult to deal with, and will be explained.

Where River Beds are not Firm

In this case the heavy abutments or piers cannot safely be built direct on the river bed, but a firmer foundation must be provided. This is provided by many piles, nowadays usually constructed with reinforced concrete, of suitable length, driven into the soft foundation to such a depth that the piles are rigidly held and form a number of slender but strong piers on which the bases of the abutments or piers can be constructed. If there is a very firm substratum near the river bed, it is usual to carry the bases down to such firm ground, and this is done by means of doing the necessary excavation below water level from inside a timber or steel cofferdam

Fig. 14 (left).—An interesting brick - arched bridge with brick abutments that carries a railway over Reigate Road at Epsom.

Fig. 20 (right).—A reinforced concrete girder bridge at Cheam, Surrey, which carries the Sussex by-pass over a road and railway.

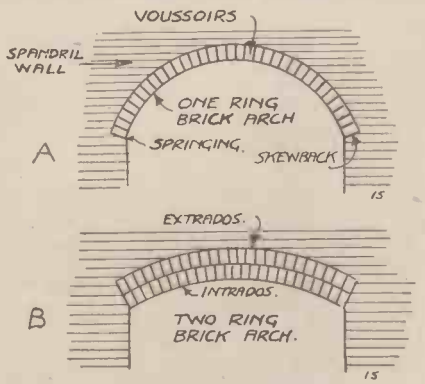


Fig. 15.—The simple brick arch used in ordinary buildings explains the large arched work used in engineering. The flatter the arch the more brick rings are necessary.

Fig. 18.—This simply illustrates the principle of the cantilever bridge.

Fig. 17.—A steel-framed cantilever bridge, as used for very large spans. Our Forth Bridge was constructed on this principle.

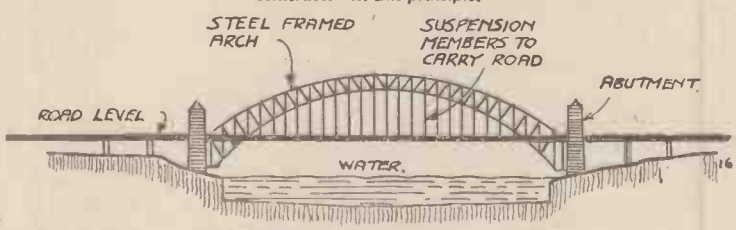


Fig. 16.—The steel-framed arch bridge used for very large spans. This illustration shows the outline of Sydney Harbour Bridge, Australia, with a span of 1,650 feet; the largest arched bridge in the world designed and constructed by British engineers.

Fig. 21.—Southwark Bridge—a fine example of a reinforced concrete bridge.

or box to exclude the water and to hold up the ground. Another method is to use caissons, which are cylindrical or rectangular in shape. These are gradually let down into the ground, which is excavated from within them, and sunk deeper and deeper by heavy loading as the excavation is done. Compressed air is used to exclude water. When a satisfactory foundation is reached, the caissons are filled with concrete, which forms part of the piers or abutments.

When River Beds are Firm

In this case not much difficulty is presented to the engineers, cofferdams or caissons allowing the construction of the bases under water.

The simple girder bridge has been explained. The erection of large bridges are often difficult problems, there being four ways in which to tackle erection.

Temporary Staging or Centering

Brick, masonry or reinforced concrete bridges are built off a temporary staging or centering, usually of timber, constructed upwards from the land or a roadway, and the top of the staging being shaped to coincide with the curvature of soffit of the bridge. Where such bridges are built over rivers, the staging must be supported by piles driven into the river bed. Very often the difficulty of providing adequate staging, or the cost of it for large spans, makes it imperative to use some other system of bridge design that will avoid the use of the temporary staging.

Cantilevering out

Large steel-framed bridges constructed on the various principles explained are usually erected by the method of cantilevering out, which means that first of all a perfectly sound "tailing-back" or "balance" is provided on both of the land sides, and then the various loose members of the framed bridge are gradually built together and outwards over the river, this operation being conducted from both sides of the river, until the two cantilevered parts meet at the centre.

Rolling out

This is a modification of the last method. The bridge unit is constructed on the land in a convenient position, roller wheels are placed under it, and the whole pushed or pulled into its final position. The rear end must be heavily loaded to prevent the front end toppling over into the space to be spanned. This method is suitable for bridges of moderate span, and can be used for heavy plate girder bridges and steel-framed bridges of independent and continuous spans.

Floating out

This is a very ingenious way of erecting bridges, and consists of constructing the steel-framed or heavy girder bridge on a staging and then transferring to floating pontoons or barges alongside. At proper tide level the whole is towed to the site of the bridge, adjusted in line with piers or abutments, but with a small vertical clearance. Water is admitted to the pontoons, which sink until the structure takes its bearings.

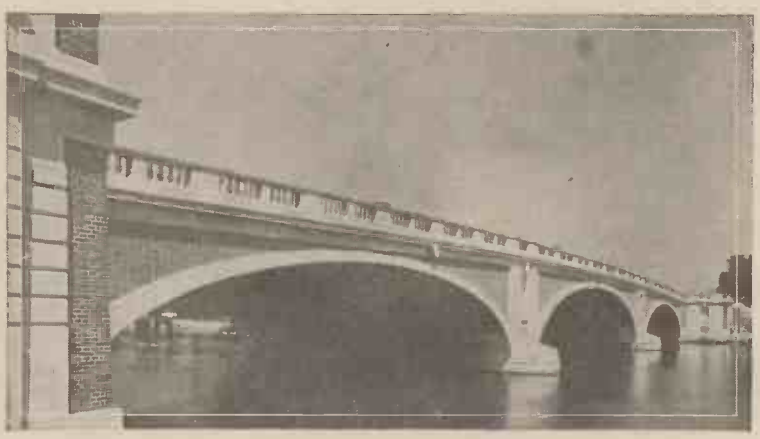


Fig. 22.—Hampton Court Bridge—another fine example of a reinforced concrete arch bridge with brick and stone dressings.

SCOTLAND YARD'S AUTOGIRO

Marconi transmitting and receiving equipment installed in the observer's cockpit of the Scotland Yard Autogiro. The receiver is immediately below the dashboard.

THE autogiro in which experimental flights over London are being made by Scotland Yard officers in order to determine the possible value of this class of aircraft for traffic control and other purposes, has been fitted with Marconi transmitting and receiving equipment to enable it to maintain two-way communication with the ground.

The wireless apparatus has been specially designed for compactness and light weight. Both the transmitting and receiving panels are fitted beneath the dashboard in the observer's cockpit of the autogiro, and the total weight of the equipment, including batteries and all accessories, is 70 lb.

The transmitter is arranged for continuous-wave telegraph working, and comprises a master oscillator and magnifier circuit, with a P.625 valve in each stage. The receiver is a straightforward 3-valve instrument, with one screen-grid high-frequency valve, type S.410, a detector, type L.410, and one low-frequency valve, type L.410.

High-tension supply for both the transmitter and receiver is taken from a 240-volt dry battery, the power to the anode of the magnifier being 4 to 5 watts; the battery is tapped at 120 volts for the receiver. A 6-volt accumulator supplies low-tension current to the filaments of the transmitter and receiver valves.

The Marconi Company has previously fitted wireless equipments in the autogiros used by Scotland Yard for traffic control on Derby Day for the past three years, and its efficient operation has contributed materially to the success of this form of traffic control on those occasions, enabling the observers in the air to give immediate information to the police on the ground regarding the state of the roads and any areas where traffic congestion was impending.

THE USE OF LIGHT FILTERS IN PHOTOGRAPHY

HOW TO OBTAIN CORRECT COLOUR SHADES IN BLACK AND WHITE PRINTS

EVEN at its best, a photograph falls far short of a true copy of the original subject. The most obvious deficiency is the lack of colour, all the various colours of the original being represented in terms of black and white. But apart from this, the ordinary type of plate or film does not record the true *density* of the colours. By this I mean their relative "lightness" or "darkness."

A bright red, for instance, is obviously of a lighter tone than royal blue, and yet

Figs. 1 and 2 (left).—Illustrating the false tone values obtained with ordinary photographic film. The white walls, for instance, are rendered no lighter than the deep blue of the sky. (Above) The same scene as Fig. 1, but using an isochromatic film in conjunction with a light filter.

if a subject containing these two colours is photographed the resulting print will show the blue as a considerably lighter tone than the red. In fact, the red will photograph scarcely a shade lighter than black, while the blue will appear almost white.

Limitations of Ordinary Films

This peculiarity of the ordinary plate or film is, of course, due to the fact that the emulsion is more sensitive to some colours than to others. If we paint a piece of card with bands of the seven colours that are popularly supposed to constitute the solar spectrum, namely red, orange, yellow, green, blue, indigo and violet, and photograph the card using an ordinary (not panchromatic or isochromatic) film, it will be discovered that the red produces little or no chemical action in the film. This part of the negative, therefore, remains clear, so that a positive from this shows the red as black. The light from the orange strip certainly has a slight effect, but it is very small considering the brightness of the colour. The printed result in this case shows a dark strip more of the density of grey or brown than of orange.

As we proceed towards the violet end of the spectrum the film appears to become increasingly sensitive. Yellow, nature's brightest colour, although reproduced as a light tone, is equalled by the green, while the blue and violet appears to be lighter than either the yellow or the green and photographs as white.

This defect of the ordinary film naturally produces an entirely false rendering of the colour values in the photographic picture.

It is usually most noticeable in photographs of sunny scenes where white clouds, white sails or light-coloured houses stand out in contrast against the deep blue of the sky. Such scenes may appear to be excellent subjects for pictures, and yet when the prints are produced the results are often highly disappointing. The blue sky is rendered as a blank white space, while the white clouds have disappeared altogether. At the same time cream-coloured stucco walls of houses which appeared dazzlingly bright to the eye are reproduced even a shade darker than the sky.

A good example of this falsification of colour values is furnished by the picture of Corfe Village, shown in Fig. 1. In the original scene there was a blue sky with a little light cloud near the horizon, while the walls of the sunlit buildings were very bright. In Fig. 1, taken with an ordinary film, the scene has lost much of its beauty. The sky is a blank space, and the buildings and roads are in a monotone of grey.

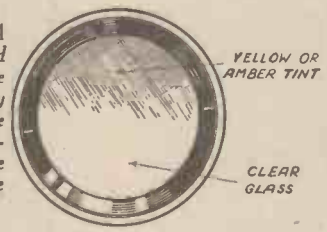


Fig. 5. — A sky filter used in landscape photography to correct the over sensitiveness of the film to the blue sky.

Colour-sensitive Films

To overcome this defect there are two methods available. One is to use orthochromatic, panchromatic, isochromatic or one of the other "chromatic" films marketed by all the well-known makers of photographic material, and the other is to use a light filter. Either may be used independently, but for the greatest degree of colour correction it is necessary to use both.

The difference between pan-, ortho- or isochromatic and ordinary films lies in the fact that the former gives a much better rendering of the greens, yellows and reds, although blue and violet are still reproduced somewhat too light. It is always an advantage to use these special films, for apart from their superior rendering of colour values they are usually faster. Before considering the action of the light filters which are used in conjunction with them, it is perhaps best to explain that the terms panchromatic, orthochromatic, etc., are not quite synonymous. Strictly speaking, a panchromatic film is one which is sensitive to all colours, and it must therefore be developed in complete darkness. Obviously the use of a red light would fog the film, since it is sensitive to red as well as other colours. The type of films called ortho- or iso-chromatic—and by other fancy names derived therefrom—are sensitive to yellow and all the colours of the spectrum from yellow upwards to the violet end, but are not equally sensitive to orange and red. In this case, therefore, they may be developed in a very subdued red light.

Action of a Filter

As already explained, even the panchromatic film is not perfect in its colour rendering, and although sensitive to all colours, it still over-emphasises the blue end of the spectrum. It is here that the light filter can be used to the best advantage. The object of a filter is to reduce the intensity of the blue light before it reaches the film.

It filters out the blue and violet rays but allows the passage of the red and yellow rays. The filter consists of a yellow or amber glass placed in front of the camera lens. One method of building up a filter consists in sandwiching a yellow-dyed film of gelatine between two plain glasses, the whole being mounted in a circular frame which can be slipped over the front of the lens.

The effect of using such a filter in conjunction with an isochromatic film is clearly shown in Fig. 2, which was taken at the same instant as the photo reproduced in Fig. 1. In Fig. 2 the blue of the sky is

Fig. 3.—Another example of incorrect colour values with an ordinary film.

Fig. 4.—In this picture a colour filter was used, thus giving the various colours their true tone values.

rendered in its correct tone so that the white clouds which were entirely absent from Fig. 1 are distinctly discernible against the deeper tone of the sky. The sunlit buildings, which were a creamy white colour, are now reproduced as the lightest parts of the picture instead of being rendered in almost the same tone as the grey stones of the cross as in Fig. 1. Another striking example is provided by the two pictures shown in Figs. 3 and 4. Fig. 3 was taken without a filter, while Fig. 4 was taken under similar conditions but using a panchromatic film and a medium yellow filter. Particular note should be made of the better rendering of the colour values of the flags. In fact, in one case a complete reversal of the tone values has taken place. What was probably a yellow-and-blue flag is shown with the yellow darker than the blue in Fig. 3, but in Fig. 4 the correct values, namely the blue darker than the yellow, are portrayed. Again, in Fig. 3 the dazzling white hull of the yacht appears no lighter than the blue sky, whereas in Fig. 4 it is given its true value.

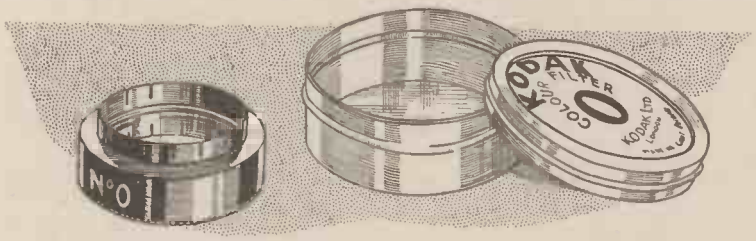


Fig. 6.—Typical colour filter used to assist in the correct rendering of the tone values in a photograph.

Filters and Exposure

As is only to be expected, the use of the yellow light filter increases the time required for exposure of the negative. It is found convenient to grade filters according to the increase in exposure which they necessitate. The usual medium density filter increases the exposure about three times when used in conjunction with a panchromatic film or about seven to ten times with the ordinary film.

As an example, a view requiring an exposure of, say, 1/100 sec. with a panchromatic film will require to be exposed for about $\frac{1}{33}$ sec. (say $\frac{1}{25}$ sec. as the nearest shutter speed), with the filter in position. However, as the latest panchromatic and orthochromatic films are considerably faster in themselves than ordinary "rapid" films the exposure may be about the same when using panchromatic film in conjunction with a medium yellow filter, as when using the older type of film without a filter.

Although a yellow filter may be used quite successfully with ordinary films and will, indeed, enable a much better rendering of the colour values, yet the increase in exposure of something like ten times which is required obviously limits the number of occasions on which snapshots can be secured with the average cheap camera.

Usually any but the brightest views are found to be under-exposed if snapped through a filter when using ordinary film. Thus, a subject requiring $\frac{1}{50}$ sec. for correct exposure will need something like $\frac{1}{5}$ sec. with the filter in use. As the camera probably has no shutter speed lower than $\frac{1}{25}$ sec., the photographer is forced either to under-expose by using the $\frac{1}{25}$-sec. setting, or else to take a very brief time exposure and risk any movement which may blur the picture.

Sky Filters

To overcome the exposure difficulty in landscape and seascape pictures, where the chief use of a filter is the repression of the blue rays from the sky portion, special filters, known as *sky filters*, are obtainable. With one of these it is claimed that no increase in exposure is necessary. A typical sky filter is shown in Fig. 5. It will be seen that it is somewhat in the nature of a compromise. The upper part of the glass is stained a suitable spectroscopic yellow, while the lower part is plain, the stain being so applied that the yellow merges imperceptibly into clear glass. Approximately half the glass is coloured and half plain. A filter of this type is quite suitable for a view such as Fig. 3 where the sky portion occupies roughly half the picture, but naturally all subjects are not so accommodating as regards the area and disposition of the sky portion.

The yellow filter used in ordinary photography is not the only type available, and at least three other types are made use of in photo-engraving in colour That is, in the preparation of the blocks used in colour printing. In this process the coloured object, such as a painting, is photographed in the same way as when making a "half-tone" block, but with this difference, that three, and sometimes four, photographs are taken. The plates used must be sensitive to all colours (panchromatic), and in each case a coloured filter is attached to the lens so as to admit only certain rays of light. A different colour filter is used for each plate. When three filters are used they are coloured blue, green and red respectively. From this, three distinct negatives are obtained which are complementary to one another, the first representing the yellow, the second the red, and the third the blue portions of the picture. Three printer's blocks are produced from the three plates and these are then inked with yellow, red and blue inks respectively and printed one after the other in that order. The first impression gives a yellow picture, the application of the red-inked block then produces a picture containing yellow and red with intermediate orange tints, and the application of the final blue-inked block gives the full colour print. The fourth colour which is often included is black, and to produce the block for this the subject is photographed through an amber filter.

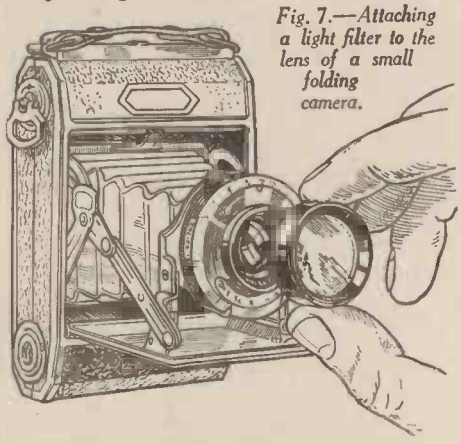


Fig. 7.—Attaching a light filter to the lens of a small folding camera.

FRENCH LINE MODEL IN LONDON

BASSETT-LOWKE LTD., the well-known model makers of Northampton, have just delivered to the French Line, 20 Cockspur Street, a magnificent model of their latest cabin steamer, s.s. *Champlain*. The model is a water-line type, 5 ft. long and built to a scale of 1 in 100.

All the most interesting characteristics of this fascinating ship have been carefully reproduced on the model—the one large eliptical stream-line funnel, the clear open games and sun deck, unobstructed by any ventilators or gear. In fact, there is not a single old-fashioned cowl-type ventilator on the whole of the ship. The finish of the model is in a new style. Instead of finishing the winches and other deck gear in gold or silver-plating or bronze, they are painted in the actual colours of the real fittings, giving the model a realistic appearance.

The realistic appearance of the finished model.

MARKING OUT FOR MACHINING

Describing the essential tools and methods for marking out work ready for machining.

A CERTAIN amount of marking out is required on most machining jobs with the exception of perhaps purely cylindrical work that is finished when it comes from the lathe. Other items may require drilling, surfacing, slotting or keyways in them before completing and the positions of details in relation to previously machined surfaces are more often than not a matter of small importance.

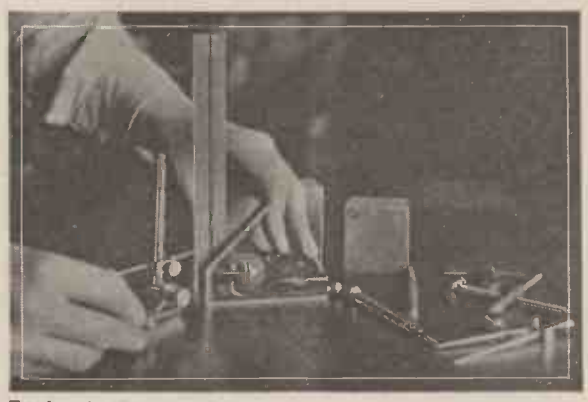


Fig. 1.—An efficient type of scribing block and universal square.

The essential tools are a surface gauge or scribing block, a good stiff steel rule, small dividers, square, scriber and a centre punch. A small angle bracket is useful under certain conditions when one or two clamps will also be required for use in conjunction with it. A simple form of scribing block consists of a reasonably heavy circular base, the underside of which is machined and recessed so that it will lay flat without rocking, and capable of sliding freely on a flat surface. This base supports a vertical spindle upon which slides a split boss carrying a scribing needle, the needle being locked by the action of tightening a knurled nut. The setting of the point of the scriber is dependent on trial and error or lightly tapping the scriber, when only held friction tight, in the desired up or down direction. A scribing block of the type shown in Fig. 1 is much more desirable for fine work. The spindle of this is connected to a rocker bar which has a screw adjustment at the rear end. After setting the point of the scriber approximately and locking it tight it is corrected by tilting the bar to raise or lower the point by means of the knurled adjusting screw. It is necessary to have a flat surface on which to rest the work while marking off. Failing a proper machined surface plate, a square of plate glass makes an efficient substitute for light work.

Coatings for Marking Out

To make the marking easily visible it is usual to coat the surface of the work to be marked out. Bright steel is coppered for this purpose by rubbing on with a piece of rag a solution made by dissolving copper sulphate crystals in water with the addition of a few drops of sulphuric acid. This is kept in a bottle for use as required. The steel must be clean and free from oil, otherwise the coppering will not result. Wipe the surface dry immediately, and if the marking out is to be retained on the work for several days rub over with oil to fill the lines and prevent them from rusting. Cast or forged surfaces are prepared by chalking over.

Marking Out

Supposing that it is necessary to mark lines on machined face, one $\frac{27}{32}$ in. away from a machined edge and another one $\frac{3}{32}$ in. away from it, a rule is held vertically against the face of an angle bracket or square block so that the end of the rule is touching the surface plate. The point of the scriber is then adjusted against the markings on the rule to the first dimension and the job to be marked is laid down on the machined edge and a line made on the face of the work. Fig. 1 shows the method of setting the scriber. The second line being $\frac{3}{32}$ in. away from the first one, is $1\frac{3}{4}$ in. away from the base, to which dimension the scriber is then set. Draw the needle along the surface of the work so that the point is trailing as in Fig. 2. This will produce a straight line. If the needle is presented square to the work a "jumping" action takes place with the result that the line is wavy. Where the rule in a combination square is used a slightly different procedure may be adopted. After making the first marking, slide the rule upwards in the head of the square until a fair line is reached, when the scriber is raised the required distance. This is particularly useful when the dimensions are in odd 64ths, and when it is apt to be confusing to count up from an odd fine marking.

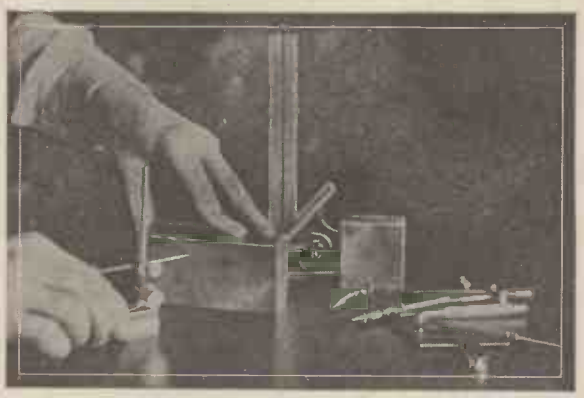


Fig. 2. (below).—To produce a straight line, draw the needle along the surface of the work so that the point is trailing.

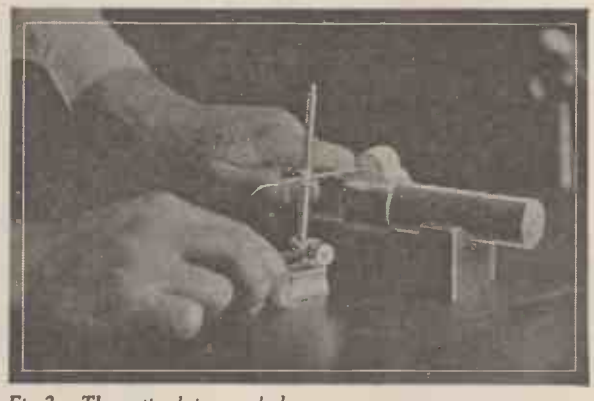


Fig. 3.—The casting being marked out above is to be drilled through the boss at a definite distance up from the centre hole.

Use of the Vee Blocks

Vee blocks are essential for cylindrical work. For most work of this nature it is essential that the dimensions are worked off of the centre line of the bar. To find the centre of a shaft by this method lay it in the vee blocks and set the end of the scriber near enough central, make a short line on the end of the shaft, or in the case of a tube at each edge turn completely over and make another mark parallel to the first one, resetting the point of the scriber exactly between the lines. If the lines are fairly wide apart a further trial is made, if not the marking is continued along the bar as required and firmly continued on the end, if necessary, for further reference.

