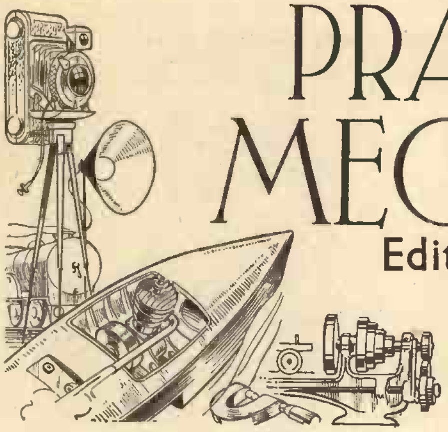
BUILDING A 9·5m.m. CINÉ PROJECTOR

NEWNES

PRACTICAL MECHANICS

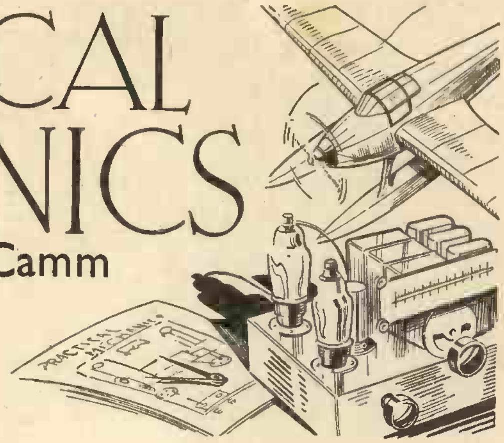
NOVEMBER

6d.



PRACTICAL MECHANICS

Edited by F. J. Camm



VOL. IV. No. 38
NOVEMBER
1936

NOTES, NEWS, AND VIEWS

Bind Your Copies of "Practical Mechanics"

THE binding case for Volume III, complete with title page and index, is now ready and costs 3*s*. 6*d*. by post from the Publisher, George Newnes Ltd., 8-11 Southampton Street, Strand, London, W.C.2. The index can be obtained separately if desired for 7*d*. post free. All readers should have their copies of Volume III bound, and thus be able easily to refer to the contents by means of the fully cross-referenced index.

Power from the Sun's Rays

A STEAM engine run by the sun's rays was recently demonstrated in Washington by Dr. C. G. Abbot. It was a crude-looking apparatus developing only half horse power, but its inventor says it is the forerunner of great revolutions in mechanics.

Pneumatic Shorts

POOR swimmers, claims a Viennese inventor, V. Veldomon, may be swept out to sea in safety if they are wearing his new "safety shorts." Victims of accidents, currents or cramp need only inflate the double front of the shorts. They can then float on their backs until picked up.

£3,000,000 Power Scheme

THE £3,000,000 hydro-electric power scheme in Galloway, which has been carried out to provide electricity for Southern Scotland and North-west England will shortly be completed.

An Aeroplane which Folds its Wings

LOCKED in a hangar at Villacoublay, near Paris, is the most astonishing aeroplane ever built. When in the air, the pilot can wind the wings in, shortening the span, and the machine can then reach a speed of 280 m.p.h.

Flying into Space

FROM New York comes the news that an inventor has discovered how to build a rocket 'plane that can be flown under complete control. Several flights have been made, some straight up through the stratosphere to heights of thirty miles. The inventor believes that rocket 'planes could achieve 1,000 m.p.h. or more in the upper stratosphere.

Into the Depths

SEVEN British scientists are leaving early next year on an expedition to study under-water life at the bottom of Lake Titicaca, which is on the boundary of Peru and Bolivia. The lake is 12,500 ft., nearly three miles, above sea level.

Showing the attractive appearance of the bound volume of "Practical Mechanics."

So This Is Love

RUMANIA'S foremost neurologist, Prof. George Marinesco, has invented an apparatus for measuring the intensity of love. It consists of two lead plates, connected to a series of electrical devices leading to a galvanometer. The two lead plates are fixed on the victim's arm, and the professor reads a list of names. As soon as the beloved one is mentioned the needle of the galvanometer begins to quiver, and the more intense the feeling the greater the deviation.

A Chandelier Organ

A NEW type of organ has been constructed in Berlin. It is electrically operated, has 138 pipes, and has a mechanism concealed in a huge suspended chandelier. Its quality is said to be normal within its range of tones.

Playing by Eye

IT is stated that with the oscillograph arrangement invented by Professor G. Hannenman, of Chicago, a deaf person could learn to play a musical instrument, by watching the visible records of the notes he produces. It is said that it can even pick out the instrument in an orchestra responsible for a bad note.

A New Bullet

IT is claimed that a new type of bullet, recently patented, has, owing to its unusual shape, about four times the acceleration of an ordinary ·30 calibre projectile. The speed of the bullet is calculated at about 3,600 m.p.h.

Largest Irrigation Canal

WHAT will be the largest irrigation canal in the United States is being dug in Southern California. Forty-four miles of the canal have already been excavated and lined with clay, while another thirty-six remain to be done.

Invisible Laundry Marks

IN Atlanta City, laundries have devised an ingenious method of marking laundry. Before the garment is laundered an indelible invisible mark is stamped on it. When ready for sorting it is held before a giant mercury vapour lamp and its identity is revealed.

From U.S.A. to Europe by Balloon

IT is learned that an attempt is to be made by a Belgian and a Frenchman to cross the Atlantic by balloon. They claim that there are winds which should land them in Norway and they estimate that the crossing should take about ninety hours.

A Magnetic Ship

OF scientific interest is the decision of the Admiralty to construct a non-magnetic ship for the purpose of compiling accurate magnetic data at sea.

SUBSCRIPTION RATES

Inland and Abroad, 7s. 6d. per annum

Canada - - 7s. per annum

Editorial and Advertisement Offices: "Practical Mechanics," George Newnes Ltd.
8-11 Southampton Street, Strand, W.C.2.
'Phone: Temple Bar 4363.
Telegrams: Newnes, Rand, London
Registered at the G.P.O. for transmission by Canadian Magazine Post

It Can be Built in a Few Hours at Very Little Cost.

Building a Projector

Features of this
Built without
of Toothed

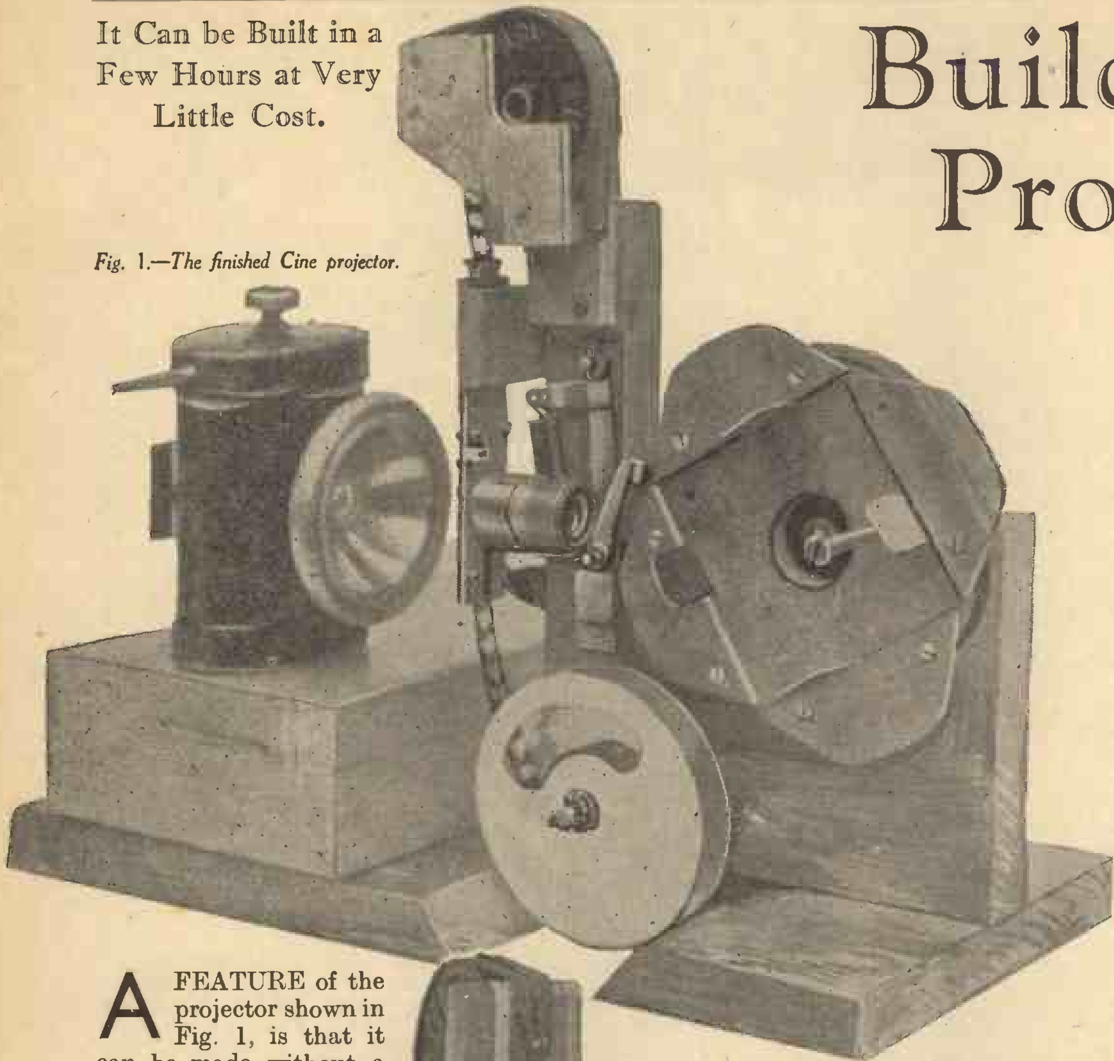


Fig. 1.—The finished Cine projector.

A FEATURE of the projector shown in Fig. 1, is that it can be made without a lathe and without the use of toothed wheels; also the mechanism has been specially worked out so that the accurate positioning of the film does not depend upon the accuracy of machined parts. Any person can therefore undertake the construction of this projector if he is handy with a drill, file, and soldering iron, and is blessed with a moderate degree of patience.

Fig. 2.—The two stops fixed in position.

The machine takes Pathé Baby Films, as these are reasonable in price, there is a good selection to choose from, and also they are non-inflammable.

It is advisable to study the photographic illustrations to get a clear idea of the working of the instrument before commencing construction. Fig. 1 is a comprehensive photograph, showing the general arrangement of the parts.

How to Operate

The metal case containing the film (every film is supplied in such a case) can be seen at the top of the picture resting in a wooden cradle and held in position by a rubber band. The film passes along a brass guide through the "gate" (i.e. the hole through which the light shines), and out on to the take-up-reel, which is conspicuous at the bottom of the picture. On the right of the picture is a wooden disc—turned by a handle—which carries four brass cams screwed on to its face. These cams operate the mechanism which moves the film; each cam causes a picture to move out of the gate and a new picture to enter. Now the pictures have to be changed at the rate of twelve a second, so it will be seen that it is necessary to turn the handle at three revolutions per second to operate the machine properly. This is quite a

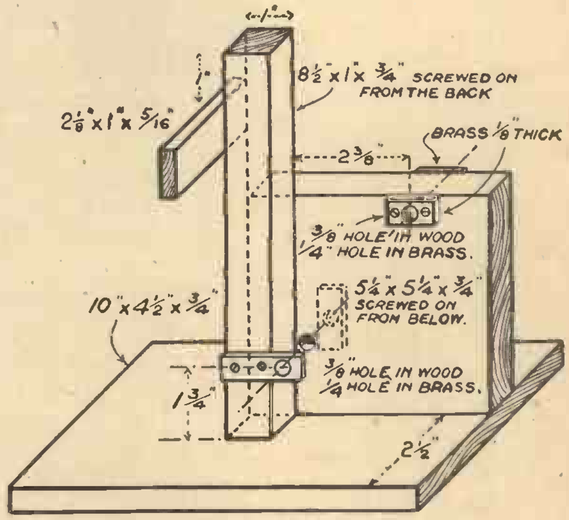


Fig. 3.—The framework of the machine.

Home Cine

By "Home Mechanic"

Home Cinema Projector is that it Can be the Aid of a Lathe and without the Use Wheels.

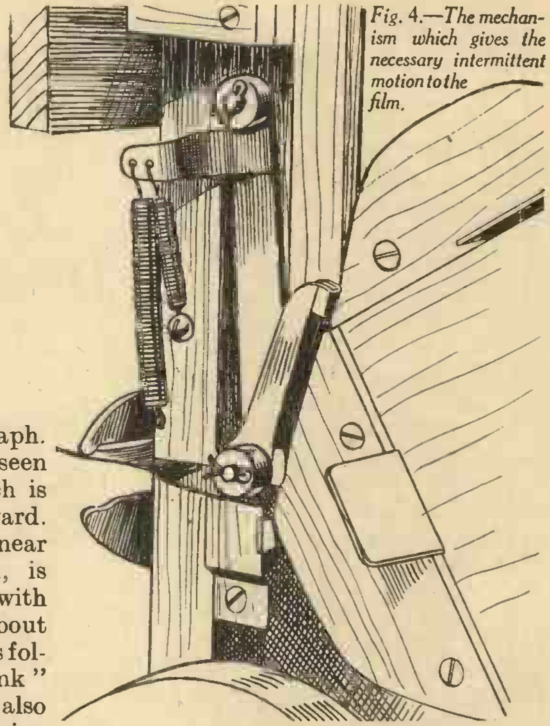


Fig. 4.—The mechanism which gives the necessary intermittent motion to the film.

convenient speed. While the picture is moving across the gate, the light is cut off by one of four flat pieces of metal which project from the face of the cam-wheel, and act as shutters. These shutters uncover the lens immediately the picture comes to rest in

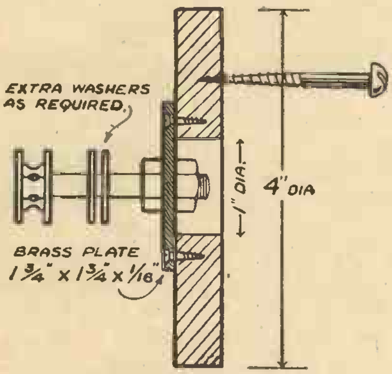


Fig. 5.—The cam-wheel and spindle.

the gate, and allow the image to be projected on to the sheet for its allotted period of a little less than one-twelfth of a second, when the next change becomes due.

The Mechanism for Imparting Intermittent Motion to the Film

The mechanism which gives the necessary intermittent motion to the film is shown in Fig. 4, which is a "close-up" view with the lens and gate removed to show the details more clearly than in a photograph.

Two "followers" will be seen in the path of the cam which is assumed to be moving upward. The lower follower, pivoted near the top of the illustration, is just coming into engagement with the cam which moves it about $\frac{1}{10}$ in. towards the left ; on this follower is pivoted a "bell-crank" lever, which is, of course, also moved bodily to the left, causing the tongue of metal on the extreme left to be pushed through one of the perforations of the film (not shown in the sketch). The cam as it moves upwards then comes into contact with the second follower—which has a movement of about $\frac{1}{4}$ in.—and pushing this to the left, moves the film

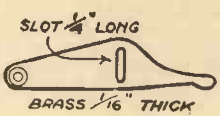


Fig. 7.—(Left) The up-and-down movement of the small tongue is limited by two stops, one of which is shown here.

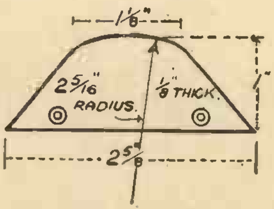


Fig. 8.—(Right) Details of the cam.

downward through the medium of the bell-crank lever. The movement of the tongue is limited by two adjustable stops, and when the cam has passed, the tongue is withdrawn from the film, and the moving parts brought back to position ready for the next cam by spiral springs in tension.

Details of the Construction of the Machine

In describing the construction of the machine only essential dimensions will be given, as it is intended that the parts should be made and assembled in the order given, each part being fitted to those made previously.

Commence by making the framework shown in Fig. 3. This does not require much description, but all the pieces of wood should be planed and fitted truly square or complications might arise during erection. Fig. 1 shows the baseboard cut away to clear the take-up-reel, but this will not be necessary if the dimensions on Fig. 4 are followed.

The Cam-wheel and Spindle

These should be made next (see Fig. 5). The wood disc can be cut out with a fret-saw ; the spindle is a $1\frac{3}{4}$ in. by $\frac{1}{4}$ in. B.S.F. bolt. A Whitworth bolt would do, though the finer thread is preferable. A washer is

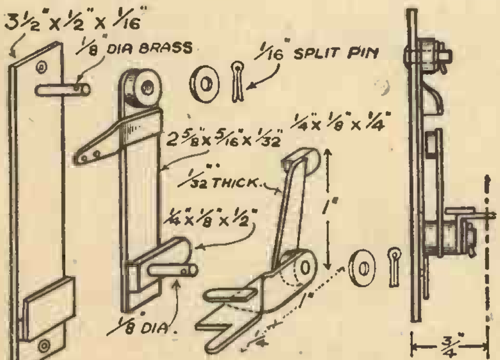


Fig. 6.—The component parts for making the film-moving mechanism.

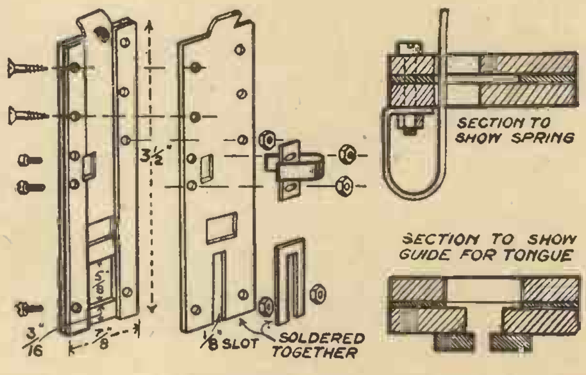


Fig. 9.—The details for making the film guide

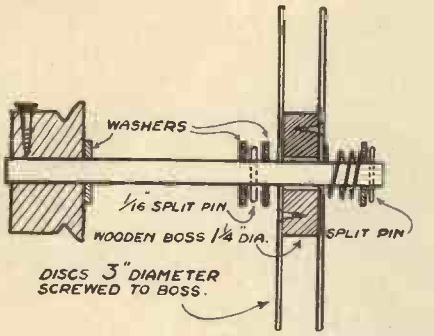
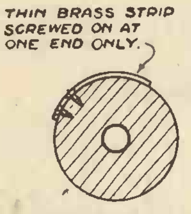


Fig. 10.—The take-up reel.

soldered on each side of the head to form a small grooved pulley for the take-up drive. Mount the wheel and spindle in its bearings, and fix a long screw into the face of the disc as a temporary handle. If the wood disc does not run true, the brass back plate can be taken off and refixed, and the face of the disc can be trued up by packing the wood away from the back plate as required. The face of the disc should stand out about $\frac{1}{16}$ in. beyond the tall upright of the frame.

The Film-moving Mechanism

This is shown complete in Fig. 2. All the separated parts are shown in Fig. 6 together with a side view of the complete assembly. The dimension marked $\frac{3}{4}$ in. from the centre of the tongue to the back of the base plate is important, and should be adhered to. The protruding end of the tongue should be well rounded off to facilitate its entry into the film perforations. The tongue itself should be considerably narrower than the perforations, but its thickness should be as great as possible consistent with free movement into and out of the film. The angle between the tongue and the point of contact with the cam on the other arm should be 120 degrees, measured about the pivot of course. This piece of mechanism is all built up from pieces of brass soldered together, and is quite an interesting part to make. It should, of course, work quite freely, and must be entirely without any tendency to sticking. When complete it should be screwed on to the tall member of the frame with the edge flush with the wood, as in Fig. 4, the vertical position being such as to bring the two cam followers equally above and below the horizontal centre line of the cam-wheel. After fixing this part, screw a small flat piece of thin brass on the other face of the upright member to act as a stop for the member carrying the lower cam follower; the end of this stop can just be seen in Fig. 4. It engages the lower end of the vertical pivoted member, where it works in the guide and prevents the member from coming out of the end of the guide.



SECTION TO SHOW FILM CLIP.

The Two Stops

The up-and-down movement of the little tongue is limited by two stops, as shown in Fig. 7. These are simply flat pieces of brass, about 18 gauge, and are fixed as shown in Fig. 2. The slotted holes allow for adjustment, the screws through the slots being round-headed and fitted with washers. The two stops should be fixed in a position to allow the tongue a movement of about $\frac{1}{8}$ in. above and below the horizontal (about $\frac{1}{4}$ in. in all) when the screws are in the centres of their slots. The exact adjustment must be left till later.

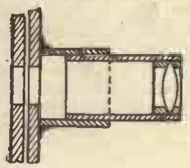


Fig. 11.—(Left) The lens should be mounted in a tube, as shown.

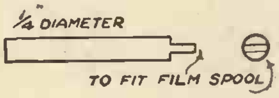


Fig. 12.—The key for re-winding the film.

The two spiral springs may now be fitted; the longer cam operating the bell-crank should be of a "light and lively" type having a pull of between one and two ounces when fitted. The other springs must be definitely stiffer and stonger, so as to ensure the tongue being withdrawn from the film before its upward movement begins.

Now make four cams as shown in Fig. 8. Fix one of these on to the face of the cam-wheel as in Fig. 4 so that the cam projects $\frac{5}{16}$ in. Turn the cam-wheel slowly and see that the lower follower is moved about $\frac{1}{10}$ in. by the cam; if the movement exceeds this amount appreciably, it should be reduced by filing down the follower a little, if less than $\frac{1}{16}$ in., shift the cam out to give the required movement. Next turn the wheel until the upper follower is fully lifted, and, leaving the wheel in this position, adjust the lower stop (Fig. 7), until it presses quite firmly against the under side of its lever, but leave the adjustment of the upper stop till later. The other three cams may then be screwed in place, taking care that they all give the correct movement to the lower follower. If everything has been done properly the tongue should move up and down too rapidly to be seen when the wheel is turned smartly by its temporary handle.

The Film Guides

Before starting to make the film guide shown in Fig. 9, the reader is strongly advised to buy a film and make sure that the parts fit the film as he proceeds. Thirty foot films can be obtained new for 2*s*. 6*d*., or second-hand (from dealers who specialise in film exchanges), for less. A second-hand one should do for the purpose of fitting up, as it will probably become scratched or torn before the instrument is finished. The construction of this part should be quite clear from Fig. 9. The copper foil should be slightly thicker than the film and the width between the two strips of foil should be very little greater than the width of the film, only just enough to allow the film to slide freely. The little bolts, 10 B.A. by $\frac{1}{4}$ in. can be obtained from a model engineers supply store. The little spring shown larger in the sectional view is to keep the film over to one side of the guide, and to steady the film by introducing a little friction; the blade that rubs on the film should be rounded off to prevent scraping, and slotted holes for the bolts allow the spring to be moved to increase or reduce the pressure on the film. The blade of the spring should project far enough to be pushed aside by your finger when the film is being threaded down the guide. The slotted piece of brass at the bottom is a guide for the tongue, which moves the film; it should fit the tongue closely, but not too tightly, and should be carefully centred before being soldered on.

The hole forming the gate should be left uncut for the present. Screw the film guide on to its wooden support (see Fig. 2) in such a position that the tongue works freely in its slot

(*Continued on page* 98)

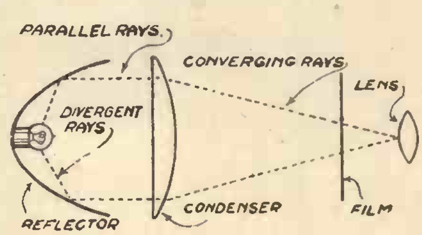


Fig. 13.—The arrangement of the condenser.

Fig. 1.—The latest type of "Direct Take-Off" autogiro. It is fitted with a two-bladed rotor, the blades of which are set to zero incidence while being speeded up before the take-off.

DEVELOPMENT OF THE AUTOGIRO

By G. R. M. GARRATT, M.A.

In Spite of the Ridicule with which the first Autogiros were received, the Inventor Persevered with the Machines until he succeeded in producing the Machine as it is to-day.

THERE must be many readers of PRACTICAL MECHANICS who remember the amused and cynical ridicule with which the first autogiros were received in this country barely ten years ago. There were very few who took them seriously, and there were many who laughed openly at the unconventional machines and at their courageous inventor, Senor Juan de la Cierva, of Spain. It is easier, however, to make fun of some rather strange invention than it is to daunt or discourage a man of the calibre of Cierva, a man who is not only an extremely competent and practical engineer, but who is also a brilliant mathematician and whose knowledge of the theory of aerodynamics is second to none.

Plane Rebuilt from Wreckage

An autogiro is so very different from the conventional aeroplane that one may be excused for wondering what led Cierva to his invention. The story is not a long one and has not often been told.

Cierva was barely fourteen years old when he commenced to study aeronautics fairly seriously, and with two companions he constructed numerous models and gliders which were tried out on the hillsides around Madrid. The experience thus gained led to more ambitious experiments, and when scarcely sixteen, Cierva and his two companions purchased the wreckage of an early Sommer biplane and proceeded to rebuild it entirely. Their efforts were successful, and "The Red Crap" as the machine was named on account of its brilliant scarlet colour, made numerous flights around Madrid before it finally fell to pieces from old age.

Fig. 2.—The rotor head of a type C19 autogiro. The hinges which permit vertical and horizontal movement of the blades may be plainly seen, and also the friction dampers and the driving mechanism for starting the rotation.

Cierva Designs a Bomber

While most of the rest of Europe was at war between 1914 and 1918, Cierva spent his time at the Civil Engineering School at Madrid, completing his mathematical and technical training and when, in 1918, the Spanish Government offered a prize of ten thousand dollars for the construction of a large bombing plane, Cierva resolved to compete. In due course the machine was completed, a large biplane with a wing span of 80 ft. and equipped with three Hispanio Suiza engines. The machine was an excellent one and embodied many details of advanced design, but it crashed on its very first flight due to the inexperience of the pilot, who had never before flown so large a machine and who attempted a turn near the ground at too low a speed. The machine stalled and was wrecked, thirty-two thousand dollars lost in a moment because an aeroplane cannot fly at a speed much lower than 45 or 50 m.p.h.!

This error of judgment was an expensive one, but it served to set Cierva thinking of ways and means whereby an aeroplane could be made to fly and to land at lower speeds. Some fundamental change had got to be made, for nothing had been done or invented in sixteen years of mechanical flight—and nothing has been done since, except the autogiro—to enable an aeroplane to fly at low speeds with safety.

Wing Speed Essential

Cierva's theoretical knowledge of the science of aeronautics told him that the essential factor in the "lift" of an aeroplane wing is speed. Without speed there is no lift above an aeroplane wing, and no support below it, and to this bare principle there is no alternative. But could not some other method be found of providing and making use of the necessary speed without making the aeroplane itself travel fast ? Could not the wings be made to travel fast while the aeroplane itself travels slowly ?

These questions led to several possibilities, a wing-flapping machine to imitate the flight of a bird might have been devised, or a helicopter, a machine without wings and depending for its support on a large airscrew on a vertical axis. Even before 1919, a great deal of ingenuity and experiment had been devoted to these problems of the ornithopter and the helocopter, and even to-day they are still problems. Probably they will never be solved since now, with the direct take-off autogiro a practical reality, they are no longer necessary.

Fig. 4.—A type C30a autogiro, introduced about 1932. This was the first production type of "Direct Control" machine and it will be noted that it has neither wings, ailerons or elevators.

Fig. 3.—One of the earlier production types of autogiro. This type was fitted with substantial wings and had the usual ailerons, rudder and elevator similar to an ordinary aeroplane.

But though they were problems in 1919, they might not have been hopeless problems and Cierva might have elected to develop his ideas on such lines. A helicopter did not seem an impossibility, but to a man trained in the mathematical theories of flight, a helicopter possesses many disadvantages and even the lay mind can appreciate that a failure of engine power means an almost inevitable crash.

An aeroplane derives its lift from its wings, and thereby escapes the difficulties of the helicopter. The propeller merely drags the wings through the air, but a wing of practical size must travel at a speed of 45-50 m.p.h. to be of any use. Cierva wanted to make an aeroplane which would fly at only 10 or 20 m.p.h. He had, in fact, to find some way to make the wings travel faster than the aeroplane, and he came to the conclusion that the only way to do this was to make the wings travel in a circle. And so the autogiro was born !

Wings Free to Rotate

At first sight, we are back again at the helicopter, but we must remember that the helicopter was always supposed to have power-driven wings, whereas Cierva's proposal was that the wings should be absolutely free to rotate of themselves. This is perhaps the fact most difficult for the lay mind to appreciate, that the wings of an autogiro revolve freely on their own, entirely unconnected with the engine except, in modern machines, during the starting up and take-off process.

Cierva's theory told him that his revolving wing, built like a windmill, would behave like an ordinary wing while allowing the machine to travel slowly and descend almost vertically. But would the wings actually rotate as the machine went through the air ? and would they be strong enough and have lift enough to support the machine ? The only way to find out was to build one and see ! And it was to prove easier to develop the theory than to make a practical machine, for the first two autogiros would not fly at all, and even the third was not capable of sustained flight.

Two Problems

There were two major problems to be encountered. One was the inevitable effect of gyroscopic action, for simple calculation showed that the machine would be quite unmanageable if nothing were done to eliminate the gyroscopic effect of the rotating wings. The second difficulty was that the blades on one side of the machine would be travelling faster than those on the other—due to the forward speed of the machine—and the lift would thus not only be very unequal but, which was even worse, the inequality would vary seriously with the forward speed of the machine.

To take care of these two troubles, Cierva proposed to have two sets of revolving blades, one above the other, and his first autogiro was actually constructed

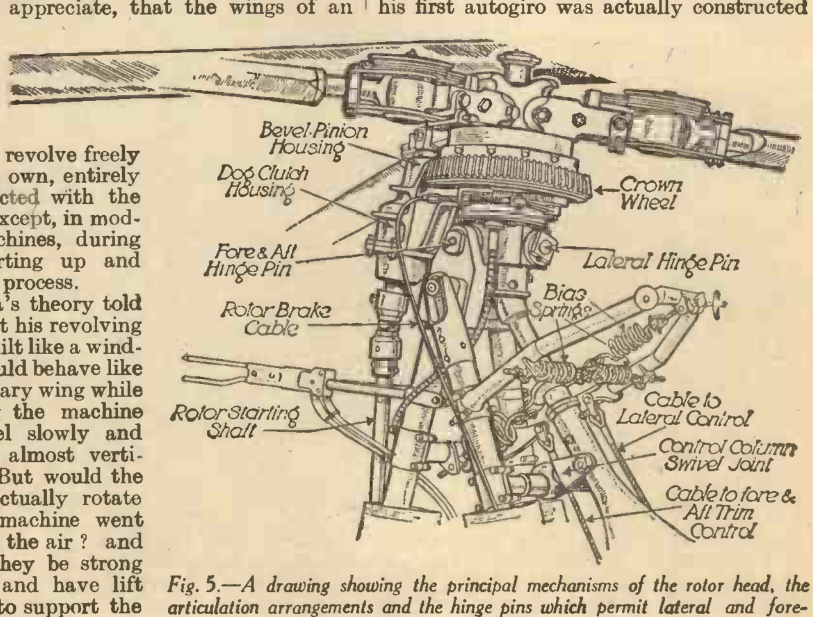


Fig. 5.—A drawing showing the principal mechanisms of the rotor head, the articulation arrangements and the hinge pins which permit lateral and fore-and-aft movement of the rotor axis.

with twin rotors. Unfortunately, the air currents from one rotor so upset the behaviour of the other that the machine would not fly.

The second autogiro had a single three-bladed rotor and attempted to overcome the inequality of lift by changing the angle of incidence of the blades as they rotated. The blades moving forwards were given a smaller angle of incidence than those retreating on the other side. Unfortunately a separate adjustment was necessary for every different forward speed and, like its predecessor, the machine refused to leave the ground, falling over on one side at every attempt.

Third Time Lucky

The number three is supposed to be a lucky one, and it certainly proved to be so in the case of the autogiro, for the third machine, which was partially controlled by a system of ailerons, actually left the ground for a few moments, thus proving once and for all the possibility of flight with revolving wings. The gyroscopic action, however, made the machine almost uncontrollable and if it had ever got properly into the air it would almost certainly have crashed.

An almost accidental experiment gave Cierva the clue by means of which the gyroscopic effect is avoided. The secret was flexibility. The wings of his little model were made of flexible material, while the rotor of his autogiro was a rigid construction and while the model was free from any gyroscopic effects, the full scale machine was uncontrollable.

It would have been a very difficult matter to construct full size wings of a flexible nature, but the same result could be achieved by hinging the blades at their roots so that each blade had complete freedom to move up and down, and this was done in Cierva's fourth autogiro.

An Articulated Rotor

With an articulated rotor, as the hinged-blade system is technically termed, the blades automatically take care of the greater lift on one side. The forward-moving blades, which experience the greater lift, rise somewhat, and so automatically reduce the effective angle of incidence, thus losing some of the lift; the retreating blades fall and thus equalise the lift on either side of the machine.

On January 9th, 1923, Cierva's fourth autogiro rose from the ground and flew steadily under perfect control across the field, and though the machine was primitive in many ways, the major difficulties were solved and the future of the autogiro assured. The essential principles were established and every difficulty which remained was only a matter of improvement and perfection of mechanical design.

Many autogiros were constructed in the years which followed 1923, improvements being made in each, but there was one fundamental feature which was common to all. The rotors of all fulfilled the same function as the wings of an ordinary aeroplane, and nothing more. True, they were more effective at low speeds, but they were "wings" pure and simple and took no part in the control of the machine which was still fitted with ailerons, rudder and elevators. To Cierva, these controls were necessary evils, but evils none the less, for they added weight and complexity in order to fulfill a purpose which, to Cierva, should be capable of achievement by control of the rotor itself.

The Rotors Perfected

It is useless to attempt to run before one can walk, however, and the theory and construction of the rotors had to be completely perfected before any attempt could be made to control the machine itself by manipulation of the rotor axis. Very many refinements had to be made, but only one will be mentioned here. I have already said that the blades are so hinged so that they are free to "flap" up and down as they rotate. Not only are they free to move vertically, but they are also free to move laterally through a small angle.

It was found that if the blades are rigid laterally, unpleasant oscillations can be set up in certain circumstances. To overcome this, the blades are hinged laterally, the permissible movement being limited to a few degrees, and large friction dampers, which may be seen in the sketch, are fitted to damp

(*Continued on page* 114)

Fig. 6.—A front view of the "flying bedstead."

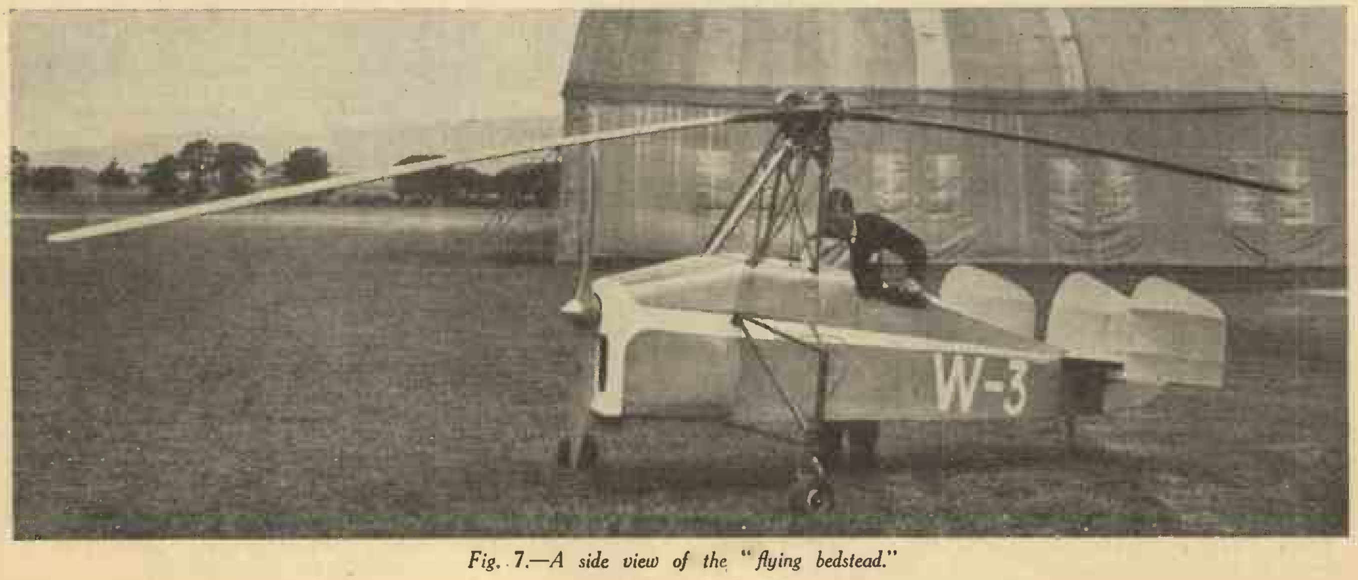


Fig. 7.—A side view of the "flying bedstead."

TRANSMITTING "PICTURE" SIGNALS OF COMPASS BEARINGS

How Television aids Navigation at Sea

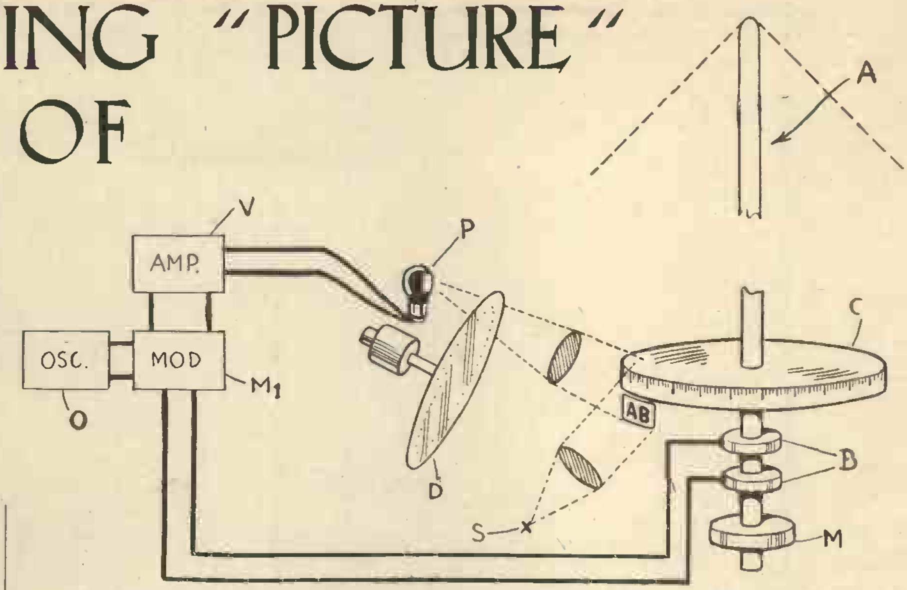
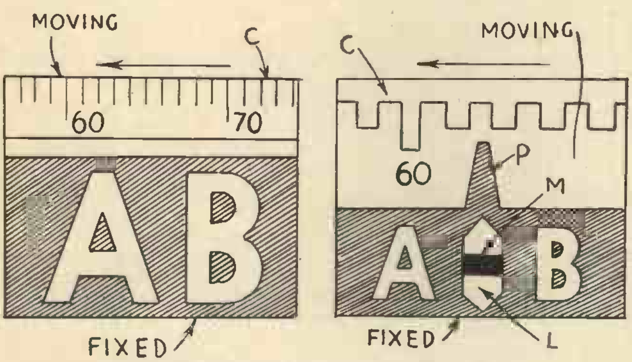


Fig. 1.—Diagram of the apparatus used in a television "beacon" station.

UP to the present, interest in television has been mainly centred around its entertainment value. We are all waiting to know exactly when the new picture service is coming into operation, and how much it will cost us to bring it into the home.

Meanwhile, whilst these questions still remain unanswered, the discovery of television is making itself felt in other directions than broadcasting. We have, for the first time in history, found out how to transmit instantaneously a picture of events occurring at a point beyond the normal range of vision, and it would be strange indeed if this new discovery did not find some useful applications outside the field of mere entertainment.

The whole subject is, of course, still in its infancy, but as a line of approach to some of the possible "outside" developments in television it will be helpful to see, in the first place, what has already happened in the case of wireless. What can be done with one, can, or will be done—where it is advantageous—with the other.



Figs. 2 and 3.—The beam pictures as seen by the navigator at sea, and which indicate the exact bearings.

Wireless first made its mark—long before the introduction of broadcasting—as a means of keeping in touch with those cut off from all ordinary means of communication, so that ships at sea, and aeroplanes in flight, for the first time lost their peculiar sense of isolation.

With the help of the radio direction-finder, a navigator can now come safely into port under conditions where all ordinary harbour lights and marks are completely blacked out. Similarly a course can be "marked out" in the air by overlapping wireless beams, so that an aviator can fly blindly along a given route, knowing that he will be automatically warned of any deviation to port or starboard by the radio instruments on his dashboard. Finally, when he reaches his destination, short-wave radio beams help him to come safely to ground, at the correct landing angle, even when fog completely blots out all sight of the aerodrome.

Aiding Navigation in Foggy Weather

Television is already following closely in the footsteps of directional wireless as a help to navigation in foggy weather. It has the definite advantage of giving a clear and unmistakable "picture" indication, which can be seen at a glance, so that the navigator does not require either a knowledge of the Morse code, or an ear sufficiently sensitive to judge when the received signals are at maximum or minimum strength in the midst of a confusion of other noises.

For instance, in one well-known method of assisting mariners to find their location during fog, a rotating beam of wireless is radiated from a beacon station, near the coast, in much the same way as the ray of light from a lighthouse. In addition, a characteristic call signal—consisting of certain Morse letters which identify the station—is broadcast or transmitted in all directions, together with the Morse letter N at the precise moment when the beam is passing through the North point of the compass. The wireless beam makes one complete revolution every 30 or 60 seconds, or more, according to the particular transmitter concerned.

In order to find his bearings the navigator must first be able to recognise the Morse call sign, so that he can identify the particular transmitting beacon on his map. He next listens for the Morse letter N, which tells him that the beam is passing through true North on the compass, and immediately sets a stop-watch going. He then waits until the beam sweeps through his own position, where it produces a "maximum" signal in his receiver. At this moment he stops his watch.

The number of seconds between hearing the "North" signal and the time the beam reaches him, then indicates his bearing relative to the land beacon. For instance, if the beam takes 60 seconds for a full revolution, and his stop-watch reads 30 seconds after hearing the North signal, he knows he must be lying due South of the transmitter. It will be seen that all this calls for a considerable amount of skill, as well as a competent knowledge of Morse.

The Television "Beacon"

By contrast it is possible to transmit comparatively simple television signals which show his bearings pictorially to a navigator, no matter where he is situated. The apparatus used at the beacon station is illustrated in simple form in Fig. 1.

The directive aerial A which radiates a clear-cut beam of wireless energy is constantly rotated at a uniform rate by a motor M. On the driving-shaft is a drum or disc C which is marked along its edges with a divided scale representing the points of the compass. At one particular point there is a card AB carrying the identification letters of the station. This card does not rotate with the drum and aerial, but remains fixed.

Light from a source S is focused upon the fixed card AB and upon the scale-markings of the disc C as the latter slowly swings past. The reflected light passes through the usual rotating scanning disc D, and is thrown on to a photo-electric cell P, so that a television picture of the fixed card AB and of the scale markings on the disc D is fed first to the amplifier V, then to a modulator M1 (which is supplied with a carrier wave from O), and finally back through brushes B to the aerial A, where it is radiated into space as part of the beam.

Simultaneously a second aerial (not shown) radiates synchronising signals, not as a beam, but in all directions, so as to keep any television receiver within range in step with the scanning disc D.

All that the fog-bound mariner now requires to do is to watch his television screen. As the beam sweeps past him, he will see a picture similar to that shown in Fig. 2, consisting of the stationary identification letters AB and a slowly moving image of the compass scale, which indicates his bearings relatively to the beacon station. Every suitably equipped ship

(*Continued on page* 114)

ENGLISH LIGHTHOUSES AND THEIR STORY

By G. Long, F.R.G.S.

(Left) St. Catherine's Lighthouse, Isle of Wight. (Right) A close up of the same lighthouse showing the screens and guards to keep sea-birds off the glasses.

FEW landsmen realise the value and importance of the modern lighthouse. There is an official map called the "Wreck Chart" upon which every spot where a shipwreck has occurred is marked with a small black dot. In the chart these marks appear in thick clusters all round our shores, and there are several notorious danger areas which *each have more than a thousand wrecks*. Imagination staggers at the thought of what this chart would look like if we had not lighthouses!

An Ancient Idea

The increasing size and speed of modern ships, which makes for comfort (and safety also, in some ways), actually renders them more vulnerable to the perils of sunken reefs and hidden rocks than are smaller and slower vessels. When breakers are sighted there is less time to change course, and a fast steamer will rip her whole bottom open if she strikes a reef at speed.

The lighthouse is a very ancient idea, and one in the Troad was mentioned by a Greek poet as long ago as 660 B.C. The most famous of all such structures in antiquity, was the famous tower on the island of Pharos, near Alexandria, built about 270 B.C. It was built of white marble, and was six hundred feet high. At the top was a chamber in which a fire of wooden logs was kept burning, which Josephus tells us was visible for forty miles. Under the name of the Pharos, it was one of the Seven Wonders of the ancient world, and lasted for nearly sixteen centuries, when it was destroyed by an earthquake.

Pharos Towers

The Pharos has given its name to lighthouses in many languages, and it is interesting to mention that nearly two thousand years elapsed before a better method of illuminating lighthouses was discovered, than the fire of wooden logs used here. Log fires were liable to burn away too quickly in a strong wind, and to be put out in heavy rain—just when they were most needed; and the idea of carrying constant supplies of fuel to the top of a six-hundred-foot tower makes one positively shudder.

The Romans built many Pharos towers around the coasts of their Empire. Two of the most famous guarded the passage of Dover Straits. The tower on the French coast was built by order of the Emperor Caligula at Boulogne. It was 192 feet high, and lasted till the sixteenth century, when it collapsed owing the the rock upon which it stood having been undermined by the waves.

> The Value of the Lighthouse and the Important Part it Plays in Aiding Navigation

But for this it would undoubtedly be standing to-day, since its neighbour on Dover cliffs is still in excellent repair. It is an octagonal tower, forty feet high, with walls ten feet thick. There are scanty remains of Roman lighthouses in half a dozen places round our coasts. After the departure of the Legions, Britain went back to barbarism, and shipping almost vanished from our coasts, so that many centuries elapsed before the friendly gleam of a warning light greeted the mariner across the dark waters of the midnight sea.

It was the Mediaeval Church which took up the work which the Romans had abandoned.

There were men called hermits, who consecrated their lives to prayer in solitary places. Some of them were situated on islands, or lonely cliffs; and were prepared during their nights of vigil to tend a beacon light to warn mariners. Some of these holy hermits erected little hill-top chapels, having a tower in which a beacon burned. The most picturesque and typical structure of this kind now in existence is St. Katherine's Chapel at Abbotsbury (Dorset). The little chapel was used as a pilgrimage church, and the open topped tower held a beacon light visible far out to sea.

Church Towers Used

Lantern Hill at Ilfracombe takes its name from the beacon which formerly blazed from the top of the little Chapel of St. Nicholas and guided ships into the harbour.

St. Michael's Chair, on the rocky summit of St. Michael's Mount (Cornwall), is another very ancient and charming tower for a beacon light.

Very often an ordinary church tower was used in the same way. The glorious "Stump" at Boston—one of the most beautiful church towers in Europe—formerly carried a beacon light to guide mariners into the port of Boston; it was visible far out in the North Sea. The hill-top church steeple at Rye, Sussex, carried another, and a second blazed on the top of the ancient Ypres Tower, the two forming an admirable pair to guide shipping entering the narrow and difficult mouth of the Rother.

Modern Lighthouses

Another was shown on the tower of Arundel Church and served as a guiding light to seamen entering Littlehampton harbour, three miles away.

We now come to modern lighthouses, which are classified by seafaring men into

A Roman lighthouse at Dover.

three main, and two lesser groups:

1. Making Lights.
2. Warning Lights.
3. Coasting Lights.

Making Lights are those first seen by a navigator as he "makes" the coast when approaching from far out in the ocean, such as the Lizard Light in Cornwall, and the Bishop Light in the Scilly Isles.

Warning Lights are used to warn ships of dangerous rocks or reefs in the fairway. The Eddystone and the Casquets are two exceedingly well-known examples.