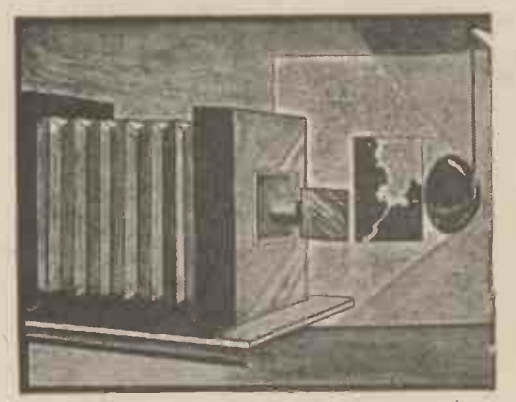
The casting being marked out in Fig. 3 is to be drilled through the boss at a definite distance up from the centre hole. This is done by mounting the job on a mandrel, the centre of which is found in the manner stated. The height of the centre is noted by placing the scriber point against the rule, and the distance that the hole is to be above centre added to it.

Using the Angle Brackets

Work that has a machined face or base but that requires marking out in a direction in

(*Continued on page 34.*)

Fig. 4 (below). — Work that requires marking out in a direction in which there is not a machined surface to rest it upon has to be clamped to a false vertical surface for the purpose.



HOW ILLUSTRATIONS ARE MADE

Practically every article you read in *Practical Mechanics* is illustrated with photographs or drawings. Have you ever wondered how these illustrations are made?

PERHAPS you know that the reading matter is prepared by a wonderful piece of mechanism called a "Linotype." This machine has a keyboard like a typewriter and assembles small brass moulds in proper order, as the keys are pressed; when enough moulds are brought together to form one line, molten type metal is pumped in and a complete line is cast in one piece. Line is added to line to form a column, and columns are brought together to make a page ready for the printer, but obviously pictures must be dealt with in a different way; they must be prepared separately and introduced into the page afterwards. PRACTICAL MECHANICS is, however, set on a "Monotype" machine, in which the letters composing each line are cast separately, as movable type, thus easing the work of correction and make-up in pages containing many illustrations with text over-run round them.

Let us consider the case of an illustration made from a black-and-white line drawing.

The drawing is first made on very smooth white paper in indian ink; this work must be done very carefully, the lines being quite black, with no tendency to greyness. It may be larger than the required illustration, but in all other respects must be exactly as it is to appear when printed.

The drawing is then sent to the photo-engraver, who prepares a "line block." This line block consists of a metal plate, usually zinc, in which the black lines form the top surface. In the intervening white spaces the metal is removed, so when the completed block is covered with ink by the rollers of the printing press only the top surface takes ink from the rollers; consequently, when the block is then brought

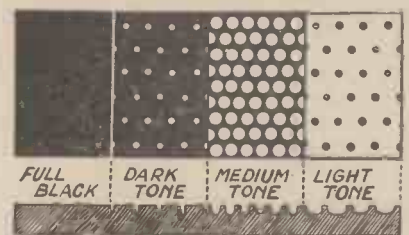


Fig. 3.—Showing the various screens used in half-tone blocks.

into contact with paper an impression of the picture is formed. The block is rather like an ordinary rubber stamp on a larger scale, except that the surface is made of metal (see Fig. 1).

The Camera used

The first thing the photo-engraver does with the drawing is to photograph it. The drawing is pinned up on to a board on a sort of easel arrangement and illuminated by electric arc lamps; there is, however, a very peculiar thing about the camera used for this job, for it does not point towards the drawing which is being photographed. This is because there is a reflector on the front of the lens which causes the camera to look around a corner, so to speak, as shown in Fig. 2. The object of this reflector (which may be a mirror or a glass prism) is to reverse the photographic image on the negative, so that when the illustration is printed it does not appear the wrong way round, *i.e.*, it would appear reversed, right to left, if photographed without the reflector.

A photographic negative is then made in

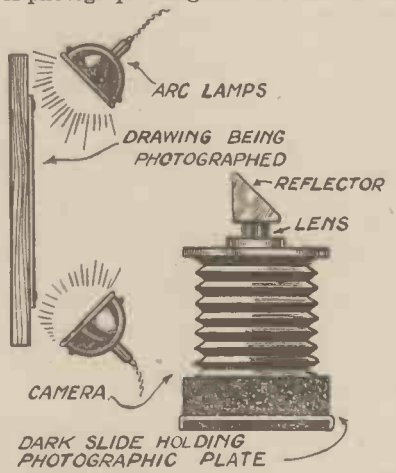


Fig. 2.—The type of camera used for photographing the illustrations.

the camera, and when this is developed and finished the black lines will show as clear glass, the white background being quite opaque. A piece of zinc about ⅛ in. thick is then coated with a solution, which on being dried leaves a film on the surface, this film being sensitive to light. This zinc is then placed behind the negative in a printing frame and exposed to the light of another electric arc lamp. This light shines through the clear lines in the negative (but not through the dense background) and produces a change in the film on the surface of the zinc. After sufficient exposure the zinc is removed from the printing frame and its surface covered all over with a thin, even layer of greasy ink applied with a printer's roller. The zinc plate is then soaked in water, and in a few minutes the water soaks through the layer of ink until it reaches the film beneath. Now comes perhaps the most interesting stage in the process, for original film coated on to the zinc plate is soluble in water and washes away, thus undermining the ink layer, which is also carried away, leaving the bare zinc. But where the light has reached the film through the clear lines in the negative, the film has become hardened and insoluble, so that the water has not the slightest effect on it. It therefore remains in place and holds the ink on to the surface of the zinc plate, showing an exact copy of the original drawing. The ink left on the plate is then treated to make it hard and strong, and the plate is ready for etching.

The plate is etched by dissolving away the bare zinc between the lines with nitric acid. This is not so easy as might be supposed, for considerable skill and experience are required to prevent the black lines from being attacked by the acid; but after etching, the black lines are left standing up above the surrounding metal. The zinc plate is finally mounted on to a piece of hard wood to make a total height equal to that of printer's type, and the completed block is then ready for incorporating in a page of type, etc., ready for printing.

Now this process, you will observe, is only suitable for subjects in full black and pure white; but in a photograph there will be—in addition to black and white—intermediate grey tones of all strengths. To reproduce such a subject the picture is split up into a multitude of tiny dots. The dots are equally spaced all over the picture, but the darker the tone the larger the dots; Fig. 3 shows this on an enlarged scale. If you examine a photographic picture in these pages with a magnifying glass the dots will easily be seen.

To divide the picture up into dots like this a special glass plate is used, ruled with cross lines and placed in front of the photographic plate in the camera. When the apparatus is used in the proper manner, the negative will be composed entirely of a series of dots which vary in size according to the darkness of tone. This negative is printed on to a copper or zinc plate as for a line block, except that it is usually done without ink.

Etching is carried out by dissolving away the metal in between the dots, but is not carried so far as for a line block. The finished block, called a "half-tone block" this time, is then mounted on wood.

For producing illustrations in colour the half-tone process is used, three separate blocks being required for each picture printed in yellow, red and blue ink.

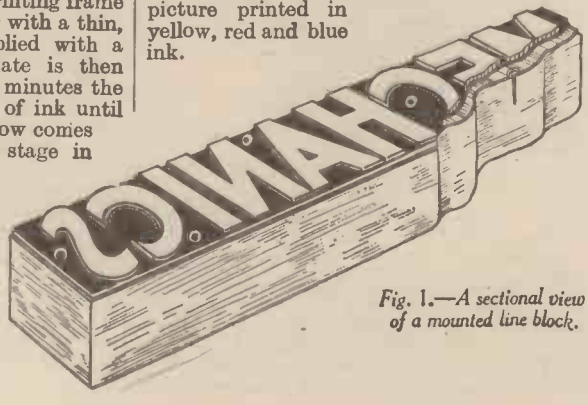


Fig. 1.—A sectional view of a mounted line block.

WATER "DIVINING"

If we attempt to trace back the origin of the divining rod, we find that it is lost in antiquity. The story of Moses striking the rock has even been suggested as an instance of a case of divining. The word rhabdomancy is used sometimes in connection with divining, and the word being of Greek origin would go to show that the ancient Greeks were familiar with the divining rod, although we have no proof that it was used actually in connection with water-finding. There is also a mention of the divining rod in the writings of Cicero. But, as water may be found practically everywhere, credit is often wrongly given to the "diviner." We greatly doubt whether it is possible to "divine" water by means of twigs and other absurd devices.—ED.

A demonstration of water divining by Mr. J. Timms.

THE first conclusive evidence of the use of the divining rod, as now understood, for the purposes of tracing not only underground water, but oil, metallic ores, coal, hidden treasure, and so on, does not, however, date back further than the sixteenth century; and considerable light was then thrown on the subject by Georgius Agricolas in his "De re metallica," which was published in 1556. We learn that different kinds of twigs or rods were used for tracing different metals; thus, the hazel twig was employed for tracing silver, ash twigs for copper, pitch pine for tin, and rods of iron and steel for tracing gold.

The late Sir Wm. Barrett considered it fairly certain that the birthplace of the modern divining rod was in the mining districts of Germany; it certainly first came into common use in Germany for locating mines and for discovering buried treasure.

In England the divining rod, as far as is known, was not used in searching for water until the end of the eighteenth century; although it appears to have been introduced into England in the latter part of the sixteenth century by German miners working in the Cornish mines.

At the present time, as in the past, many condemn the use of the rod as a superstition and a fraud. In the past it was often considered that the so-called "diviner" had close dealings with the "Evil One," and those using the rod laid themselves open to the risk of being charged with sorcery.

The most-used form of rod employed nowadays consists of a V-shaped twig of hazel or some other wood. The twig being grasped in the palm of each hand, the arms of the operator being held in front of the body.

It has often been claimed that the movement of the twig is faked, but this can hardly be the case. If, for instance, the operator is blindfolded, the twig will almost invariably turn whenever he walks over the same spot where he feels that water is located, although he would have no idea in which direction he was being led.

Again, if the twig is held conjointly by the diviner and another person, a very considerable force will be felt if he endeavours to resist the movement of the rod; in fact, the rod will often snap if too much resistance to movement is made.

What causes the Twig to move?

It will naturally be asked: What is the force that causes the twig or rod to move? but up to the present it does not appear possible to give a satisfactory reply, although numerous explanations have been given from time to time.

We must be content, therefore, to assume that so far as underground water and minerals are concerned, they are capable of radiating a form of magnetic force of some description. This force reacts upon the nerves of the human body, and the nerves in turn cause subconscious muscular action, thus causing a movement of the twig. Radium, in particular, is known to cause a strong reaction on the twig. We cannot go much further than the hypothesis of unconscious mental and muscular action.

According to Barrett, "the phenomena of dowsing are attributable to an unknown and subconscious cognitive faculty giving rise to a chain of physiological and psychological happenings." The human body can be looked upon as a very delicate and complicated instrument, capable of reacting upon the alleged force, whatever it may be.

Showing Mr. Timms locating water in a field.

It is a well-known fact that when the diviner, or dowser, applies the rod and starts operating, he sooner or later becomes fatigued, as though he has undergone considerable physical exertion. In some cases the diviner will complain of sickness and giddiness, at the same time breaking out into a violent perspiration.

An interesting fact to note is that no movement of the rod will take place unless the underground water is in a state of motion, and it is quite possible for the diviner to stand over a large mass of water such as a hidden reservoir, and feel no reaction whatever.

Some diviners claim that there must be direct contact with the ground, otherwise they lose the faculty, and that a rubber mat, for instance, is sufficient to isolate them. On the other hand, others claim the entire reverse, and that they can trace running water, even when flying over the land in an aeroplane.

Different Types of Divining Rod

It must not be imagined that the V-form of twig is the only type of rod employed. All kinds and shapes of rods are used, such as pieces of copper wire, clock springs, whalebone, pieces of cane, bars of solder, and so on. Some diviners prefer to use the "pendulum," which usually consists of a small wooden or metal ball suspended by a fine line held between the finger and thumb. When passing over water, the pendulum begins to oscillate violently, and will continue to do so as long as the diviner remains over the stream.

Others state that they require no rod or instrument of any description, and claim to be able to detect underground water by using the hands and arms only, and that a distinct tingling in the finger-tips is noticeable.

Again, there are authoritative cases where the diviner claims to actually see the water flowing. A well-known case was that of a South African boy, who had this gift in a highy developed degree.

In India, the home of the mystic, there are those who profess to trace water by the sense of smell.

There is little doubt that in a number of cases the water diviner fails in his diagnosis. This may be due to quite a number of causes. To begin with, it can be put down to inexperience. Unless the diviner is skilled, he is quite unable to distinguish the difference between a small stream near the surface and a much larger one at a greater depth. Thus he may be wrong both with regard to the depth and to the quantity of water available.

Again, it is often essential that the well or borehole should be put down at the exact spot under which the stream runs. Very often, however, the influence of the stream is such that the diviner feels the effect several yards away from the line of stream, and marks the wrong spot, many feet away. Further, there appears to be little doubt that certain masses of stratum, such as clay, affect the diviner in such a way as to give an entirely incorrect impression.

On the other hand, whilst it is desirable for the well or bore to be sunk on the exact line of the underground stream as located

How the hazel twig is grasped in the hands when locating water.

by the diviner, it is not always essential. Cases have been known where successful boreholes have been drilled several feet away from the stream. When pumping takes place, however, the diviner is able to detect a flow of water travelling from the stream and flowing towards the borehole.

Instruments for detecting Water Flow

Instruments have been designed which claim to be able to detect the flow of underground water, such as a carefully balanced magnetic needle in conjunction with specially constructed magnet. The writer has seen these instruments in operation, and there is no doubt that considerable movement of the needle takes place under certain conditions; but in general, the results were too inconsistent to draw any decided conclusions, and it could hardly be said that the instrument would lend itself to a conclusive scientific test.

The most usual method adopted by the diviner when starting operations is to grasp the twig firmly in both hands and start walking in a straight line across the area under investigation. If no movement of the rod takes place, he then walks in a direction at right-angles to the first line, moving his position from time to time, until the whole area has been roughly covered by a series of lines crossing at right-angles. Once the stream has been located by a movement of the twig, it is a simple matter to trace the line of it, the twig turning each time the diviner crosses over the line of the stream at the surface. A series of pegs can then be driven into the ground to mark the course of the stream. Frequently, more than one stream can be located, and it is often found that if traced far enough, the two flows will meet forming one large stream, and the point of junction is often a favourite spot for drilling the borehole or sinking the well.

To come down to a concrete instance of water divining. The writer remembers the case of a borehole drilled in solid granite on the borders of Dartmoor at a high elevation. The site selected by a water diviner appeared a very unlikely one. The bore was drilled to a depth of 100 ft., and very little water was obtained. A slight trickle of water was observed, however, entering the bore at a depth of 30 ft., and it was therefore decided to fire off a charge of explosive to shatter the rock at this point. After the shot had been fired, a pump was inserted, and a permanent yield of 200 gallons per hour was obtained. This tended to show that the borehole must have missed the line of the underground stream by a few inches, and an opening was required to enable the water to flow into the bore.

Hard Fissured Rock

In a great many districts, the underground strata is fissured, and it is through these fissures that the water flows. On the other hand, an underground bed of gravel may be saturated with water, and under these circumstances water can usually be obtained by sinking at any spot, even if there is no evidence of a supply as far as the diviner is concerned.

It is clear, therefore, that the diviner, or dowser, as he is sometimes called, is likely to be of more service in districts where hard fissured rock is met with, rather than in districts where large beds of gravel and sand are found. It by no means follows, however, that his services should be ignored even in the latter districts. Very frequently underneath these gravel beds, clay is met with, and large supplies of water may be flowing through the gravel in channels cut in the clay; the clay forming, as it were, the bed of an underground stream. An interesting case of this description came before the writer a short time ago. Three wells 30 ft. deep had been excavated in an extensive deposit of gravel, but no very large supplies of water had been obtained. A water diviner, however, located the line of an underground stream promising big supplies. A well was duly sunk, but so vast was the supply of water that it was found impractical to excavate below 10 ft. Pumping plant was installed, and a yield of 90,000 gallons per hour was pumped continuously for ten days, but utterly failed to exhaust the supply.

A further demonstration of water divining.

One method of testing the powers of the diviner is to arrange for him to stand over a pipe through which water can be caused to flow at will. The diviner should be able to detect whether the water is flowing or not. Many tests of this nature have been carried out, and although many successful demonstrations have taken place, it is equally true that there have been many failures. This rather tends to show that auto-suggestion may have considerable bearing on the subject.

Avoiding Pitfalls

There is no doubt that considerable practice and years of experience are required before the diviner becomes an expert, so that he can avoid the many pitfalls inherent to the work. There is a good deal more in it than merely grasping the rod and waiting for it to turn. The power does not lie in the rod itself; it is merely an indicator.

The velocity of the flow of water also has considerable bearing on the action of the rod; and this aspect, in the writer's opinion has not been sufficiently taken into account. But it would appear to be clear that the higher the velocity of flow, the greater the reaction of the rod.

It is a curious fact that no action appears to take place if the water is flowing above the diviner, *i.e.*, if he walks through a tunnel there may be a vast quantity of water flowing in the strata above the tunnel, and the diviner is quite unable to detect its presence. It would also appear essential that the diviner should stand in an upright position; some diviners state that when lying in a recumbent position the faculty entirely disappears, and no action of the rod takes place.

The divining rod is sometimes turned to strange usages, and there are those who claim to be able to locate the position of dead bodies even at considerable distances. It may be asked: What is the maximum depth it is possible to detect water below the surface? Whilst it has been claimed by some to be possible to locate water as deep as 1,000 ft. below surface, it is generally conceded that the greater the depth, the less reliable are the results, and, generally speaking, 300 ft. or so is the maximum depth that the diviner's claims can be relied upon.

There is no doubt that a considerable amount of mystery is still attached to the whole matter, and much careful and patient investigation is called for. In the meantime, the art of water divining should not be condemned as a delusion, nor, can it on the other hand, be looked upon in any way as an exact science.

FLYING MENAGERIES

A SPECIALLY interesting feature of airway traffic at the present time, as shown by figures which have just become available, is the increase which continues to be recorded in the transport of livestock by air.

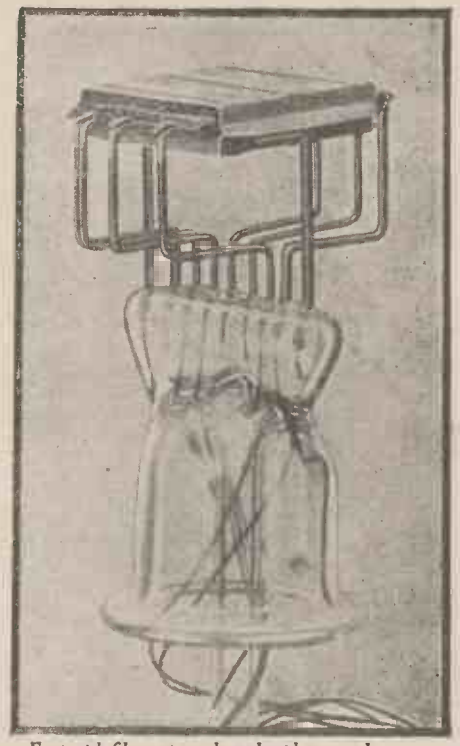
More and more pedigree animals, such as dogs and cats, are being sent over to the continent by air. There is also a growing traffic in the air despatch of day-old chicks from poultry farms in England to similar establishments throughout Europe, while from along the Empire routes tropical fish in tanks are now consigned to London by air. Not long ago the Imperial Airways received a crate of live locusts from Africa, intended for experiments in this country with a view to the extermination of the locust plague by chemical means.

The list attached, which has just been brought up to date by their freight department, shows the variety of the livestock they are called upon to handle:

Dogs.	Cats.
Rabbits.	Monkeys.
Small bears.	Lion cubs.
Mice.	Live locusts in crates.
Parrots.	Turkeys.
Day-old chicks.	Live fish in tanks.
Racing pigeons.	Bees.
Live alligators.	Rare Zoo specimens.

One day they brought over a fully grown lion from the Continent in a special cage. On another occasion they fixed up the freight compartment of a machine as a horse-box, so as to fly over a valuable performing horse from Paris. Sometimes an aircraft will arrive with a regular menagerie on board—animals, birds, and all kinds of tropical fish in tanks; while from one of the machines which landed one evening they unloaded a number of live alligators in crates.

As a means of transport for livestock the air is now recognised as ideal. Valuable animals of the pedigree type, for example, make their journey by air in a minimum of time, while during their periods of transport they can be fed and receive special attention from the airway staff, arriving at their destinations in a condition which gives them every chance of success if—as they often find to be the case—they have been sent to take part in some exhibition or show.



Foot with filament anode and grid mounted.

HOW WIRELESS VALVES *are* MADE

A visit to a modern valve factory is always full of interest, and one is certain to come away more convinced than ever that the process of valve making calls not only for careful planning and ingenious machinery, but also for a very high degree of skill on the part of individual operators.

THE valve starts life as a very insignificant piece of glass tube about an inch long and perhaps three-quarters of an inch wide. One end of the tube is flattened to give a long, narrow mouth, and the other is splayed out in the form of a small funnel.

The first process is called "foot-making." Seated round a number of curious machines, above each of which is a large cowl, are groups of operators whose duty it is to feed into revolving holders on the machine one of the glass funnels already mentioned together with a number of wires and a short length of thin glass tube. As soon as one of the holders has been filled with its quota of parts, it moves away from the "loading position" and pauses between a battery of gas blow-pipe flames. In a few moments it moves on to another battery of flames of greater intensity, and, after further successive heatings, the flattened portion of the glass funnel becomes semi-molten.

At exactly the right moment a pair of clamping arms move forward and squeeze the softened glass, causing the wires to be firmly embedded in the flattened top of the "pinch," as it is now termed.

Before leaving this section of the factory, the various parts of the foot should be examined rather closely. Each of the wires, for example, which have been sealed into the glass is of composite make-up—a length of stout pure nickel wire which will ultimately support one or other of the valve electrodes, then a very short piece of another kind of wire, and lastly, in some cases, a third piece of wire which will in due course form one of the electrical connections to the pins of the valve.

The Foot and Electrodes

The reason for the very short piece of wire in the middle of the support is that since it is composed of a special metal which expands and contracts, when heated, at the same rate as the glass, there is no risk of the glass being shattered by expansion of the wire, or of the valve leaking because of contraction.

In the case of each "foot" the thin glass tube has also been fused on to the larger foot tube, and a hole exists in the foot tube where the thinner tube has been joined on. Actually, the thin tube is used at a later stage as the means whereby the air is pumped from the bulb, and the opening at its upper end, where it is sealed to the foot, is made by air pressure during the time it is in the foot-making machine. In fact, the opening is nothing but a burst bubble of glass.

In the sections devoted to making the different electrodes many interesting processes can be watched. One ingenious machine turns out neatly wound grids of various sizes in long, continuous strings, ready to be cut up into the correct lengths. Then there are machines pressing plain nickel blanks to the correct form for the anodes of different types of valve. There are so many classes and types of valve in the present-day range of every valve maker that the number of sizes and designs of grids and anodes is very considerable.

In the same section can be seen machines and benches where other small parts of the valve are prepared—the mica spacers and "steady strips" which play such an important part in the construction of the more complicated types of modern valve; glass bars and "beads" which act as supports and insulators to the "top hamper" of many valve types; and numerous other queer-looking assemblies of wire, glass and gauze which form part of the make-up of the complete article.

Assembly

In the assembly department the foot of the valve meets with the other components and the working portion of the valve is built up. The actual method of assembly varies with the type and design of the valve, that is to say, an indirectly heated octode is not put together exactly in the same way as a battery triode. There are also slight differences in the methods of various manufacturers, but there is a certain similarity in them all, and it will suffice to deal first with the assembly of an ordinary battery valve.

The first thing that happens is that the foot, with its projecting support wires, is taken in hand by groups of operators who bend the supports accurately to the correct shape to take the electrodes. This usually requires two stages, in one of which the nickel wires are bent to shape, while in the second hooks are formed on the filament supports. Both operations are performed by inserting the support wires into presses which, by a single movement of the dies, manipulate the wires to exact shape.

Now the grid and anode have to be mounted. This is always done by electric spot-welding. Usually the grid and anode are held in a special tool or jig and placed in position on the support wires. Then a movement of the operator's foot causes the welding head of the spot-welder to descend on the spots where the join is to be made. A heavy electric current then passes through the point of junction, and the heat generated at the contact due to its comparatively high resistance is sufficient to make a neat and very strong weld.

Assembly Detail: Bending the supporting wires accurately to size and shape to receive the electrodes.