Coasting Lights are placed on convenient headlands along the coast to *lead* the mariner along. First he sees the Making Light as a tiny point of flame in the far distance, and as he nears the shore the coasting lights appear one beyond another—"Just like the lamps in the High Street," as an old sea-captain put it to me. It is a fascinating sight on a clear dark night to steam up the Channel in a fast modern liner, and see light after light appear in majestic succession. Each of them can be distinguished by a skilled navigator by their differing *beam* or *flash*, and sometimes by a change of *colour*.

The other kinds of lights are found in harbours, and in the channels leading thereto.

Leading Lights are placed at suitable points along a difficult channel to guide the seaman into harbour.

Port Lights are placed at the end of piers and jetties, and glow out in crimson warning, "don't come too near." The most famous and romantic of all British lighthouses is of course the Eddystone, because of the difficulty in building it on a small rock surrounded by raging seas; and also on account of the tragic history of the earlier attempts. The first was swept away by a gale, and everybody in it was drowned, the second was burned down, and the third became unstable because the rock on which it stood was undermined by the force of the waves. But the epic story of the Eddystone Light has been told so many times before that it is unnecessary to repeat details of it in this article.

St. Catherine's

One of the most interesting lighthouses around our coast is St. Catherine's, in the Isle of Wight. It was one of the very first to be lighted by electricity, and its beam has the stupendous power of *seven million candles.* So vivid is this searing ray that any man who dared to stand on the platform and gaze into the incandescent blaze would be instantly struck blind, and those whose business takes them near the lights are compelled to wear dark glasses The lighthouse is shown to visitors and is one of the most popular excursions in the island. The electrical apparatus is in duplicate, and an oil-fired system is kept as a final reserve. The same power which drives the dynamos works the mighty double syren, whose roar can be heard far out to sea during foggy weather. The light has been seen at Cherbourg, seventy-two miles away; and glimpsed from Bournemouth — over thirty miles distant — it resembles a searchlight, sweeping the horizon. Another famous lighthouse is that at Beachy Head, which was built at the base of the cliff in 1899. It is 123 ft. high, and was erected to replace the old Belle Tout Light which stands on the cliff above, with a light nearly three hundred feet above the waves. Experience proved that the summit of the cliffs was often shrouded in fog when the air was clear lower down, and so the light had to be placed at a lower level. Beachy Head juts far out into the channel, and badly needs a warning light.

The *light* of the lighthouse is a subject on which a whole article could be written For perhaps two thousand years, an open fire of wooden logs was the only method, but in the reign of our King Edward the Third pitch pots were tried. These failed because rain quickly extinguished them; coal was the next idea, but was terribly smoky.

Reflectors

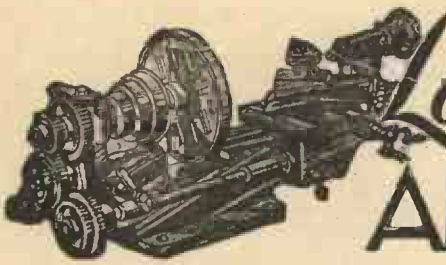
Space will not permit a detailed description of the elaborate systems of reflectors by which the light is enormously increased in intensity. Since it is of the utmost importance that navigators should know *which* lighthouse they can see, elaborate arrangements are made so that each light shall be easily identified.

Lights can be roughly grouped as under:

1. A steady continuous light.
2. One showing a flashing light at regular intervals.
3. One showing a steady light, which at intervals goes out entirely. (This effect is produced by a revolving screen which passes in front of the light.)
4. Coloured lights.

It will be realised that since various permutations are possible, quite a number of differing signals are practicable, and by means of this the identity of every lighthouse is known.

(Above) Rye Church, Sussex, the tower once used as a lighthouse. (Left) St. Katherine's Chapel, Abbotsbury, Dorset, also used as a lighthouse



Lathe Work FOR AMATEURS.

GRINDING OPERATIONS

By W. H. Deller

THE demands of certain classes of work are such that a high degree of accuracy plus good surface finish is called for. Satisfactory work may be produced, providing that a fair degree of skill is employed, by the use of ordinary turning methods. Where the part or parts are subsequently heat treated, the care bestowed in obtaining accuracy and finish, frequently results in wasted effort. While it is true that parts made from mild steel may, with careful handling, be lightly case hardened and polished without any appreciable deterioration in the surface condition (a point also applying to direct-hardening steel, providing that the hardening temperature is a relatively low one). The fact remains, however, that the distortion, even if only slight, resulting from heating and quenching is sufficient to render the part unserviceable. The nature of this distortion would depend upon the character of the part. Thus an object in the form of a bush may shrink or become oval while one in the nature of a spindle of any length will tend to warp.

Grinding forms the most reliable and effective method to employ as a finishing process for parts which need to be hardened. As may be gathered, these remarks are intended to apply mainly to cylindrical work. Grinding of this nature is normally carried out on a machine specially designed for the purpose but really good work can be produced by adapting a lathe to perform the operation.

A certain amount of additional equipment in the form of a grinding attachment will be necessary, this aspect, by the way, having been dealt with previously. However, in this direction two important points must be stressed before good results can obtain, namely, the attachment must be rigidly mounted on the lathe and the grinding wheel spindle needs to be a good fit in its bearings.

Grinding Wheels

The attachment apart, one of the most important factors bearing on the quality of the work produced, is the question of proper grinding wheel selection. It is not sufficient merely to have a grinding wheel of requisite diameter, width and bore, to suit the attachment, as the wheel must conform to requirements in other respects as well.

Fig. 1.—(Left) A grinding wheel with a lead bushed central hole.

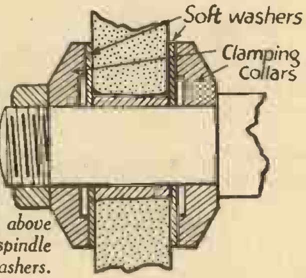


Fig. 2.—(Right) The method of clamping the above wheel on the spindle between two washers.

The importance of these requirements will be more readily understood when it is realised that grinding is actually a cutting process in the same way that turning is, the material being removed in the form of microscopic shavings.

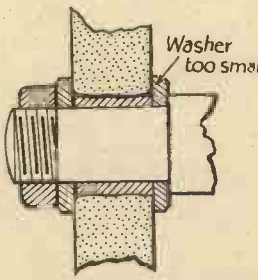


Fig. 3.—Small engineers' washers should not be used.

A grinding wheel is composed of abrasive particles held together by a bond, these particles, sticking out from the face of the wheel, provide thousands of separate cutting edges. Thus it will be seen that the size of the particles will have a bearing on the finish obtained.

Wheels are manufactured by one of several processes namely, vitrified, silicate, rubber or elastic. The processes differ, chiefly as regards the method of bonding the abrasive particles together. Each type of wheel has its particular sphere of usefulness. A greater number of wheels by far are made by the first process than any other, and those so made are readily distinguishable by their colour, which is a warm shade of brown. This type of wheel is most suitable for the readers present requirements.

Grade and Grain

The term "hardness" as applied to grinding wheels refers to the manner in which the abrasive particles are held together. In use, the cutting particles should break away from the face of the wheel in contact with the work when they become too dull to cut and so expose, as it were, a fresh set of cutting edges.

Different classes of work and conditions require wheels of different grades, so that whereas one that is too soft for a particular job will wear away rapidly, one that is too hard will soon glaze up. The usual method of designation of grade is by a letter of the alphabet. As already mentioned, the work in which the amateur will be interested is that which is hardened and the most suitable grade of wheels for such work will lie in the soft range represented by letters I. J. K and L. The grain of the abrasive has a definite relation to the size of the particles, i.e. number 46 grain has been passed through a sieve with a mesh having that number of holes per linear inch, thus the higher the number, the finer the grain of the wheel. For hardened steel parts the grain of suitable wheels will lie between numbers 46 and 60. Mention should have been made of the fact that elastic wheels are usually marked with a numeral to indicate grade, nos. 1, 1½, 2 and 2½ representing the soft range. Such wheels are unsuited to general grinding, but a narrow wheel of the kind may be employed in cases where an ordinary wheel would otherwise require dressing extremely thin.

There is one other point, and that is in regard to the kind of the abrasive which has a marked effect on the performance of the wheel. Aluminium oxide is probably the best abrasive for the work under discussion and wheels so composed are sold under the trade names of alumdum, aloxite, etc.

Conditions Affecting Grinding Wheels

It is impossible to advise regarding wheel selection, unless the actual conditions in which the grinding is to be carried out are known. The surface speed of the wheel

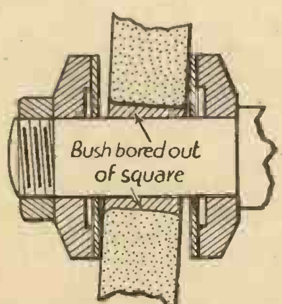


Fig. 4.—A badly set wheel that may lead to breakage.

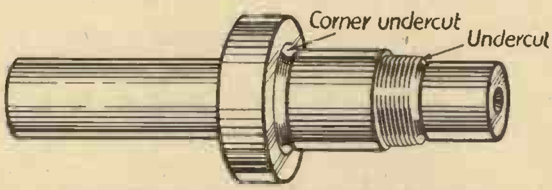


Fig. 5.—A method of undercutting where the face of a shoulder requires grinding.

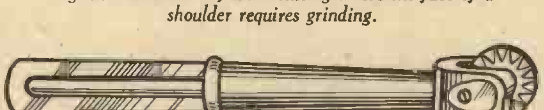


Fig. 6.—A "huntingdon" type of dresser.

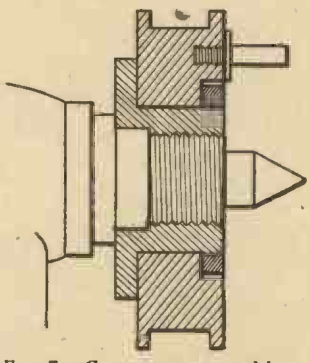


Fig. 7.—Greater accuracy and better grinding will be obtained by working on "dead centre."

and work must be taken into consideration and also the question of whether the continuity of the grinding will be intermittently interrupted by anything in the nature of keyways or splines. A Grinding Wheel should be run at a speed in revolutions or feet per minute very closely approximate to that stated on the tag attached to the wheel when purchased. The effect of running

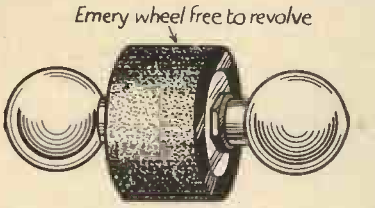


Fig. 8.—A substitute for a diamond dresser.

under speed is the same as if the wheel were of a softer grade than it actually is, and it may therefore, wear away quickly in use. An excessive speed on the other hand has the reverse affect in regard to the grade, and is a practice that should never be indulged in, having consideration for safety. Where the work is relieved by keyways, etc., it is advisable to use a slightly harder wheel than that used for similar plain job owing to the abrading action of the sharp corners.

Mounting Grinding Wheels

Grinding wheels with the exception of those intended for small internal work and those of the "elastic" variety are supplied with a lead bushed central hole, Fig. 1, which fits the grinding spindle. The wheel should be clamped on to the spindle between large collars recessed away in the centre (see Fig. 2). The inner collar nearest to the shoulder on the spindle is preferably made a tight fit or better still fitted over a small peg to act as a key. A thick paper washer (made from something in the nature of heavy blotting paper) should be interposed between each side of the wheel and the collars before tightening the nut. Most wheels are provided with suitable paper washers but this point must not be neglected or the wheel may crack under the strain of tightening. Washers made from thin rubber insertion are more effective and will give considerably greater service. On no account must ordinary small engineers washers, Fig. 3, be used to clamp the wheel between as these will provide insufficient drive and further will cause the wheel to move on the lead bush. It may happen that a grinding wheel (or wheels) can be picked up and which are suitable except for the fact that the centre hole is too small for the spindle. When such are to hand, care should be exercised in opening out the lead bush. This is best accomplished by setting up the wheel true in the lathe, and boring out with a boring tool. It is an easy matter to open out by hand, but not so as to ensure that the hole is at right angles to the side. This may lead to the result seen in Fig. 4, which, if not noticed, may lead to breakage.

Wheel Truing

Before any grinding can be attempted the face of the grinding wheel needs to be dressed true and flat. A wheel surface good enough for cylindrical grinding will not be obtained by the use of a "huntingdon" type of dresser, Fig. 6, or one of the type shown in Fig. 8. These types are intended for hand use on tool or general grinding heads. An ideal tool to use is a diamond dresser, Fig. 10. This may be used as a hand dresser or mounted as afterwards described for the present purpose. Such a dresser or a small diamond mounted in small shouldered stud will cost about 25*s*. A substitute not quite as effective in use is a "diamcarbo" dresser shown in Fig. 9. This consists of a steel tube filled with an abrasive mixture similar to Carborundum. This wears away in use and the tube acting as a support is ground away at the same time. Possibly the best method of mounting the truer is to make a substantial centred shaft having a hole direct through the centre and fitted with a set screw to take the shank of the truer after the manner of a boring bar. This is fitted with a carrier and locked between the centres, with the tail of the carrier resting on the driving pin to stop the shaft from rotating. The point of the dresser is set towards the wheel and central with it, the truing being effected by driving the grinding wheel and bringing it in contact with the truer, traversing the wheel backwards and forwards with the saddle. Where the face of a shoulder has also to be ground the side of the wheel will need dressing appropriately. To accomplish this the dresser will need mounting on the catch plate in a manner similar to that described, or a flange to serve the same purpose fitted to the shaft, the dressing being carried out by feeding the wheel to the dresser by saddle movement and working the cross slide.

Dead Centres

Prior to grinding work between the centres, see that the points of both centres

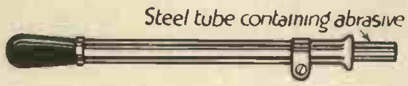


Fig. 9.—This type of dresser is suitable for hand use only.

are in good condition and that the head stock centre runs truly when the spindle is revolved. Greater accuracy and better grinding will be attained by working on "dead" centres. This is accomplished by making a boss to screw on the nose of the lathe, on which a pulley secured by a screwed ring runs (as in Fig. 7). A driving pin is fitted to the face of the pulley and drives the work via a carrier.

Preparation of Work for Grinding

Work which is to be finished on centres needs to be accurately centred with a combination centre drill as deeply as possible to provide good bearings. Changes in diameter should, where the difference is substantial, have an undercut between them and where the face of the shoulder requires grinding, the undercut should be made in the corner, as seen in Fig. 5. This undercutting is essential where the diameter being ground must remain constant to a point close up to the shoulder and also to preserve a sharp corner on the wheel. Hardened Mild-Steel parts will need to be deeply case-hardened. Open hearth treatment will prove unsatisfactory as the depth of case so obtained will be removed by grinding.

As a general rule the following allowances for grinding will be ample providing that the finish of the turning is reasonably smooth. Outside diameters plus ·010 in.—·015 in., faces of shoulders plus ·002 in.—·004 in., and minus ·005 in. — ·008 in. in internal diameters.

It is difficult to lay down any hard and fast rules as for work speed, etc., as many factors have to be taken into account. A work speed of between 20 and 50 surface feet per minute will probably give best results. Too slow a speed may cause burning of the work locally, while one that is too high is likely to cause chatter. Light cuts should be taken and the wheel traversed fairly quickly, far in excess of the feed likely to result from the sliding motion. On this account the saddle is best wound along by hand as it can thus be better controlled.

With the lathe running normally the wheel, if in front of the work will need to run upwards. This should be avoided as the sparks will fly upwards and may be dangerous to the eyes. Where a dead-centre attachment is made the direction of rotation of the work can be reversed by a crossed driving belt, otherwise unless the grinding wheel can operate behind the work a crossed belt on to the cone pulley becomes imperative. For internal work this point does not matter as the difference in direction of rotation can be obtained by grinding at the side of the hole nearest to, or away from the operator to give the desired result.

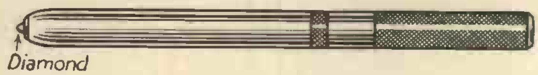


Fig. 10.—An ideal tool is the diamond dresser shown.

Small internal grinding wheels can easily be made from portions of broken wheels about ¼-in. thickness by boring a hole with the tang of a file and rough grinding to shape, finishing to size on the outside with the wheel truer (see Fig. 12).

Some surface grinding can be carried out by mounting the work on the face plate and using a cup shaped grinding wheel. For flat work to result the face or edge of the cut needs to lay parallel with the face plate. Where the width of the work will permit it will not be necessary to rotate the work, but owing to the power consumed and heat generated, the surface of the wheel may require reducing in width by dressing away as in Fig. 12.

Cutters and reamers can easily be sharpened between the centres or on a mandrel providing that a spring tooth-rest is fitted to support the teeth and permit indexing as in Fig. 13.

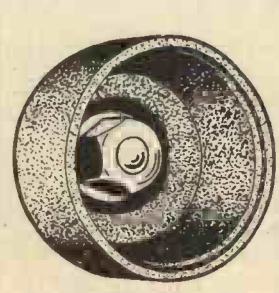


Fig. 11.—Details of a cup grinding wheel.

Fig. 12.—Boring a hole in a broken wheel with the tang of a file.

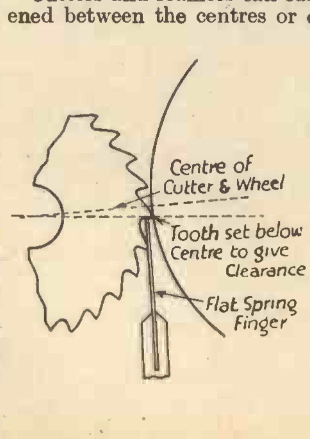
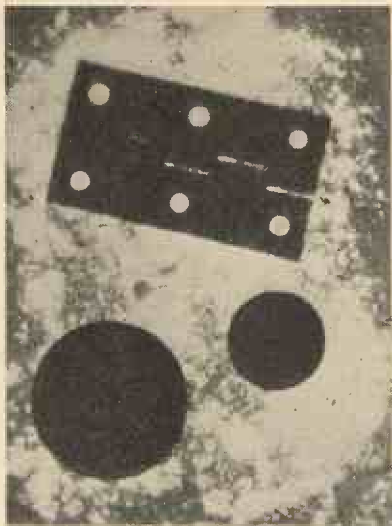


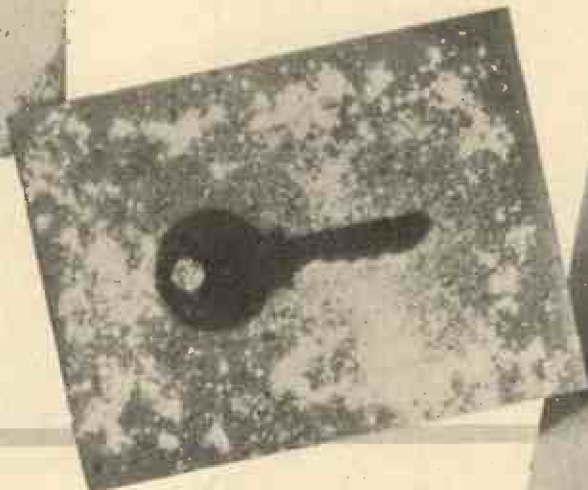
Fig. 13.—Details of the spring tooth-rest.

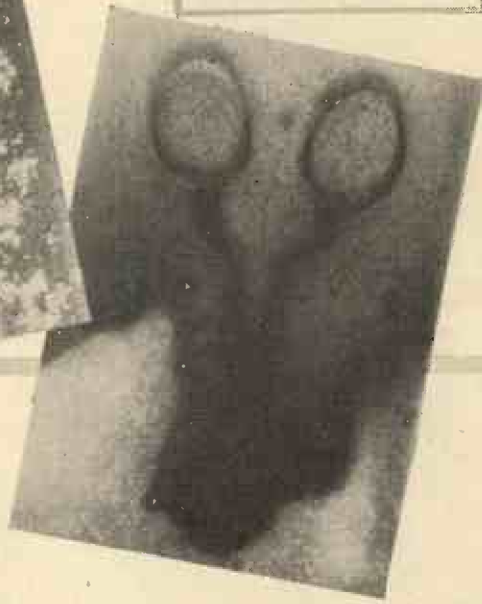
X-RAY PHOTOGRAPHS AT HOME

How to Take Simple X-Ray Photographs by Means of Waste Gas-mantles



An X-ray photograph of two coins and a hinge taken by the process described in this article.





(Centre)—A Yale key. (Below)—Pair of scissors. With the obscuring effect of brown paper.

THE common gas mantle consists of a "skeleton" composed of 99 per cent. of thorium oxide and 1 per cent. of cerium oxide, the small proportion of the cerium oxide being absolutely essential to the light-producing powers of the mantle.

Thorium, in common with uranium and a few other elements, is a radio-active element. Hence, all its compounds are radio-active, also. Thorium compounds, of course, have not a tithe of the intense radio-activity of true radium preparations. Nevertheless, all such compounds and preparations of thorium are definitely slightly radio-active and, in many instances, this radio-activity can be applied to an interesting purpose.

Gas-mantle Powder

A readily available example of the radio-activity of thorium compounds consists in the making of simple "X-ray" pictures by means of waste gas mantles. Broken and disused gas mantles should be stored until half a dozen or more of these articles are obtained. Crush up the broken mantles and pass the resulting powder through a fine sieve in order to filter out the grosser particles. The sieved material is then stored in a dry bottle. It will not deteriorate in any way, and it may be used over and over again for the photographic experiments described in this article.

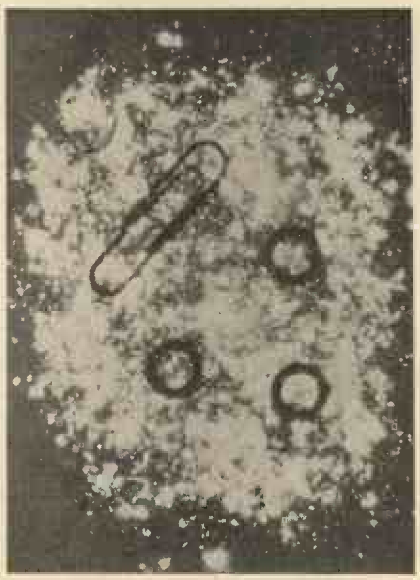
In order to make an "X-ray" picture, take a plate or cut-film of medium speed, place it in an empty box provided with a light-tight lid and place on the emulsion side of the plate or film (which faces upwards) a small flat metal article such as a modern key, one or two coins, a pen-nib or some similar object. Then scatter over the surface of the plate or film a little of the sieved gas-mantle powder, taking care that the plate surface is fairly well covered with the powder.

The whole of the above operations, of course, must be conducted in a dark room and in ruby light.

Using the Plate

The lid is placed on the plate-containing box and the latter is then gently placed on a shelf and allowed to remain absolutely undisturbed for a period of between forty and fifty hours. At the end of this time, the plate is again removed from the box (in the dark-room red light, of course), the gas-mantle powder carefully dusted off its surface and collected for further use, and finally the plate is developed in any ordinary strong developer. The result will be that a silhouette image of the metal object will develop upon the plate.

If contrasting images are desired, these can best be obtained by "exposing" the plate for about three and a half days (approximately sixty hours) and then by



A paper clip and washers.

developing it in the following hydroquinone developer :

Hydroquinone	40 gr.	or	2·5 grams
Sodium sulphite (cryst.)	½ oz.		15 ,,
Caustic soda	40 gr.		2·5 ,,
Potassium bromide	5 gr.		0·3 ,,

The shadow images so obtained are not true X-ray images, for the rays from the thorium oxide in the gas-mantle powder possess but very feeble penetrative powers and are incapable of passing through any appreciable thickness of metal. Such pictures, however, are exceedingly interesting as well as being very easy to obtain, and an instructive period of time can be experienced by any amateur scientific worker who attempts their production.

Letters and Designs

By cutting out letters or designs in silver paper or tinfoil and by pasting down such characters to the emulsion surface of the plate and by finally dusting the entire plate surface over with the gas-mantle powder, silhouetted or shadowgraph letters and designs can be obtained.

In most instances it is not advisable to prolong the "exposure" of the plate or film to the gas-mantle rays for an undue period. An "exposure" of from forty to fifty hours is about right and it should never exceed, say, sixty-five hours. If such exposures are doubled, the image, instead of being more clearly defined or more contrasty, will, on the contrary, be rendered flatter and less distinct owing to the general fogging effect of the thorium rays on the emulsion of the plate or film.

Interesting effects can often be obtained by mixing the gas-mantle powder with varying proportions of some inert and finely powdered material such as chalk powder, the finest sand, fine metal filings, boric acid powder and many other similar materials. These have the effect of "diluting" the active gas-mantle powder and spacing its constituent grains farther apart. Note, however, that gas-mantle powder thus "diluted" does not necessitate a greater exposure than the average being given to the plate or film.

Ordinary Bromide Paper

If the individual experimenter has not available a supply of plates or cut-films with which to make experiments on the above lines, he should note that such experiments can be conducted with ordinary bromide paper in place of plates or films. In such instances, however, the necessary exposure will have to be increased very considerably, according to the make and speed of the bromide paper used. Even gaslight papers can be used for the above purpose, but, in such instances, the requisite exposures generally run into weeks.

The "gas-mantle radiograph" results on photographic papers are never so good as those which are made on plates or films. Moreover, such paper prints will be "negatives," that is to say the silhouetted image will be in white on a dark background. These paper "negatives" can only be "printed" by copying through the camera, using a piece of bromide paper for the reception of the copied image instead of the usual plate or film. In this way positive images can be obtained from the paper negatives of the gas-mantle radiographs.

It is advisable to use backed plates in order to get the best results from the gas-mantle "exposures." The backing of the plates prevents the scattering of the plate-affecting rays from the thorium oxide in the gas-mantle powder and thus assists in the production of a cleaner-cut image. If, however, backed plates are not available, a fair substitute for them may be made by pasting a piece of black paper, or, better still, black cloth over the back of the plate. With films, no such precautions are usually necessary.

A Warning

Do not on any account allow particles of the gas-mantle powder to fall into a box or envelope containing unused plates, films or papers, for if even a single grain of the radio-active gas-mantle powder obtains access to such regions, it will play havoc with the light-sensitive material in its vicinity. For this reason, the bottle containing the gas-mantle powder should be stored right away from all photographic material and all manipulations with the powder should be performed away from such sensitive material except, of course, the film, plate or paper actually in use.

SCIENCE NOTES AND NEWS

Radio Valves for Centimetre Waves

THE efficiency of the ordinary type of wireless valve becomes very low at ultra-high frequencies and only a few will oscillate at all at wavelengths as short as 1 metre.

Now, however, a new standard valve has been introduced by the Western Electric Corporation of America which will oscillate at wavelengths as short as 40 cms. At half a metre, it can generate an output of 6 watts.

Power and light are represented here as Boulder Dam, completed at last, and officially opened, starts turning water of the Colorado River into electricity. This picture was taken as the electric circuit, closed by President Roosevelt in the White House, opened wide the gates of the dam.

Bulbs of Pyrex Glass

The new valve is built into a heavy dome-shaped bulb of Pyrex glass, about 2½ in. in diameter. The anode is about ½ in. long and less than ⅛ in. in diameter, but it is capable of dissipating no less than 30 watts.

Studying Molecular Structure

Although we think of wavelengths of 40 or 50 centimetres as being ultra short, they are long compared with those now being used by Dr. Potapenko and Dr. Meng of Caltech, U.S.A., who are using waves of only 1 centimetre to study molecular structure. They use a three-electrode valve in which the anode is only one-fiftieth of an inch in length and diameter. The power available is, of course, very small, but they have discovered that the waves generated will not penetrate a moisture-laden atmosphere.

Atom Smashing

A LARGE equipment has just been installed by the University of Rochester, U.S.A., known as a Cyclotron for research into the disintegration of atoms.

The apparatus consists of an extremely powerful electro-magnet which weighs about 15 tons and which is excited by a current of 400 amperes at 110 volts. Between the poles of the magnet a metal vacuum chamber is placed in which the atoms can be accelerated to an energy of 5,000,000 volts. When the magnet is energised, the powerful magnetic flux causes the atoms to travel in a spiral, and on reaching the outer extremity of the chamber it strikes an obstruction and disintegrates.

Windows of Sapphire

WINDOWS of synthetic white sapphire about ¾ in. in diameter are being used to provide transparent openings through which the happenings inside the cylinder of a motor-car engine can be observed and studied. Synthetic sapphire has been found to be the best material for this purpose as it combines good mechanical strength with resistance to chemical action by the fuel and lubricants and it transmits the visible and invisible light rays with very little loss.

Microphotography in Libraries

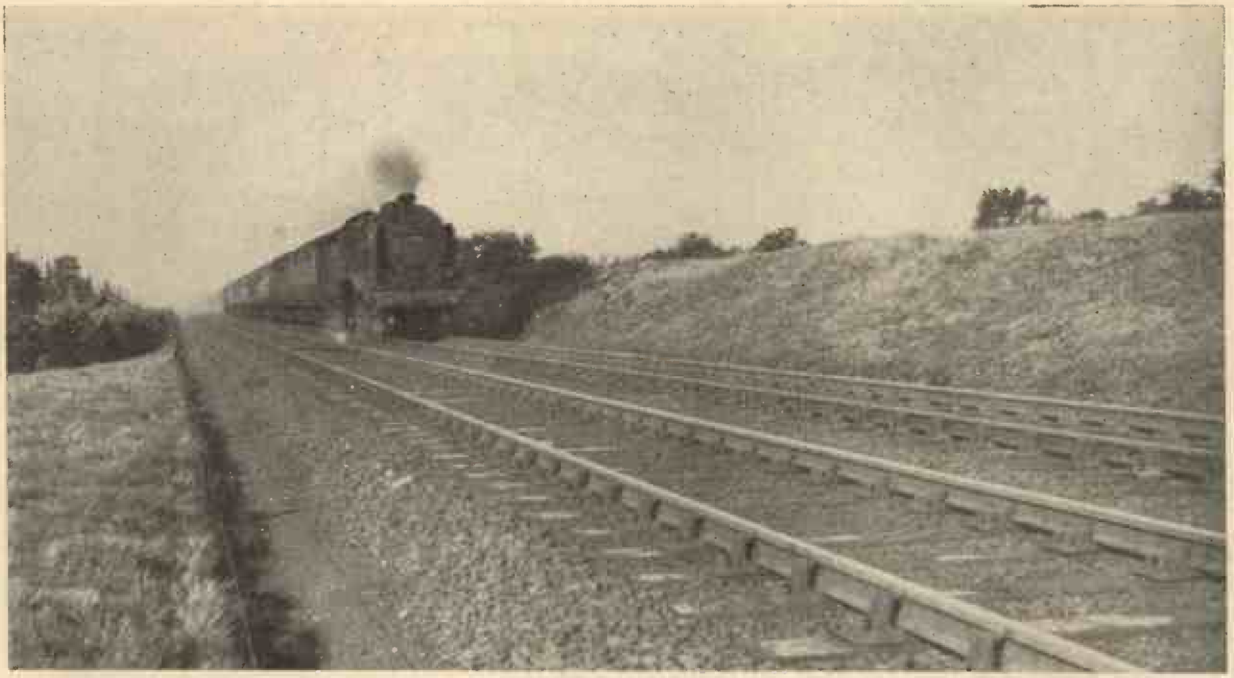
A NEW application of microphotography is being widely developed in America for the recording of documents, drawings, newspapers and books in order to save storage space. The pages of a large and thick volume, when photographed on cine film, weigh only a few ounces and occupy far less space than the original volume.

In order to render the films readable, special reading machines are used. These are really a form of photographic enlarger and serve to magnify the film record to render the matter easily readable.

A Refrigerator Ship

THE latest advances in the science of food preservation have been incorporated in a 12,000-ton refrigerating ship recently launched on the Clyde. To provide an even temperature in all climates, cooled sea brine will circulate through more than 1,000 miles of pipes laid throughout the ship and ozone will be used to keep the cargoes of fruit and meat fresh. To do this, over 300,000 cubic feet of sea air will be passed through freezing chambers every hour and discharged into the cargo space.

Thousands of cases of fruit are sometimes tainted as the result of one case going bad, but under the new conditions decay will be prevented from spreading.



The famous railway track over Chat Moss as it appears to-day. It was originally laid down by Stephenson in 1839 in the face of great difficulties and against much opposition.

MASTERS OF MECHANICS

NO. 15. THE STORY OF GEORGE STEPHENSON AND HIS ASTONISHING SUCCESS

WYLAM-ON-TYNE, so far as engineering, commerce and industry are concerned, is one of England's most historic villages. For there, even at the present day, stands the humble, stone-built cottage, in which, early on the summer morning of June 9th, 1781, the eyes of George Stephenson, mechanical genius, inventor and, above all, the "Father of the Railway," were first opened.

Stephenson's genius is now universally recognised and, for the most part, is beyond dispute. Probably no single individual managed by a lifetime of endeavour to change the face of the country more fundamentally than did Stephenson. When Stephenson was born the roads carried most of the country's merchandise, although, to a large extent, the heavier classes of goods were transported along the network of canals which had then been recently constructed in many areas. Before he died, however, Stephenson witnessed an age in which the railway had begun to reign supreme. Canal transport, towards the end of Stephenson's life, had been scrapped, road conveyances, for the most part, had all been allowed to fall into disuse. The entire kingdom had become railway-minded.

Surprising as it may seem, although Stephenson, with the aid of his son, Robert, engineered the majority of the early railways, he never put forward the railroad as a panacea for all industrial troubles. From the beginning he opposed the mad speculation, the "railway mania," which quickly sprang up all over the country after his initial success in the construction of commercial railroads.

His Earlier Life

Stephenson's earlier life was a much impoverished one. His father, Robert Stephenson, or "Old Bob," as he was locally called, gained a precarious living by acting as fireman for one of the colliery engines in the neighbourhood. On an income which never exceeded twelve shillings a week, "Old Bob" found himself faced with the necessity of maintaining a wife and six children, the second of which was his famous son, George.

Gifted with inborn mechanical faculties, Stephenson managed to get himself taken on as an engine boy at his father's colliery. That was at the age of fourteen, and the pay was a shilling a day. Gradually, the boy worked himself up, devoting all his available spare time to the study of engines and to making good the lost general education of his early youth until at the age of nineteen he became appointed brakesman at Black Collerton colliery at a wage of nearly a pound a week.

Busy as Stephenson was at this time, he nevertheless found time to attend to one very important business, namely that of falling in love. Fanny Henderson, a young woman employed at a neighbouring farm, had taken his fancy and before long she became Mrs. George Stephenson. The marriage of George Stephenson was an intensely happy one. In 1803, Stephenson's only son, Robert, was born, and in the following year his young wife died. The loss affected Stephenson deeply. Its ultimate result was to direct his activities into two directions, the education of his son, Robert, and the study of engineering and, in particular, of locomotive construction.

At Killingworth

Being promoted to the post of engineer at Killingworth colliery, near Newcastle, one of Stephenson's first inventions was that of a miner's safety lamp. For a considerable time, this lamp was an active competitor of the better-known lamp invented by Sir Humphry Davy. Stephenson also went in for clock making and clock repairing and the small income which he drew from this occupation he devoted to his own benefit and to the education of his son.

About 1814–15, Stephenson, with the aid of interested patrons, managed to construct his first successful locomotive. The engine functioned well, but it was not capable of continuous effort and Stephenson quickly grew dissatisfied with it.

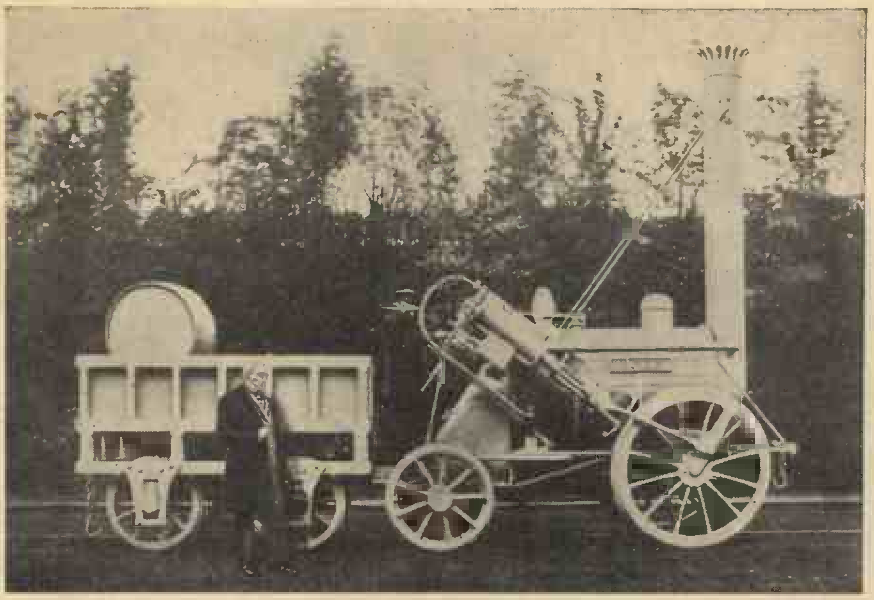
Soon after this period came Stephenson's great invention of the furnace blast by means of which the combustion rate of the fuel is automatically regulated by the work which the locomotive is doing. This invention proved itself to be a fundamental one in the history of locomotive construction and from it the success of the early railroad locomotives may be dated.

In 1823, Stephenson, having by this time made quite a degree of local fame for himself, borrowed capital and set up for himself as a locomotive-maker in Newcastle. In his Newcastle factory he devised the tubular boiler and from this time, it is said, he never looked back.

Two years later—in 1825—the first railway in the country was engineered by Stephenson. It extended from Stockton to Darlington and it was opened on September 27th, 1825, the speed of the locos employed on it being about that of a trotting horse.

A Mistaken Idea

Stephenson's success with his Stockton-Darlington railway opened the eyes of many in the country. For a long time the notion had gone about in influential circles that, under practical conditions, a locomotive could never be got to run on rails, a mistaken idea having prevailed that the



The most famous of all historic locos. The original "Rocket," built by Stephenson in 1829.

plain wheels of a locomotive carriage would slip round without gripping the iron guiding rail. Indeed, some years previously, attempts had been made at working with a locomotive equipped with *toothed* carriage wheels which engaged in rack-cut rails.

Very quickly, Stephenson's early trials convinced interested parties that the weight of the locomotive was amply sufficient to keep its wheels in firm contact with the rails under practically any conditions. Money for the construction of railroads and improved locomotives began to be forthcoming and quite a number of locomotive designs entered into competition with those of Stephenson's.

Perhaps the most spectacular and interesting chapter in Stephenson's life is that which deals with his conquest of Chat Moss and his building of *The Rocket.*

The county of Lancashire previously abounded in "mosses"—large flat areas of swampy, boggy land, the sites, mainly, of prehistoric forests and fit, usually, for little else than for cabbage and potato growing and for similar "coarse" agricultural purposes. The largest of these boggy areas is Chat Moss which, in Stephenson's day, was a veritable quagmire of watery, peaty pulp extending for miles on the western side of Manchester. Chat Moss acted like an enormous sponge. In wet weather, it soaked in water and expanded. In dry weather, the surface-water evaporated and the Moss contracted. Chat Moss, therefore, was almost continually in a condition of upwards expansion or downwards contraction.

The Second Railway

When it was decided to build the second railway in the kingdom, that between Liverpool and Manchester, Stephenson was appointed as engineer and surveyor for the task. It was impossible to drive a straight railway from Liverpool to Manchester without crossing Chat Moss. To go round the Moss, the railway would necessarily have to add many miles to its total length. Stephenson weighed up the matter and decided to take his railway across the bog of Chat Moss.

Most of the interested parties were aghast at Stephenson's revolutionary proposal. They called him mad and the directors of his company would have retrenched themselves and called off the railroad project if they had been able to do so. However, they eventually expressed confidence in their appointed engineer and surveyor and Stephenson went on his own way with the "impossible" task of flinging a safe and durable railroad across this renowned morass of Lancashire.

The principles upon which Stephenson devised his plans were quite simple. Just as snow-shoes, by reason of their large surface, prevent a man from sinking into the snow, so, he reasoned, could a railroad be carried across any bog if only it rested on a sort of mattress or platform of sufficient size.

Having surveyed out the projected railroad track across Chat Moss, Stephenson's first plan was to form a footpath of heather across the Moss. This was to provide a route for workmen and it also served to carry a light narrow-gauge railway for the carriage of materials.

Across Chat Moss

Gradually, from this beginning, Stephenson constructed a huge under-bed or mattress across the dreaded Chat Moss and upon this he laid his railroad. Thousands of tons of dry moss, turf, bracken and other raft-forming materials were used up in the task. Whatever drainage was possible was performed and although, particularly near the Manchester end of the Moss where the ground was very bad, progress was exceedingly slow, the herculean task, after many difficulties and after the exercise of almost heroic optimism on the part of Stephenson, was accomplished.

The directors of the line, early in 1829, offered a prize of £500 for a locomotive capable of fulfilling certain conditions. The announcement of the competition aroused considerable interest among practical engineers up and down the country and Stephenson himself, assisted by his son, Robert, who was then in charge of the Stephenson Locomotive Works at Newcastle-on-Tyne, was soon busy with the designing and construction of a locomotive for the new Liverpool-Manchester railway which he had engineered.

The result of Stephenson's work in this direction is well known, for, eventually, it produced *The Rocket*, Stephenson's famous winning locomotive which, during its trials on the Liverpool-Manchester railway attained an average speed of 15 miles per hour more than the minimum speed of 10 m.p.h. laid down by the promoters of the competition.

Some ten locomotives were actually designed for the Liverpool-Manchester railway trials, but, of these, only four actually underwent the test, viz. *The Rocket, Sans Pareil, Novelty* and *Perseverance*, Stephenson's *Rocket*, as we have seen, winning easily.

321 Miles of Railroad

After his astonishing success in the construction of the Liverpool-Manchester railway and, also, in the design and making of *The Rocket*, George Stephenson, as well as his son, Robert, became in demand everywhere as railway surveyors and engineers. It is on record that in the course of two short years, no fewer than 321 miles of railroad were constructed under the direct superintendence of George Stephenson at a cost of £11,000,000.

The close association and understanding which had always existed between the two Stephensons, father and son, now culminated in a sort of business partnership, the father attending to the actual laying out of the railways, whilst the son, Robert, devoted all his energies to the improving of the Stephenson loco designs.

The first railway station in the world! The Manchester terminal of Stephenson's original line. It is now used as a railway company's office.

A SUCCESSFUL 1-C.C. PETROL ENGINE

FULL CONSTRUCTIONAL DETAILS TO BE GIVEN IN THIS JOURNAL

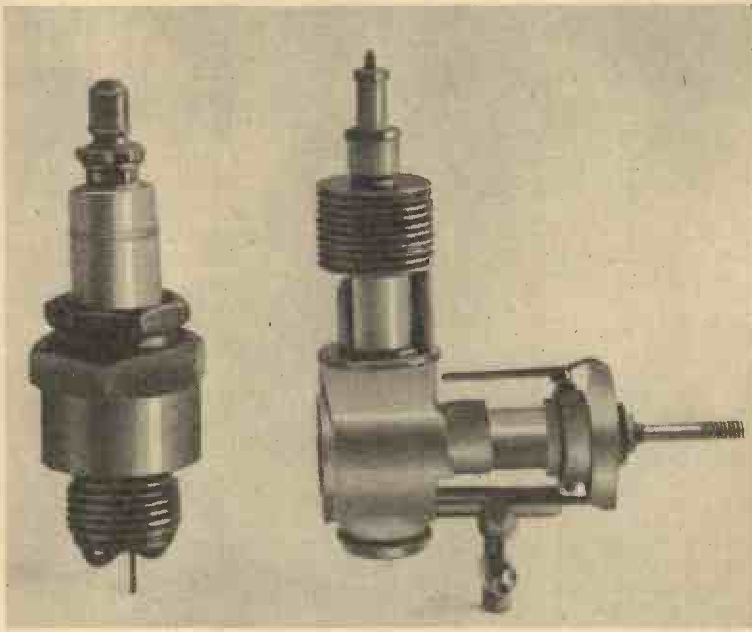
The Model Maker's Ideal

WHEN an internal-combustion engine of 15 c.c. was produced it was regarded as the ultimate in miniature design for a prime mover of this class for the propulsion of models. This, relatively speaking, was not so long ago, but during the intervening period, engines having capacities of 9, 6, and 3·5 c.c. have followed at fairly regular intervals. I am also aware of the fact that an engine of dimensions very considerably smaller has also been made, and for which a very successful performance has been claimed, but constructional details of it have been withheld, nor have I been afforded an opportunity of seeing it run.

In my possession is a petrol engine of 1·155 c.c. which I designed and built to provide power for model purposes. This engine performs remarkably well, and it is really surprising that such a small engine can develop the power that it does. I am entitled to claim that it is the first working petrol engine in the world to be made of such a small size.

In view of the keen interest centreing round such productions, it is proposed to deal with the construction of this engine in future issues. Blueprints will be supplied. As may be imagined, the work in all its stages must necessarily be carried out to close limits. Such work calls for a high degree of skill, and the full details will enable those so equipped to produce a similar working model.

The particulars relating to the engine are in brief: Bore, $\frac{7}{16}$ in. diameter; stroke $\frac{15}{32}$ in.; cycle, 2-stroke; total weight with plug a fraction over 2 oz. Carburation is effected in a simple manner, the mixture being controlled by an adjustable needle valve, the petrol to which is fed directly to the jet tube from the tank. The inlet is taken into the bottom of the crankcase, the admission of the gas being governed by a mechanically-operated piston valve. This valve is operated by a face cam carried at the outer end of the crankshaft, a lobe cam on the edge of which serves also to operate the simple adjustable contact breaker. No castings are required, the parts in the main being machined from round bar material. All joints are screwed, only two screws are used in construction, these being on the contact breaker. Due attention has been given in the design to avoid difficult machining operations, and for this reason the cylinder head is made detachable.



Here is a picture of the 1-c.c. engine compared with a standard sparking plug. Although only $\frac{7}{16}$-in. bore by $\frac{15}{32}$-in. stroke, it starts easily and runs for long periods. It will fly a model weighing 16 oz.

One of the real difficulties with an engine so small lies in the provision of a suitable sparking plug. An idea of the size of the special one used in this instance can be gauged from the photograph showing it compared to a 12-mm. and a $\frac{3}{8}$-in. sparking plug. A view of the engine in comparison with a standard sparking plug gives a fair indication of its tiny overall dimensions.

The performance and practicability of this engine have been demonstrated to the Press, and it would seem from the results obtained that there is no limit to the size to which it is possible to build a petrol engine, except that one must soon reach that point where internal friction would exceed the power developed, and where the weight of the associated equipment—coil, condenser, and tank—would be excessive.