Sometimes the filament is fitted before the grid and anode are mounted on the supports, but in many cases, especially in horizontal electrode systems, it is found advisable to thread the filament through the grid which has already been mounted. This is an operation which calls for adept hands and steady nerves, the filament being coaxed through the grid by means of a species of crochet hook. In many types of valve a spring device is fitted to maintain the filament in correct tension, and this with other small parts of the valve are next fitted.

Rigid Inspection

Before the valve is allowed to proceed to a further stage of manufacture the assembly is subjected to rigid inspection. The viewers have to see that filament and grid are correctly centred inside the anode and that no one electrode is touching any other. A few deft touches with a pair of small pliers is all that is required to rectify any small errors in alignment.

Assembly Detail: Fitting grids and anodes by electric spot welding.

Before following the embryo valves to the next stage the electrode assembly should be examined closely. Some valves have a small piece of metal, a few millimetres square, welded on the anode, while others have a mysterious growth, either bell-shaped or flat, attached to one of the supports. This is called the "getter" and consists of a small piece of the metal magnesium, or some other preparation which plays an important rôle in the creation of a good vacuum inside the bulb.

In the case of the electrode assemblies of some of the latest multi-electrode valves, evidence of the wonderful accuracy of the machinery and the skill of the workers is quite apparent. The mounting of a cathode and no fewer than six concentric grids within a cylindrical anode only some ¾ in. in diameter is the task performed during the assembly of an octode, while the inter-electrode clearances of such comparatively simple valves as high-frequency pentodes are so small as to represent a really noteworthy achievement in workmanship.

A point to notice here is that a minimum of transportation takes place. Components and partly finished valves move from stage to stage on belt conveyors and are removed by the different operators, undergo the next manufacturing process, and are replaced on the belt for transport to the next worker.

The next group of machines carry out several essential operations. First of all, the valve has to be fitted with its glass bulb. The foot, with electrodes mounted, is placed on a holder, and the bulb is slipped over it, being held in position by the machine. The bulb has a long "skirt" and extends a considerable distance below the bottom of the foot. Also the neck of the bulb is practically the same diameter as the flange of the foot. The foot, and the bulb suspended over it, commence to revolve before a series of gas flames adjusted to fine points of heat which play on the side of the bulb just opposite the flange of the foot. Passing from one set of flames to another of greater intensity, the glass softens until the foot and the neck of the bulb are fused together. Then the excess glass of the "skirt" falls off, due to its own weight, and leaves the valve sealed into the bulb.

Forming the Vacuum

Of course, the bulb is still full of air, but the interior of the bulb communicates with the outer atmosphere *viâ* the thin tube or "stem," as it is termed. The next process is the formation of the vacuum, and the stem is inserted into a rubber bung, which forms part of the exhausting machine and puts the interior of the valve into communication with a battery of very powerful air pumps. The valve now begins to travel slowly along a circular tunnel, and as it does so the pumps work steadily, drawing the air from the bulb. Inside the tunnel the valve is subjected to great heat, which has the effect of driving air or other gases from walls of the bulb or from the metal parts of the valve. By the time the valve has completed the circuit of the tunnel the vacuum is about as perfect as can be obtained by pumping alone. The degree of vacuum is tested by high tension discharge, and the bulb finally sealed by a gas flame which plays on the stem, heating it until the external air pressure causes it to collapse inward, thus closing the tube and allowing the excess of glass to fall away, but although the degree of vacuum is already very high, it is not good enough for the modern valve.

In the cage on the left the valves are heated by "eddy-currents." In this stage the vacuum is completed by a chemical process and the filament is "activated."

Before the vacuum is finally cleared up it is usual to fit the base. Valve bases are made of moulded insulating material, and the valve pins are moulded into position, the pins themselves being hollow. The bases are prepared by spreading a quantity of cement just inside the rim of the base. Next the operator takes the uncapped bulb, straightens the leading-in wires, and threads them through the holes in the pins, taking care that the correct wire goes into each pin. The base is then pushed hard against the shoulder of the bulb, and placed in an oven to set the cement. Finally, the excess of leading-in wire is cut off and neat blobs of solder make the final contact between wires and pins.

Final Stages

The final stage of manufacture completes the vacuum, and also gives the valve its silvery coating inside the bulb. Indeed, the two are inseparable, for the method of clearing up the vacuum is nothing less than volatilising the magnesium "getter" previously described. The residual gas in the bulb combines with the magnesium, and the magnesium itself is deposited on the wall of the bulb, giving the familiar silvery appearance.

The method of firing the "getter" is interesting. The valves are fitted into valve holders in a revolving frame, and over each valve slides a wire cage or spiral. A high-frequency current, generated by what is nothing more or less than a powerful radio transmitting circuit, is made to circulate through the spiral cage. The cage now acts as the primary winding of a high-frequency transformer, of which the secondary winding is the metal portion of the valve. Heavy eddy-currents are set up in the electrodes and supports of the valve, which become very hot—so hot that any gas mixed in the substance of the electrodes is driven off into the bulb. After a certain time, which is carefully predetermined, the heat becomes sufficient to volatilise the magnesium getter. Chemical action between the getter and the residual gases removes the latter, and the getter is sprayed on to the internal surface of the bulb.

Assembly Detail: Threading the hair-thin filaments through the grid—a task calling for delicate touch and a steady hand.

After the gettering process, each valve is "aged" by running it under something like normal conditions for a number of hours. Previously it has undergone various electrical tests, but at the completion of the ageing process far more stringent quantitative tests are given. The filament current is measured, and the emission of the valve is tested. The anode current, measured at various values of anode voltage and grid voltage, gives an indication of the "slope" or mutual conductance of the valve, while numerous other readings show whether the vacuum is perfect and whether the performance of the valve comes within the very narrow limits laid down by the manufacturer.

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The answer to these and to many other questions relative to *Your Success* and its assurance through Pelmanism, will be found in the new book, "The Science of Success," that is yours for the asking. Fill in the coupon below, mail it to-day, and to-morrow your copy of "The Science of Success" will be sent you free of charge, post paid. In this book you will read thrilling accounts by Pelmanists themselves of how whole lives have been changed for the better by Pelmanism. Men and women in every walk of life have obtained undreamed-of success through taking this Course.

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Pelmanism may be studied when and where most convenient to you, for the Course is taught by correspondence only. There are no classes to attend. Each student receives individual instruction. The needs and problems of each Pelmanist are considered and studied separately by highly trained, sympathetic, friendly instructors, who love their work. Under this understanding system even the most timid student gains self-confidence immediately.

A Famous Newspaper Owner

The head of a great newspaper must necessarily have a deep comprehension of the human mind. A successful publisher must know and understand all sorts and conditions of people. Therefore what he says is valuable. Read what Lord Riddell says of Pelmanism—"Pelmanism is rapidly becoming part and parcel of our daily lives," states Lord Riddell, and then he tells a little story that demonstrates the practical usefulness of Pelmanism in such a simple, yet such a convincing, manner that it is a real tribute to the practicability of Pelmanism. Lord Riddell continues in these words: "A friend of mine has the habit of marking documents which he reads in three different ways. Important passages he marks in blue: less-important passages in red: and the least important in black. The other day he sent for a document. It was brought to him by a new junior clerk, who had turned up the page containing the only passage marked in blue. My friend remarked, 'That is just what I want. How did you know ?' 'Well, sir,' replied the clerk, 'you always mark your important things in blue.' 'That's true,' said my friend, 'but I never said so. Who told you ?' 'No one; I just noticed it,' answered the boy. 'You must be very observant,' said my friend. 'I don't think I am so naturally,' replied the clerk, 'but I've studied the Pelman System !' My friend at once took a Pelman Course. To-day he is an ardent Pelmanist."

The counterpart of Lord Riddell's story may be seen in the thousands of testimonial letters constantly received by the Pelman Institute from men and women glad to tell us of the progress, the promotion, the increased incomes they have achieved since becoming Pelmanists.

The Tidy Mind

Pelmanism banishes self-consciousness and nervousness, and helps you to so concentrate on the task in hand that you are bound to succeed in whatever you undertake. Pelmanism directs your energy, and prevents you from wasting it in useless conjectures and mind-wandering.

The Pelmanist has a tidy mind. He wastes no time looking for things or trying to remember where ? when ? what ?

In other words, the Pelmanist does not bungle. He knows what he wants to do, and does it. His leisure time is not all cluttered up with half-formed projects, desires, memories. The Pelmanist keeps his mental house in order, and in consequence has time for his work (uninterrupted by day-dreaming), and after his work is done he has a healthy interest in some sport or hobby that refreshes and recreates his mind and body so that the time that he spends at his work is really productive.

The Pelmanist is courageous, cheerful, quick and accurate in his decisions. He is so interested and occupied with the business of life, its work, its pleasures, and the success he makes of it, that he has no time to spend on being morbid, timid, fearful.

France Honours the Pelman Institute

At the International Exposition of Applied Arts and Sciences held at Liége, in 1930, the Pelman Institute received the same awards and medals as were awarded to the University of Montpelier (one of the oldest Universities), the Normal School of Nancy, the Binet Society of Paris, and the Jean Jacques Rousseau Institute of Geneva. At the Exposition at Nancy in 1932 the Pelman Institute was awarded the Diploma of Honour. In March, 1933, the French Government conferred the Diploma of Honour and a medal on the Pelman Institute.

FOR THE YOUNG AND THE OLD

A Practical Course for practical men and women who have in most cases to earn their own living.

There is no such thing as an age limit for the study of Pelmanism. While many young people find a course of Pelmanism the greatest aid in their studies, and a wonderful help in preparing for examinations, and in passing them successfully, many men and women who have long since passed into the autumn of their lives have discovered renewed interest, and, indeed, many say, a mental rejuvenation in Pelmanism.

Remember this: If there is anything you want, such as an increased income, success in your examinations, promotion in business, the professions, or the Services, greater social success, or a general improvement in yourself, your mind and body, your will to have this improvement, plus Pelmanism, will assure you of it.

Sir Herbert Barker

A well-known advocate of Pelmanism says:—

"The world owes an enormous debt of gratitude to the inventors of the Pelman System for discovering a means, so easy and pleasant, by which the Nation's mental equipment can be brought to its very highest possible pitch of efficiency and maintained there.

"I know of no other method to compare with it."

"Benefit Beyond Computation"

"The system brightens our outlook on the glorious possibilities of life; strengthens and quickens our memory and understanding; gives coherence and clarity to our thoughts, and enhances unbelievably our capacity for intellectual enjoyment and usefulness.

"I am convinced that benefit beyond computation can be secured by all—whether the student be nineteen or ninety—who will follow the directions given in the Course."

The present direction of the Pelman Institutes throughout the world is the same as for the past thirty-five years, so that the "essential factor of experience" is one of the very important qualifications upon which students of Pelmanism can rely. During these years more than five hundred thousand men and women have enrolled for the Course.

We shall be glad to send you a copy of "The Science of Success," 48 pages, post free. You can write us fully, or you can make just a bare application by using or copying the form below. In any case your enquiry will be regarded as a confidential communication.

To the Pelman Institute,
130 Pelman House, Bloomsbury Street, W.C.1.

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THE NEW 1935 WIRELESS PROGRAMMES

A review of the latest designs in wireless sets and components for the new year.

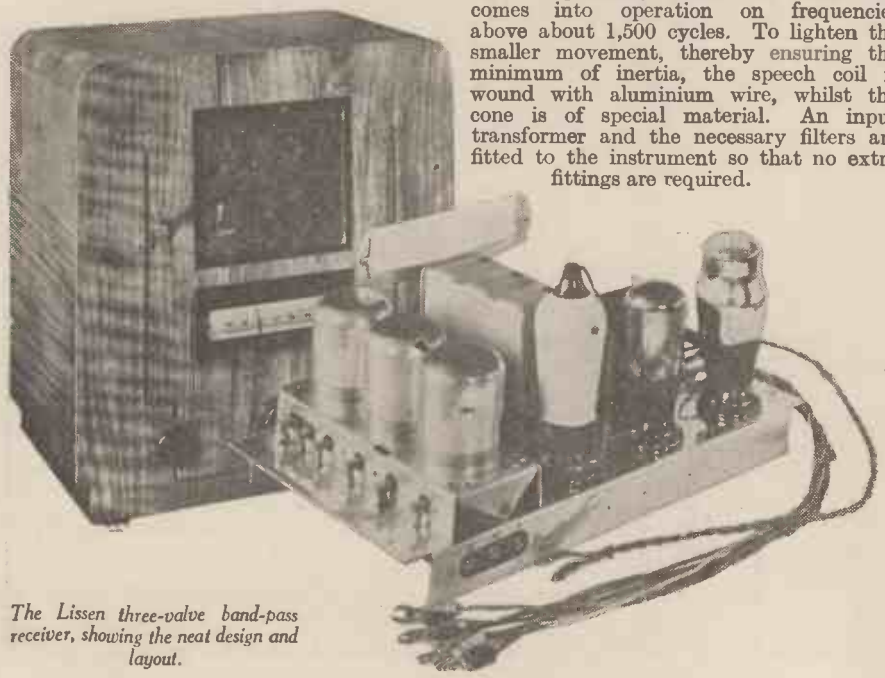
THOSE sceptics who are continually claiming that radio has reached "saturation" point must have had a shock on visiting the 1934 Radiolympia to find that the display was not only the best yet, but that interest in every branch of wireless was keener than in any previous year. It must be admitted that a considerable amount of space was devoted to complete ready-made receivers, but it is equally true to say that the variety and quality of components and accessories offered to the home constructor were very much in evidence, despite the enormous price reductions which manufacturers have been able to effect. So great was the interest in home construction that it is agreed that the coming season is going to be a "bumper" one for the amateur and experimenter, who can pursue his hobby more inexpensively than at any time since radio became Britain's national hobby.

In this splendid piece of cabinet work—a Halcyon product—the sloping baffle and bookcase form interesting departures from normal design.

New Designs of Loud-Speakers

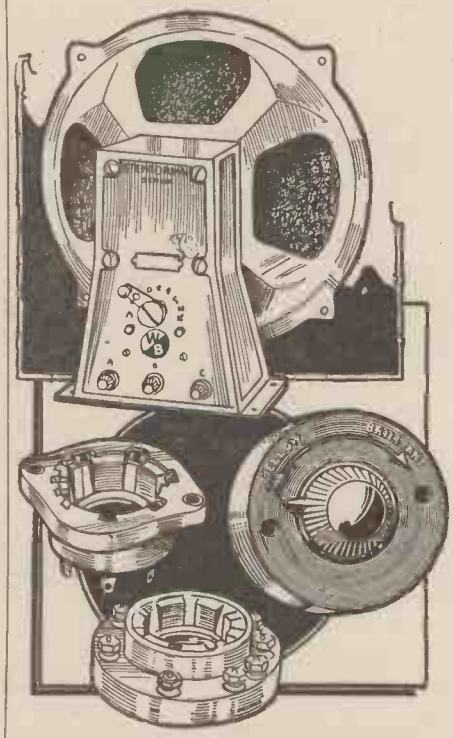
In going the rounds of the exhibition one could not fail to be impressed by the variety of novel and interesting loud-speakers which were to be seen on a number of stands. It was very apparent that makers have been carrying out a large amount of experimental work with a view to improving the quality of reproduction—and that success has attended their efforts. A few manufacturers have tackled the problem of quality reproduction by designing a special and additional speaker which gives maximum response to the higher musical frequencies. This is used in conjunction with the normal instrument, which gives maximum response to the lower and middle frequencies, with a result that a uniform response is obtained at all frequencies between about 50 and 10,000 cycles.

Another new speaker for providing equal response to the complete musical spectrum is the Blue Spot "Super Dual" which combines two separate cone-diaphragm moving-coil units, these being mounted concentrically. The large cone is of normal type and deals with all except the very high frequencies, whilst the small one comes into operation on frequencies above about 1,500 cycles. To lighten the smaller movement, thereby ensuring the minimum of inertia, the speech coil is wound with aluminium wire, whilst the cone is of special material. An input transformer and the necessary filters are fitted to the instrument so that no extra fittings are required.



The Lissen three-valve band-pass receiver, showing the neat design and layout.

Another loud-speaker development of importance which was revealed at Olympia was the introduction by Messrs. W. B. of the new "Stentorian" range of units. These are of especial interest to the owner of a small receiver who has hitherto been obliged to stick to the old moving-iron speaker because of the comparative insensitiveness of the average moving coil; the "Stentorians" certainly give a greater output for a given input than do any other moving coils we have tested. A new feature of interest on the W. B. Stand was the neat tone control which can be fitted to almost any speaker in order to vary the pitch of reproduction as required.



In addition to the popular Stentorian speaker Messrs W. B. also manufacture the volume control and valve-holders shown in this group.

Still dealing with speakers, mention should be made of the bowl-type instruments made by Kingsway Radio, Ltd. These are very attractively made and are finished in a modern style. Another novel speaker is the "Mastersinger," which is combined with an electric light shade which is shown in the illustration on page 26. Due to the position of the speaker, near to the ceiling, and to the fact that the electric shade gives a "diffusion" effect, it is claimed that particularly good reproduction can be secured.

High-Grade Measuring Instrument

It was very interesting to find that a number of manufacturers were now catering more than ever for the real experimenter who wishes to take accurate measurements. The Automatic Coil Winder Co., who are so well known as manufacturers of the

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4th Prize - £3
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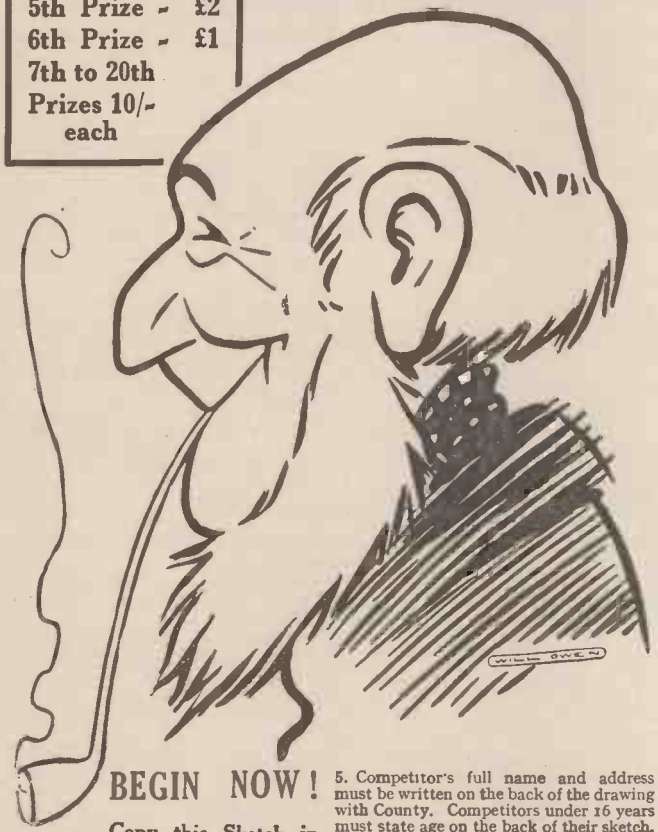
Copy this Sketch and send us your Drawing. The Competition is being held to advertise the British and Dominions School of Drawing and is OPEN TO EVERYBODY WHO LIKES TO TRY. The only persons not allowed to compete are those who have had Sketches purchased by a newspaper or advertiser. The competition is confined strictly to Amateurs.



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Copy this Sketch in pencil or pen and ink. See how well you can do it. Sit down and try. First of all read the Rules of the Competition. You can draw on any paper. Prizes will be awarded to the best drawings. All drawings will be returned to the competitors at the close of the competition. DON'T MISS THIS! SOMEONE WILL WIN THE £20. WHY NOT YOU? Send in your sketch to-day.

RULES OF THE COMPETITION

1. Anyone is eligible to compete except past or present students or employees of the British and Dominions School of Drawing and Professional Artists.
2. All sketches must be received by 22nd October, 1934.
3. Only one sketch may be submitted by each competitor.
4. The bottom left-hand corner of envelope should be marked plainly "COMPETITION."
5. Competitor's full name and address must be written on the back of the drawing with County. Competitors under 16 years must state age on the back of their sketch.
6. Sketches must not be drawn on paper larger than 8 in. high by 6 in. wide.
7. All sketches will be returned to competitors at the close of the Competition, together with a list of the prize winners. The British and Dominions School of Drawing cannot be held responsible for any sketch which may be lost in the mails or elsewhere.
8. Sketches must be accompanied by a crossed postal order value 6d. (sixpence), in return for which each competitor will receive an illustrated book demonstrating the methods of artists in producing drawings. This will be sent with the results of the competition. Please do not send coins.
9. Sketch and Postal order **MUST BE SENT IN THE SAME ENVELOPE.** Competitors are particularly requested **NOT** to send their sketch in one envelope and postal order under separate cover.
10. Sketches received insufficiently stamped will not be accepted. All packages should be sealed and bear letter rate of postage (2 oz. for 1½d.).
11. Competitors agree to accept the decision of the Artists of the British and Dominions School of Drawing as final and conclusive.
12. The British and Dominions School of Drawing reserves the right to purchase any sketch submitted. Any sketches purchased will be paid for at the rate of £1/1/0 (one guinea) for each sketch.

BRITISH & DOMINIONS SCHOOL OF DRAWING LTD.,
54 Greycoat Galleries, Greycoat Place, LONDON, S.W.1

This illustration is of the Lampex "Unifive" receiver, which embodies a number of attractive features.

"Avometer," and "Avominor" and "Avodaptor" have added to their range of instruments the "Avo-Oscillator," which is extremely useful for making a variety of tests on receivers and components. It provides a modulated H.F. signal, the frequency of which is variable over the complete long and medium-wave bands; the frequencies to which it is adjusted can readily be determined by use of the graphs which are shown on the front of the unit.

A new pick-up, with built-in volume control, by the British Blue Spot Co., Ltd.

The price of this high-grade accessory, complete with valves, dry cell and 20-volt H.T. battery, is £5 10*s*.

A variety of other useful test instruments were to be seen on the Bulgin stand. There were here meters of almost every type required by the experimenter, and at remarkably attractive prices. Other meters shown were for use as visual tuning indicators, and these also were in various types and shapes, so that they are suitable for use in conjunction with any type of tuning dial or component arrangement.

A console radiogram from the extensive Cossor range of 1935 receivers.

Among the low-priced, though accurate, testing instruments and meters came the "Pifco" units made by Provincial and Incandescent Fittings Co., Ltd. The A.C.–D.C. "Radiometer" and the "Rotameter" are items in question, and both of them attracted much well-merited attention.

The new-model "Atlas" receiver. This set embodies what is known as spectrum tuning, whilst, as can be seen, the loud-speaker baffle board is arranged at an unusual angle.

Tuning Units

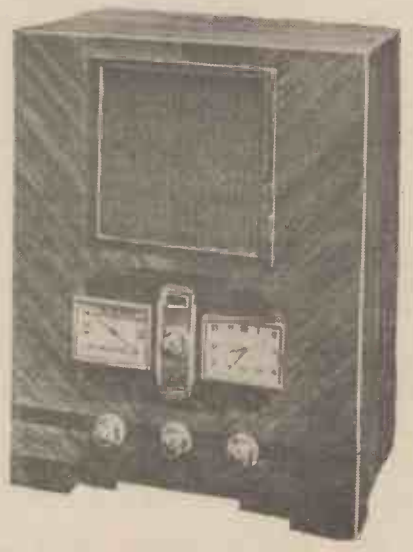
Tuning coils and condensers were to be seen in a variety of very interesting types, and one could not fail to be impressed by the many important changes which have been brought into effect since last year. There were several midget gang condensers which must have warmed the hearts of those constructors who are in favour of buying components of high mechanical efficiency and who are also interested in the development of the compact receiver. The midget screened gang condensers on the stands of Wingrove and Rogers ("Polar") and of Jackson Bros., Ltd., proved to be very popular indeed; both were shown in both "plain" and superhet. types.

Among the many types of coil which were to be seen, the new Colvern "Ferrocart" units, employing a new form of construction, were to the fore. Other coils of novel type were to be seen on the Bulgin, Wright and Weaire ("Wearite") and Telsen stands, whilst something quite new was shown on the Varley stand. This was a new ganged permeability tuner which, it is claimed, gives constant selectivity and amplification over the whole of both wavebands. In order to demonstrate the efficiency of the new tuner two cathode-ray outfits were set up on the stand; these showed the response curve of the permeability tuner and of a set of ordinary Varley coils, and it could be seen that the permeability assembly was far superior.