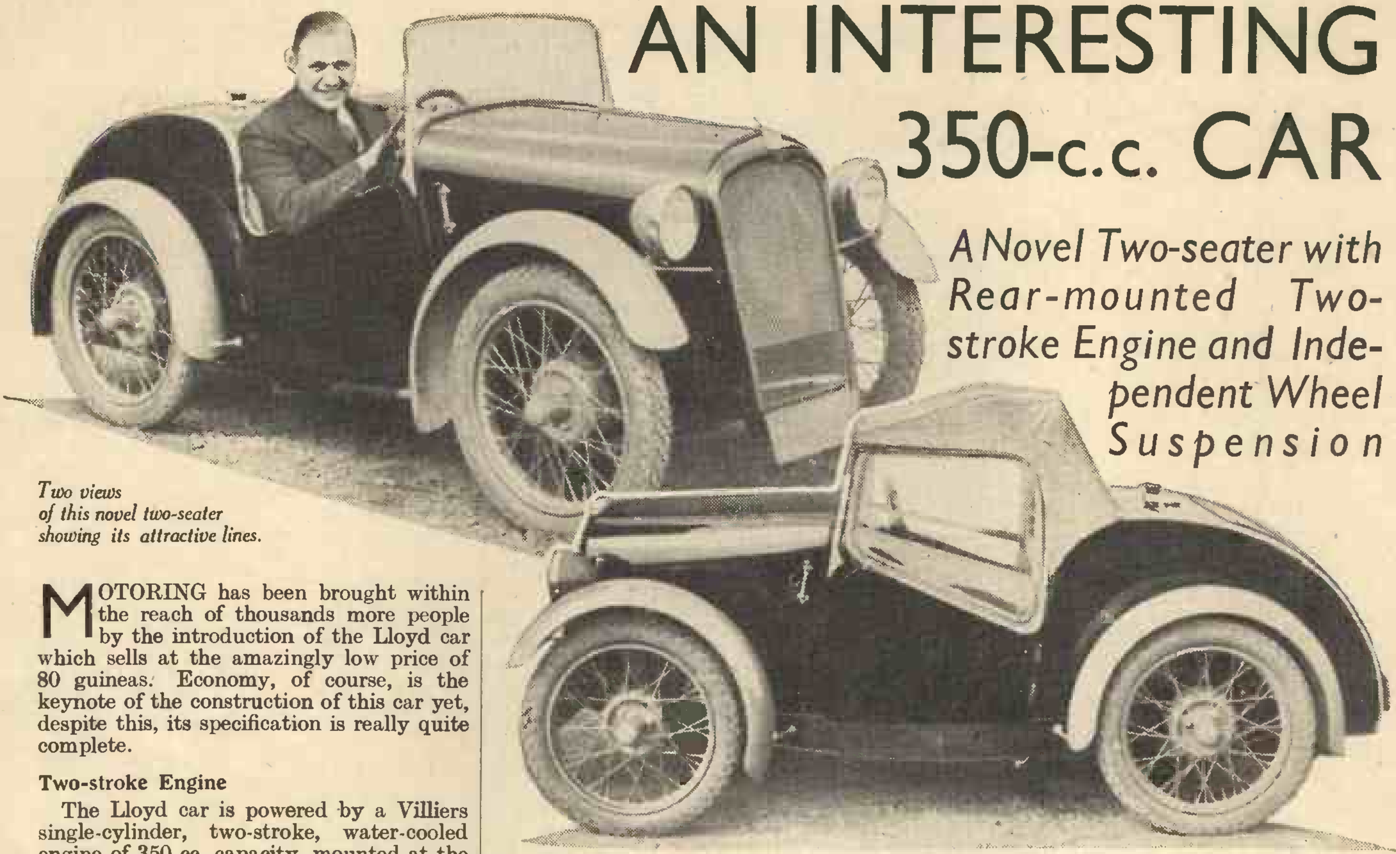
The weight-per-horse-power is the important factor. The engine here described will fly a model weighing 16 oz. W. H. D.

The sparking plug is shown on the right. The other illustrations show the usual size of plugs for models 12-mm. and $\frac{3}{8}$-in. respectively.

Two further views of the 1-c.c. engine, showing its almost microscopical size.

AN INTERESTING 350-c.c. CAR

A Novel Two-seater with Rear-mounted Two-stroke Engine and Independent Wheel Suspension



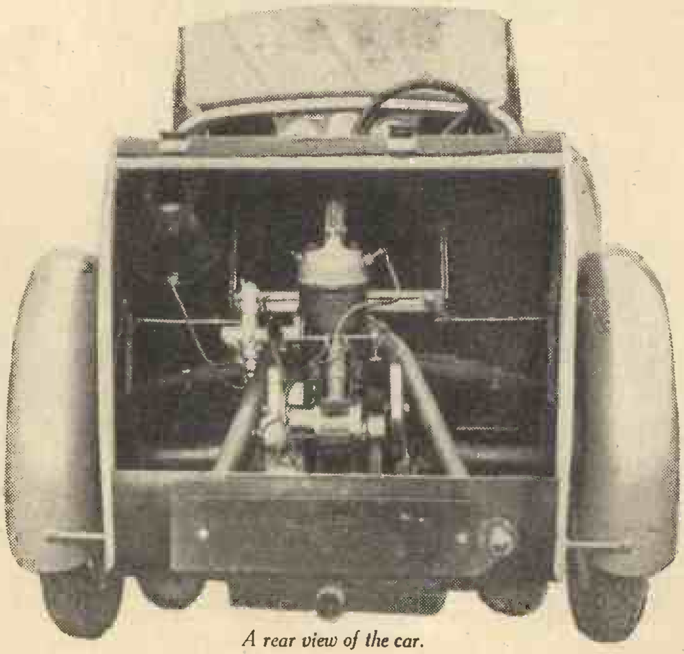
Two views of this novel two-seater showing its attractive lines.

MOTORING has been brought within the reach of thousands more people by the introduction of the Lloyd car which sells at the amazingly low price of 80 guineas. Economy, of course, is the keynote of the construction of this car yet, despite this, its specification is really quite complete.

Two-stroke Engine

The Lloyd car is powered by a Villiers single-cylinder, two-stroke, water-cooled engine of 350 cc. capacity, mounted at the rear. Both cylinder barrel and cylinder head are detachable. The crankshaft is mounted on two large diameter ball bearings whilst the connecting rod big-end is of the roller-bearing type. Lubrication is by Petroil system, incorporating a mixing device in the petrol tank. A rear-mounted radiator and thermo-syphon system ensure efficient cooling. Coil ignition is used with automatic advance and retard control. Starting is effected by a mechanical lever operated from the driver's seat.

The chassis next commands attention: it is of the torsionless tubular-backbone type with transverse members for body mounting. The central tube is 5 in. diameter and the cross members are cantilever type pressed steel. All four wheels are independently sprung. The front suspension is arranged by bronze-bushed lever arms mounted on hardened steel pins and employing a transverse leaf spring. A similar system is used at the rear, but axle tubes are employed instead of lever arms. The rear axle itself consists of two robust tubes each terminating in a bronze-bushed fork mounted on hardened steel pins and anchored to two aluminium bango housings.



A rear view of the car.

Drive from the engine to the back axle is by means of a roller chain through a three-speed and reverse gearbox to the final-drive sprocket, and then through a Hardy-Spicer universal joint to the near-side rear wheel. A multi-plate clutch is embodied in the gearbox. The gear-change lever is conveniently mounted on the central chassis member. The gear ratios are: top, 6·2 to 1; second, 10·5 to 1; first, 16·1 to 1 and reverse, 21·5 to 1.

The brakes operate on all four wheels and are of the usual internal expanding type, extremely powerful and smooth in action. They are operated by pedal, supplemented by a hand lever and ratchet for parking purposes. There is a simple independent adjustment for equalising the brakes and a master adjustment for taking up wear. The handbrake is adjustable from the driver's seat.

Equipment

The general equipment, bearing in mind the price of this car, is really very comprehensive. A six-volt dynamo lighting set is used and there are two large headlamps fitted with parking bulbs. A dip switch is provided. The chromium-plated switch panel carrying the ammeter and switch with locking device is placed centrally in the instrument panel, which is in the middle of the dash. A cubby hole is thus provided each side. An electric horn, windscreen wiper and driving mirror are, of course, provided. There is a full set of tools, including jack, wheel brace and tyre pump. The spare wheel is mounted in a horizontal position under the "bonnet," above the driver's legs. The hood and side curtains are concealed behind the seat when not in use. A three-gallon gravity-feed petrol tank is mounted at the rear, above the engine. The overall dimensions of the car give some idea of its size and roominess. Wheelbase is 5 ft. 9 in; length, 9 ft. 3 in.; width, 4 ft. 5 in.; track (front) 3 ft. 8 in., (rear) 3 ft. 5 in.; ground clearance, 6½ in.; height to top of screen, 3 ft. 11 in. The turning circle is 35 ft.

Maximum speed is said to be 50 m.p.h., and, in second gear, 40 m.p.h. Cruising speed is 35-40 m.p.h. The manufacturers are Lloyd Cars Ltd., of Patrick Street East, Grimsby.

ORDER NEXT MONTH'S Big Xmas Number Now!

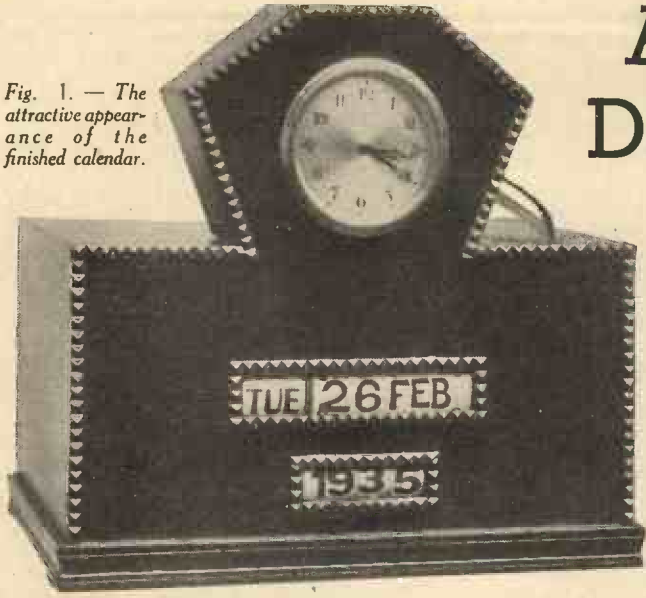


Fig. 1. — The attractive appearance of the finished calendar.

AN AUTOMATIC DAILY CALENDAR

Instructions for Making a Useful Combined Time-piece and Calendar are Given in This Article

I HAVE read somewhere that laziness is the mother of many inventions; and when one comes to think of it, there is a great measure of truth in the statement. For in practically every home and factory to-day, work is being done by machines which was previously done laboriously by hand.

Take, for example, such a simple thing as changing the daily calendar; there is not much labour attached to it, but one feels it a bother and moreover one will forget. Then, after a day or so, or a week or more, the date is required on a day, say, in September. The calendar is consulted only to discover that it has not been changed since somewhere in August. Off comes a handful of leaves and again the calendar is brought up to date.

To remedy this state of affairs and take this work off my unwilling hands, I conceived the idea of a calendar that would change automatically.

The older method of doing this by a train of specially cut wheels did not appeal to me. Moreover, I had not the tools required to do such fine work. Then again, by such means the size of letters and figures used is necessarily small.

I wanted an automatic calendar with real printed letters and figures of no less a size than one inch high; something I could see if I happened to be at the opposite end of the room.

Cost of Materials

The illustration shown of the completed clock will help you to judge in what measure I have succeeded. Moreover, the total cost was not much over £1. The small eight-day clock which controls the calendar-changing mechanism was bought for 16*s*. The other parts were made mostly from odds and ends from my workshop; while the clock-case was cut out of oak-faced plywood and French polished. The calendar and its changing mechanism are mounted on a wooden framework of ⅜-in. yellow pine. This has a brass drop handle on the back to enable it to be pushed into, or withdrawn from, the clock-case. The sizes that are given are not arbitrary. In my own case they were dictated by the parts at my disposal. The clock could, therefore, be made smaller, or larger if that were considered desirable.

Each night on the stroke of midnight the calendar turns and shows the date of the day then begun.

Wheels Required

When I bought the clock I took it out of its case, prised off the hands and lifted off the face. Then on to the hollow spindle of the hour-wheel I fitted tightly another wheel having twelve teeth (see Fig. 2, *A*). This wheel I made to engage with another wheel having twenty-four teeth, which I fitted on the left-hand side of the clock (see Fig. 2, *B*). It is obvious, then, that if the wheel with twelve teeth turns with the hour-wheel once in twelve hours, the wheel with twenty-four teeth will turn once in twenty-four hours.

On this wheel is fitted a small cam, as shown in Fig. 2. Now, this cam, as it turns, lifts lever *D*, which is pivoted through the clock-frame and then extends from the back of the clock to trip pin *E*, on the calendar changing mechanism (see Fig. 3).

The changing mechanism is simplicity itself. From a scrap merchant I purchased an old eight-day clock movement. From this I removed the time wheels, as all I wanted for my purpose was the train of wheels that operated the striking of the hours. Then I took off the slotted disc that controls the number of hours being struck, and on its place I fitted a brass disc having seven equidistant slots. When, therefore, the control pin *F* is lifted out of one of those slots, the brass disc is free to move till the next slot is under control pin *F*. Into this slot the control pin falls, and so prevents further movement. This movement, which is, of course, equal to a seventh of its circumference, is transmitted by wheel *H* to a brass cylinder *I*, which as it turns moves the calendar a distance of one day (see Fig. 4). Control pin *F* is fixed to trip pin *E* and is lifted out of a slot by lever *D* on the clock acting on trip pin *E*.

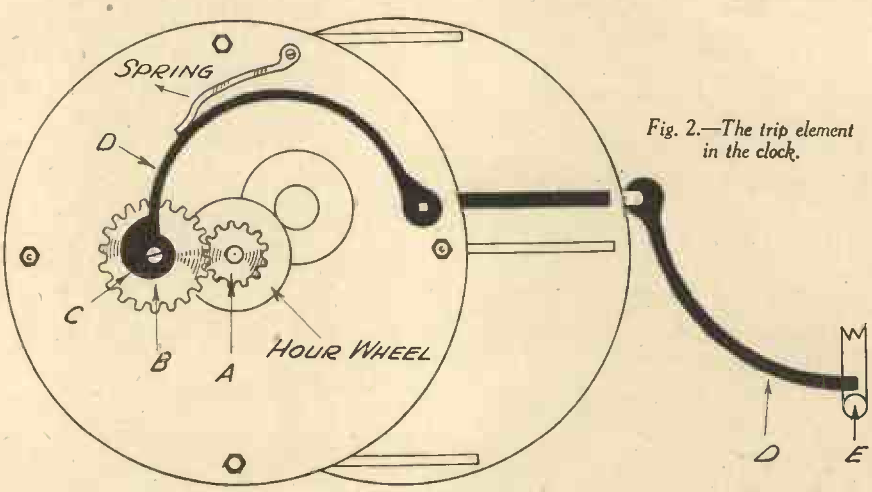


Fig. 2.—The trip element in the clock.

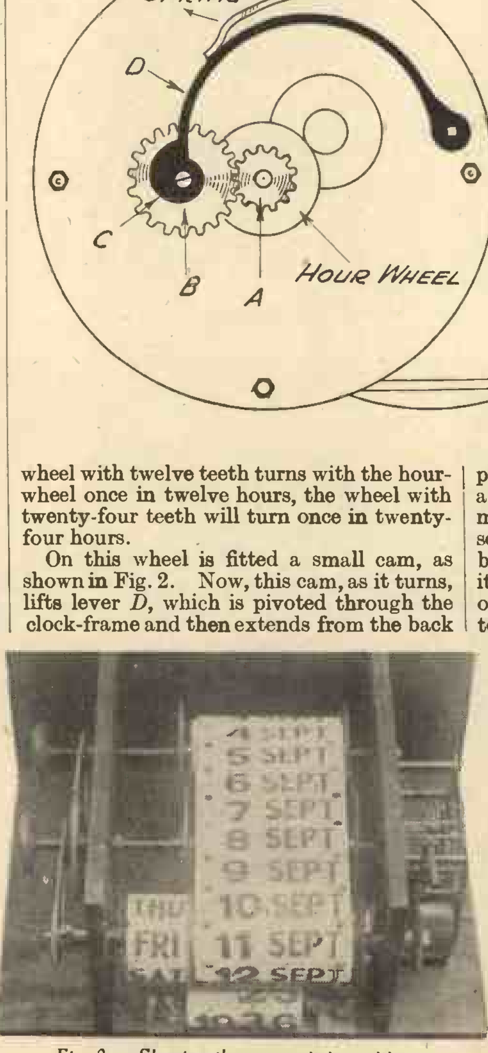


Fig. 3.—Showing the year unit in position.

The Hollow Cylinder

It should be noted that the hollow brass cylinder—an aluminium one would also be excellent—is driven by a clutch pin fixed to the driving spindle *J* (Fig. 4). A quarter turn on a knurled wheel *K* withdraws the clutch pin and allows the cylinder to run freely. This is necessary when turning back the calendar at the beginning of a new year.

As mentioned before, the size of the figures on the calendar is 1 in. and the space between them is about a ¼ in. A simple calculation will show that the length of calendar will be approximately 38 ft.

To make this, I bought a roll of good white wallpaper, measured off a width of 3¾ in., and cut it with a pair of scissors.

The Numbers

On this strip of paper I marked off, and punched out, holes or perforations with a $\frac{1}{4}$-in. leather punch; the distance between them being equal to the pitch of the seven holes which were bored in the brass cylinder $\frac{3}{8}$-in. distance from either end, and tapped to take $\frac{3}{16}$-in. brass rod. The sprockets were made from short lengths of this rod; these were then screwed and turned into the tapped holes in the cylinder, and the ends nicely rounded off. The cylinder itself measures $5\frac{3}{4}$ in. long by 2 in. in diameter, with a hole bored through the end flanges to take $\frac{1}{4}$-in. steel rod.

A local printer willingly gave me on loan a set of wooden type and some printer's ink, black and red. With a little bit of patience and ingenuity I soon had the full year from January to December, printed.

Two spools were then made and slots cut in their hollow spindles. These spools are $4\frac{1}{4}$ in. long with a flange of $2\frac{3}{4}$ in. diameter, and are fitted to run behind the cylinder. Into the slot of one of the spools one end of the perforated calendar was fixed, then passed round the cylinder, the perforations falling nicely on to the sprockets, and then into the slot of the other spool.

Fitted to the ends of the spools, and also the cylinder rod or shaft, are small grooved pulleys. On these are placed $\frac{1}{8}$-in. round elastic bands or belts. When, therefore, the cylinder is turned by the clockwork mechanism it draws the calendar from one spool and winds it on to the other.

Only the numbers of the days and the names of the different months are printed on the perforated paper. The names of the days are printed on a separate band of paper and glued on to a thin metal sleeve which fits over the left end of the cylinder.

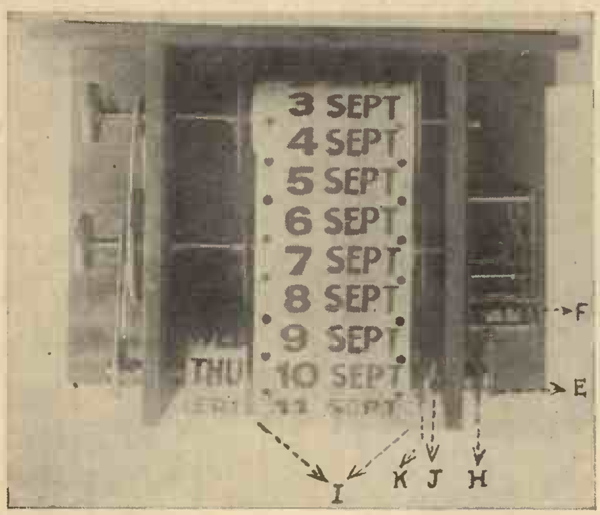


Fig. 4.—Showing the disposition of the calendar mechanism.

This is spring-retained, and has seven notches cut on its circumference, one opposite each day, and into any one of those notches it can be placed as required.

Fitting in Leap Year

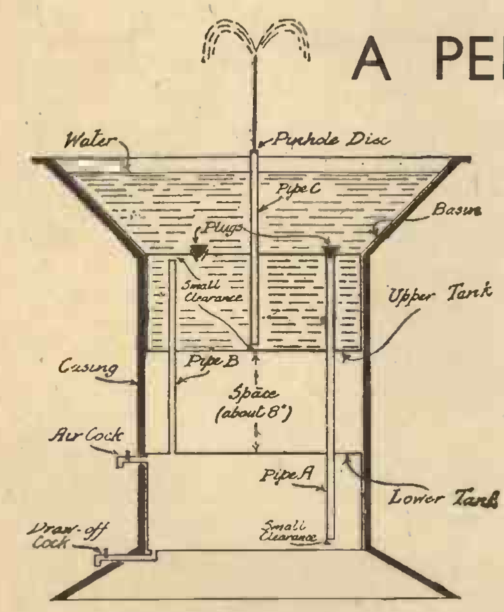
The reason for this is self-evident. For if the days, the numbers, and the months were printed together on the calendar it would only be correct for one year. For example, this present year began on a Wednesday; 1937 will begin—as this is a leap year—on a Friday.

So then, all that requires to be done when changing the calendar at the beginning of the year is a simple matter. The perforated calendar is wound back from one spool to the other until January 1st appears, then the sleeve with the days is turned until the correct day is opposite, and the calendar is set right for another year.

But, you will say, what about leap year? How does the calendar make provision for that extra day in every four years? Easy enough. February is printed with twenty-nine days, but the calendar is divided between the 28th and the 29th. The two ends are provided with snap fasteners and with these can be joined together at either of two positions. February can then be made to have twenty-eight or twenty-nine days according to the pairs of fasteners that are used. This adjustment is made when the calendar is being set at the beginning of a leap year.

The year unit is made separate from the calendar, and is held to the baseboard by two wireless terminals. The figures 19 are a fixture; but the two outside figures are printed on separate endless bands; that is from 0 to 9. By turning them any number up to 99 can be shown. In 1999 the 19 can be changed to 20 and the calendar would be good for another thousand years!

A PERPETUAL TABLE FOUNTAIN



Showing how the fountain is made.

THIS little fountain is quite self-contained and does not need a constant supply of running water. It is portable, and can be used either indoors or in the garden. At first glance it looks as though I had discovered the secret of perpetual motion. The water in the basin is forcing itself in a jet to a height of 10 in. or more above its own surface! Actually, however, the jet will cease when all the water in the upper tank has been forced out.

The fountain is made quite simply. If you have a couple of old petrol cans of equal size, they will do slendidly for the tanks and will give about forty-five minutes' working without attention. They should be fixed on their sides, one above the other, with a space of about 8 in. between them. A simple frame of wood or metal can be easily rigged up to keep them in position. The lower tank must have an air cock at the top and a draw-off cock underneath; old gas fittings will come in useful here. The top basin can be made from any handy metal; it rests on the upper tank and has a filling plug, as shown.

Pipes *A*, *B*, and *C* are tubes of $\frac{1}{4}$ in. or smaller diameter, preferably of brass. It is best to solder all joints between pipes and tanks, as they must be quite watertight. To finish the job, solder on the top of pipe *C* a thin brass disc in which a pinhole has been drilled. On the size of this hole depends the volume of the jet and the length of time the fountain will play.

How the Fountain Works

To start the fountain, first put a plug in the top of pipe *A*. Remove the plug from the bottom of the basin, fill the upper tank and basin with water and put back the plug. Now unstop pipe *A* and the fountain will start to work.

Magic? Not at all. When you unplugged pipe *A*, the water ran down and compressed the air in the lower tank. Pipe *B* transmitted the pressure to the water in the upper tank, which was forced up pipe *C* and so out through the pinhole, forming the fountain jet. The flow will go on, because the head of water in *A* is acting against a smaller head in *C*. No water flows through *B*.

Of course, as the water rises in the lower tank, the "working head" of water is reduced and the jet weakened. The jet does not, however, become a mere dribble, but stops quite suddenly when the lower tank is full of water and the upper tank full of air. The water level in the basin remains the same.

Restarting

To restart the fountain, plug pipe *A*, open the air cock and empty the bottom tank through the draw-off cock. That tank will now be refilled with air and the air cock should be closed again. Now refill the basin as originally described, and the fountain is ready for another "run."

A painted casing, of either wood or metal, will give the job a finished appearance. The fountain is silent except for the sound of falling spray.

PERFECT SCALE MODELS OF FAMOUS SHIPS

Each of these true scale ship kits makes a fine exhibition model . . . every kit is sent out on a money-back guarantee of satisfaction. You may return the kit within 3 days—as it was received — and your money will be refunded without question.

BUILD THE "QUEEN MARY"

SHAPED HULL. LENGTH 18".

A real bargain kit containing many finished details, such as metal lifeboats, davits, anchors, ventilators, etc. Fully shaped hull. Masts, spars, rigging, printed balsa parts, winches, funnels, cements, and coloured dopes, etc., and clear full-sized plan.

Complete kit, carriage paid **7/6**

"Queen Mary," 10" Model. Without carved hull and finer details.
Complete kit, carriage paid **3/-**

CLIPPER SHIP

"FLYING CLOUD"

This kit makes a fine model of a record-breaking Clipper. Kit includes balsa block for hull, printed balsa sheets, masts, spars, rigging, coloured dopes, etc., etc. Length 12 inches.
Complete kit, carriage paid **2/-**

Send penny stamp for illustrated list showing many models of famous ships.

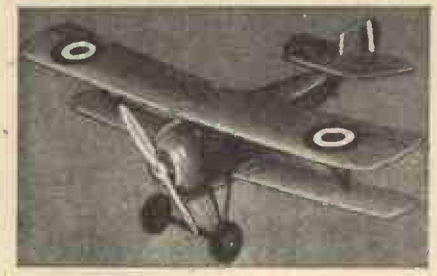
SEND YOUR P.O. NOW TO

P. M. SWEETEN LTD.

BANK HEY STREET - **BLACKPOOL**

Balsa Model Aeroplanes

REAL FLYERS



We are offering the finest American Kits of parts ever put on the market for the Model Aeroplane Builder. All Kits are complete, including all Balsa wood, Japanese tissue, wheels, pins, wire, elastic and full-size Drawing with instructions.

PRICES

Kits for 26" wing span flying model of the Fokker D8, Nieuport, Curtiss Robin, Puss Moth, Sopwith Camel, Douglas, Fairchild 22, Monocoupe.
Price per Kit **2/6**, postage 4d.

Super Kits for building up 24" wing span models which can be fully controlled from the cockpit; everything wanted is included in these Kits to make a Stinson Reliant, Curtiss Swift, Albatross D-5A, Spad, Hell Diver, Douglas O-38.
Price per Kit **7/6**, postage 6d.

If you are starting to look for Christmas presents, send for Bond's General 198 Page Catalogue, price 6d.; this contains everything wanted for the Model Aeroplane maker, Model Railway builder from Gauge "O"—½ Scale, or the Model Ship Builder; also all Tools and Materials required.

BOND'S O'EUSTON ROAD LTD.
254, Euston Road, London, N.W.1
'Phone: Museum 7137 Est. 1887

Up-to-Date HANDBOOKS

Newnes'

HOME MECHANIC

Series. Each 1/- net.

Specially written and produced for the up-to-date handyman.

SIMPLE ELECTRICAL APPARATUS
ACCUMULATORS
MOTOR CAR UPKEEP & OVERHAUL
MODEL AIRSHIPS & AEROPLANES
MODEL BOAT BUILDING
25 SIMPLE WORKING MODELS
THE HOME WOODWORKER
THE HANDYMAN'S ENQUIRE WITHIN
HOUSE DECORATION & PAINTING
POWER DRIVEN MODEL AIRCRAFT

And these are just a few of the attractive titles included (all fully illustrated).

From Booksellers Everywhere or 1/2 post free from

GEORGE NEWNES, Limited,
8-11 Southampton St., Strand, London, W.C.2

MSS VALUE KITS MSS

"Value Kits" because we do not offer huge parasols at ridiculous prices but because of sound design and construction.

READ THIS AMAZING REPORT from the "Romford Recorder" (Sept. 4th).
REMARKABLE FLIGHT OF CADET MAJOR.

"Climbing in circles, it quickly reached an altitude of about 500 feet. At the end of 12 mins. the model was so high up as to be nearly invisible. The timekeeper, no longer being able to see the machine, stopped his watch. Time, 18 mins. 20 secs. out of sight! The machine landed unharmed in a field at Dagenham. It is impossible to say how long it remained in the air, but it is estimated to be several hours. The distance flown is also hard to compute, as the machine was circling all the time, but as the crow flies it must have been at least seven miles."

ELASTIC DRIVEN. 18 mins. 20 secs. out of Sight!
THE CADET MAJOR SCORES AGAIN!
CADET MAJOR KIT (Elastic Endurance Model).
Identical with the above, 9/- Complete, post free.

Sole British Agents for Cadets and all Bunch Models. Scientific Hi-flyer Kits. Gwin Aero Petrol Motors. Tornado Motors and all Imp Supplies.

MODEL SUPPLY STORES
(Dept. P.M.), 46 Derby Road
Prestwich, near Manchester

Send 2d. for 18-page Catalogue. Full of Illustrations and useful hints.

engineering

Our NEW ENGINEERING GUIDE explains clearly how all the best jobs are secured. It shows how to obtain such money-making qualifications as **A.M.I.C.E., A.M.I.Mech.E., A.M.I.W.T., A.F.R.Ae.S., etc.** How to secure permanent, progressive and pensionable posts in the Government and Municipal Service, and describes numerous "Higher-pay Courses" in **CIVIL, ELECTRICAL, MECHANICAL, AUTO and AERO-ENGINEERING; TELEVISION, TALKIE-PICTURE WORK, etc.**

SUCCESS—OR NO FEE

We definitely guarantee success. If you fail your examination, or if you are not satisfied in every way with our service, then your full tuition fee will be returned without question.

Write to-day for this remarkable publication and details of our employment service, etc.

NATIONAL INSTITUTE OF ENGINEERING
(Dept. 29), Staple Inn Bldgs., High Holborn, London, W.C.1


(Left) Making sparklers. Wooden splints being coated with the sparkler composition contained in a test tube. (Right) Incorporating pellets of special composition in a firework " candle " in order to produce the " silver star " and " basket of flowers " effect.

Making Fireworks at Home

A Successful and Safe Method of Making Fireworks at Home

THE making of fireworks dates back a considerable number of years, and although in modern times the commercial manufacture of pyrotechnical pieces has reached a supreme degree of excellence which cannot be imitated on a small scale, there is no reason why any amateur who is interested in chemistry and its allied sciences should not try his hand successfully at the making of a number of safe and simple firework articles for home display purposes.

Spectacular Displays

The various firework " mixes " described in this article are all easy to make and, used intelligently, they are capable of giving spectacular displays. Moreover, provided that the most elementary and commonsense precautions are taken during the manufacture of the various firework pieces, no accident can possibly occur. Do not, therefore, compound the firework ingredients near to a fire or in the vicinity of an open flame. Always treat potassium chlorate with great respect. This firework ingredient is normally perfectly safe to handle, but if, for any reason, it is required to be mixed with sulphur and/or charcoal, the potassium chlorate MUST NOT be ground up with these materials, otherwise it will be liable to explode spontaneously. Always, when mixing potassium chlorate with any other material whatsoever, employ no other method for this purpose other than a very gentle stirring of the ingredients together. Potassium chlorate, of course, can be powdered up *alone* with impunity; it is only when it is powdered or ground up with other materials—particularly sulphur—that it becomes dangerous.

Coloured Fires

Having now sounded a necessary warning to all home experimenters who propose to engage in the truly interesting task of small-scale firework making, let us now proceed to the actual details of simple pyrotechnic manufacture.

The very easiest firework pieces to make are the coloured fires, of which many different varieties are possible.

Below are given several tested formulæ for the preparation of coloured fires. They are all fairly slow-burning, but, if required, the rate of burning can be speeded up by adding to each " mix " a small proportion of saltpetre and/or powdered sulphur.

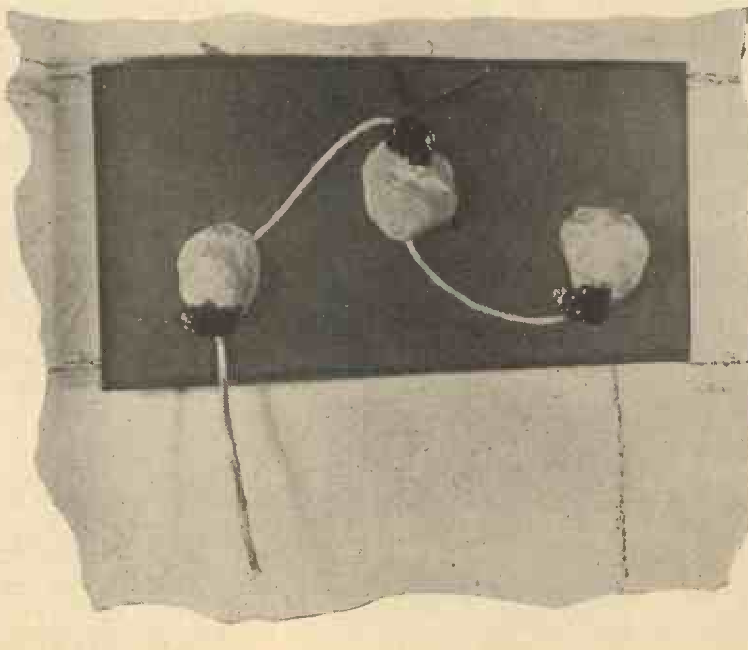
The coloured fire ingredients should be intimately mixed together and, if required, the various " mixes " may be damped with a little methylated spirits. The coloured fire powders are best put up in little pill-boxes (procurable cheaply from any druggist) or, if more convenient, similar boxes may easily be made at home by gluing cardboard strips together. Having filled the boxes with the coloured fire powder, provide for each pill-box a fuse. See that the fuse dips below the level of the powder in the box and passes through a hole in the lid. Such fuses are made from ordinary tow or string and a description of their preparation will be given later.

White Fire

Saltpetre	25 parts
Sulphur	8 ,,
Charcoal	1 ,,
Shellac	½ ,,

Green Fire

Barium nitrate	3 parts
Potassium chlorate	4 ,,
Saltpetre	1 ,,
Charcoal	½ ,,
Shellac	1 ,,



This simple firework piece, the making of which is described in this article, gives three brilliant flashes of light in quick succession.

Red Fire

Potassium chlorate	30 parts
Strontium carbonate (or nitrate)	6 „
Charcoal	½ „
Shellac	4 „

Blue Fire

Potassium chlorate	30 parts
Copper sulphate	6 „
Shellac	4 „
Charcoal	½ „

"Fountains" and "Coloured Candles"

"Fountains," "Coloured Streamers," and "Many-coloured Candles" can be made by utilising the properties of the above coloured fire "mixes." Make up a number of cylindrical cardboard containers, each about half an inch in diameter, or even smaller, and four or five inches long. Fill a container a quarter full with a coloured fire mixture. In this instance it is best to have the mixture slightly damped with methylated spirits and to compress it within the container by tamping it down with a pencil end. On top of this coloured fire layer, tamp down another layer of a different burning colour, and so on until you have three or four layers of different coloured fire mixtures within the one container. Place the fuse in position and then seal up the upper end of the container by means of a plug of tissue paper which has been soaked in saltpetre solution and dried.

Fireworks so fashioned will burn first in one colour and then in another, the colours changing according to the type of "mixes" which they contain. For the best effect, the colour changes should be placed in this order: white, red, green, blue, white. Do not let green follow either red or white, or else a good deal of the spectacular effect will be destroyed.

An Interesting "Candle"

A still more interesting "candle" can be prepared on the above lines by making up little pellets (about the size of a pea) of the following mixture:

Barium nitrate	6 parts
Fine iron filings	1 „
Aluminium powder	1 „
Saltpetre	½ „
Methylated spirit	Sufficient to damp the mixture.

In the middle of the firework candle prepared as above (and such can be either of the single or multi-coloured variety) place two or three of the above pellets, surrounding them with a mixture of powdered sulphur and potassium chlorate (equal parts).

A firework so prepared will, when the burning layer has reached the pellets, throw out a number of silver stars, the potassium chlorate-sulphur mixture igniting the pellet composition and driving out the metallic part of the latter with an exceedingly spectacular effect.

Fuses for fireworks are readily made. Simple touch-paper may be prepared by taking ordinary tissue paper and soaking it in a strong solution of saltpetre, afterwards allowing it to dry. Such paper will burn slowly, as also will string and tow which has had the same treatment. If to the saltpetre solution a little potassium chlorate solution is added, the burning of the touch-paper will be speeded up.

Quick-burning Fuses

A quick-burning fuse may be prepared by making into a paste with a little dextrine or gum solution a quantity of the following mixture:

Saltpetre	15 parts
Sulphur	2 „
Charcoal	2 „

String, tow, hemp, flax or other fibrous material is smeared over with the above-mentioned paste and allowed to dry.

Sparkler manufacture is an interesting firework preparation which can be carried on at home. The sparkler mixture contains the following ingredients:

Saltpetre	5 parts
Iron filings (fine)	1 „
Aluminium powder	2 „
Potassium chlorate	½ „

This is made into a thin glue-like mixture with a methylated spirit solution of shellac, and wooden splints are coated with it and left overnight to dry. In actual home practice, it is best to make the sparkler composition up in a test-tube and to dip the wooden splints into this. The splints are thus coated efficiently and wastage of the mixture is prevented. If preferred, of course, the sparkler "mix" can be coated upon wire instead of upon wooden splints. Such sparklers, when ignited, burn with a brilliant shower of sparks, the colour of which can be modified a little by incorporating with the sparkler "mix" a small quantity of any coloured fire mixture.

Coloured fires in the foreground and "candles" in the rear.

A Firework Piece

Quite an interesting firework piece can be made from any of the above sparkler composition which may be left over. Place two, three or more "blobs" of this composition upon a cardboard or wooden strip and in contact with each "blob" attach a little of the quick-burning fuse composition previously mentioned. Connect all these fuse-blobs together with string or tow impregnated with either quick- or slow-burning fuse mixtures and provide, also, a similar fuse-tow to the first "blob" in order to start the firework. A light applied to this latter fuse-tow will travel up the tow and, reaching the first "blob," will ignite it, the result being a brilliant flash of light. The other "blobs" will similarly ignite in quick succession, thus giving rise to a succession of flashes.

For its most effective display, such a pyrotechnic piece should be nailed up to a wall or to the end of a long pole.

Gunpowder, as is well known, consists of a mixture of sulphur, saltpetre and charcoal in varying proportions. Not much interest is attached to its making, however, for it is messy and dirty stuff to handle, and its mode of burning is not spectacular. Moreover, when burned in a confined space, gunpowder, in any but small quantities, may exhibit dangerous properties.

Pinwheels

If, however, gunpowder "mixes" are rolled up into little cardboard tubes of about ⅛ in. diameter and the latter coiled around a central disc, the familiar pin-wheels will result. Similarly, such tubes when folded concertina fashion and bound securely in that position will constitute the well-known "rip-rap" fireworks.

Detonating mixtures of sulphur and potassium chlorate and/or gunpowder are not safe to handle, let alone to make. Consequently, details of their preparation are not given here. The reader, however, may be assured that in the firework preparations described in this article he will find ample opportunity for making numerous experiments in the directions in which his own fancy may dictate. Many variations in the composition of the mixtures given in this article are permissible, but the mixture-compositions given above are the ones which, under normal conditions, are calculated to produce the best results.

Powdered Charcoal

It should be noted in all cases that powdered charcoal cannot be very successfully substituted by soot or lampblack. Any attempt to do so may result in poor results, or even in complete failure, since soot has the effect of "blocking" the burning of a firework.

Finally, remember the warning uttered at the commencement of this article. DO NOT grind or otherwise powder together sulphur and potassium chlorate, and DO NOT make or store firework mixtures in the neighbourhood of an open fire or naked flame. Taking those simple precautions, no harm can come of home firework making on the lines described above.

All the various chemicals mentioned in this article are to be obtained from any ordinary chemist or druggist or, more cheaply, from one of the suppliers of laboratory and chemical equipment who are to be found in every large town.

How— Automatic Record Changers Work

Being a Brief Explanation of Some of the Mechanisms now Available

Fig. 1.—The latest model introduced by the Garrard Company. The records are supported partly by the bracket seen on the left and partly by a special notched spindle which, of course, does not rotate.

TAKEN as a whole, the human race is a lazy one and it generally hails with enthusiasm the advent of any device or mechanism which can save the carrying out of some monotonous process. I suppose that it is this natural laziness which has contributed so largely to the popularity of the automatic gramophone. In spite of the fact that these automatic mechanisms are by no means cheap, more than two thousand are sold in England every week, and if it were not for the comparatively high price which one must pay for such complicated luxuries, the number sold would undoubtedly be considerably higher.

Important Features

A complete description of even one of the many delightful mechanisms now available would be far too long for these pages, but a brief outline of the more important features and some of the mechanical "dodges" may be of interest. In the operation of a gramophone, there are a number of separate operations to be carried out. For example, there is the placing of the record on the turntable, the lifting of the tone-arm or pick-up, the movement of the pick-up over the edge of the record, the dropping of the pick-up on to the edge of the record and the feeding-in to the playing grooves —to name only the few motions concerned with the start of a record, and when one considers also the various operations at the end of a record, the changing or repeating mechanism, and the necessary provision for different sizes of records, it will be realised that an automatic gramophone cannot be a very simple affair. In fact, the various devices which control the sequence of operations are among the most ingenious of modern mechanisms.

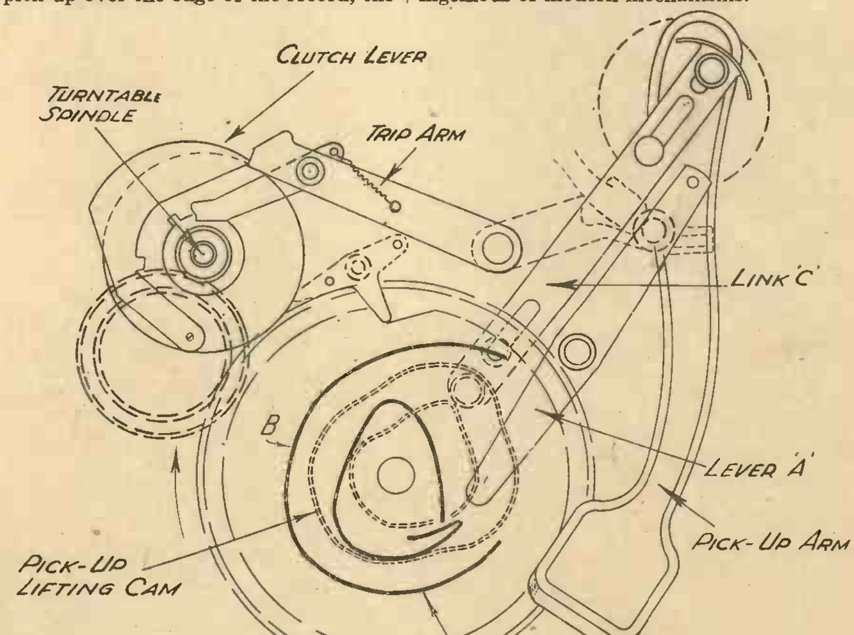


Fig. 2.—Simplified diagram of the H.M.V. unit showing clutch mechanism, gearing, and pick-up cams.

Fig. 3.—The H.M.V. Automatic Record Changer. The records are supported by the blades of the two pillars, which may be set for either 10 in. or 12 in. records.

Although the various operations to be carried out are complicated, they follow each other in a definite sequence. This fact enables the actions to be controlled by various types of cam gearing and the cam arrangements really constitute the "brains" of the whole mechanism.

Four Cams

There are too many individual actions which operate simultaneously for one cam to be able to control all, and the majority

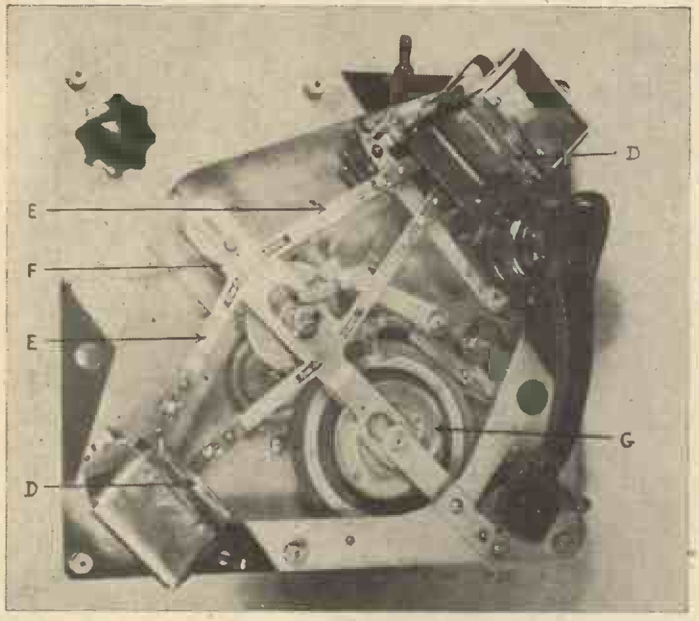


Fig. 4.—Showing the cams, links, and guide-plates of the record-dropping mechanism.

of automatic mechanisms contain no less than four. In the H.M.V. mechanism, which is perhaps one of the best known, two of the cams control the jaws which support the records and drop them, one at a time, on to the turntable; another cam controls the lifting of the pick-up arm, and a fourth controls the lateral movement of the arm. The contours of the respective cams are so designed that each motion takes place in its proper sequence, but since the automatic sequence only comes into action at the start or end of a record, the cam gear must be declutched and out of action during the actual playing period.

The following brief description of the H.M.V. mechanism will serve to give a general idea of the operations which have to be carried out by an automatic gramophone, and although the constructional details are very different in the various makes, the changing sequence is similar in all.

At the end of a record, or at the beginning of a fresh series, the changing mechanism requires to be brought into action in order to place the next record on the turntable and bring the pick-up on to the disc. In the H.M.V., the cam gear is brought into operation by means of a "trip" mechanism which is shown in Fig. 2.

The Trip Arm

It will be seen that the turntable spindle carries a small wheel which rotates with the turntable and which has a single square-shaped tooth. When the mechanism is tripped, either by pressing the starting button or automatically by the pick-up reaching the spiral finishing groove at the end of a record, the trip arm releases the point of the clutch lever and the square tooth on the turntable spindle engages with a similar tooth on the clutch lever and carries the whole clutch assembly round with it. The clutch wheel is geared through an idler wheel with the set of cam gears and hence, as soon as the mechanism is tripped, either by depression of the starting button or by the pick-up reaching the end of a record, the cam gear commences to make a single rotation and the changing cycle is carried out.

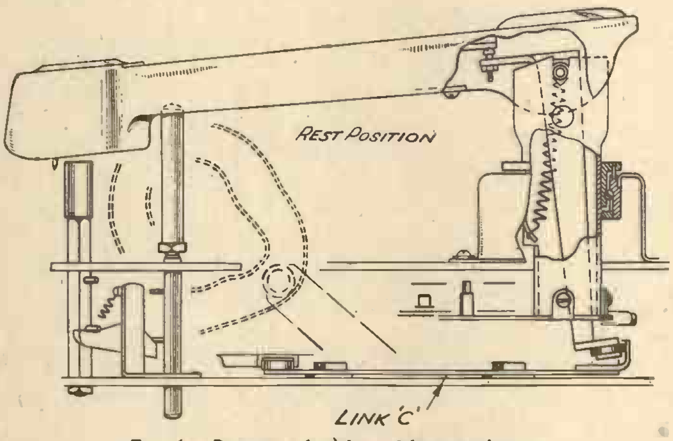


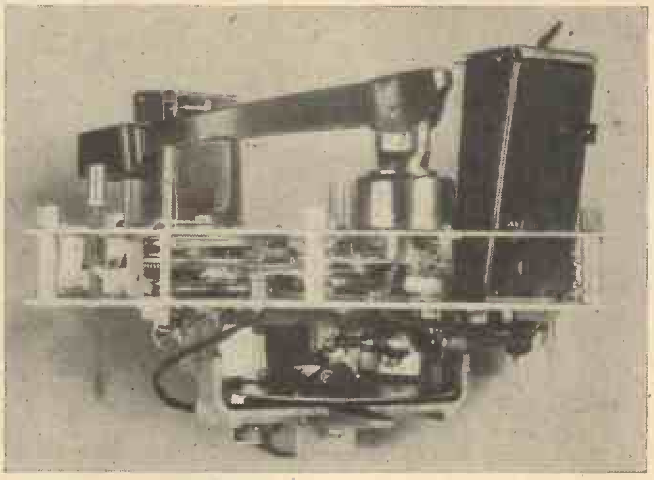
Fig. 6.—Diagram of pick-up lifting mechanism.

Since the cam gear comprises four independent cams, it will be clear that four separate sequences occur together, two of which —those connected with the raising and traversing of the pick-up—can be followed in Fig. 2. The cams are shown in the positions which they occupy during the actual playing of a record, and they remain stationary until the mechanism is tripped, when they commence to rotate quite slowly in a clockwise direction.

The Pick-up Traverse Cam

The top cam, shown black in Fig. 2, is called the "pick-up traverse cam" and engages with a small roller on the end of lever *A*. This lever is pivoted near its centre and at the other end it engages with the lower part of the pick-up pillar. It thus controls the lateral traverse of the pick-up.

Fig. 5.—(Below) A side view of the H.M.V. mechanism.



As the cam rotates, the roller end of lever *A* is gathered in by the edges of the cam and by the time it has completed half a turn, the roller is at the point of minimum radius, *B*, and the pick-up is then right outside the periphery of the record.

During the time when the pick-up has been moved outside the record, it has also been raised above the record surface by means of the second cam shown dotted in Fig. 2. This cam engages with a roller on the end of the link *C* which is connected to the bottom of the pick-up lifting lever as shown in Fig. 3.