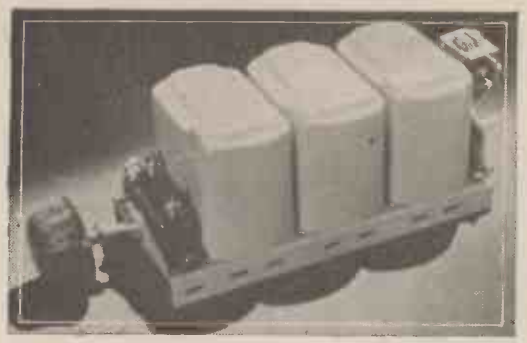
The British Pix Co. had two new items, both designed for improving aerial and earth efficiency. The importance of a low-resistance earth connection has been many times stressed in these pages, and various suggestions have been made by readers and a number of firms have produced commercial forms of chemical earth. The Pix metallised earth consists of a small can with a perforated top to which is attached a substantial terminal. The earth wire is attached to this terminal and the can is buried. Moisture in the earth renders the chemical active and in a short while the whole of the surrounding earth is rendered moist and remains in this condition almost indefinitely. The only point which requires attention is the attachment of the earth wire to the terminal, and it will obviously be necessary to periodically inspect this connection unless a soldered joint is made, painted, and wrapped with insulation tape or some similar medium. The can is of copper and is thus rot-proof, and the constituents of the earth are guaranteed harmless to plants and animals.

As a safety precaution many listeners prefer to have some form of lightning arrestor in the aerial circuit and the neat arrestor made by the British Pix Co. is designed to link the aerial and earth wires, which are simply passed through small holes in the ends of the device. Signals are unaffected by this connection, but a powerful static discharge will pass through the lower resistance circuit to earth and thus prevent damage to the tuning coil or other parts of the apparatus. The two devices mentioned above, which are of universal application, cost 2*s*. and 1*s*. respectively, and with the latter device a full insurance is provided.

The latest type of Jackson Bros. all-enclosed three-gang condenser.



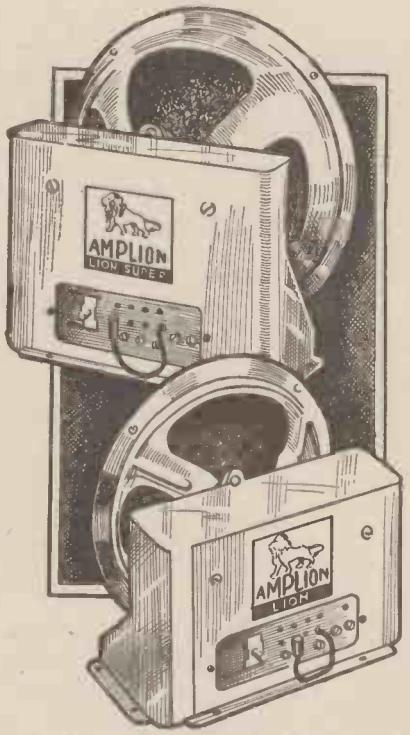
The novel appearance of the clock and the tuning dial strike a new note in this Aerodyne receiver.



This is a set of the latest type of Colvern G-type coils, the cores of which are now self-supporting, no wax being used in their assembly.

Bulgin Accessories

The Bulgin stand formed a most attractive display and it was noted that several components had been reduced in price, and amongst the new lines were some very interesting items shown in the sketch. For switching purposes various suggestions have been made and various types of contact have been devised from time to time to avoid the difficulty of noises and poor contacts caused by weakened springs and other defects. The rotary study switch (1) is a



The latest "Lion" speakers; two forms introduced by Messrs. Amplion, Ltd.

panel mounted device of the normal one-hole fixing type, and it will be seen that a spring arm bears on small tags and thus cleans the contact points as it is operated, and is similar in this respect to the old-fashioned selector switches which graced the panels of the early wireless receiver. Connection to the contact points is made highly satisfactory, owing to the fact that the wires have to be soldered, and a switch of this nature should give years of service. It is available in three types: three-way, four-way, and five-way, the prices being 1*s.* 6*d.*, 1*s.* 9*d.* and 2*s.* The toggle switch provided with a rotary movement instead of the familiar dolly action is also shown (2), and this forms a very neat method of mounting a switch on the panel in order to maintain symmetry in control layout. This is obtainable in all the usual types such as on-off, D.P.D.T., 4-point, wave-change, etc. A switch of more complicated form is shown in (3) and this is designed primarily for wave-change purposes. The action of this switch is very definite, and again a trouble-free type of wiping contact is provided, and the contacts are so designed that the switch may be used with practically any type of coil.

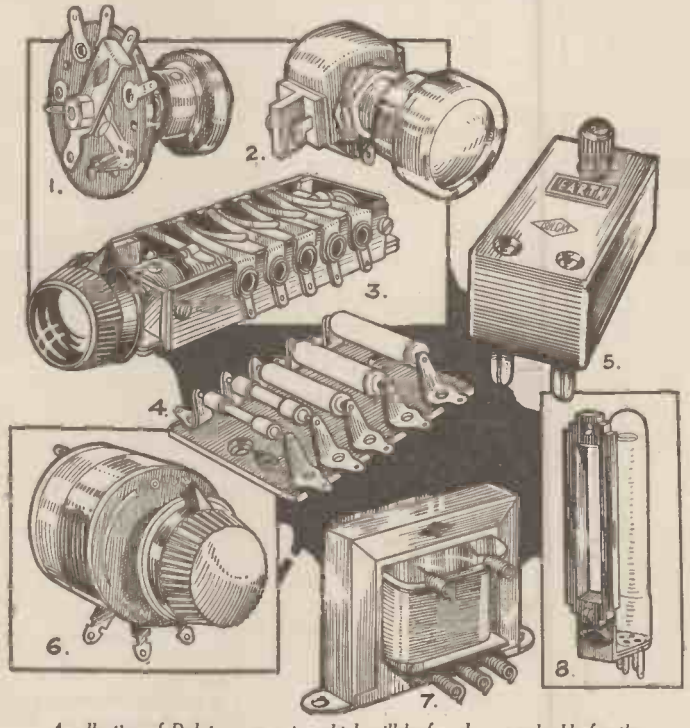
When constructing a mains receiver it is generally found that a number of resistances have to be connected to the voltage supplies, and it is often convenient to connect these resistances together at one end in order to simplify construction. The illustration (4) shows a device which Messrs. Bulgin have termed a "group board," and this has spring clips provided with solder tap ends and is designed to hold resistances or tubular condensers, and will be found of great use in both mains and battery receivers for simplifying the connection of these parts. The base is constructed from bakelite and is attached to the chassis by two screws. It is obtainable in five-way and ten-way types.

The suppression of interference from the mains is usually carried out by connecting two fixed condensers across the mains with a centre-point earthed, and although several suppressors specially designed for this purpose are obtainable, the connection of the device is rendered exceedingly simple in the new Bulgin suppressor shown at (5) in the sketch. As may be seen, this consists simply of a plug which is fitted with pins on one side and sockets on the other, and it is interposed between the receiver plug and the mains socket and thus connects the suppressor condensers in circuit without any difficulty. The addition of an earth wire is all that is required.

Volume controls have previously been dealt with and the model shown in (6) is one of the 3-watt type controls manufactured by Messrs. Bulgin and may be used for various purposes in mains receivers.

A skeleton Q.P.-P. transformer is also obtainable in the new Bulgin range and this is provided with leads instead of terminal, and consequently is obtainable at a low price.

For visual tuning, the new Cossor neon will no doubt prove very attractive during the coming season and a special holder with a small escutcheon has been designed by Messrs. Bulgin and is shown in (8). This will add to the appearance of home-constructed receivers as well as providing a useful indication for tuning purposes where A.V.C. is fitted.



A collection of Bulgin accessories which will be found very valuable for the experimenter.

Some New Polar Components

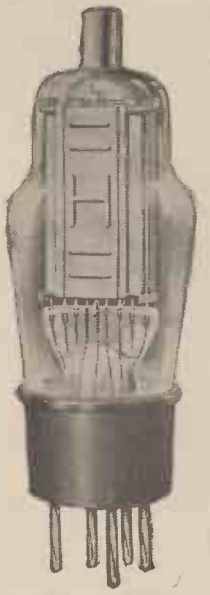
The Polar Midget Variable condensers and the three-gang model is only approximately 2 in. wide by 3 in. high by 5 in. deep. It will thus be seen that it enables a very compact receiver to be constructed when modern iron core coils and other midget accessories are employed. For tuning indication purposes the drives with this condenser are very satisfactory, and these

The novel Amplion receiver.

provide a full vision scale with a very smooth action and a pointer which is clearly visible and thus provides a very accurate reading of the condenser setter. The escutcheons are of moulded bakelite and are attached to the panel by bolts which are fixed to the moulding, and thus no difficulty is experienced in giving a receiver a really finished appearance.

Baker Selhurst Radio

A new type of speaker was produced by Messrs. Baker for the coming season and was seen at the Exhibition for the first



The Hivac valve shown above has only just been released—it is the mains-operated H.F. pentode.

time. This is known as the "Fydelitone" and is obtainable in two models — the Major (45*s.*) and the Minor (35*s.*). A matching transformer is included in the cabinet, which is of modern design moulded in bakelite and obtainable in walnut or black and chromium. The overall dimensions are only 8½ × 8½ × 3in., and a new type of permanent magnet manufactured from nickel aluminium steel gives very high efficiency in a minimum of space. If it is desired to use the speaker with an existing output transformer it may be obtained without the transformer for 37*s.* 6*d.* and 29*s.* 6*d.* respectively.

Hivac Valve Price Reductions

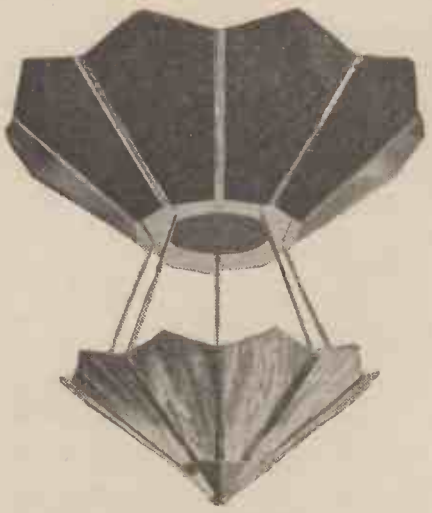
The popular Hivac battery valves have now been reduced in price, and these valves represent a considerable saving to the home constructor. The following prices show the types of battery valve together with the old and the new prices.

Type No.	Use.	Old Price.	New Price.
		s. *d.*	*s.* *d.*
H210	H.F. amplifier	4 6	3 9
L210	L.F. amplifier	4 6	
D210	Detector	5 6	
Y220	L.F. pentode	12 6	10 6
Z220	L.F. pentode	12 6	
HP215	H.E. pentode	12 6	
VP215	H.F. var-mu pentode	12 6	

This range of valves has been augmented by a complete range of A.C. mains valves, which range in price from 9*s.* 6*d.*

The Sinclair Speaker

A loud-speaker of a very novel and striking appearance is a matched two-in-one speaker, manufactured by Sinclair speakers. A 9-in. cone operated by a special cobalt steel magnet (or an energised field where desired) is mounted in such a manner that an extension chassis may be bolted to it, and this extension has a ring magnet which operates a special high impedance speaker coil attached to a 5-in. or 7-in. cone, the common output transformer being connected to act as a choke for this second speaker. The construction is very novel and the speaker may be obtained with one permanent magnet and one energised, or with two permanent magnets for 84*s.*



A novel type of speaker which incorporates an electric-light fitting.

The Peto-Scott Lucerne S.G.3 Kit.

The Peto-Scott Lucerne S.G.3 kit should prove popular with home constructors. The components are of sound construction,

Anti-interference (or impedance-matching aerial) device manufactured by Messrs. Ward and Goldstone.

and are all fitted with terminals in order to facilitate wiring, and a blueprint and an instruction booklet are supplied with each kit, thereby enabling the veriest novice to assemble the various components without difficulty.

The coils are of the air-core unscreened type, but as a large metal screen is used for separating the components of the two tuned circuits, the receiver should prove quite stable. The use of a Metaplex base-board also helps to ensure perfect stability, as the metal coating of this acts as a screen and a reliable earth return of low resistance.

To ensure good-quality reproduction the output valve specified is of the super-power type, and the speaker is of the permanent magnet moving-coil type.

The circuit is the well-tried SG HF triode detector and super-power output arrangement, and the coupling between the SG and detector valves, is of the tapped tuned grid type, with transformer coupling between the detector and output valves. The grid winding of each coil is fitted with tappings, in order that maximum selectivity may be obtained in congested localities, and the coils have been designed to meet the Lucerne Plan wave

The large and easily read tuning dial is an interesting feature of this Ekco consolette.

length arrangements. Separate tuning condensers are used, thereby enabling the listener to obtain maximum output from the HF stage without the necessity for adjustment of trimmer condensers. The makers recommend the use of a 120-volt battery for supplying H.T., but a reliable H.T. eliminator, having an output of approximately 120 volts at 20 m.a., should prove quite satisfactory.

The cabinet is of neat design, and there is ample room in the speaker compartment for housing all the necessary batteries or an H.T. eliminator if used in place of the 120-volt battery.

A newly designed wonder plug. The new Clix aerial-earth plug which accommodates heavy gauge wire.

New Types of Valve-holders

Messrs. Lectrolinx Ltd., whose wireless connecting devices are well known to readers under the trade name of Clix, introduce a number of new lines. These include American chassis-mounting valveholders for soldered connections in 4-, 5- and 6-pin types at 7*d.*, 8*d.* and 9*d.* each; 7-pin continental chassis-mounting valveholders, including a screened model for use with Ostar Ganz valves, as well as an unscreened model, a 9-pin chassis-mounting valveholder and a new valve-cap connector. All of their connections and terminals provide a smooth and positive grip contact

This illustration (an Ekco receiver) shows how the question of the tuning dial has been tackled.

HISTORIC LOCOMOTIVES

PART VI

By E. W. TWINING

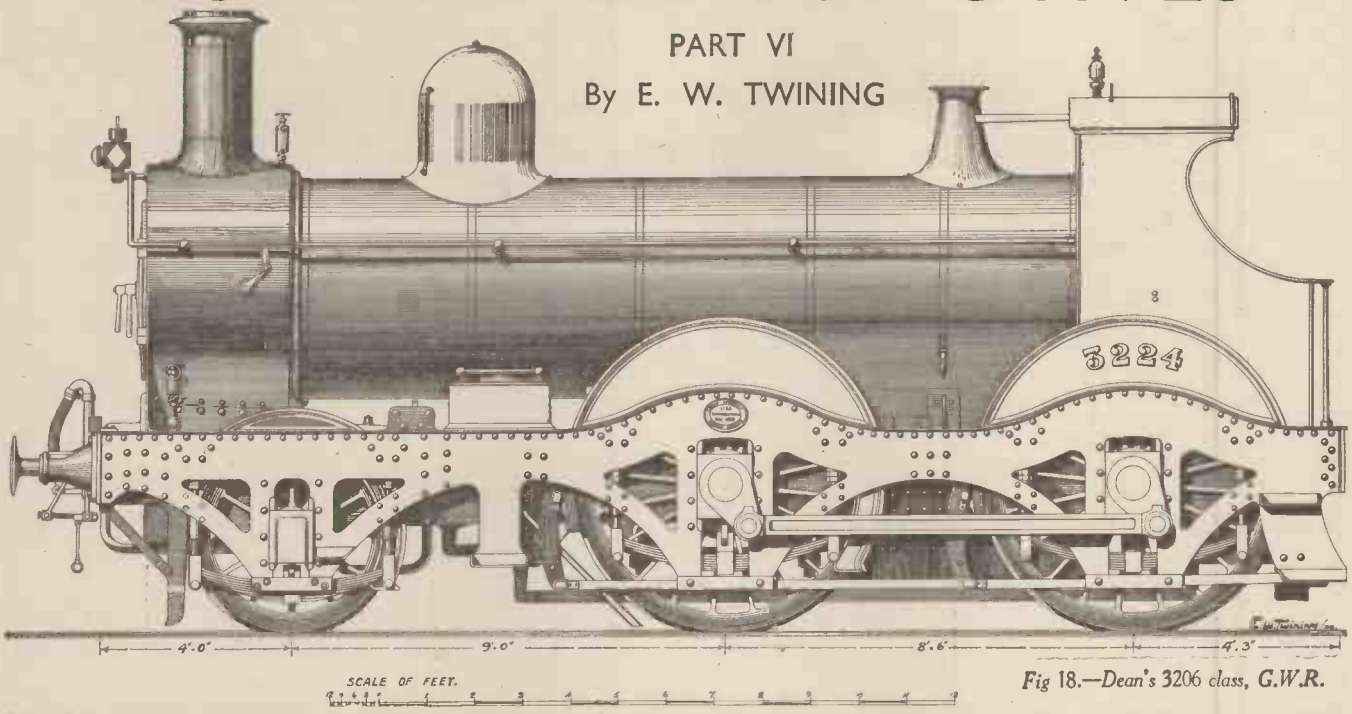


Fig 18.—Dean's 3206 class, G.W.R.

IN the year following that in which the last broad-gauge engine was built, that is to say in 1889, Mr. Dean designed and constructed at Swindon a new class of 2-4-0 type passenger engine. This was a batch of twenty numbered 3206–3225. Other writers have, when referring to these engines, expressed surprise that in them Mr. Dean should have again reverted to the slotted type of sandwich frame. It is true that during Mr. Dean's control at Swindon he built many inside-framed engines, including several lots with the same wheel arrangement, but he nevertheless returned from time to time to the typically Great Western Stephenson-Gooch sandwich-pattern framing.

Dean's 3206–3225 Class

A drawing to scale showing the external elevation of these engines is given in Fig. 18, and the following are the principal particulars concerning them. The driving wheels, coupled, as will be seen, by outside cranks, were 6 ft. 1½ in. diameter, the leading wheels 4 ft. 1½ in. The cylinders were 18 in. diameter by 24 in. stroke. The boilers had an outside diameter of 4 ft. 3 in. and a total heating surface of 1,468·82 sq. ft., the grate area being 19 sq. ft. and working pressure 150 lb. The weight in working order was 42 tons 6 cwt. They were particularly handsome and well-proportioned engines.

From 1899 onwards, when Mr. Churchward's influence began to be felt at Swindon, the 3206 class were rebuilt with Belpaire boilers of slightly larger diameter, namely 4 ft. 5 in. Some of them were without domes, but others had domes on the back ring of the boiler. The working pressure was put up to 180 lb., and 2 in. additional length given to the cylinders, but strangely enough the heating surface and grate area were both reduced to 1,284·9 sq. ft. and 17 sq. ft. respectively. Mr. C. B. Collett, the present chief mechanical engineer, very kindly provided me with drawings and data to enable me to construct Fig. 18, and has informed me that ten of the engines of the 3206 class are still in service, numbers 3206, 3210, 2311, 3213, 3216, 3217, 3219, 3222, 3223 and 3225. Of these, six have superheaters, two are fitted with piston valves, and all have the top feed.

The next class of engine which must be described is the 7 ft. 8½ in. single-drive engines of the late Mr. Dean's design. The complete history of these, or rather of the earlier ones of the class turned out, is somewhat involved. I should mention that for some years before the broad gauge

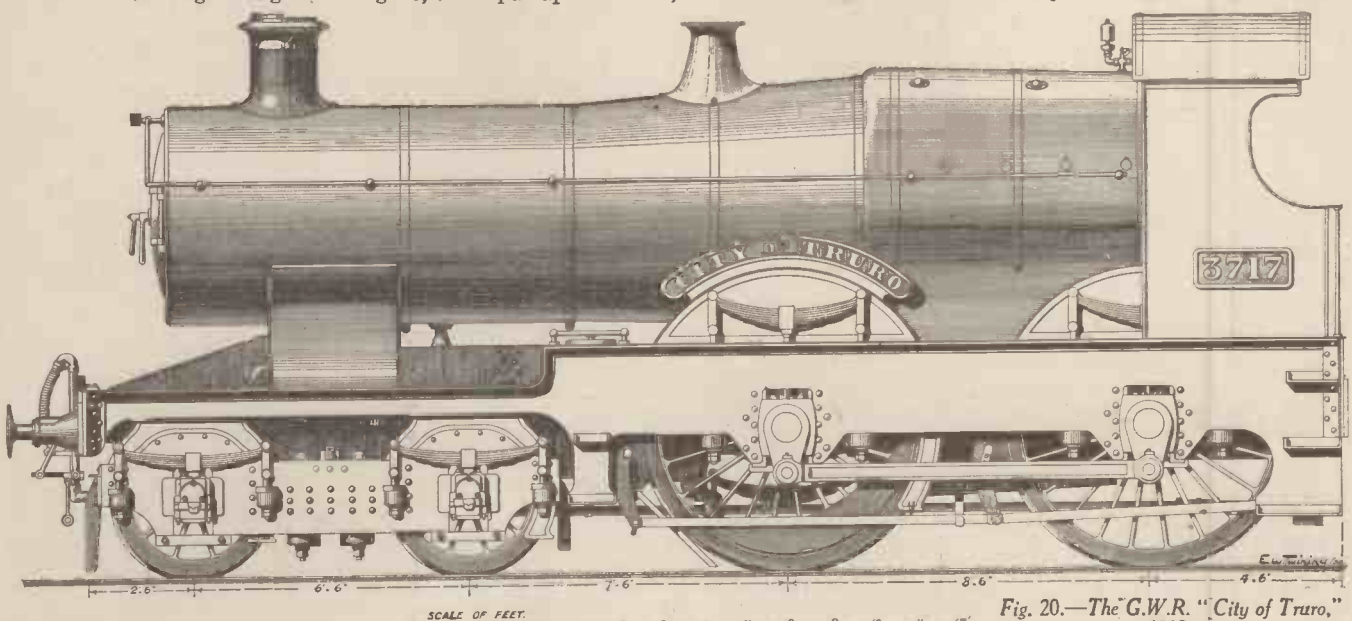


Fig. 20.—The G.W.R. "City of Truro," 1903.

was finally removed, the important step of abolishing it was contemplated by the board of directors, and when a definite date was fixed upon, Mr. Dean set about designing engines to take the place of the 8-ft. singles. During the year previous to the abolition it was deemed necessary to temporarily increase the express passenger broad-gauge locomotive stock, so Mr. Dean designed and built, in 1891, eight 7-ft. 8½-in. singles in such a manner that they could be readily converted to narrow gauge. He placed all the wheels, six in number, outside of the heavy plate frames, and in this condition they ran on broad-gauge metals until May, 1892, when the 7-ft. gauge rails were taken up. These engines were then sent to Swindon, their axles dropped and shortened, and the wheels placed inside of the frames, there being, of course, additional frames inside of the wheels.

At the same time as these temporary broad-gauge engines were turned out, Mr. Dean was building narrow-gauge locomotives of exactly the same design, and on conversion of the eight referred to, the Company had, in 1892, a batch of thirty engines of 2-2-2 type having outside bearings to all the wheels. Then, in 1894, one of these engines ran off the line in Box Tunnel. For some reason they were very unsteady, and I remember at the time that they first came out being told by one of the old broad-gauge drivers, who had, of course, been put on to drive the new narrow-gauge engines, that he was sometimes terrified by the violent oscillation and pitching. Of course, one can understand this from a man who had probably never known high speeds on anything but the steady, smooth-running broad-gauge singles.

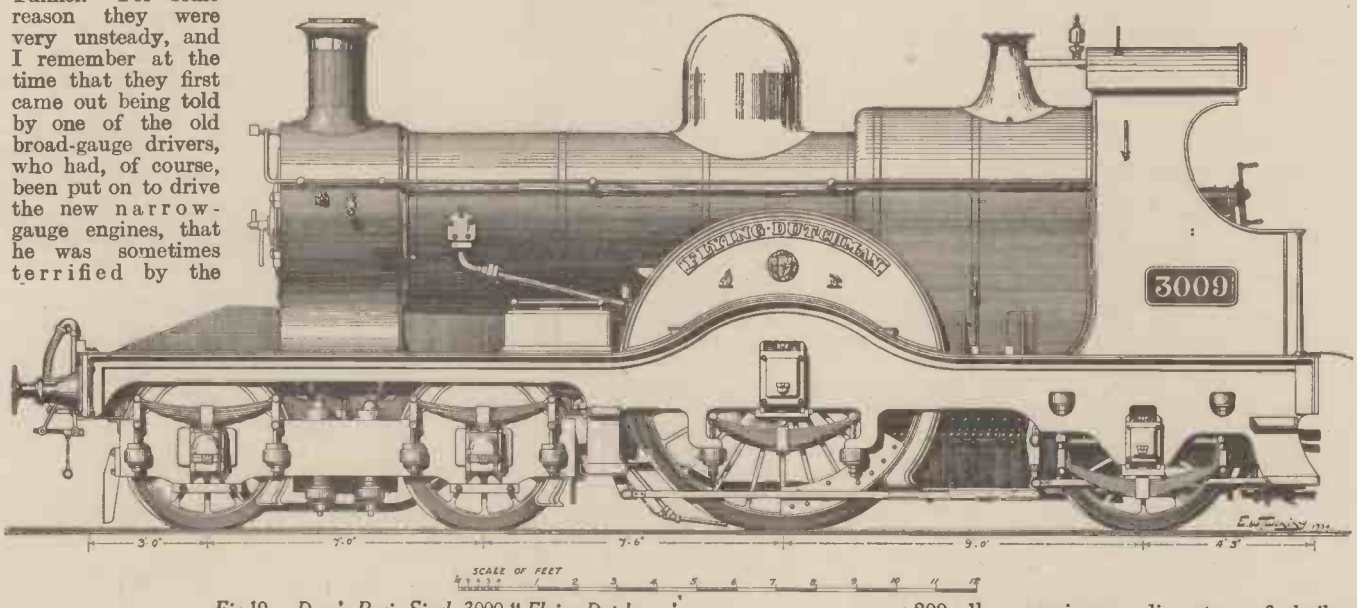


Fig 19.—Dean's Bogie Single 3009 "Flying Dutchman."