While the pick-up is raised and right outside the periphery of the record as described above, the next record, which has hitherto been resting on the rest plates *D* (Fig. 4), is

Fig. 7.—The Garrard Automatic Record Changer. The records are carried by the three pillars, a quick angular movement of which causes the bottom record to fall on to the turntable.

allowed to drop on to the turntable by the withdrawal of the rest plates under the action of the links *E*, the sliding guide plate *F* and the heart-shaped cam *G*.

Further rotation of the cams brings the pick-up again over the edge of the record, and at this point, the increasing radius of the dotted cam in Fig. 2 causes the pick-up to be lowered on to the record and fed into the playing grooves. The rest plates have now returned to their normal position, and the separator plates, which have been isolating the bottom record of the pile from the others above, withdraw and deposit the pile of records on the bottom rest plates.

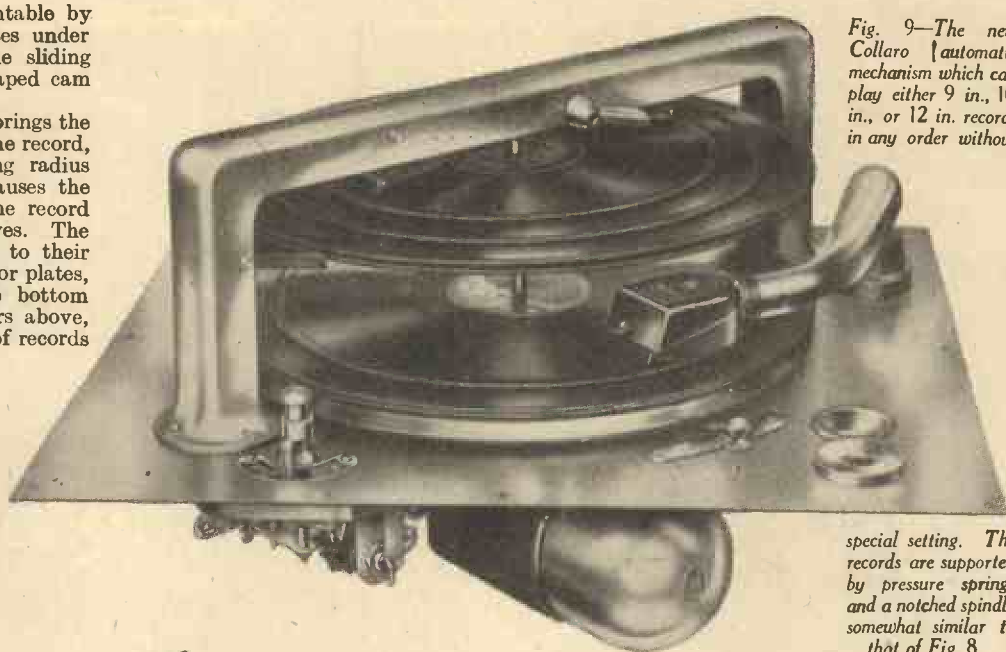


Fig. 9—The new Collaro automatic mechanism which can play either 9 in., 10 in., or 12 in. records in any order without special setting. The records are supported by pressure springs and a notched spindle somewhat similar to that of Fig. 8.

The Mechanical Sequence

The cam assembly has only made one rotation during the changing cycle, which is now complete, and the clutch gear is thrown out of action. The playing of the record proceeds and the changing cycle is not repeated until the mechanism is again tripped by the pick-up reaching the end of a record or by the pressing of the rejector button.

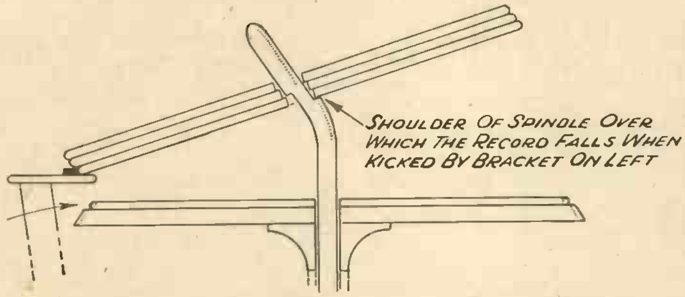


Fig. 8.—Diagram showing the principle of operation of the latest Garrard mechanism. The little pegs on the arms of the bracket shown on the left cause the bottom record to be shifted slightly to the right, thus passing over the shoulder of the spindle.

This very brief account of the changing cycle has only covered the main features and there are innumerable details which, however, belong more properly to an instructional manual than to the pages of PRACTICAL MECHANICS. Sufficient has been said, however, to give an indication of the methods by which mechanical sequences can be achieved.

Prominent among other automatic mechanisms which can now be purchased by home constructors of radio-gramophones are two made by the Garrard Engineering Company. The first is shown in Fig. 6, and it will be seen that the records are carried on three standards, the top of each of which is fitted with a special knife-edged blade known as the separator blade, the function of which is to isolate the bottom record of the pile during the dropping motion. The three standards are connected together by a link arrangement underneath the motor board and are controlled by a special form of cam. At the correct instant, the standards make a quick angular movement, the knife edges separate the bottom record from the rest of the pile, the bottom record is dropped on to the turntable, and the standards return to their normal position.

This mechanism is controlled by a very ingenious cam, which, unfortunately, defies description in brief and simple language. It is unusual, however, in that it combines all the essential movements in a single cam by means of employing both a traversing and a radial contour to the cam face.

The Garrard Mechanism

The second mechanism made by the Garrard Company is delightfully simple in operation and is shown in Fig. 1. The records are supported, partly by an ingenious bent spindle which fits into a slot in the centre of the turntable, but which does not rotate, and partly by a bracket seen on the left. The arms of this bracket are fitted with two little pegs, and in order to drop a record the bracket is caused to

(*Continued on page* 118)

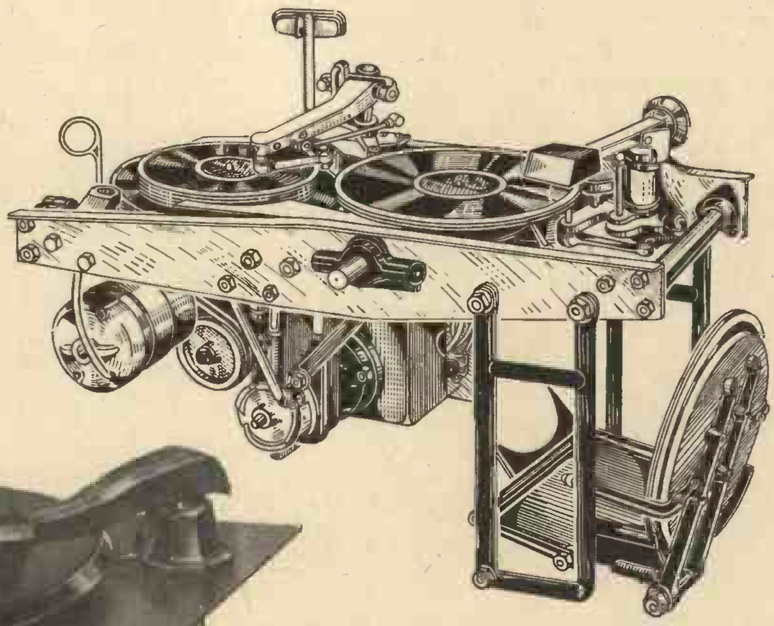


Fig. 11—The Autotrope, an automatic record-changer de luxe which is capable of playing a series of 33 records which may be of any sizes and in any order. This mechanism has the unique feature that it plays both sides of the records without attention.

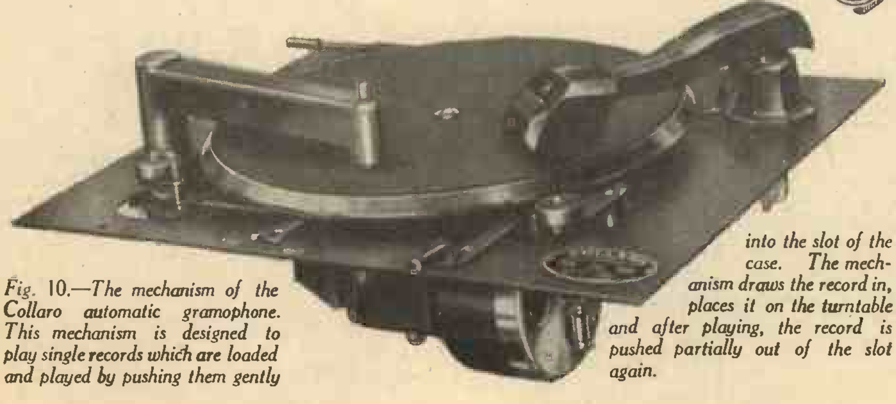
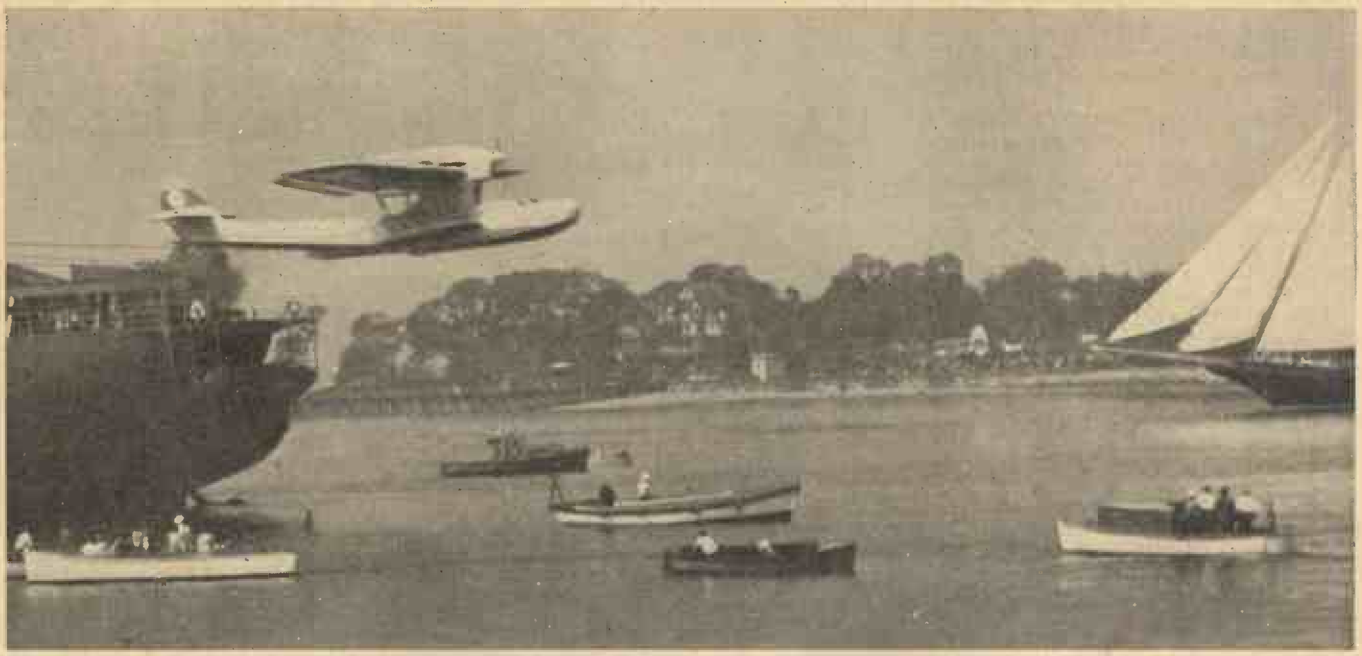


Fig. 10.—The mechanism of the Collaro automatic gramophone. This mechanism is designed to play single records which are loaded and played by pushing them gently into the slot of the case. The mechanism draws the record in, places it on the turntable and after playing, the record is pushed partially out of the slot again.



The giant German flying-boat "Zephyr" is shown leaving the catapult aboard the steamer Schwabenland, *on a test hop. The "Zephyr" with its sister-ship "Aeolus" are being used on tests over a proposed Trans-atlantic commercial air route, with the* Schwabenland *acting as a floating, mid-ocean airport. The above illustration gives an excellent example of the advances in transportation with the huge flying-boat leaving the stern of the steamship.*

IN THE WORLD OF SCIENCE AND INVENTION

Testing Metal Castings

A NEW method of testing metal castings and machined parts whereby cracks and similar defects can be detected depends upon the use of supersonic sound waves. The material under test is covered with a film of oil on the surface opposite to that upon which the sound waves fall. The sound waves pass through the material and produce visible oscillations in the oil film. The waves are unable to permeate through any defective portion, and thus a defect, such as a crack is shown up by static or non-vibrating patches in the oil film.

Cosmic Rays

NO one can yet say with certainty what cosmic rays really are or how they originate. So much research is being done, however, that their nature cannot remain a mystery for ever. Cosmic rays can be counted, their direction and intensity measured—but what are they ?

An Automatic Radio Transmitter

THEY are found to be more numerous at high altitudes, and a balloon equipped with recording gear and an automatic radio transmitter has been developed by the Franklin Institute to provide data of cosmic rays at extreme heights. The radio transmitter sends out a series of dots, the interval between which indicate the height of the balloon, and the arrival of cosmic rays also causes the transmitter to send out special signals which are received and interpreted by special oscillographs on the ground.

Cosmic rays research at present seems to lead nowhere, but the energy of the rays is so enormous that it is not inconceivable that practical applications will be discovered.

Glass Erasers

GLASS has many strange applications, and a new one is a rival to the familiar "india-rubber." Thin fibres of glass are secured in a holder like the bristles of a brush and the numerous tiny points are so sharp that they will erase indian ink, typewriting, or even paint. The "brush" is said to be soft and less liable to wear a hole through the paper than ordinary rubber.

The Nation's Petrol Resources

A VALUABLE discovery which would render England independent of imported motor spirit has been made recently in Edinburgh. Experiments have shown that considerable quantities of motor spirit can be distilled from cannel coal, a poor form of coal which was once mined in considerable quantities in Scotland but is now regarded as a waste material and left unworked whenever possible.

Cannel Coal

It is claimed that if the gas industry were to use cannel coal for gas production, it would be possible to produce 700 million gallons of petrol yearly—three-quarters of the nation's requirements.

It has been shown that cannel tar can be hydrogenated by the low-temperature process, one ton of cannel producing 26,500 cubic feet of gas, 57 gallons of motor spirit and 28 lb. of wax. The coke which is produced in the process has been found suitable for domestic use in boilers and open grates.

A "Death Ray" for Insects

ONE of the most serious troubles of wheat storage is the damage caused by weevils, a tiny form of beetle which multiplies exceedingly rapidly, and the cost of preventative treatment and the fumigation of storehouses is a very serious item.

A method has been developed by Mr. C. G. Lemon by which all grain could be effectively treated and all insect life, whether in the form of eggs, larvæ or mature weevils, exterminated by passing the grain through a special machine as it is stored in the warehouse.

The Machine

The experimental machine consists of a chute down which the grain is fed and it then passes on to an oscillating metal plate above which are a series of gas-tubes. These tubes are electrically energised by a very powerful induction coil and a miniature lightning display takes place between the tubes and the metal plate beneath. Any insect life is immediately killed by electrocution.

Safer Submarines

WHEN a submarine is on the surface it is propelled by a Diesel engine, but when submerged it has to rely on electric power derived from large accumulators because the Diesel engine would rapidly use up all the air. The accumulators, however, are a serious potential danger, because they give off poisonous gases if they come into contact with sea water.

A New Power Unit

A new power unit has been evolved in Germany which can be operated by compressed hydrogen and oxygen when submerged and the cumbersome and dangerous electrical equipment will no longer be necessary.

This development will facilitate the building of very small but highly efficient submarines.

FAIR COMMENT

By The Editor

Random Remarks on Diverse Topics

Time, Tide, and Printers

THE three things which never return are the past life, the spoken word, and the neglected opportunity, and there are three things which wait for no man—time, tide, and printers. I hope the printers will excuse me for designating them as inanimate "things" instead of the extremely virile, animate and active beings they have to be and are.

They have been called lots of names, but never before, I believe, things. They, too, are blamed for many things with which they have had nothing to do. It is very convenient for some Editors to lay the blame for a piece of remissness at the door of the printer by labelling it as a printer's error. Sometimes the journalist will insert a paragraph under the egregious title of "errata et corrigenda," thus obscuring the fact that he is acknowledging a list of his own mistakes.

What I merely started out to say was that printing presses have voracious appetites; they run to a clock-like schedule, and when the printer rings me up to say that he must have the last bit of copy by such and such a time, who am I to say him nay? Thus it was that I was unable to deal in the last issue with the Model Engineer Exhibition sponsored, engineered, and fostered by my old friend Percival Marshall. I visited this Exhibition several times, and as one who is not unacquainted with the work involved in building models, I was amazed at the ingenuity and the thousands of man-hours of toil which this exhibition epitomises. It must have been a source of extreme satisfaction to Mr. Marshall to see his large family of model-makers gather round each year at this large family gathering of modellers. This Exhibition is a national institution and I wish it a long-continued existence.

* * *

"What shall I be?"

MANY years ago the hoardings were adorned with a poster which asked the pertinent question, "The Boy—What Will He Become?" It drew a parallel between the future of a boy who digested the contents of a certain Educator and he who did not. The poster was not far wrong, for knowledge is always power, *scientia est potentia*. It is even more necessary to-day, when competition is keen and education has advanced, for every individual to fortify himself with sound knowledge as a background to experience in the particular field which he will make his *metier* in life. Indeed, competition is now so keen that in a few years a man will have to be a master of arts in order to get a job as a road sweeper. You may be a skilled artisan but without theoretical knowledge your progress will be limited. You will never progress beyond the stage of becoming a foreman or a charge hand. That little more, how much it is; that extra effort to lift yourself from the rut, to gain that extra knowledge which will place you ahead of your fellows requires effort and abnegation. Each year our heritage of knowledge is richer, and it is there for all to tap in the nation's storehouse of knowledge—its technical books. I visit the homes of many readers in the course of a year, and I am able to assess the mental plane of each by an inspection of the books which repose on the shelves. There are those who regard books as ornaments to fill a bookcase. Some have never been handled more than two or three times, others bear the marks of frequent consultation, they are well worn, contain marginal notes, press cuttings amplifying a particular point in the book; those possessing such volumes go far.

I am often consulted by parents as to what they shall do with their boys when they attain school-leaving age. The only information provided for my guidance is the headmaster's report, and perhaps the fact that the boy has matriculated. That does not help me, for the power to get on is not provided by some well-known formula. The driving force must exist within the individual himself, and given that force, plus the knowledge, there are no limits. Influence means nothing, except to provide perhaps an early opportunity. Knowledge alone is useless. It is a key, but it does not unlock the doors to self-advancement of its own accord. Those who have not the advantage of a sound education can remedy this defect by purchasing technical books on subjects in which they feel they could do well. They should also take advantage of the many splendid Correspondence Courses now available at modest terms—even on hire-purchase terms—and planned by those who have themselves been through the mill. If you are on the threshold of your career, you must remember that you cannot keep a good man down, for good wine needs no bush.

* * *

WHICH brings me to another point concerning queries. PRACTICAL MECHANICS is a magazine which is referred to long after the issue ceases to be current, and hence many readers preserve their copies. This is a dangerous practice, for loose issues become lost, or mislaid. We supply each year a binding case and an annual index at the inclusive price of 3*s*. 6*d*., and I recommend readers to have their volumes bound, and thus preserve in permanent form with the contents indexed and readily consultable, the twelve issues which make a volume. Even though you do not have them bound you should certainly purchase an index, which costs 7*d*.

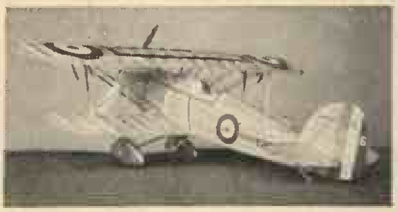
Fascinating to Build?

THEY CERTAINLY ARE!

There is real pleasure in working with balsa wood, and our special quick-drying cement is a joy. Once start and you will be fascinated. Send your order now!

PUSS MOTH

The ideal kit for the beginner. Wingspan 16 ins., length 12 ins. It is an excellent flyer. Complete kit with shaped flying prop., carriage paid, for **2/-**



HAWKER FURY

Wingspan 19 ins., length 17 ins. Exact $\frac{5}{8}$ in. scale. A very sturdy model, which is a strong and fast flyer. Complete kit with all balsa needed, quick-drying cement, shaped flying prop., etc., carriage paid, for .. **6/6**

- *Send two penny stamps for illustrated catalogue showing the largest range of scale model flyers in England.*
- *If you live in a country district state your nearest railway station (carriage extra abroad).*

GLOSTER GAUNTLET

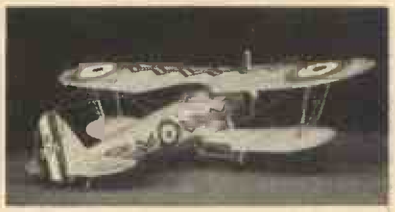
An exact $\frac{5}{8}$ in. scale model. Wingspan 21 ins., length 16½ ins. The plan has a great deal of fine detail. The model is sturdy and a good flyer. The kit is splendid value and has everything needed. There are special transfers for the delicate R.A.F. rudder numbers. The fuselage is built on Comet's special feature, the Auto-line-up method. Clear full-size plan with special instructions. Complete kit, carriage paid, for **6/6**

WESTLAND WALLACE

Wingspan 18 ins., length 13 ins. A very detailed model, which builds an exact replica of the real plane. Complete kit, carriage paid, for **3/6**

BRISTOL BULLDOG

Wingspan 18 ins., length 12¾ ins. A most attractive kit, which makes a model of great beauty and detail. Everything required is included with a clear plan. Built on Comet's exclusive Auto-line-up principle. Complete kit, carriage paid, for **3/6**



Send your Order *NOW* to: P. M. SWEETEN LTD. Bank Hey Street, BLACKPOOL

FLYING MODEL AEROPLANES "BURD" MODELS

A "BURD" ALWAYS FLIES

25-inch Waco MILITARY "D"

These kits are the famous "BURD" Kits of America. They contain everything required to build a "FLYER"; even the 1/3 kit contains a shaped saw-cut propeller.

16-inch span 1/3 post free. Six models: Mr. Mulligan, Fokker D.7, 1936 Stinson Reliant, Curtiss Hawk, Ryan St., and Curtiss Robin.

25-inch span 2/3 post free. Six models, including: Consolidated P30, Waco Military "D," Monocoupe, etc.

30-inch span 3/3 post free. Mr. Mulligan, Boeing P26A, and Douglas Observation.

60-INCH WING-SPAN FAIRCHILD 24, only 9/6 POST FREE. WHAT A KIT! Two other models. These kits include a 12-inch PROPELLER, READY CUT-OUT RIBS and SHAPED COWL where needed. **60-inch** "KING BURD" Gas Model £1.1.0 post free.

SELLEY-TEX KITS "Lighter than Balsa"

The simple Method of Construction. Super Detailed Kits. Flying Models.

12 Models from 5/- to 23/- post free.

16-inch span Rearwin Sports 5/-. Monocoupe 8/-. 20-inch span, Waco Military 23/-, 24-inch span.

The De Luxe Models have included an "ADJUSTABLE PITCH ALUMINIUM PROPELLER." What is SELLEY-TEX? Read all about these practically INDESTRUCTIBLE Models in our Catalogue. EVERY model illustrated. Full list of accessories, "LATA" balsa. Adjustable Pitch Props, etc. Price 3d.

ÉLITE MODEL AIRPLANE SUPPLIES

Dept. 3,

45 Tamworth Av., PRESTWICH, Manchester

BRITISH RECORDS held by models built with OUR MATERIALS

FUSELAGE MACHINES

Rising off Ground	9 mins. 50 secs.
Rising off Water	1 min. 46 secs.
Hand Launched	23 mins. 10 secs.

Our petrol engine model, "COMET," during 1935 entered 3 Competitions, won these awards:

First Prize: B.M.A.S. Power Competition.
First Prize: "Hallum" Power Competition.
Second Prize: S.M.A.E. Sir John Shelley Competition.

You can build this model, or the "Sky Rocket" which made the flight of 1935 (Cranborne to Isle of Wight: 35 miles!), from drawings or kits obtained from us.

The "COMET" 18-c.c. 2-stroke petrol engine is the finest on the market, its only fault being that it runs so well that a time switch is necessary if you don't want to lose your model!