Eighty Engines Running

After the Box Tunnel derailment, both the original thirty and the further fifty which Mr. Dean built were fitted with 4-wheeled leading bogies. By 1898 the company had eighty of these fine engines. My drawing, Fig. 19, shows one of the first thirty, which were numbered 3001 to 3030. These, for a time, retained the form of framing and underhung spring at the trailing wheel; all the others were built with the trailing spring above the frame, and in course of time the first thirty were made uniform with them.

The first thirty differed very slightly from the remaining fifty when originally built in one or two measurements. For instance, the earlier batch at first had 20 × 24-in. cylinders, and heating surface 1,459 sq. ft. After all were made uniform, the principal measurements were as follows: driving wheels 7 ft. 8½ in. diameter, bogie wheels 4 ft., and trailing 4 ft. 7½ in. Cylinders 19 × 24 in., heating surface 1,561 sq. ft., and grate area 20·8 sq. ft. The working pressure was 160 lb., and the weight in working order, 49 tons.

I have often thought that the excessive oscillation set up by these engines was partly due to an unnecessary amount of flexibility in the springs, and it seems to me that had the leading and trailing springs been very much stiffer they would have been steadier, and so perhaps would never have been altered to leading bogies. At the same time, the fact that there was side play in the leading axle boxes cannot be overlooked. Then, again, there may have been some inaccuracy in the position or amounts of the balance weights in the wheels. I am not aware that the balancing was ever altered, and I have many times observed, even after bogies were fitted, that when running at speed, the front end of the engine was swaying from side to side quite a considerable amount.

The Great Western "City" Class

The 4-4-0-type engines of the *City* class, though built after Mr. Churchward took office as chief at Swindon, were really developments of Mr. Dean's *Atbara* class; in fact, they were practically identical, with the exception that Mr. Churchward fitted the *Cities* with his new coned Belpaire boilers, to which was afterwards added the top waterfeed.

My drawing, Fig. 20, shows the notorious *City of Truro* with the top waterfeed fitted. I say notorious because this engine is credited, and by a very reliable authority, with having on one occasion reached the highest speed ever attained by a steam locomotive—102·3 miles per hour. The authority referred to is the late Mr. Charles Rous-Marten. A certain writer has quite recently thrown doubt upon this record, apparently basing his doubts upon the assumption that the stop-watch used by the late Mr. Rous-Marten could not have been correct, but I think that the details of the timing given in the record of the gradual acceleration of the train as it passed each successive quarter-mile post are too circumstantial and bear the stamp of accuracy to such an extent that they cannot but be correct.

The *City of Truro* made the record with a special train carrying ocean mail and specie from Plymouth on May 9th, 1904. The train consisted of five 8-wheeled postal vans, and weighed 148 tons without the engine and tender. The destination of the train was, of course, London, and the *City* engine hauled it as far as Bristol, where it was taken on by one of the 7 ft. 8½ in. singles. The maximum speed which constituted the record was made on the down grade of the Wellington Bank over the very stretch of track where the old Bristol and Exeter 9-ft. single reached the then unapproached speed of eighty-one miles per hour. The whole distance of 128 miles from Plymouth (North Road) to Pylle Hill, Bristol, was covered in 120 minutes 12 seconds, and the 246½ from Plymouth to Paddington was run in 3 hours 40 minutes.

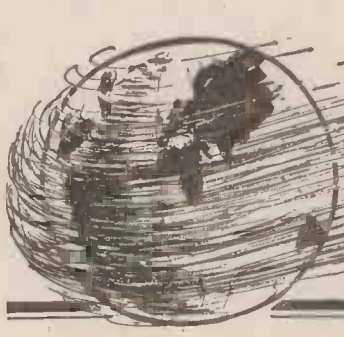
The *City of Truro* is now preserved in the Railway Museum at York. She was built in 1903 and then numbered 3440. Her dimensions are: coupled wheels 6 ft. 8½ in., bogie wheels 3 ft. 8 in. diameter, cylinders 18 × 26 in., heating surface 1,820 sq. ft., grate area 20 sq. ft., working pressure 200 lb., maximum diameter of boiler 5 ft. 6 in., and weight in working order 55 tons 6 cwt.

Big Engines on other Railways

During the early years of the twentieth century many startling developments in the size and power of locomotives took place on a number of the largest railways in this country, and on the Great Western the *City* class was not the biggest in use, for in 1902 Mr. Dean put on the rails an engine of the 4-6-0 type, *No.* 100, which was subsequently named *Dean* by Mr. Churchward in honour of his recently deceased chief. As a matter of fact, there is little doubt that *No.* 100 was actually designed by Mr. Churchward.

But the Great Western was not the first company to introduce the 4-6-0 type for passenger service, though Mr. Dean had built it for goods haulage in 1899, and Mr. Jones, on the Highland Railway, as far back as 1894. To Mr. Worsdell, of the North-Eastern Railway, belongs the honour of constructing the first passenger engine with 6-ft. 8-in. six-coupled driving wheels and a leading bogie.

(*To be concluded next month.*—ED.)



Speeding Up the Earth

By V. E. JOHNSON, M.A.

AS everyone knows, the earth turns round on its axis once every twenty-four hours. As the earth's radius is roughly 8,000 miles, a person at the equator would be travelling through space at the rate of somewhat over 1,000 miles per hour owing to this rotation, which causes a surprising difference in weight at the Poles and at the Equator, neglecting altogether the flattening of the earth at the Poles. The earth is nothing more or less than a gigantic top, and a centrifugal force is generated which acts outwards from the earth's axis. It is obvious that this force is zero at the Poles and gradually increases, reaching its maximum at the Equator. This causes a difference in weight; as a matter of fact, a body at the Equator loses rather more than $\frac{1}{289}$ of its weight from this cause. A cubic foot of water which weighs 1,000 oz. weighs about 4 oz. less at the Equator, and 2·5 oz. less in our latitude.

Now how much must we speed up our earth's rotation so that a body at the Equator has no weight?

If you care to consult any standard work on mechanics, and work it out, you will find that you will have to speed it up (approx.) some sixteen times to do this, remembering that increases of velocity increase the centrifugal force not merely sixteen times, but sixteen times sixteen times.

Decrease in Weight

So our decrease in weight of 4 oz. now becomes 4 × 250 or 1,000 oz., and the centrifugal force at the Equator now exactly balances this weight.

The earth now turns round once every one and a half hours, and day and night would then be three-quarters of an hour long. In our latitude we should roughly weigh about half as much as our original weight.

Our plight would be bad enough, but nothing to those living on or near the Equator, they would be drifting about like a feather in the wind, ready to be blown north, south, east or west.

Even we ourselves should be able to exercise some startling stunts, owing to the fact that our weight would no longer act vertically downwards. Therefore the centrifugal force and the force of gravity would combine to have a resultant (as it is called in mechanics) no longer, pointing as gravity itself does towards the earth's centre, for the centrifugal force (now very large) acts perpendicularly to the axis of the earth.

Keeping our Balance

In order to keep our balance we should no longer have to stand upright, but at a slant like a cyclist rounding a corner. One would easily be able to climb up the north side of a building or a house, provided we climbed it like a fly standing. All motorists travelling northwards would be pulled up, stopped and be pushed backwards by this mysterious and unknown force. It would be found, however, that this force would not be felt at and near the Poles.

The polar bears could trot about quite comfortably, and the Esquimau pursue his usual advocations so long as he did not come too far south, when they would at once become aware of a mysterious force pushing them southwards.

But men and animals are not the only things that centrifugal force acts on—it acts on all matter, including air.

The weightless air would rise up at the Equator, creating a partial vacuum into which would rush the air from the north and south.

We should have winds of terrible velocity blowing in the upper regions *away* from the Equator, while down below equally terrible storms would be blowing in *towards* the Equator. And what about the water? We should have the tropical seas pouring over Europe and Australia. South America towns raining down on New York and Chicago and lions, tigers, elephants, etc., pouring down on what was once London.

A terrifying vision certainly. So perhaps it would be as well in these modern "speeding up" times, if mother Earth was left alone.

THE GAME OF "UP JOHNNY"

AT the recent Model Engineering Exhibition which was held at the Agricultural Hall, one of our contributors, Mr. V. E. Johnson, designed the game which is shown in the photograph.

Hundreds of visitors who visited the Exhibition were intrigued by its novelty. The main object of the game is to project four coons one at a time into a travelling basket and then project them one at a time on to the wire hammocks shown on the left of the photograph. It is quite simple to play and below is given the rules of the game.

Rules

Only one of your coons must be in the basket at a time.

When striking the lever with the stick the hand must not be raised above the iron bar.

Should the coon hit the edge of the hammock, or from any cause fall back into the basket again, you have another shot; or as many shots as often as this happens.

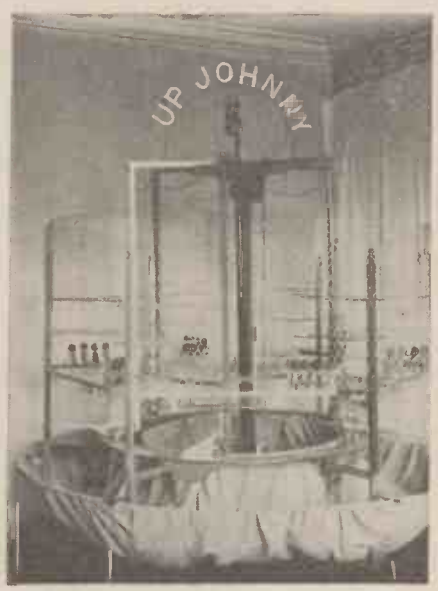
Except when projecting the coon into the travelling basket, the stick must be kept outside the iron bar.

One hand must be kept behind the back whilst playing.

No one must start until the bell rings.

Should a strange coon land in your basket, hit the lever and make it jump out—NOT on to one of your hammocks.

Any strange coon in one of your hammocks disqualifies you from winning.



Showing the general arrangement of the game.

Any infringement of the above rules disqualifies a player from winning.

The Winner

The winner is the one who first "lands" one coon on each of the three hammocks—irrespective of what happens to the fourth; virtually the game is then finished, but this seldom happens.

Should no one do this, *i.e.*, should one hammock be empty, the game is continued until each player has disposed of his four coons, and decided on "points"; 4 points for the first coon landed on any hammock, 3 for the second on the same hammock, 2 for the third, and 1 point for the fourth.

MAXIMUM points, 14; MINIMUM, all coons landed, 10.

Hints

Hold the stick with the thumb along the top side.

Hold the stick so that the free end is higher than the hand; strike downwards at about an angle of 45 degrees.

It is the "QUICKNESS" not the "force" of the blow that makes Johnny jump; strike with a "free" wrist—just a flick with the wrist—that is the best.

Legs and arms of coon should be straight down when in first position.

Don't think you are playing cricket still less golf, make no attempt to carry your stroke "through."

WIRING THE HOUSE FOR ELECTRIC LIGHTING

The wiring of one's own house for lighting supply, etc., is a job that should not present any difficulty to the amateur capable of using such ordinary tools as may be found in the average household.

TO begin with, it is best to understand the system used throughout the installation, as this will make clear at the onset any doubts that may be entertained as to the difficulty of the task. All lighting or other points are placed in parallel with the main feeds of the supply, one lead in each point being broken by a switch to allow the control of the light or point. The multi-wires which often look so complicated to the amateur are due to the method used in passing the current from point to point without returning to the main feed for each particular circuit; a glance at the theoretical drawing will convey the whole idea. Before getting to practical work, the reader must be able to arrive at the number of points required, the power at each point and the last and most important item, what the total current will be for the installation, and upon this last will depend the materials required.

The information given will, of course, not suit all houses, and each individual will be called on to make his own list to suit the circumstances. The information is therefore intended to instruct on the making of a list; this will apply to all the tables, etc., given, but whatever the requirements, the method remains the same.

Deciding the Total Current

The current passing over the system in AMPS. may be found by adding the wattage of each point and dividing the total by the voltage of the main supply. Below is given a list for a suggested installation.

Room.	Lights.	Plug Points.
Reception	1, 60 watts	—
Dining	1, 60 ,,	—
Bedroom	1, 40 ,,	—
,,	1, 40 ,,	—
Kitchen	1, 60 ,,	1, 500 watts
Universal point for cleaner, etc.	—	1, 250 ,,
	260 ,,	750 ,,
	260	
	750	
Total	1,010 watts	
Using the method explained previously	1,010	4·4 amps. appro.
Suggested mains	230	

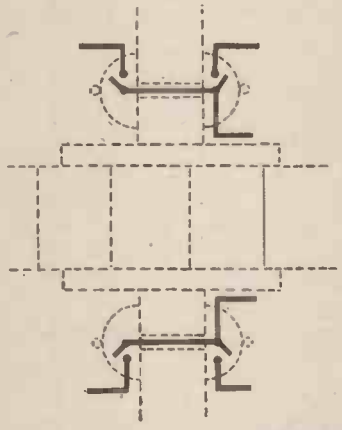
Having given the method by which the total current is ascertained, the next item is the material purchasing list, and it must be kept in mind that the rating of the materials should be to the nearest commercial value above and not below the total current figures. As in the example installation, it would be 5-amp. fittings, this also applying to the cable list.

Some difficulty may be experienced in obtaining 10-amp. fittings, the usual practice being 5 amp. for all lighting and small equipment, and 15 amp. for power.

Room.	Switches.	Ceiling Roses.	Plugs & Sockets.	
Reception	1	1	—	—
Dining	1	1	—	—
Bedroom	1	1	—	—
,,	1	1	—	—
Kitchen	1	1	1	—
Universal point	—	—	1	—
Ironclad and Fuses	1	—	—	—
Connection Box	—	—	—	1
Lamp Holders	—	—	—	5

1 Mounting board for main switch, 2 blocks, 5 wooden switch boxes.
Fittings may be obtained in 5 amp. 10 amp. 15 amp.

No. of Strands.	WIRE all Types Dia. of each Strand.	Current in Amps. Maximum.
1	·044	3
3	·029	5
7	·036	15



Three types of cable are in commercial use to-day, and any one of these may be used and remain within the regulations of all concerned, including insurance companies, the types being braided cable, which must be enclosed in metal tubing, lead-covered, which has the metal covering supplied by lead being moulded over the insulation by the cable manufacturers and tough rubber-covered cable, this last consisting of a heavy covering of rubber over the inside insulation and is known as "Cabtyre."

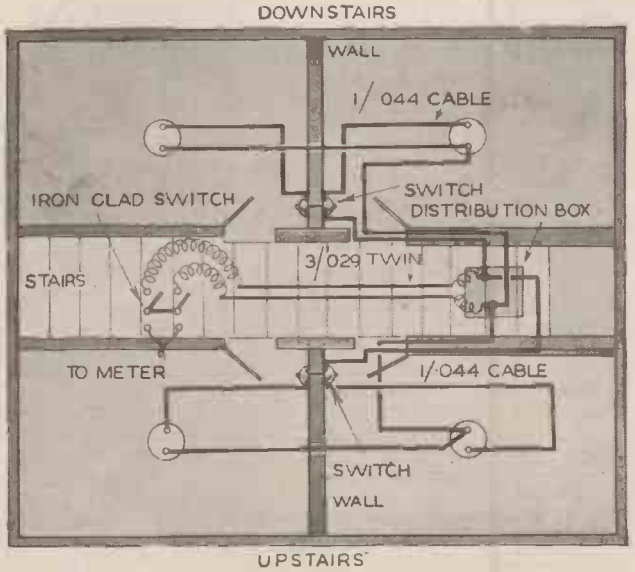
Commencement of the Wiring

Having decided on the materials required, the actual work of wiring can now be commenced, and the first point to decide is the position of the ironclad switch carrying the fuses. This should be as near as possible to the meter, and, as a rule the meter is placed under the stairs, it is best to commence at this point. Mount the ironclad on the switchboard with the fuses at the top and fix the board to the wall by means of Rawlplugs.

The total current was found to be 4·4 amps. in the example, and therefore use 3/·029 where the whole current has to be carried, and twin cable for the main feed.

Cut off a short length of cable, bare the wires at one end and fix to the terminal at the bottom of the ironclad, leaving the other end of the short piece of cable for attachment to the meter. We now need to find a central point in the house from which distribution to the rooms can be made with the least trouble, and in most cases under the boards at the top of the stairs is a good point, allowing the wires for the downstairs to pass under the floorboards, while the wires for upstairs can readily be passed up to the roof Remove one of the small boards at the top of the stairs, pass the twin 3/·029 cable down to the ironclad switch and cut to length, allowing a little extra for making connections—conditions will decide the best manner of fixing and concealment—bare the ends of the wire at the switch end and connect to the switch above the fuses.

All wiring will now proceed from the top of the stairs, or wherever the distribution point was decided upon, and the next job is to prepare the floors and walls for the cable. It will be necessary to remove one or two floorboards if the wires are to be hidden from view, the wires thus being



A typical layout for wiring a house, the circuit diagram being shown above.

protected and do not disfigure the rooms; this alone making it worth the extra trouble.

If the cable is not to be let into channels in the wall, all wiring will be done in, or as near as possible to, the corners, but if it is to be let into the walls, and this is to be strongly recommended as worth the trouble, channels must be cut to receive them, and this is the type of wiring we will deal with. The general practice is to place the light switches on the wall just inside the door, and where the doors of two rooms meet at a partition wall one switch can be placed each side of the wall exactly opposite each other, thus allowing the use of one channel for the two switches; where this cannot be done a channel must be cut for each switch, but whatever is to be done the method will be the same.

At the point selected cut a channel from the floor to the ceiling in the upstairs room about an inch wide and the depth of the plaster, this channel will carry the cable for the switches and also the feed to above the upstairs ceiling for the light points. At a height of 5 ft. enlarge the channel into a square hole just large enough to fit the wooden switch boxes into. If the switches are to be placed opposite each other on a partition wall, a square hole only will be needed for the box and a small hole just large enough for the cable to go through, carried through the brickwork; this will complete the cutting upstairs.

The channels for the downstairs switches must be cut down from the ceiling to a height of 5 ft. from the floor, and the holes for the boxes treated in the same way as the upstairs, and, with the exception of boring a hole through from the channel for the downstairs switches to the upstairs, this is best done from the downstairs with an iron rod, any damage will then take place above, where it cannot be seen when the boards are replaced.

Laying the Cable

All wiring will now be from the distribution point to the various lights and switches, and we will deal with the downstairs complete first.

The cable to be used for the light points is 1/·044, this is capable of 3 amps., and as may be ascertained from the table, a household lighting point cannot possibly require this amount of current, and, further, for this concealed wiring we may use single cable and do away with the use of insulating boxes. Commencing at the distribution point, lay a cable to the lighting point *viâ* the floor, cut the cable, bare the wire at the light point, now bare an end of the cable and twist the two ends together, carry the wire into the next room to the light point, and don't forget, in all cases leave a little extra length of wire.

It can now be seen by a glance at the drawing that one side of each light has been wired and that the circuit will be completed *viâ* the switches. To get to the switches the wires must pass down the channel to the lower room and back again from the switches, so going again to the feed point; the cable is layed to the channel downstairs, pushed through the ceiling down the channel to the switch; now this cable is to serve the two switches, therefore connection must be made from one to the other by means of a short piece of cable through the hole in the wall.

Bare the long lead at the switch and bare a short length, twist them together, push the other end of the short cable through the hole to the room, one side of the switch is now wired. The other side of each switch will be connected to the light points and a length of the 1/·044 will have to be laid from each light point down the channel and connected to each of the respective switches, the cable for room 2 being passed through the hole in the wall with the short length of cable.

This completes the downstairs wiring, but before commencing the upstairs the switches may be mounted and connected. Pass the leads through the hole in the wooden switch box and nail the box to the wall, driving the nails into the mortar between the bricks, then screw the switch into the box, making sure that the switch is the right way up, that is, when the contacts are out the switch is up, and connect the two wires to one side and the single wire to the other. Mount the switch in the other room in the same way and connect with the short length of wire going to one side of the switch and the long length to the other side.

The upstairs wiring is exactly the same as the down, and all that is needed is to repeat the whole operation over again, the main leads in this case coming from the top of the stairs and going up the channel from the floor to the roof.

Having finished the top part of the house in the same way as the bottom, we find that we have an accumulation of wires at the top of the stairs; our distribution point consisting of twin cable (main feed) and one wire from each light point, also one wire from each switch, the next step will be to sort them out into two bunches, the light points and the switches respectively, and if we do this before closing the wall channels and replacing the floorboards it is quite easy, as the whole wiring can be seen from the top of the stairs.

When the reader has assured himself that the two bunches are correct, bare the ends of one bunch and twist them together neatly with one of the twin main feed, repeat this with the other bunch and twist to the other side of the main feed, insulate with the connectors and tuck into the distribution box.

Testing the Circuit

The test for the circuits may be made easily and without expense by means of a flash-lamp battery and bulb. Attach the battery to the length of twin cable that is left hanging to the bottom of the ironclad and set the switch on, make sure that a piece of fuse wire has been put into each fuse holder, take each room in turn, put the switch on and test the circuit at each light point with the bulb; if the bulb will operate with the opening and closing of the switch, the circuit may be passed, if not, carefully check all your wiring with the drawing.

A few words on fixing fittings; if you are using ordinary ceiling roses these will be screwed to the ceiling and a hole made for the wires to pass through into the terminals; should, however, the position selected for the rose be between two rafters, cut a piece of board to fit tightly between the rafters to give something for the screws to bite into. The ends of the flex for the lamp holder should be separated, passed through the hole in the rose and tied before connection is made to the terminals; to take the weight of the lamp, it is not safe to trust to the wire fixed to the terminals alone. If the reader is using all metal roses, such as are used for hanging bowls, the flex must be joined to the cables by means of insulated connectors, and in this case the weight will be taken by knotting the flex until it cannot pass through the hole in the metal rose; the connection of the lamp holders explains itself, and that is all the wireman's work, for the lighting.

Nothing has yet been said about the plug points, the reason being that they come direct from the main switch.

The universal point can be mounted under the stairs near the main switch and the cable will be a length of the 3/·029 twin; bare the ends and connect to the fuses, cut to length and again bare the ends, repeat this for the next length to the kitchen, carrying on the wire from the previous point by twisting the wires together and fixing two leads into each terminal of the plug point, carry on the cable to the point next mounted and connect to the terminals of the plug point. The sockets of these points are mounted on small wooden blocks, the cable passing through the back of the block.

Application will have to be made to the local supply company for the supply to be laid on, and in many cases they will require to know the total wattage of the installation; this can easily be supplied from the list made for the materials. Before connecting the meter they will test the circuit and the insulation, so do your work carefully.

MARKING OUT FOR MACHINING

(*Continued from page* 13.)

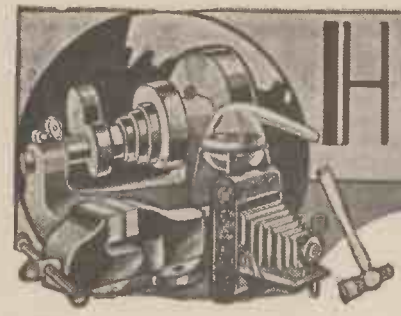
which there is not a machined surface to rest it upon, has to be clamped to a false vertical surface for the purpose. The casting in Fig. 4 is such an instance, and which calls for the use of an angle bracket and clamp. Having been previously machined on the base, the casting is clamped with this face against the face of the bracket, one side of the casting being squared up with the surface plate. The centre of the slot in the rough casting is found by transferring the height of the edges to the rule and the dimensions worked from a point midway between.

Rough Castings and Forgings

Rough castings or forgings that are to be marked out for facing or other machining, and on which there are no previously machined surfaces, are packed up so that the important points on the casting lay level with the plate. This can be checked by using the bent end of the scriber as a gauge. When level, a line is scribed at the distance down to which the machining is to be carried.

Not infrequently it is necessary to mark off from the centre of a rough cored hole, to do which it becomes necessary to stop the hole up in a temporary manner to provide a centre for the dividers. This can be done by wedging a strip of hard wood across the mouth of the hole.

Holes that are to be bored on the face plate and which must be accurately disposed in relation to previous machining are set up to a scribed circle. At the junction of the centre lines mark a prick with the point of the scriber and use this as a centre point for the dividers. A centre punch marking unless lightly made with a fine punch is likely to be off the point where the lines cross, without being discernible.



Hints about Hobbies

THAT HINT OF YOURS

Every reader of PRACTICAL MECHANICS must have originated some little dodge which would be of interest to other readers. Why not pass it on to us? For every item published on this page we will pay 5s. Address your envelope to "Hint," PRACTICAL MECHANICS, George Newnes Ltd., 8-11 Southampton Street, W.C. Put your name and address on every item. Please note that every hint sent in must be original. No other correspondence whatever should be included

Shockproof Hammers

THE shock of a downward blow with a hammer will be greatly reduced if treated in the following simple manner. Remove the head and wrap the upper part of the handle with rubber, cut from an old inner tube, as shown in the illustration, and secure with rubber solution. When replacing the head, make sure it is wedged on securely. A good soaking of the handle in salt water will assure a tight fit.—S. Whimpole (E.C.1).

Drying Prints

WHEN drying a large number of negatives or prints, a far better method than using pins is the use of an ordinary spring curtain rod.

String up the rod in a convenient position without putting any actual tension on it.

As the illustration shows, the prints are easily held by just bending the spring with the fingers and inserting between the coils.

It will be found the prints are held quite firmly and are speedily withdrawn when dry, by just stretching the whole spring.—J. H. Skinner (City Road, E.C.1).

Details for making a shock-proof hammer.

A Window Hint

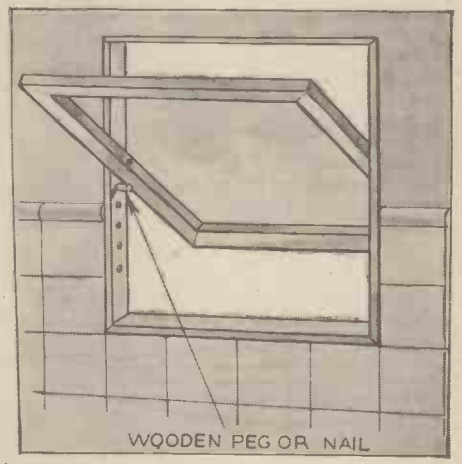
ONE very often sees kitchen and scullery windows propped open with a piece of wood, etc. A good way to hold the window in various positions is to drill a few small holes in the side of the frame and insert a nail with a big head or a stud. This is a neat way, and the nail or stud, fitting loosely, can be altered instantly to any desired position.—B. Holmes (Yorks.).

Preventing Stove Lids from Slipping

STOVE lids have a tendency to slip off of the ordinary lifter. The following little idea will prevent this.

Cut a piece of springy brass about 1 in. long. Heat it to a red heat and allow to cool slowly. Bend it to the shape shown in the illustration and heat again, this time plunging in water to cool, thus regaining the temper. Rivet to the lifter as shown.

The spring should be bent so that it will grip the lid, but not so tightly as to prevent the lifter from being easily withdrawn.



An idea for keeping a window in position when open.

Protecting Tool Handles

THE wooden handles of tools that are subject to a certain amount of pounding with a mallet soon give way under the blows unless given some form of protection.

The use of an ordinary metal bottle cap has been found to be ideal for this purpose. Force the cap over the handle and secure with a small screw.

Of course, very heavy work will smash the cap in time, but a new one can be easily fitted.—J. H. Skinner (E.C.1).

Protecting a Mallet

A WOODEN mallet, given a fair amount of use, soon gives way to the continual pounding unless its surfaces are given some form of protection.

Protecting the handles of tools by means of bottle caps.

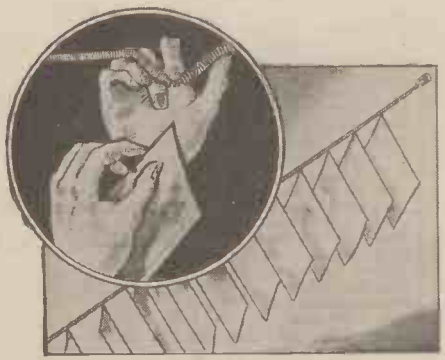
The following idea meets the case perfectly.

Cut two pieces of stout leather and wrap over the pounding surfaces, securing with small screws (see illustration).

A mallet, treated in this way will last almost indefinitely, the strips being easily replaced when the leather finally wears through.

Fixing Loose Drawer Knobs

FIXING a loose drawer knob is a job that the woodworker is often called upon to perform. His thoughts naturally turn to glue, and while this provides sufficient fixing in many cases, it is often found, especially when dealing with large heavy drawers, that something stronger is necessary. A piece of thin plywood should be fitted inside the drawer and a screw driven through it and into the drawer knob. The piece of wood may be square or oblong with its edges chamfered, and a brass screw should be used. The shape of the wood is immaterial, but it should be large enough to get a good grip of the back of the drawer. The knob can be glued in if desired, but the fitting suggested will hold it quite firmly.



Drying prints by clipping them in an ordinary spring curtain rod.

Preventing stove lids from slipping.

A strip of leather fitted over the mallet head as shown prevents undue wear on the mallet.

A FUSELAGE

The general purpose class of model aeroplane has ance have been successfully allied to an almost and other mishaps inseparable from model flying. which score by virtue of their extreme simplicity. porated in a

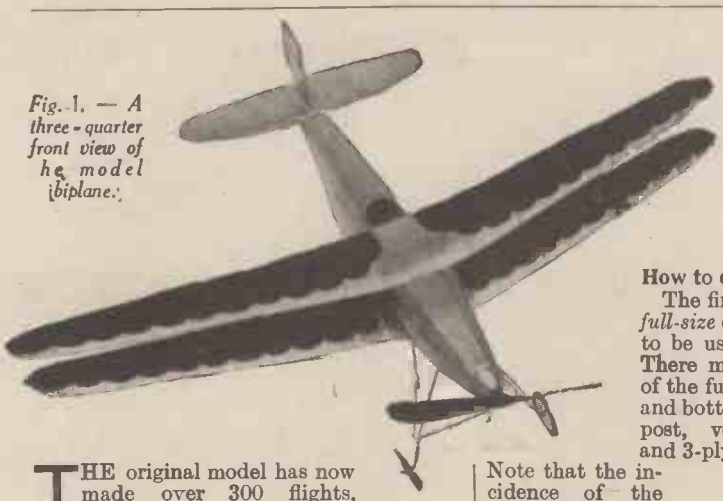
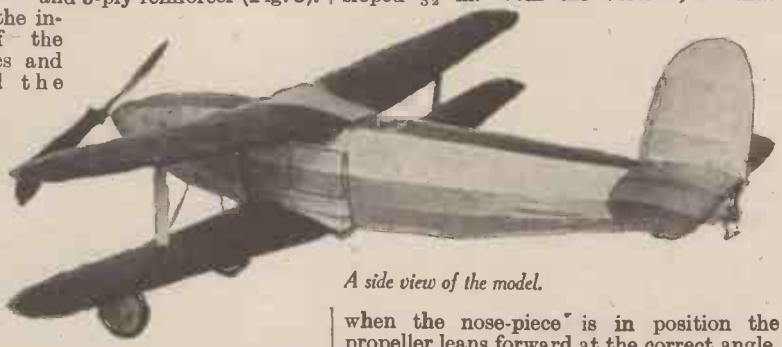


Fig. 1. — A three-quarter front view of he model biplane.

THE original model has now made over 300 flights, and has attracted considerable interest. It has been flown by the experienced modellist and the absolute novice, and so has been well and badly launched; flights have taken place in high and gusty winds. Aided by good gliding qualities, flights of 45–60 seconds have been obtained repeatedly. The machine is still in good flying condition. The special feature of the design is that centre section struts and interplane bracing wires, so prone to lose their adjustment or tear away, have been eliminated. Nevertheless, the machine is certainly not freakish in appearance, being reminiscent of the latest De Havilland air-liners.

How to commence

The first step is to prepare *full-size* drawings, which are to be used as building jigs. There must be a side view of the fuselage, showing top and bottom longerons, stern-post, vertical cross-struts and 3-ply reinforcer (Fig. 5). Note that the incidence of the main planes and tail and the forward inclination of the propeller are obtained by a special shaping of the fuselage, and this obtained on the drawing by measuring the position of top and bottom longerons from a horizontal datum line. For instance, where the upper plane rests, the longerons are horizontal, thus securing neutral incidence; the lower longerons are sloped to set the lower plane at positive incidence; the upper longerons rise from No. 6 former to the stern-post to set the tail at negative incidence; and the 3-ply reinforcer is sloped $\frac{5}{32}$ in. from the vertical, so that

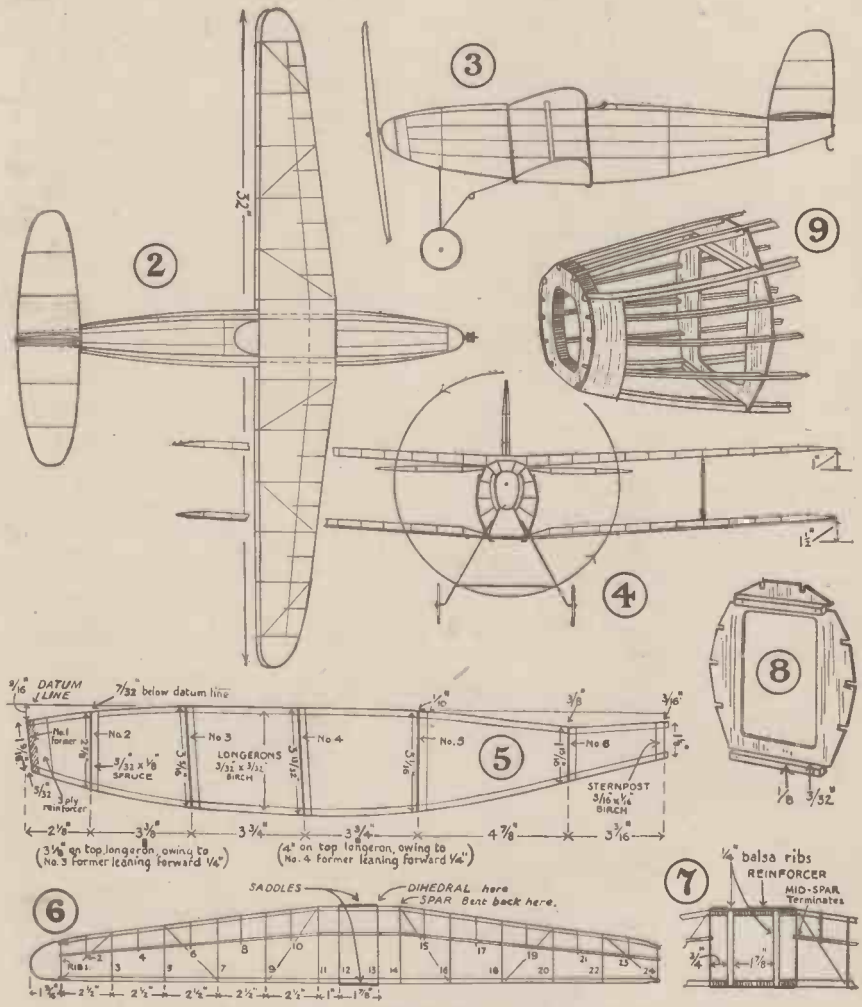


A side view of the model.

when the nose-piece is in position the propeller leans forward at the correct angle. [*This idea is based on a fallacy and is quite unnecessary.*—ED.] Then there must be a plan view of the upper plane, showing the location of all spars and ribs (Fig. 6). This drawing can also be used, with slight variation (Fig. 7), for the lower plane. A front view of both wings is helpful in checking the dihedral angle, which is greater on the lower plane, and in getting the correct angles for the upper plane mid-spar. Lastly, draw a front view of the undercarriage (Figs. 21 and 22), a plan view of the tail plane (Fig. 25), and the fin (Fig. 26). These drawings should be pasted on to pieces of board which are free from warp.

Fuselage

One side of the fuselage is built up at a



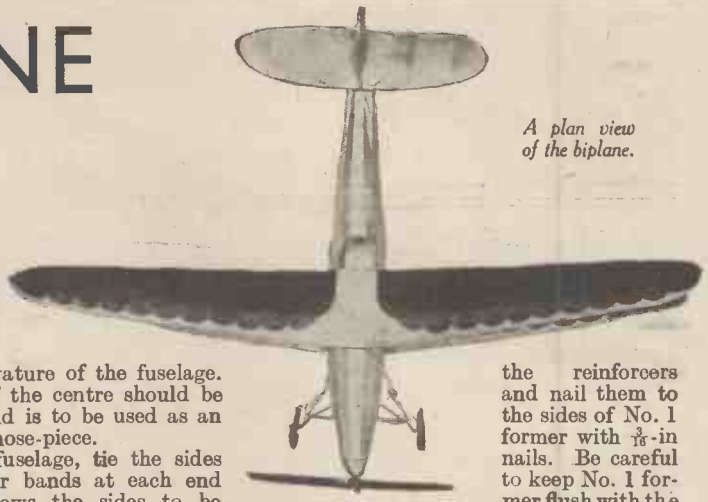
Figs. 2 to 9.—A plan, front and side view of the biplane with other constructional details of the model.

LIST OF MATERIALS REQUIRED

9 ft. of $\frac{3}{32}$ × $\frac{1}{16}$-in Birch (longest dimension needed 22 in.).
10 ft. of $\frac{1}{8}$ × $\frac{3}{32}$-in. Birch (longest dimension needed 29½ in.).
5 ft. of $\frac{1}{8}$ × $\frac{1}{16}$-in. Birch (longest dimension needed 29½ in.).
4 in. of $\frac{1}{16}$ × $\frac{1}{16}$-in. Birch.
6 ft. of $\frac{1}{16}$ × $\frac{1}{8}$-in. Spruce (longest dimension needed 3¾ in.).
12 ft. of $\frac{1}{8}$ × $\frac{1}{16}$-in Spruce (longest dimension needed 18 in.).
2 ft. of $\frac{1}{16}$ × $\frac{1}{16}$-in Spruce.
1 ft. of $\frac{1}{16}$ × $\frac{1}{16}$-in. Bamboo.
6 in. of $\frac{3}{16}$ × $\frac{1}{16}$-in. Bamboo.
14 in. of $\frac{1}{4}$ × $\frac{1}{4}$-in. Hard Balsa.
16 × 3 × $\frac{1}{16}$-in. Hard Balsa.
12 × 6 in. × ·75 mm. 3-ply.
3 ft. of 18-gauge Steel Wire.
1½ ft. of 20 " " "
9 ft. of 22 " " "
36 × 18-in. Jap Silk.
4-oz. Tin of Clear Dope.
2-oz. Tin of Coloured Dope.
One pair 2-in. Plywood Wheels.
1½-in. 20-gauge Brass Tubing.
2 × 1½ × ¼-in. 3-ply.
1¼ × 1½ × ¼-in. Satin Walnut.
One Propeller, 12 in. diam., 11 or 12 in. pitch, 1½ in. Blade Width (Chauviere or Symmetrical).
One Propeller Shaft Bearing, 18-gauge.
20 ft. of $\frac{1}{8}$ × $\frac{1}{16}$-in. Rubber.
1 ft. of Valve Tubing.
One Tin Rubber Lubricant.
Several Large Cup Washers.
One Tube Glue.
$\frac{1}{4}$-in., $\frac{3}{8}$-in., and a few $\frac{1}{2}$-in. *Thin* Nails.
Thin Binding Wire.
Reel of Thread, Pins, Tin for Clips.
Possibly Tin of Cellulose Paint and Reel of Silk.

MODEL BIPLANE

reached a high level of effectiveness. Stability and good perform- uncanny ability to withstand cross-wind landings, collisions, About 99·9 per cent. of these machines have been monoplanes, Here is an example of the above qualities being incor- fuselage biplane.



A plan view of the biplane.

time. Two pieces of birch, $\frac{3}{32} \times \frac{3}{32}$ in. and 22 in. long, are required for top and bottom longerons. Steam them and place in position on the drawing, securing with pins placed on each side in the positions shown in Fig. 16. Cut pieces of $\frac{3}{32} \times \frac{1}{8}$-in. spruce for the vertical cross-pieces and a piece of $\frac{3}{16} \times \frac{1}{16}$-in. birch for the stern-post, allowing them to overlap the longe- rons by about $\frac{1}{4}$ in. Glue them in position on top of the longerons, securing with fine $\frac{1}{16}$-in. nails if available, otherwise lashing with fine silk after removal from the draw- ing. The reinforcer, of ·75 mm. 3-ply $\frac{1}{4}$ in. wide, is glued and placed *below* the longe- rons. When thoroughly dry, remove the side from the jig, trim the cross-pieces and stern-post flush, trim the longerons $\frac{1}{8}$ in. beyond the stern-post, but leave them over- lapping the reinforcer.

The other side is made similarly, but in this case the cross-pieces and stern-post are placed on the drawing first, the longerons placed over them and the rein- forcer over the longerons.

All the formers except No. 1 are cut from ·75 mm. 3-ply (Figs. 10–14). Great care is necessary in shaping them and in cutting the slots for the longerons and stringers. The slots may seem small, but the slightest inaccuracy will cause fuselage distortion and may affect the seating of the wings or tail. When the centres of the formers have been cut away, the edges should be smoothed with fine glasspaper to prevent them cutting the rubber. The horizontal cross- pieces of $\frac{3}{32} \times \frac{1}{8}$-in. spruce are cut to exactly fit between the slots and are glued and nailed or lashed into place (Fig. 8). No. 1 former (Fig. 15) is cut from $\frac{1}{4}$-in.

TABLE OF WEIGHTS

	oz.
Fuselage and Undercarriage, minus Nose-piece	2¼
Nose-piece and Propeller	6
20 ft. of ⅛ × ⅛-in rubber	7
Upper Plane	2¾
Lower Plane, without Struts	4¼
Complete Tail Unit	1½
With Fixing Bands, Struts and Lead Ballast	6

DIMENSIONS OF FULL RIBS

Given in Millimetres for Accuracy

Rib Nos.	1 and 24	3 and 22	5 and 20	7 and 18	9 and 16	11 and 14	12 and 13
	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Dimension "A"	15	19½	22½	25½	28½	31½	31½*
" "B"	8	9	10	11	12	13	13†
" "O"	51	61	70	78	86	94½	94½

* Lower plane, nil. † Lower plane, ½ in.

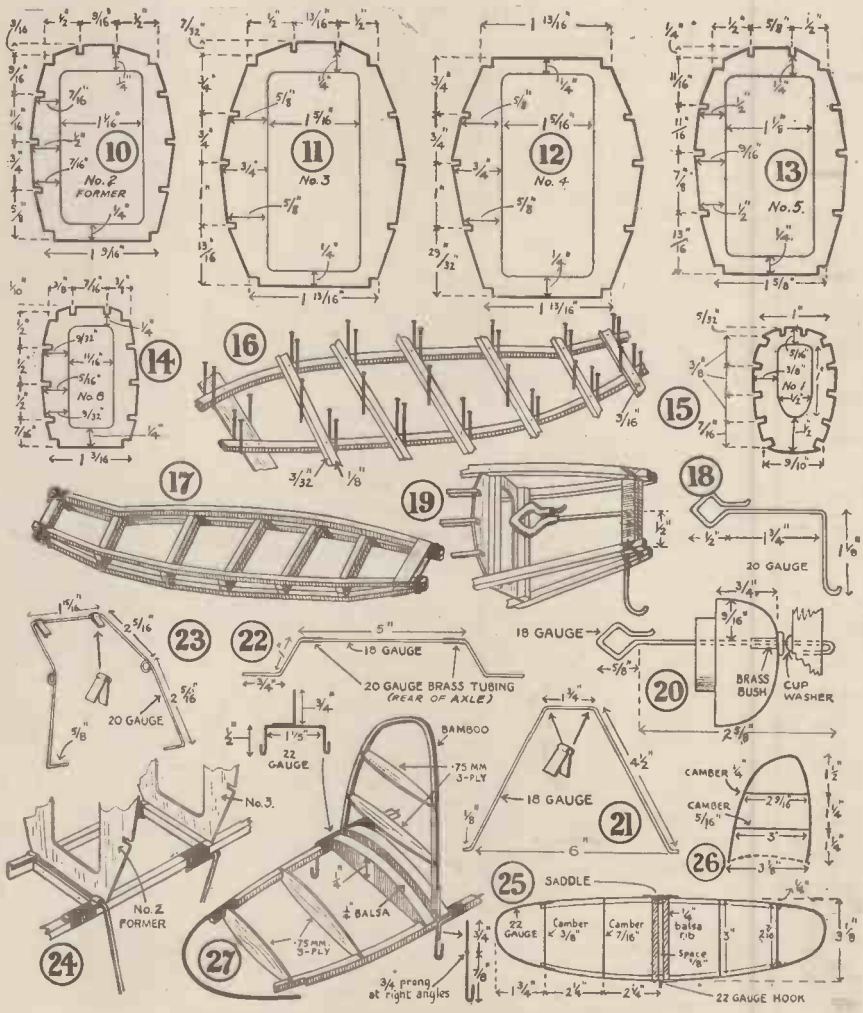
DIMENSIONS OF RIBLETS

Riblet Nos.	2 and 23	4 and 21	6 and 19	8 and 17	10 and 15
	mm.	mm.	mm.	mm.	mm.
Dimension "A"	18	21	24	27	30
" "B"	8½	9½	10½	11½	12½

Leading and Trailing Edge Slots, ⅛ in. wide, $\frac{1}{16}$ in. deep.
Mid-spar Slots, $\frac{1}{16}$ in. wide, ⅛ in. deep.

3-ply. The dimen- sions given are those of the front surface; the sides must be carefully sloped to conform to the curvature of the fuselage. The piece cut out of the centre should be shaped as shown, and is to be used as an "adapter" for the nose-piece.

To assemble the fuselage, tie the sides together with rubber bands at each end (Fig. 17). This allows the sides to be pulled apart sufficiently for the formers to be slipped into place. The latter are first glued where they will rest against the vertical cross-pieces, and are then slipped into position in front of and tight up to the vertical cross-pieces in the following order: 4, 5, 6, 3. The horizontal cross- pieces should be to the front. Nail or lash the formers to the vertical cross-pieces. Correct any tendency to distortion, and leave the structure to set. Then remove the front rubber bands and fit formers 1 and 2. Glue and nail the longerons into the appropriate slots in No. 1 former with $\frac{3}{8}$-in. nails. Then glue the inner surfaces of the reinforcers and nail them to the sides of No. 1 former with $\frac{3}{16}$-in nails. Be careful to keep No. 1 for- mer flush with the reinforcers in front. The three stringers of $\frac{1}{8} \times \frac{1}{16}$-in. spruce which run along each side of the fuselage and terminate at No. 6 former are then fitted. After gluing the former slots, the stringers are slipped behind the reinforcers and into the slots in No. 1 former, then into the other formers in turn (Fig. 9). Fix the top stringers from No. 1 former to No. 3, and from a point about 1½ in. behind No. 4 to No. 6. Longerons and stringers are now trimmed flush with No. 1 former. Cut the cockpit edging from ·75 mm. 3-ply, and glue and nail to the longerons and the projecting stringers, as shown in Fig. 37. A realistic



Figs. 10 to 27.—Further constructional details of the biplane.

effect can be obtained by cutting open a length of cycle-valve tubing, gluing and placing it round the cockpit edging, and securing temporarily with small pins. When dry, the pins are removed and the tubing painted with cellulose, preferably red.

Make up a tail skid and rear rubber hook from a single piece of 20-gauge steel wire (Fig. 18). Unlash the fuselage end, glue the inner surfaces of the stern-post halves, slip the wire fitting between and lash stern-post and longerons with strong thread, well glued (Fig. 19). Be careful to avoid distorting the rear of the fuselage in the process.

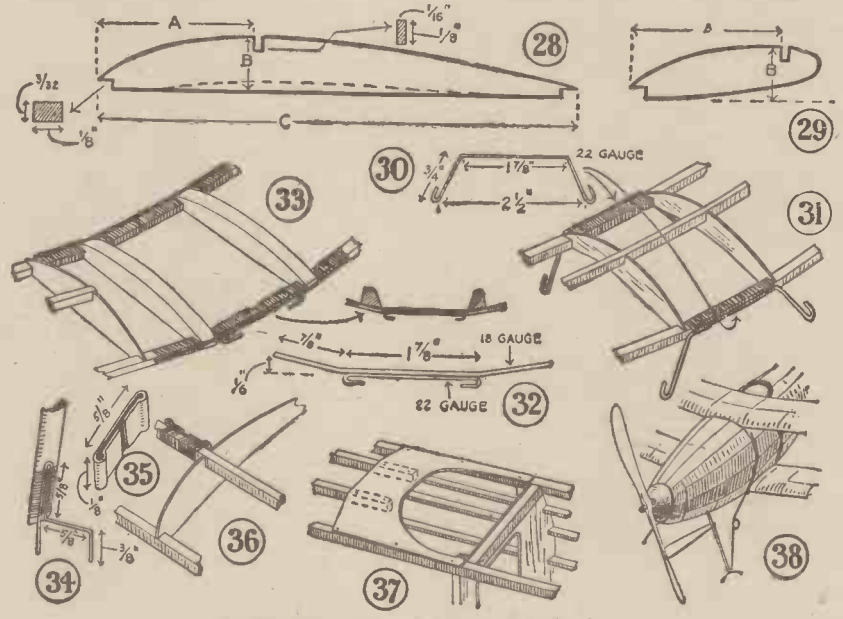
The nose-piece (Fig. 20) is cut from a piece of satin walnut, ¾ in. thick. The piece cut out of No. 1 former is first glued and nailed to the block of walnut with ½-in. nails; this "adapter" is so shaped that the nose-piece cannot be placed upside down accidentally, thus altering the position of the thrust-line and probably resulting in a wrecked model. If the adapter is too loose in No. 1 former, it can be liberally painted with cellulose. The hole for the propeller shaft is now drilled, care being taken to make it the correct distance from the top of the fuselage, and at right angles through the block. Carve the nose-piece to the correct shape; the final shaping is best carried out with the block in place in No. 1 former, so that the lines of the fuselage are correctly carried on. Finish off with fine glasspaper, and then push the propeller shaft bearing into place. The latter should be of 18-gauge wire, and can be obtained at any model aircraft stores.

The Undercarriage

First form the front legs from 18-gauge steel wire (Fig. 21), pass them through the fuselage in front of No. 2 former and secure to the lower longerons tight up to No. 2 former, with small metal clips and thread lashings, which should be well glued (Fig. 24). Make the axle (Fig. 22) from 18-gauge, lash to the front leg extremities with thin binding wire and solder. The wheels are then slipped on, binding wire being bound round the axle ends and soldered to keep the wheels on, and the surplus wire cut away. The strongest wheels are those of about $\frac{5}{32}$-in. 3-ply, bushed with brass tubing; 2 in. is the required diameter, and they can be bought ready made. Two pieces of 20-gauge brass tubing, ¾ in. long, are soldered to the outer ends of the axle, to the rear. The rear legs (Fig. 23) are formed from 20-gauge wire. The loops, which secure adequate springing, are best formed with round-nosed pliers, but in the absence of such a tool the wire can be bent round a nail or metal skewer. To ensure that left- and right-hand loops are in line, be careful to grip the wire with the pliers the same distance from the bend. The great thing is to get the axle at right angles to the line of flight, otherwise the machine will swerve when rise-off-ground flights are attempted. The rear legs are secured with tin slips *beneath* the lower longerons just ahead of No. 3 former; in this position the clips will prevent the lower plane moving too far forward (see Fig. 24). The turned-over ends fit into the tubing on the axle, and can easily be withdrawn to collapse the undercarriage for packing.

Main Planes

The wings are built up in the flat, dihedral



Figs. 28 to 38.—Details of the wing assembly, etc.

being applied later. The leading and trailing edge spars are cut from $\frac{3}{32} \times \frac{1}{4}$-in. birch, and are fastened down on the drawing with pins, as in the case of the fuselage sides. The leading edge is first steamed and bent back at the points indicated, and the spar ends slightly curved (Fig. 6). The full ribs are cut from $\frac{3}{32}$-in *hard* balsa, care being taken to make the distance from front slot to rear slot dead accurate, and the mid-spar slot in correct relation to the others (see Fig. 28 and the Table of Rib Dimensions). Two ribs of each number are required, except Nos. 12 and 13, of which one each is needed. The ribs of each size should be placed together and finally shaped with fine glasspaper, to ensure identical camber. The slots are glued and the ribs slipped into place between the leading and trailing spars. Diagonals of $\frac{1}{16} \times \frac{1}{16}$-in. spruce are glued on the spars in the positions shown in the drawing. When the upper wing structure is thoroughly dry, remove from the jig. Proceed to build up the lower plane in the same way, but substitute for ribs 12 and 13 two specially shaped pieces cut from $\frac{1}{4} \times \frac{1}{4}$-in. hard balsa (Fig. 32). After removing from the drawing, smooth the sharp edges of all

spars and slightly hollow the underside of the ribs, so that the air pressure will impart a concave under camber in flight. Slot the ends of the leading and trailing spars to receive the 22-gauge wire tips, which are lashed with thread and glued.

The dihedral is next applied. Taking first the upper plane, steam the spars at ribs 12 and 13 and bend to an angle of 4 degrees. Lay the wing on a flat surface and weight the spars between the centre ribs with flat irons or similar weights. Prop up the wings on each side, so that the wing-tip ends are 1 in. above the flat surface. Correct any curvature of the spars, and leave to set. Meanwhile, cut a piece of $\frac{1}{8} \times \frac{1}{16}$-in. birch for the mid-spar, steam to the correct dihedral, as shown on the front elevation drawing (note that the angle of this spar differs from that of the other two spars), glue the slots in the tops of the ribs and slip the mid-spar into place. In dealing with the lower plane, note that the dihedral is 6 degrees, not 4, so the tips must be $1\frac{1}{2}$ in. from the flat surface, and that the mid-spar is in two parts, each terminating at ribs 11 or 14.

Cut the half-ribs or riblets from ·75 mm. 3-ply (see Fig. 29 and Table of Rib Dimensions). Glue the slots and slip into place $1\frac{1}{2}$ in. from each full rib. For the lower plane reinforcing wires are cut from 18-gauge, bent to the dihedral angle (6 degrees), attachment fittings of 22-gauge wire are soldered to them, and the completed fittings lashed to the leading and trailing spars, as shown in Figs. 32 and 33. The upper plane attachments are in the form of 22-gauge wire saddles. These are cut carefully to size, bent to conform to the fuselage shape, and lashed to the main spars, as shown in Figs. 30 and 31. These lashings must be neat, or the wings will not sit squarely on the fuselage.

The upper plane rests on the top longerons tight up to No. 3 former. The lower rests against the bottom longerons tight up to the undercarriage. Four 2-in. rubber bands connect the upper wings to the lower, and in so doing keep them in position on the fuselage. Each band is passed round the lower wing attachment hook, round the upper wing hook above it and back to the lower hook. The planes are thus free to slide backwards under the impact of blows, but they should not be moved along the fuselage to correct the trim of the machine; this is achieved in another way. Test the attachment fittings for accuracy and firmness, and re-lash if necessary before covering the wings.

The two interplane struts are cut from bamboo, and are $2\frac{3}{4}$ in. long, $\frac{3}{16}$ in. wide, and about $\frac{1}{8}$ in. thick. Fittings of 22-gauge wire are lashed to the lower ends (Fig. 34). Tin clips are bent round to grip the prongs (Fig. 35), and are lashed to the lower plane mid-spar so that the struts are touching ribs 5 and 20 (Fig. 36). These struts, besides enhancing the appearance, serve to steady the wing structure in rough weather, but as they are not actually attached to the upper plane no damage results if the wings are knocked along the body.

Tail Unit

This consists of a tail plane built up similarly to the wings, with a rudder of bamboo permanently joined to it (Figs. 25, 26 and 27). The leading and trailing spars of $\frac{3}{32} \times \frac{3}{32}$-in. birch are steamed to the shape shown and fastened to the drawing with pins. Small packing pieces of $\frac{1}{8}$-in. wood are slipped beneath the spars, raising them sufficiently for the four outer ribs of ·75 mm. 3-ply to be slipped into position. These ribs are cambered equally above and below, the depth being as shown in Fig. 25. The two centre ribs are carved from $\frac{1}{4} \times \frac{1}{4}$-in. hard balsa, and are glued to the spars $\frac{1}{8}$ in. apart. They are flat underneath, to enable the tail to rest firmly on the fuselage. When dry, remove from the drawing, slot the spar ends for the 22-gauge wire tips, and make up the two attachment fittings, also of 22 gauge. The latter also serve as angle pieces, to which the rudder edging is to be lashed. This edging is formed from $\frac{1}{16} \times \frac{1}{16}$-in. bamboo, steamed and bent to shape. The two ribs in the rudder are of ·75 mm. 3-ply, the camber being as shown.

Separate strips of silk are used for the bottom and each side of the fuselage. The top is covered with two pieces, one being taken from No. 3 former to No. 1, and a piece from the cockpit to No. 6. From there to the stern-post the top is left uncovered, to give access to the rear rubber hook. Two pieces of silk are used for the upper wing and three for the lower, the top surface of the lower wing being left uncovered between the $2\frac{1}{4}$-in. balsa ribs. The tail unit is covered in the following manner. The underside of the tail plane is first covered with a single piece. Then the upper surface is covered, the silk passing through the rudder framework. A separate piece is used for each side of the rudder. Each is first glued to the centre rib, close to the rudder base, and allowed to dry. It is then drawn carefully across the rudder and glued to the bamboo edging.

For the wings and tail unit, two coats of clear dope and one of coloured should suffice. For the fuselage, two of clear and two of coloured will be required. The wheels and nose-piece can be painted with cellulose or coloured dope.

The Propeller and Shaft

The propeller suggested is one of 11 in. diameter, 11 or 12 in. pitch, and $1\frac{1}{2}$ in. maximum blade width, revolving anti-clockwise, as viewed from the front of the machine.

The propeller shaft (Fig. 37) is formed from a piece of 18-gauge wire, the diamond-shaped hook tending to prevent the rubber slipping off when well lubricated. One or two large cup washers should be placed between the bearing and the propeller, and the front end of the shaft bent round and pushed into the boss, leaving a loop to engage with the hook of a geared winder.

Twenty feet of $\frac{1}{4} \times \frac{1}{32}$-in. rubber, well lubricated, is made up into a skein of ten strands, the ends being stretched and tightly bound with thread. Front and rear rubber hooks should be covered with cycle-valve tubing. The skein is then placed over the front hook and dropped down the fuselage from the front. It is placed over the rear hook a loop at a time.

Having checked all the completed parts for warp, attach the wings to the fuselage, and place the interplane struts in their sockets. The trailing edges of each wing should be in line, and the incidence of all four equal, as viewed from the front. Stand the model on a flat surface and take measurements to ensure that the gap between the wings is equal on each side, and that the left-hand and right-hand tips are an equal height from the flat surface.

Attach the tail unit by a 2-in. rubber band from the front saddle passing under the fuselage, and a smaller band from the rear hook round the tail skid and back. The rear attachment fitting rests between the longeron extensions, and the leading edge should rest against No. 6 former. Viewed from the front of the model, the tail plane should appear horizontal and the fin vertical.

What the Clubs are Doing

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

THE BRITISH INTERPLANETARY SOCIETY

THE most successful meeting of the Society to date was held in Liverpool on Friday, September 7th. Five new members were admitted into the Society, including one lady.

Suggestions had been received from several members about the future form of the Journal, and these were discussed at length. It was decided that the October issue would appear in the usual form, but before the following issue was published the matter would be discussed more fully.

The question of copies of lectures becoming available to members was also discussed, and a definite line of action was decided upon.

A very friendly letter of co-operation and goodwill sent by Herr Ing. Guido Pirquet, of Vienna (Fellow of the B.I.S.), a prominent Continental experimenter, was read to the members by the Secretary.

A fierce and most interesting discussion took place between the President, Mr. P. E. Cleator, and the Vice-President, Mr. Colin H. L. Askham, over the future policy of the Society as to the election of representatives in foreign societies. After a long verbal duel the matter had to be referred to the next meeting.

The problem of a branch in London was considered, as such a branch had been proposed. It was decided to establish such a branch when the membership in London justified one.

INSTITUTE OF SCIENTIFIC RESEARCH

WE wish to announce our new programme of work for the winter months. Meetings will be held regularly on alternate Saturday afternoons, and one visit will be arranged for each month.

The laboratory will be open to members and visitors on Monday evenings, and the library will be open on Monday and Thursday evenings.

We are also forming a Correspondence Section, and any person in the British Isles or abroad who is interested in any branch of science should get into communication with the Secretary, Mr. D. W. F. Mayer, 20 Hollin Park Road, Roundhay, Leeds 8.

"SIR JOHN SHELLEY CUP" CONTEST

THE Sir John Shelley Cup Contest for power-driven model aeroplanes was held on August 26th, at Fairey's Great West Aerodrome. All the five models competing were powered with the petrol engine. This is a fair indication of the year's progress, as last year's contest produced only one starter. Nevertheless, this type of model is still in its infancy, and much coaxing of refractory power units and long waits between flights reminded one of the early days of full-scale flying.

The winner, Capt. Bowden, appears to have got a good lead on all other enthusiasts. It was worth the somewhat tedious journey to Fairey's to witness his effort alone. The machine, a high wing, named "Blue Dragon" (Atom Minor engine), was built for the contest, and had just completed a few short tests. In the contest it took off in about 4 yd., climbed rapidly in small circles, and was soon a tiny speck in the clouds. It was timed for 12 mins. 48 secs. "out of sight," and is estimated to have reached a height of several thousand feet. The owner pursued it in his car as far as Staines, and saw it gliding down in the distance after a 19 min. flight, but so far the landing-place has not been located.

Second in the contest was the high wing "Flamingo II.," flown by Mr. F. Harris. The 14 c.c. engine was the work of Mr. Harris, a senior power-boat trophy winner. The best flight was 3 mins. 42.5 secs.

Third came Mr. J. W. Bishop's huge biplane, "Endeavour," with a 25 c.c. engine. This machine flew very steadily and climbed quite well. Its best effort was 3 mins. 25 secs.

STREATHAM COMMON MODEL RAILWAY CLUB

OUR Clubroom at 201 Gleneldon Mews, High Road, Streatham, is now open three nights a week, on Tuesdays, Fridays and Saturdays, from 6.30 p.m.

We are anxious now to increase our membership and will for one month only—October—grant membership to anyone over sixteen years of age free of any entrance fee. Full particulars of membership and details of the club are contained in our four-page publication, "Concerning Ourselves," a free copy of which will be sent post paid to anyone requesting particulars of the club.

Our stand at the recent "M.E." Exhibition held the interest of many visitors, and models that were exhibited gave a good representation of members' work.

We shall be pleased to welcome any readers to come down and visit our clubroom by arrangement with the Secretary.

An invitation form to our next lecture will be given to anyone interested.

The Rocket, our quarterly journal, is now ready and can be obtained price 5*d*., post paid, from the Secretary now. This contains full club news, together with interesting items of real railway news.

Full particulars from the Secretary, Brooke House, Rotherhill Avenue, Streatham, S.W.16.

Catalogues and Publications Received

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To save readers trouble, we undertake to send on catalogues of any of our advertisers. Merely state on a post-card the number (or numbers) appearing at the end of the paragraphs below and address it to "Catalogue," PRACTICAL MECHANICS, Geo. Newnes Ltd., 8/11 Southampton Street, Strand, London, W.C.2. Where advertisers make a charge, or require postage, this should be sent with applications for catalogues. No other correspondence whatsoever should be enclosed.

A New Radio Feature

THE TECHNICAL & COMMERCIAL RADIO COLLEGE, Cromwell House, High Holborn, advise us that they have recently introduced into their College course a number of additional lessons, dealing with the design of the modern superhet and the use of the new types of valves of the multi-electrode type for frequency changing and A.V.C. in such circuits. They also give instructions dealing with the adjustment and servicing of modern superhets and other receivers. [64]

The 1935 Whitfield King Stamp Catalogue

THE new edition, which is right up to date, is an improvement upon its predecessors in several respects, being printed on thicker and better paper, and certain alterations have been introduced in regard to lay-out which make for clearer reading and easier reference. The size of the pages has also been slightly increased to accommodate the number of new stamps recorded without becoming unduly bulky.

The binding has been improved and strengthened and an innovation which, no doubt, will be welcomed by retailers is an attractive jacket, this being a novelty so far as stamp catalogues are concerned.

Although compiled upon simple lines for ready reference, it is not primarily a simplified catalogue, since it records essential particulars, including watermarks of every issue of the world's postage and air mail stamps. Only minor variations of colour, perforation, etc., are excluded, these being of no interest to the average collector.

The catalogue is now on sale, and despite the cost of improvements and increased size there is no alteration in the retail price, which remains at 7*s*., and it is obtainable from the above firm's address at Ipswich. [65]

A Valuable Valve Guide

A COPY of the 1934-35 Osram valve guide, published by the General Electric Co. Ltd., has just come to hand. Since its introduction in 1926, this valve guide has proved its popularity and utility by an increasing circulation year by year amongst wireless enthusiasts.

The rapidly multiplying number of valve types on the market to meet modern circuit developments has set its own problem, which is to compile a reference booklet providing complete technical information and working data for each type, and yet retaining a handy pocket size. This little publication certainly achieves this aim with success.

The 1934 Osram valve guide solves the problem for the technical reader by giving full tabulated data of all the Osram ranges of valves, and at the same time offers a clear guide to the non-technical reader as to which valve is most suitable for every stage in a modern set.

In addition to the data charts, the Osram valve guide contains much helpful information, circuit diagrams, and useful description of the application of modern valves. A copy can be had on application to the General Electric Co. Ltd., Magnet House, Kingsway, W.C.2. [66]

The 1935 Gibbons Stamp Catalogue

THE Jubilee edition of the Stanley Gibbons Postage Stamp Catalogue is specially notable for the fact that a number of rare stamps are now priced for the first time, no less than £131,892 worth of *extra* prices having been added in this way. Market fluctuations are indicated by the fact that 23,990 prices have changed during the past year—about 10 per cent. of the whole.

To provide space for the 2,000-odd stamps which represent the world output for the twelve-month, over fifty extra pages have been added, though no alteration has been made in the price at which the catalogue is sold.

For the convenience of collectors, the list of Egyptian stamps has been reinstated in Part I., which is now described as "British Empire (with Egypt and Iraq)." Typical plate varieties in the earliest British issues are now illustrated, and it is noticeable that there has been a sharp rise in the prices quoted for many of the older stamps of Great Britain. The catalogue is obtainable from Messrs. Stanley Gibbons Ltd., 391 Strand, London. [67]

FREE SERVICE FOR READERS

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

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CLASSIFIED ADVERTISEMENTS

MANUFACTURING ARTIFICIAL SILK

One of the marvels of modern industry is the production of artificial silk or rayon, and to those who make chemistry their hobby, a brief account of how such a material as wood is chemically converted into this wonder fabric should be of great interest.

IT is now nearly thirty years since artificial silk became a commercial possibility. The original method of production was discovered by M. Chardonnet, but is now very little used, the three other systems being better known.

"Viscose" and Acetate

Of these the most important are "Viscose" and "Acetate," the most widely-known make of the latter being "Celanese."

With the exception of acetate silk, all systems employ the same principle, that of converting the cellulose in the raw material to various compounds and finally reconverting these compounds to cellulose again, but in a form much different from that which it was at first.

In the case of viscose silk, wood pulp, or cotton, from which all the natural impurities have been removed, is first bleached. Incidentally, vegetable compounds such as wood and cotton are almost entirely composed of cellulose ($C_6H_{10}O_5$)n.

Conversion of Pulp into Alkali Cellulose

The next stage of production is the conversion of the pulp into alkali cellulose by steeping it in caustic soda (NaOH). This compound is then treated with carbon bisulphide (CS_2), the resultant being cellulose xanthate. An ageing process is possibly the most remarkable of all, for the strained fluid, is forced by means of a pump through small jets of platinum or a similar material. The holes in these jets are so fine that they can scarcely be seen by the naked eye. As may be imagined, the streams of liquid issuing from the jets are almost invisible. Some idea of the diameter of these fine filaments may be gained from the fact that a finished thread has been produced of less than one denier count, or gauge, which, in non-technical language, means that there are 4,437,333 yards in a pound.

The Coagulating Bath

To revert to the manufacture of the thread, the liquid emerges from the jets into a settling or coagulating bath, which may be sulphuric acid (H_2SO_4). The fine filaments now consist of crude viscose from which the sulphur and other unwanted elements must be removed. A number of the filaments, usually up to eighteen, are then spun together to form a thread, which is artificial silk in rough state. The thread thus obtained is reeled into hanks, in which form it is washed, bleached if necessary, and then dried. The drying takes place in special ovens, for it is necessary to keep the air in the ovens at a special degree of moistness or humidity. The dried hanks are next stretched on to racks, and strange to say, the effect of the stretching is to bring out the lustre which is such a feature of this form of artificial silk. All that now remains is to sort out the various grades and sizes.

The artificial silk thus described is known as regenerated cellulose for the reason that, when finished, and in spite of apparently being entirely different, it is still the same as when it began its unpleasant journey through numerous acids and alkalis. That is, it is still cellulose.

Acetate Silk

Acetate silk is of an entirely different nature, for it does end at its travels by actually being different chemically from its raw material, which is the same as for viscose—wood pulp or cotton. In the same way, the wood pulp or cotton is purified and bleached, but from now on a different process is employed and which is, from a chemical point of view, much simpler.

The purified pulp or cotton is treated with acetic acid (CH_3COOH), and the product is cellulose acetate. The acetate compound is then dissolved in acetone (CH_2CHOH), and the liquid obtained is the actual spinning solution. This is filtered and forced through minute jets as in the case of viscose. The fine filaments which issue from the jets are hardened or coagulated simply by means of warm air, after which they are spun together to form the thread, which is reeled into hanks and finished.

Acetate silk is a definite cellulose compound even in its finished form, and it is this feature which distinguishes it from the other types, which are practically pure cellulose.

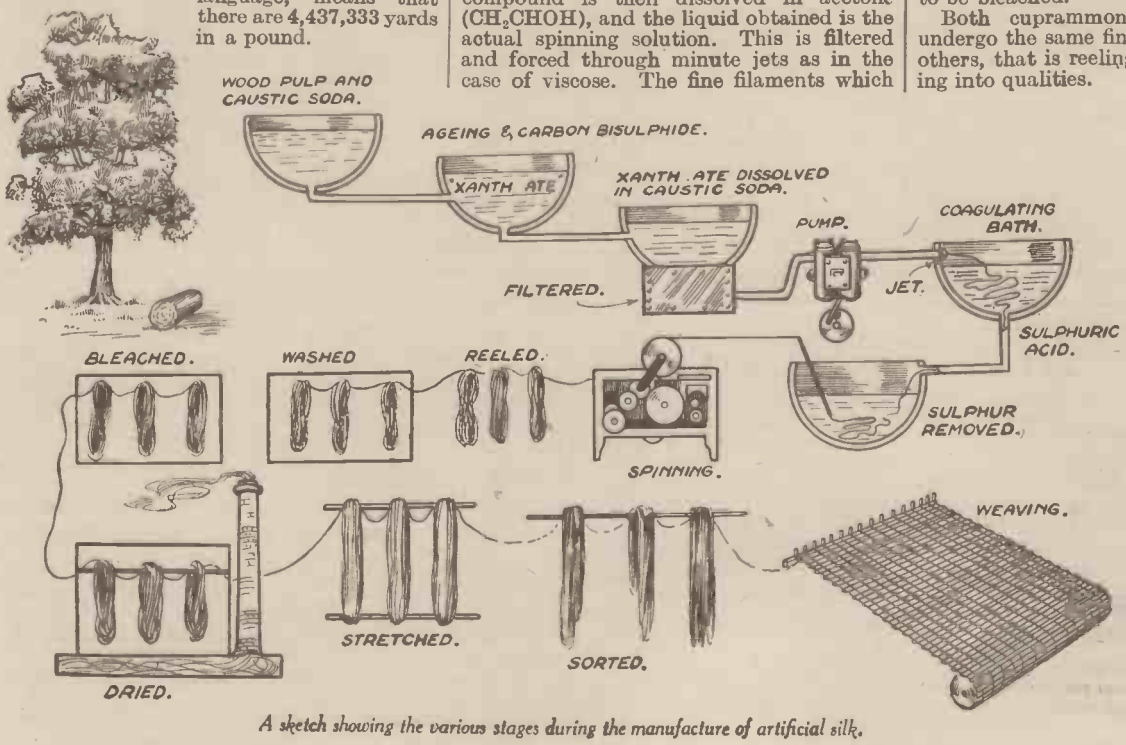
As a matter of interest, it may be identified in the following way. On burning it gives off a "vinegary" smell and shrivels up into small knobs. It will dissolve in acetone. There are also two types of artificial silk, and the methods employed in their manufacture are similar to those used for viscose, but with different chemicals.

Nitro or Chardonnet Silk

Nitro or chardonnet silk is made from cotton which is treated with nitric acid (HNO_3) and sulphuric acid (H_2SO_4). The nitro-cellulose thus obtained, and which is very similar to gun-cotton is dissolved in alcohol and ether. The solution is forced through small jets, after which the acids are removed whilst the alcohol and ether are evaporated to coagulate the filaments. To economise the alcohol and ether they are distilled after evaporation.

The remaining type is known as "Cuprammonium," and is also made from cotton or wood pulp, which is dissolved in an ammoniacal cupric solution. This solution is obtained by forcing air through ammonium in which copper turnings have been placed. The fluid is filtered and forced through jets, as with all other types, but in this case is hardened by the action of caustic soda, the copper and ammonium being recovered. The resultant hardened thread is blue in colour and, naturally, has to be bleached.

Both cuprammonium and nitro silks undergo the same finishing processes as the others, that is reeling into hanks and sorting into qualities.



A sketch showing the various stages during the manufacture of artificial silk.

A cross section of acetate silk.

A cross section of viscose silk.

The LATEST Novelties

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

An Ingenious Weather Prophet

NAMED after the well-known aerodynamist and meteorologist, Dr. Manfred Curry, the device shown in the illustration is both ingenious and novel. It works on the principle of a hygrometer—a chemical material which indicates the degree of moisture in the air by change of colour (each colour grade corresponds to a change of about 20 per cent. in the degree of moisture in the air). Of the five comparison colours, blue, for instance, corresponds to an atmospheric degree of humidity of 0 to 20 per cent., and bright red to one of 80 to 100 per cent. A compass is provided in the centre of the dial by means of which the cardinal points, and hence the direction of the wind, may be ascertained. Great humidity of the air as a rule brings rain, snow or fog; slight humidity, on the other hand, fine dry weather. As, however, the degree of humidity in its effect upon the weather has to be estimated differently according to the direction of the wind, this factor has also been included for determining the weather. The chemical indicator is affected some 8 to 15 hours before a change in the weather sets in. By this means you can forecast the weather for the next day. Whereas the barometer comprises only one factor, the atmospheric pressure, this weather prophet bases its weather forecast on two factors, the atmospheric moisture and the direction of the wind. As will be seen, the weather forecast and wind direction is shown in the small windows which are cut in the dial. It is sold in two types, with full instructions for use, costing 6*s.* 9*d.* and 7*s.* 9*d.* respectively. [81.]

An ingenious novelty for forecasting the weather.

This floor washer is simplicity itself to use, having no complicated mechanical parts, no extra gadgets, no mechanical power, in fact, nothing that can go wrong.

Easy Floor Washing

MOST housewives know how tiresome it is when kneeling on the floor to wash the floors. At its best it is a depressing job, which generally gives rise to an aching back and chapped and roughened hands. The floor washer shown in the illustration relegates this arduous duty, and makes it quite a simple job. It is an ingenious contrivance which, simply by the movement of the lever shown, squeezes the washer dry and completely rinses it of dirt. All you have to do is to plunge the base of the washer in water, which results in the special fabric becoming thoroughly soaked and ready for use. After washing the floor, the water, plus the dirt, is expelled by pulling the lever towards you, and the washer is now ready for drying the floor. For floor polishing, remove the washing fabric and the wet pad, insert the rods in the polishing cloth, which is included in the outfit, stretch the cloth over a dry pad, and fasten the rods in the eyelets. It costs 10*s.* 6*d.* [82.]

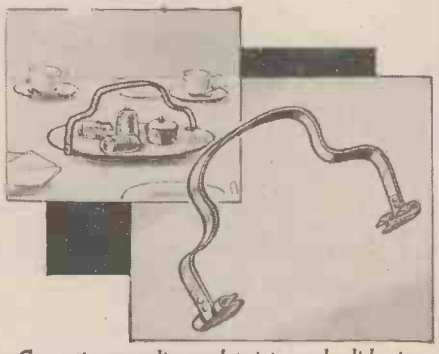
Simple washing tongs that will prove a boon to the housewife.

Washing Tongs

THE tongs shown in the sketch on this page will be found ideal for the housewife during washing day. They are absolutely rustproof, and will not damage the clothes. Once gripped in the tongs, the washing cannot slip back into the copper, and large articles can be removed with ease. It costs 1*s.* 3*d.* [83.]

A Useful Plate Holder

BY using the handle shown in the sketch below, an ordinary plate can be converted into a cake-stand. As will be seen, the plate slides into the two clips, thus making an efficient handle for lifting the plate. It is chromium plated, and costs 1*s.* 9*d.* [84.]



Converting an ordinary plate into a cake dish, etc., by means of the handle shown.

A Domestic Robot

AN electrical novelty with a wide appeal has just been introduced on the market, appropriately called the "Cockorse." It comprises a small cabinet on which is a lampholder and a plug, so arranged that it can be attached to one's alarm clock. The device is connected to the nearest plug or lampholder, and when the alarm rings in the morning the lamp is switched on, and also, at the same time, any appliance such as kettle or fire, switched on. Thus the "Cockorse" not only gives a light in the dark mornings, but provides hot water for tea or shaving water, or can even be used to cook the breakfast. The "Cockorse" has many other uses. For those out all day at business, or when going to the theatre, it can be set to switch on the electric radiator half an hour or so before arriving, thus ensuring a warm welcome home. The radio enthusiast can use it to switch on the set *any given time*, so as not to miss one's favourite item. It can be connected to an electric immersion heater in the hot-water system, so that a plentiful supply of hot water is available for baths immediately on rising. It sells at 12*s.* 6*d.* [85.]

A domestic robot, details of which are given above.

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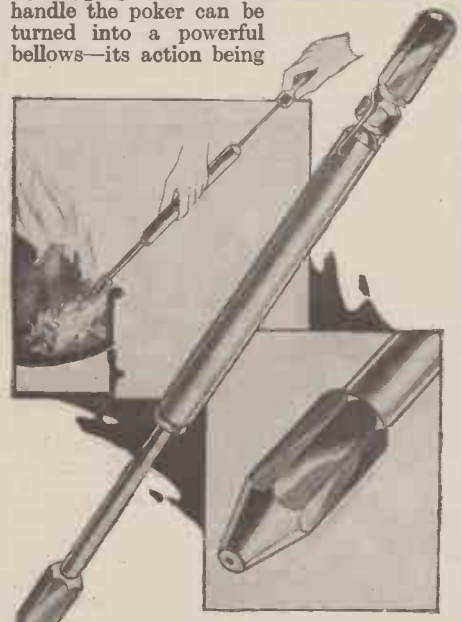
A Poker and "Bellows" Combined

THE poker shown herewith, which is finished in bronze, is somewhat unique, as by a simple adjustment it can be used for kindling the fire when it refuses to draw. By slipping back the catch shown on the handle the poker can be turned into a powerful bellows—its action being similar to a cycle pump. It is marketed at 6*s*., post free. [85.]



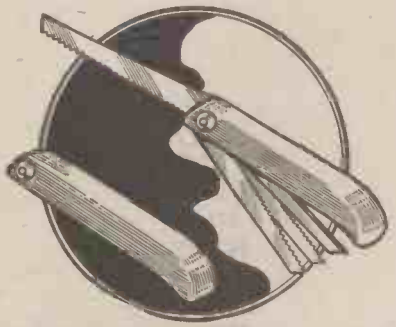
A combined poker and "bellows."

A Handy Combination Pocket Tool

THE neat combination tool illustrated below has a number of applications. It is provided with four strong steel blades, three of which have saw teeth, and are coarse, medium and fine, respectively. The fourth blade has a knife edge, whilst all four fold up into the metal handle when not in use. The overall length of the tool, when folded, is 5 in. Priced at 3*s*. this tool represents excellent value.

A Universal Lever Flooring Cramp

A CRAMP specially designed for use in cramping floor boards is now on the market at a very reasonable price. With the long handle supplied, the handyman can operate the cramp whilst standing. Its lightness contributes to its good working, as it can be handled far more easily than the heaviest cramps. The cramp is easy of adjustment, convenient in use, a complete tool in that it deals with all the boards of a floor, and by its differential and reciprocal movement brings continuous pressure and acts as a wedge until the nailing is done. It is undoubtably a labour-saving tool and costs 28*s*. 6*d*. [86.]



The combined pocket-saws and knife is only 5 in. long when the blades are folded away.

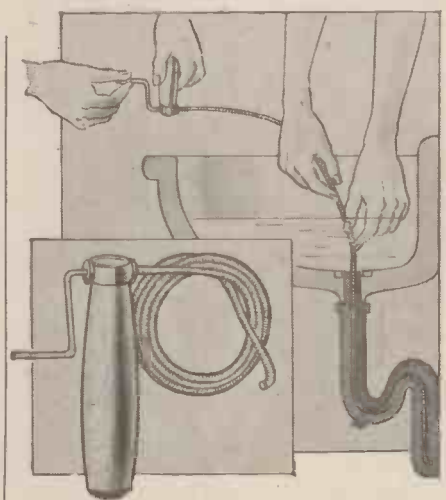
An improved design of table knife with a short blade and long handle, ensuring a comfortable grip.

New Style Table Knives

AS a large part of the blade of the old type of table knife is seldom used, a designer has improved on its design. This new pattern has a shorter blade and longer handle, making it much more comfortable to use (see sketch). The dessert knives cost 42*s*. per doz. and the table knives 45*s*. per doz., carriage paid. [87.]

A Two-Speed Bench Drill

A NEW design of two-speed bench drilling machine is now on the market. This machine will drill holes to ¾ in. diameter, being fitted with two speeds, the lower gears for large holes, and the quick speed for smaller diameter holes. It is fitted with automatic and hand feed of strong design and construction. The spindle will take ½-in. parallel shank drills direct in the spindle, and smaller jobber drills in the self-centring chuck. The base is of stronger design than usually found in this type of machine, and includes a drill stand for the drills. Another feature of the drill is that the circular table may be removed and a small self-centring vice fitted in the table socket. The price of the machine is 55*s*., and the self-centring vice 6*s*. extra. [88.]



A device for cleaning out pipes that have become clogged with dirt.

A "Rotary" Drain Cleaner

THE device shown in the above sketch will simplify the unstopping and cleaning of bath outlets, lavatory pipes, etc. It will go round any bend in the pipes with ease. Costing 4*s*., post free, it is sold complete with full instructions for use. [89.]

REPLIES TO QUERIES & ENQUIRIES

If a postal reply is desired, a stamped addressed envelope must be enclosed. Every query and drawing which is sent must bear the name and address of the sender and be accompanied by the coupon appearing on page 48. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes Ltd., 8-11 Southampton Street, Strand, London, W.C.2.

AN ANTISEPTIC OINTMENT

"QUITE recently, on account of numerous cuts, etc., received at my work, I looked round for an ointment that would be cheap, and at the same time possess good antiseptic and healing properties.

"I iodised petroleum jelly, and the result was all to be desired. Could you tell me if such an idea is worth patenting?

"I am aware of that excellent ointment '——.' I was wondering if it was identical." (R. R., Lancs.)

It is not possible to obtain a Patent for the new ointment unless it is prepared by a particular process, and it is not deemed to be a particular method or process of manufacture, the mere admixture resulting only in the aggregation of the known properties of the ingredients of the mixture. If, in order to produce the iodized petroleum jelly, it is necessary to submit the jelly to a particular process, it may be possible, provided such process is novel, to obtain a Patent for the process and the product of such process. It is not, however, possible to patent the addition of iodine to petroleum jelly or the product resulting from such mixture.

It is not known how "——" is prepared or what its constituents are, but should it be sold without a stamped wrapper, *i.e.*, not as a "Patent Medicine," the formula of the preparation will probably be given on the label.

AUTOMATIC PILOT FOR MODEL AEROPLANES

"Would you please tell me if the following idea is worth patenting, and where I should send to try and sell it? It is an automatic pilot for use in model aeroplanes. I have tested it and it works perfectly—the cost is negligible. It consists of a miniature joystick, which has a leaden knob on the end. This joystick actuates two side-sticks, which are connected by control wires to the tail-piece, to a large, hinged rear flap.

"While the model aeroplane is on level keel, a piece of strong elastic holds the joystick straight up, and the elevator is level. When the model zooms, the weight of the lead at the top makes the joystick fall back, pulling the control wires and causing the elevator to move down, so that the 'plane regains a level keel. The same applies to a dive, the controls working in the opposite directions.

"Advantage of this arrangement are—

"(1) Adds to the flying, gliding and landing abilities of 'plane.

"(2) Very cheap to build and install in the 'plane.

"(3) A novelty which will appeal to the model aeroplane enthusiast.

"(4) Also adds to the realistic appearance of the 'plane. With a fuselage model, of course, the pivoting of the joystick is easily managed by the crosspiece projecting through the sides of the fuselage." (F. K., Redcar.)

The automatic pilot for use in model aeroplanes is, from personal knowledge, thought to be novel and is fit subject-matter for protecting by Letters Patent. It would be advisable to obtain Provisional protection for the idea by filing an Application for Patent with a Provisional Specification, by which means protection may be obtained in the least expensive way for a period of about twelve months, during which time it should be possible to interest a firm in the device and ascertain its probable commercial value. After the invention has been protected, it could be submitted to firms making a speciality of model aeroplanes. Many such firms advertise in PRACTICAL MECHANICS, for instance Warnford Flying Aircraft, Greenwich, London, S.E.10; The Model Aircraft Stores, 133 Richmond Park Road, Bournemouth, etc.

A WALL-PLUG SOCKET

"I would be very much obliged for your advice on the following idea. I have devised a new type of wall-plug socket to cut out the present method of plugging in and then switching on. The following is a description of how the socket works. The base is 2 in. in diameter, to which points are fixed internally for the wires. Projecting from the base are four hollow pillars ½ in. long with three solid pillars 2½ in. long. The other part slides on the long pillars, with springs attached to its inner end to fit into the hollow pillars, so that when the plug is inserted and pushed home, contact will be made automatically. The plug is held in place by a small spring-locking device." (J. L., Ayrshire.)

The proposed combined wall plug and switch for electric wiring is novel so far as is known from personal knowledge and would form fit subject-matter for protection by Letters Patent. The only possible difficulty which may be encountered with the proposed arrangement is the question of obtaining a sufficiently quick action as to prevent arcing when using the switch with relatively high tension current.

AN AUTOMATIC STOP LIGHT

"Can you advise me on the novelty and validity of the following idea?

"It is an automatic stop light on a cycle, which is worked with the rear brake. I have for an experiment converted a reflector with a small 2·5 lamp bulb, and two-cell lamp battery can also be used with a 4·5 battery.

"The connection is by the rear brake block." (L. C., Bournemouth.)

It will not be possible to obtain any Patent for the broad idea of signalling the stoppage of a cycle by means of a rear lamp which is automatically lit on the application of a brake. It is common practice to use such a signalling means on motor road vehicles, and there is no subject-matter for a Patent in adapting the known idea for use on a cycle.

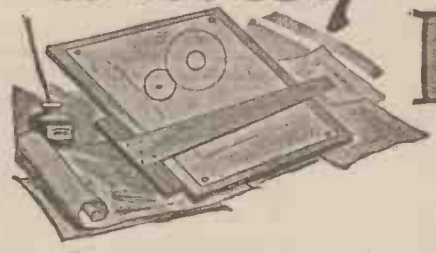
However, the particular means or construction of the mechanism employed if novel may form the subject-matter for protection by Letters Patent, but since no particulars are given of the mechanism it is not possible to give the inventor more definite advice.

A NEW TYPE OF GRAMOPHONE

"I have an idea for a new type of gramophone which will not require winding. Please let me know if it is worth patenting?" (J. K., Liverpool.)

We cannot advise you without having further details of your invention. It is always necessary to explain the principle of an idea before we can advise.

Money Making IDEAS



SUGGESTED BY OUR READERS

A PHOTOGRAPHIC ENLARGER

"(1) I have a Zeiss 'Skon' camera which takes pictures 1⅝ in. × 1¼ in. As this size is on the small side, I wish to enlarge (when printing) to 2½ in. × 3½ in. I have constructed an arrangement utilising the camera as part of the enlarger. However, I find that I am unable to focus to the size required. The image appears about 3 ft. from the camera, but is 14 in. × 10 in. approximately.

"(2) Is it possible to print in daylight or by means of a 100-watt electric light?

"I think that the idea is practical, but would esteem it a favour if you would advise me fully." (K. G., Somerset.)

(1) Your difficulty in obtaining a moderate degree of enlargement is due to the negative not being far enough away from the lens. Assuming your lens to be 3-in. focus, the negative should be 4½ in. from the lens to give an enlargement of twice the linear dimensions. The image would then be only about 9 in. in front of the lens instead of about 3 ft. as at present.

(2) The arrangement of electric lighting that you mention should be satisfactory provided you use some form of diffuser. You could use a matt glass bulb and, say, two pieces of ground glass placed between the lamp and the negative. Don't put the two ground glasses in contact, but space them out equidistantly between the lamp and the negative.

TRANSMITTING SET

"I desire to make a transmitting set; please can you help me?" (A. C., Highgate.)

I recommend you to get into touch with the Radio Society of Great Britain, 53 Victoria Street, S.W.1, who will probably be able to help you. It is, of course, essential for you to obtain a transmitting licence, full details of which will be sent to you by the Postmaster General, London.

MAKING WIRELESS CRYSTALS

"Can you please give me the formula for making wireless crystals?" (K. L., Cape Town.)

Crystals are minerals, and as such cannot be produced synthetically.

MICANITE AND SOLENOID QUERY

"Can you supply me with the address of a firm who sells micanite? Also are there any formulæ for the self-capacity of a solenoid?" (A. W., Poole.)

Micanite is obtainable from Mica & Micanite Supplies Ltd., Mica House, 1 Offord Street, N.1.

There are no direct formulæ for ascertaining the self-capacity of a solenoid, and to obtain it it is necessary to know the reactance and also the inductance of the coil and, using these factors in conjunction with the winding data, to arrive at the value required. We might add, incidentally, that the self-capacity of a solenoid is seldom required, and we wonder if you are confusing this with the inductance.

CARBON GRANULES FOR A MICROPHONE

"Can you tell me what grade of carbon granules and from what kind of dry cell carbons (for electrodes) I can make the home-made microphone described in your December, 1933, issue?" (W. R. B., Fife.)

Any high-tension battery should yield you the carbons from which you can pound the carbon granules for the microphone mentioned.

PELTON WHEEL QUERY

"I have a 12-volt car dynamo and wish to know if a Pelton wheel would be strong enough to drive it at its full capacity." (T. S., Matlock.)

A Pelton Wheel such as you suggest would not be sufficiently powerful to drive a 12-volt car dynamo.

MELTING GLASS

"Could you please tell me the simplest and cheapest way to melt ordinary window glass to a liquid form, in order to cast a mould?

"I tried a Bunsen burner, but got no results at all.

"If any apparatus is required, could you supply me with the name of a local firm if possible?" (R. P., Glamorgan.)

Ordinary window glass cannot be melted to a liquid form—when liquid it is quite viscous. To bring it even to this state requires more heat than can be supplied by one Bunsen burner. Large furnaces are employed by glass workers, and it is possible that a blacksmith's forge would answer querist's purpose, to the extent of melting the glass. I fail to see how he is going to cast it, as it would be difficult to pour into a mould, although it could be pressed to shape while in a plastic state.

COPPER-PLATING ON PLASTER OF PARIS

"Referring to your answer to 'J. H. D., Oxford,' in your current issue, I am also interested in this matter, and have tried the method recommended, but without satisfactory results.

"I have not been able to obtain a deposit of copper on the black-lead (polished) surface, and, furthermore, the plating solution gets into the plaster of Paris and softens same.

"Should not the plaster be rendered waterproof before the black-lead is applied perhaps? And if so, what do you advise for that purpose so that the black-lead would adhere satisfactorily?

"In the same connection could you suggest a practicable method of copper-plating wood? I am particularly interested in this idea.

"I have tried 'Gold Paint' in both cases as a first coating, but this does not answer, presumably on account of the 'gold-size,' or whatever the fixing ingredient is.

"I should also like to say I have tried the 'Seccotine and Vinegar' combination for hardening plaster of Paris, but in this case also the results have not been, in my opinion, equal to the plain 'water' mixing.

"I was once recommended to use 'milk' instead of water for this purpose, but this was quite useless, although the idea seemed

feasible, with casein in mind." (J. W., Southport.)

Wax moulds are more usual, and it is advisable when using a plaster mould to render this more absorbent by soaking it in melted paraffin wax. If removed from the wax bath while really hot, there is no surface film to cause trouble. The surface should then be dusted with graphite (not ordinary polishing blacklead; this often has a waxy or resinous base). This should give sufficient conductivity. If, however, the article is flat, it is washed after dusting with graphite and its surface flooded with copper sulphate solution. Iron filings are then sprinkled over it and a primary copper deposit is formed, which subsequently plates well. The same remarks would apply for copperplating wood.

For hardening plaster of Paris nothing equals sodium silicate solution (water glass). Use two parts of silicate solution to one of water and mix with the plaster to the required consistency.

A CHEMICAL QUERY

"Could you please tell me the underlying chemical principles in the following; (a) Bleaching, (b) Tanning, (c) Photography?" (J. R., Cumberland.)

Bleaching

This may be brought by oxidation, reduction, or even the action of strong light—and in some cases by simple solution.

Sodium hyposulphite and other compounds bleach indigo by reducing it to indigo white, while hypochlorous acid and ozone bleach indigo by oxidising it to isatin. Sodium hydroxide bleaches blue prints because it is an active base and interacts with the ferrous ferricyanide.

Tanning

The object of this process is to prevent putrefactive changes and to render the skin permanently flexible and porous. The hair is first removed from the skin, usually by the action of milk of lime, which at the same time causes the skin to swell. The lime is then dissolved out by soaking the skins in fermenting liquors (made of dung, bran, etc.) which contain organic acids. The skins are then steeped in solutions of tannins. Various tannins are used, and the solutions are aqueous extracts made by soaking various vegetable substances (oak bark, hemlock bark, cutch, sumach, etc.) in water. The chemical effect of the tannin solution is to precipitate gelatine and to form an insoluble compound with it. Any compound which has the property of rendering gelatine insoluble may be used in the final process—formaldehyde is used as are also chromic salts and alum.

Photography

Bromo-gelatine dry plates are made by preparing an emulsion of gelatine to which silver nitrate and a slight excess of ammonium bromide have been added. After further treatment the emulsion is applied to plates. When exposed for only a short period to light a change takes place in the nature of the emulsion, although there is no visible alteration in it. The image is then developed either in darkness or in a light having a colour to which the film is not sensitive (usually red). Chemically the developing process consists of reducing the affected silver bromide to metallic silver. The reduction takes place at a speed proportional to the intensity of the exposure illumination undergone by each part. After contrast sufficient has been obtained the unaffected silver bromide is removed by placing the plate in sodium thiosulphate solution. The result is a negative in which the high lights of the object photographed are reproduced as opaque and the shadows are transparent.

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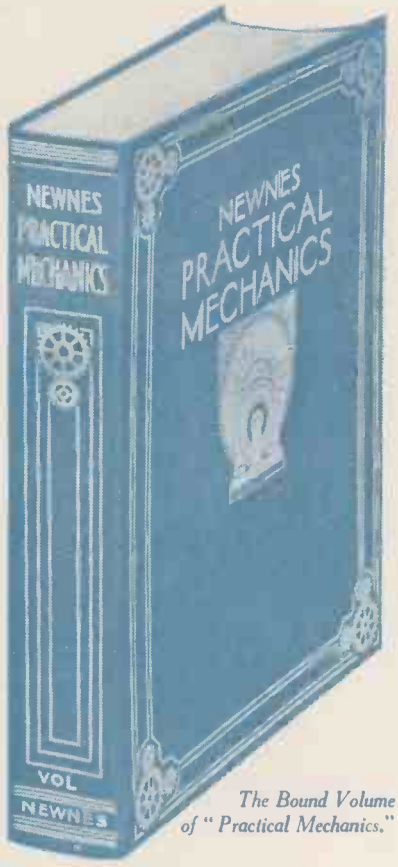

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Published by GEORGE NEWNES LIMITED, 8–11 Southampton Street, Strand, London, W.C.2, and Printed in Great Britain by THE WHITEFRIARS PRESS LTD., London and Tonbridge. Sole Agents for Australia and New Zealand—Gordon & Gotch Ltd. Sole Agents for South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