Send 2d. stamp for lists, and become a satisfied customer of

MODEL AIRCRAFT STORES
133 Richmond Park Road, BOURNEMOUTH

THE WONDERFUL "BABY CYCLONE" ENGINE

Of outstanding Superiority. Brief Specification: 1/6 h.p. Rotary Valve 2-cycle; Bore $\frac{3}{4}$", Stroke 13/16". Runs upright or inverted. Variable Speed from 500 to 5000 r.p.m. with 13" propeller. Fitted 1½ oz. capacity light weight petrol tank-constant feed in steep climbs. Exhaust manifold permits perfect cowling of engine. Special A.C. plug. Weight complete with Tank, Coil and Condenser 10½ ozs. Dimensions, 3¼" long × 1½" wide (without exhaust manifold) × 4½" high. Send for full specification.

£4 19s. 6d.

"BABY CYCLONE" MODEL AEROPLANE KIT FOR ABOVE

(Home Constructor's Kit).

£2 15s. 6d.

NORTHERN MODEL AIRCRAFT COMPANY
37a FOUNTAIN STREET, MANCHESTER
Model Aeronautical Specialists for 27 years.

MODEL AERO TOPICS

By F. J. Camm

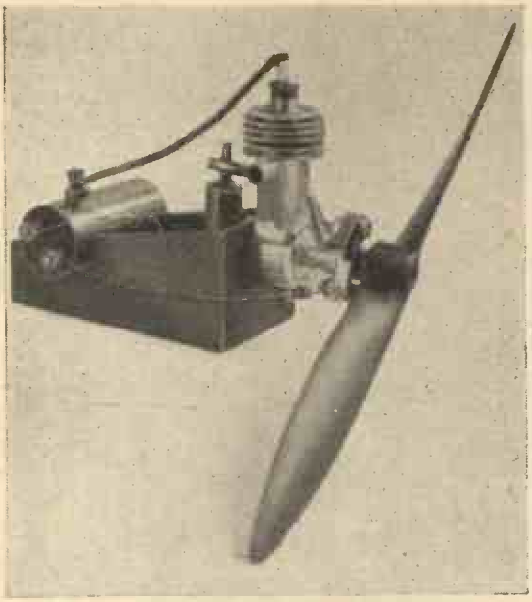


Fig. 1.—The Grayson "Gnome" 3·5-c.c. two-stroke.

A 3·5-c.c. Petrol Engine

MESSRS. E. GRAY & SON, LTD., of 18/20 Clerkenwell Road, London, E.C.1, have sent me details of their new 3·5-c.c. two-stroke petrol engine. Readers will observe that the march towards the ideal midget petrol engine goes on, and I have no doubt that within a year there will be several engines of 1 c.c. on the market. The specification of the Grayson "Gnome" is as follows: ⅝-in. bore by ¾-in. stroke, 3·5 c.c.; light alloy cylinder and crankcase cast in one with shrunk in cast-iron liner; main bearings phosphor bronze; very firm and simple mounting which allows the engine to be detached from the plane in a few seconds; connecting rod of duralumin working direct on steel crankshaft; special alloy piston with one ring; cylinder head detachable; ⅜-in. plug; carburettor of the single jet type with adjustable air sleeve and needle valve; petrol is drawn by engine suction from the tank; lubrication on the petroil system; car type contact breaker, adjustable and ensuring trouble-free ignition. The engine is of the four-port type, two-stroke, and the size of prop. recommended is 8 to 9 in. diameter.

This engine reduces the model power-driven aeroplane to a convenient size, as the engine is suitable for biplanes as small as 3-ft. wingspan.

A Free-Wheel Device

MR. R. GINN of Luton, Beds, has sent me a description of his device for a free-wheel airscrew. I have illustrated it on this page. As I have mentioned in another issue the motor runs for but a fraction of the total duration of flight, and the airscrew, it is thought, offers considerable resistance during the glide. In the device shown the ratchet is for a clockwise propeller (viewed from the front of the machine) and operates as follows:

The arm *A*, which is the portion bent at right angles to the shaft, is bent over at the top and a brass washer *C* soldered in position. Another piece of wire is bent to shape of *B*, placed on the shank of *A*, and another brass washer C^1 soldered on. Thus the arm *B* is free to swing in the direction of the arrow *Q*, but locks up against *A* in the other direction. Thus during winding and flight, the arm *B* is locked hard against the left-hand side of the propeller, until the drive ceases when the rubber is unwound, when the propeller, which being bushed rotates loosely on the shaft, swings round due to the motion of the machine and brushes the arm *B* aside, thus allowing it to rotate freely.

Automatic Rudder Control

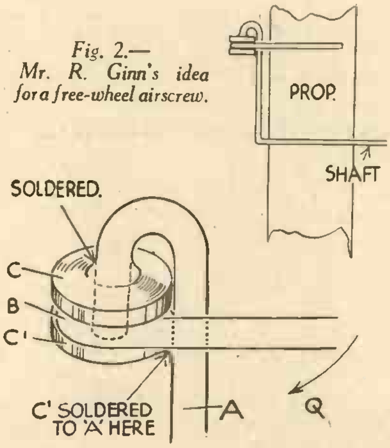
APROPOS my recent remarks concerning devices for predetermining the flight course of the model, especially power driven models, Mr. A. E. Mulholland, M.A., has devised an ingenious method of operating the rudder. This is illustrated on the following page.

The method utilises the tension of the rubber skein when fully wound, and the loss of tension when run out.

The rear-hook *H*, instead of being anchored to the rudder-post *X* is fixed to spring *A*, which is secured at the lower end but free to move up and down by slot *S* engaging with pin *C* (Figs. 3 and 4). Thus, when the rear-hook is moved backwards and forwards according to the tension of the motor the spring moves up and down in the slot *S*.

To the end of the spring is attached thread *T* which is fixed to the horn *H* on the port side of the movable rudder hinged to the fin. The horn *H*, on the starboard side, is connected to the right fuselage by means of elastic *E*.

Fig. 2.—Mr. R. Ginn's idea for a free-wheel airscrew.



Fully wound, the tension of the motor draws forward the spring *A* and it moves down the slot *S*. As power runs out the tension of elastic *E* moves the rudder in the opposite direction and so controls the path of flight. As thread *T* slackens so the pull of elastic *E* increases.

Experiment alone will decide the strength of the spring, and the length of thread *T* will depend upon the shape of the flight-path desired. Thus by varying the position of rudder by the length of the thread different flight-paths may be arranged previous to the flight.

When normal flight is desired the device is at once put out of gear by removing elastic and thread.

One disadvantage is the grouping of extra weight round the rear of the machine and this suggests that the system would be rather heavy for balsa duration models, whereas negative incidence on the elevators could be employed in a heavier-weight machine.

The rudder control is simple and easily adjustable, and a similar system could be employed for the actuation of other movable control surfaces, particularly the elevators, for it cuts out a complicated arrangement of threads and pulleys which might interfere with the motor as it wound out.

Note.—The arrangement of the control will, of course, depend on the directional torque, and hence on the direction of revolution of the airscrew.

Biplane Competition

FROM results of various competitions it seems that the enthusiasm for model aircraft is keenest in and around London, the Bristol Club being the next most enthusiastic. There were fourteen entries for the decentralised biplane competition in spite of the weather.

RESULT

Order	Name	Club	1st	2nd	3rd	Average
1st	S. R. Crow	Blackheath	91·2	50·4	78	73·2
2nd	F. Almond	North Kent	27·4	54	50	42·85
3rd	C. Edwards	North Kent	42·8	49	35	42·26
4th	R. T. Howse	Bristol	51·7	37·7	10·4	33·26
5th	G. Thompson	Mid Kent	46·2	6	37·2	29·8
6th	C. Gibson	North Kent	37·6	10	41·4	29·66
7th	H. W. Conn	Bristol	51	7·6	28·2	28·93
8th	H. Jones	North Kent	18·8	22·4	44·1	28·43
9th	L. C. Darling	Mid Kent	33	37·8	7	25·93
10th	C. W. Needham	Bristol	12	10·5	44·5	22·33
11th	R. Brown	Blackheath	11·4	7·25	26·15	14·9
12th	P. Montgomery	Blackheath	5·1	13·85	11·3	10·083
13th	R. W. M. Mackenzie	Blackheath	5·25	8·65	6·7	6·863
14th	L. B. Mawby	Unattached	6	Smashed		2·00

The Park Model Aircraft League (Mitcham and Tooting)

November 4th, at Streatham Hall, Hints and Tips, led by H. W. King.

December 1st, Photographic Competition closes.

December 9th, at the Bedford Hotel, Bedford Hill, Balham (near Balham Station). Second Annual Dinner, Prize-giving, and Social Evening. Tickets 3s. 6d. each from Officers. At 7.45 p.m. for 8 p.m.

January 27th, at the Farnan Hall, as above, Third Annual Dance, Exhibition, and Social Evening. Tickets 2s. each from Officers. 7 p.m. till 12.

February 3rd, at Streatham Hall, Sixth Annual General Meeting and Election of Officers.

March 3rd, at the Streatham Hall, General Debate. Motion: "That from the point of view of model aircraftsmanship heavyweights are superior to lightweights." Mover, G. S. Broadway; opposer, R. T. S. Gillett.

Mr. Mulholland's idea for automatic rudder control.

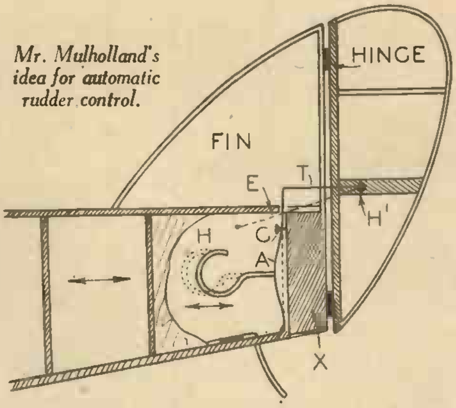


Fig. 1.—A near side elevation. The elevators and elevator fin are omitted for clearness.

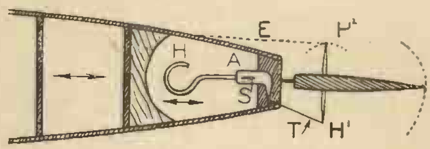
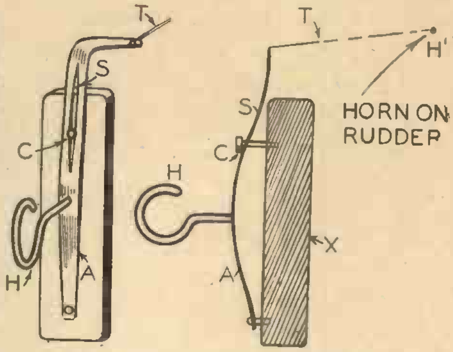


Fig. 2.—A plan view.



Figs. 3 and 4.—A near side section.

BUILDING A HOME CINE PROJECTOR

(*Continued from page* 70)

within the limits of the large holes opposite. Then adjust the top stop (Fig. 7), so that the tongue has exactly the required movement to bring it directly opposite to a perforation in the film. It should withdraw from one hole when at the bottom stop and come directly opposite the next hole when at the top. The position for the gate should then be marked out, so that when the tongue is in a perforation at the top of its movement there is one picture between the tongue and the bottom of the gate.

The Lens

This should now be fitted. An ordinary magnifying glass of about 1½ in. focus will give a fairly good result, though, of course, a better lens will give a sharper picture. The glass should then be mounted in a tube as shown in Fig. 11, this tube being a sliding fit (for focusing purposes) in another tube which is soldered on to the film guide centrally over the gate.

The Shutters

They are simply thin brass ½ in. by 1½ in. bent at right angles and clipped under the cams. Position them so that they come opposite the lens while the film is being moved, but leave the lens uncovered when the film is at a standstill. A permanent handle can then be fitted tight behind one of the shutters (Fig. 1).

The take-up reel, Fig. 10, is simple, the centre is part of a cotton reel and the cheeks of aluminium; the hole in the outer cheek is to allow the film to be pushed into its clip by one's finger. The pulley is the remainder of the same cotton reel fixed by a radial wood screw, and a rubber band serves for a driving belt. The take-up reel is loose on the spindle and driven only by the pressure of the very light spiral spring, so that it can slip readily without putting appreciable tension on the film.

The Film Cradle

The cradle for carrying the film can be made of three-ply wood, as shown in Figs. 1 and 2. No spindle is required as this is embodied in the metal case. For rewinding the film after a show a key like Fig. 12 should be made. It can be "twirled" between the fingers, this being a quicker method of rewinding than a tiny handle.

The Lamp

A lamp of the type illustrated in Fig. 1, but provided with a "bull's-eye" condenser, will give a good picture about 12 in. wide. A condenser is an absolute necessity and should be arranged to make the light converge right into the lens, as illustrated in Fig. 13. The more powerful the light, the larger the picture. A motor-car headlight could be arranged to give excellent results.

TRADE NEWS

Ellison Plastic Compound

ELLISON Plastic Compound has almost innumerable uses. It will insulate electrical apparatus, protect metal from corrosion by acid, and seal a leak in a motor-car radiator. It is proof against petrol, oil, water, most chemicals and acids, and is not attacked by vermin. There are two grades of plastic. Grade A, for electrical work, is a stiff plastic compound at normal temperatures. It does not shrink in a dry atmosphere, and does not run or drip when warm. The plastic is applied by first warming to make it easily workable, and then pressing on to the part to be covered. It can be shaped with the fingers to the thickness required.

Grade D is softer than grade A at normal temperatures, and consequently takes longer to harden. It is intended for use where heating is impossible. Grade A costs 3*s.* 9*d.* per 2 lb. tin and grade D 3*d.* a lb. extra. It is produced by Ellisons Insulations Ltd., Perry Barr, Birmingham, 20.

Lionel Trains

THE latest catalogue issued by the London agents for Lionel Trains, 35-6, Aldermanbury, London, E.C.2, reveals a wide range of stock. Complete electric trains for seniors range in price from 50*s.* to £14 14*s.* Accessories of every description are also included, as well as complete trains for juniors ranging in price from 32*s.* to 38*s.* 6*d.* Readers should apply for this 24-page well-illustrated catalogue without delay.

Index and Binding Cases for Vol. 3 of PRACTICAL MECHANICS are now ready. Indexes cost 7*d.* by post, and binding cases complete with title page and index costs 3*s.* 6*d.* from Geo. Newnes, Ltd., 8/11 Southampton St., Strand, W.C.2.

This is

International Buildings

Kingsway, London, Head Offices of the

I. C. S.

It is the centre from which radiates technical, commercial, and professional instruction that has been of great benefit to tens of thousands of ambitious people.

The I.C.S. is the greatest as well as the largest institution in the Empire devoted to spare-time training. Its prestige is unequalled. The Admiralty, Royal Air Force, Royal Army Service Corps, and other State Departments have entered into working arrangements with the I.C.S. for the training of men.

More than 1,000 I.C.S. text-books, prepared at International Buildings, are marvels of clearness, accuracy, and practical helpfulness.

There are 80 Instructors at Kingsway, many of them Associates, Members, or Fellows of their respective technical or professional bodies. All are *specialists*, and expert in giving the student *individual* attention throughout his Course of Study.

Among the 400 I.C.S. Courses there is one that can qualify YOU for Promotion and Better Pay.

YOUR WORK AND YOUR PAY

The size of your salary is more or less in accordance with the measure of what you know and therefore can do. The more you know, the greater your pay.

Success—progress won by merit—depends on trained ability. Unless you have studied IN YOUR SPARE TIME, you have little chance of promotion, for knowledge that comes through everyday work is not enough.

You must know the principles underlying your work and be familiar with the many processes closely related to that work. *The one and only means of obtaining such knowledge is specialized study.*

No man need be without that extra efficiency which adds so much to his income, security and happiness. He can acquire it, on easy terms, by the simple I.C.S. method of teaching by post.

If you are in the early stages of your career and have not yet had a specialized training, you should start to get one without delay. Or perhaps you feel that your knowledge is a little out of date and ought to be modernized. In either case

The International Correspondence Schools can help you.

Our expert advice on any matter concerning your work and your career is yours for the asking—free and without obligation. Let us send you a booklet dealing with the subject in which you are especially interested. It is packed with valuable information. All you have to do is mention your subject and, if you wish, tell us your problem or your difficulty. Write to us to-day or fill in and post the attached coupon. Your inquiry will be dealt with promptly. It may prove to be one of the most fortunate things you ever did.

COUPON FOR FREE BOOKLET

INTERNATIONAL CORRESPONDENCE SCHOOLS, LTD.; (Dept. 95), International Buildings, Kingsway, London, W.C.2

Please send me your booklet containing full particulars of the Course of Correspondence Training before which I have marked **X**. I assume no obligation.

- ☐ Accountancy
- ☐ Advertising
- ☐ Aeronautical Engineering
- ☐ Air Conditioning
- ☐ Architecture
- ☐ Boiler Engineering
- ☐ Book-keeping
- ☐ Building
- ☐ Chemical Engineering
- ☐ Civil Engineering
- ☐ Draughtsmanship
- ☐ Electrical Engineering
- ☐ Engineering Shop Practice
- ☐ Fire Engineering
- ☐ Garage Management
- ☐ Gas-Power Engineering
- ☐ Heating & Ventilation
- ☐ Hydro-Electric
- ☐ Marine Engineering
- ☐ Mechanical Drawing
- ☐ Mechanical Engineering
- ☐ Mining Engineering
- ☐ Motor Engineering
- ☐ Pattern-making
- ☐ Plumbing
- ☐ Radio Equipment & Servicing
- ☐ Sanitary Engineering
- ☐ Scientific Management
- ☐ Sheet-Metal Working
- ☐ Steam Engineering
- ☐ Surveying
- ☐ Telephone and Telegraph Eng.
- ☐ Textiles
- ☐ Welding, Gas & Electric
- ☐ Wireless Engineering
- ☐ Woodworking
- ☐ Works Management

EXAMINATIONS

Technical Institutions and Civil Service (G.P.O.). State which..............................

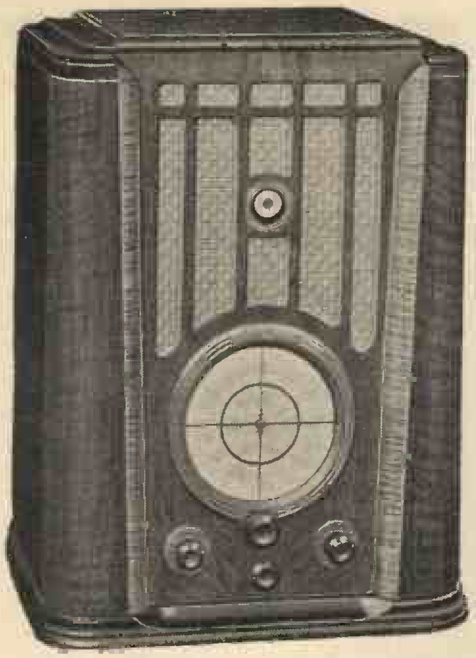
NOTE.—If your subject is not on the above list, write it here ....

NAME.............................. AGE..............

ADDRESS..............................

A PILOT ALL-WAVE SUPERHET

A Review of the Model U.650 A.C. Mains Receiver



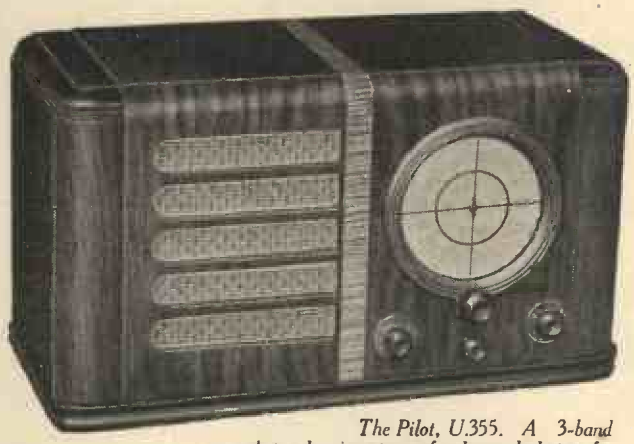
The Pilot, U.650 which is reviewed on this page. It is a powerful 6-valve Super-het, giving world-wide reception during day and night. The tuning beacon simplifies accurate and silent tuning of stations with volume control at minimum. The 5½ in. calibrated Compass Dial gives selective illumination for each of the four wave bands covered. It costs 16 guineas.

As may be seen from the illustration on this page, this new Pilot receiver represents the last word in modern receiver design. Apart from the large full-vision, four-band tuning dial which is fitted, the front of the cabinet also contains a unique tuning device, known as the "Tuning Beacon." This may be seen situated in the centre of the loudspeaker grille. Four controls are provided, two of these being in the form of dual controls. On the left is the volume control and on the right the wave-band selector, whilst the two central knobs control tuning (the upper knob) and a combined on/off and tone control. The tuning knob in addition to a rotary movement also incorporates a push-pull movement, and this operates the gear reduction used for turning the condenser. When pulled out a very high gear is employed, a reduction of 95 to 1 being obtained. When pushed in a more rapid movement is provided, the reduction gear being 12½ to 1.

An interesting feature of the tuning dial is the provision of separate sections behind the transparent dial, and each division is provided with its own illuminating device. Thus the scale is divided into two circles, one inside the other, and a horizontal line divides both circles. The lower wave range (from 16 to 52 metres) occupies the outer lower half of the scale, and the next short-wave range (from 48 to 150 metres) occupies the inner lower half. The medium broadcast band (from 175 to 550 metres) occupies the outer top half of the scale and the remaining central portion is taken up by the long waveband from 750 to 2,000 metres. A double-ended pointer traverses the scale, and when the wave-band selector switch is turned to the requisite setting the appropriate lamp is illuminated and only that portion of the dial is illuminated (with the exception that on the medium waves the entire dial is illuminated).

The Circuit

The circuit which is employed in this receiver consists of a more or less standard superhet, with a pentagrid converter following a signal H.F. stage. A variable-mu pentode I.F. amplifier follows this stage and feeds a double-diode-triode 2nd detector which in turn feeds the out-pentode. A comprehensive system of A.V.C. is employed and from this part of the circuit the cathode-ray tuning indicator (the "Tuning Beacon") is fed. Variations of signal strength affect the radiation from the cathode of this device and a green light which illuminates the outer portion of the mounting of the indicator varies. Tuning is carried out for the maximum green area (or if found simpler to follow, for the smallest dark space). The speaker which is fitted in the receiver is of the mains energised type, and the field coil is used as a smoothing choke on the H.T. side of the mains supply. A plug is provided so that an external loudspeaker may be employed when desired, and a jack is provided for the connection of a gramophone pick-up.



The Pilot, U.355. A 3-band superheterodyne receiver of advanced design for operation on long, medium and short wave bands. It costs 12 guineas.

Test Results

The receiver was tested out without an outside aerial. The short aerial lead which is provided in the receiver was connected to a short length of wire slung across a room, and full volume was obtained on a large number of stations. With the local B.B.C. stations, of course, the volume control had to be set almost to minimum to avoid overloading. Full sensitivity on the short waves was experienced and all of the well-known stations could be easily tuned in.

The station-calibrated dial was found of great utility in this particular section, and the majority of the names marked on the dial could be received during our test. No doubt when tested on a domestic aerial clear of the interference which is experienced at this particular point, all of these stations would be heard with consistent strength. We were particularly impressed by the ease with which the American stations could be heard, and the tuning beacon gave a substantial indication of the tuning of these stations, which meant that they could be located, when once the correct tuning point was found, by first setting the volume control to the most silent point and then tuning by the beacon. In addition to Caracas, Melbourne, Tokio, Ecuador, and one or two other stations named on the dial, numerous experimental stations were heard, and the amateur band alone would provide any listener with an evening's entertainment. Similarly on the long waves the sensitivity was adequate for all normal requirements.

The A.V.C. Circuit

The A.V.C. action was found to be perfectly satisfactory, and held those stations which normally faded badly at a good constant volume. The tone control was found to provide a very complete range of tone, from maximum bass to highest treble, and this was, in fact, found to be of extreme value when removing some of the atmospheric noises which were obtained on very weak stations. The controls all functioned in a smooth manner and no backlash was experienced.

The maximum output, when the last valve is fully loaded, is 3 watts, which is, of course, ample for all normal domestic requirements.

The receiver may be thoroughly recommended and will be found very good value at 16 guineas.

SPECIFICATION

Receiver: All-Wave Superhet.

Circuit: Signal H.F. stage, pentagrid frequency changer, H.F. pentode I.F. stage, double-diode-triode second detector and A.V.C. stage, and pentode output stage. Nine tuned circuits, with visual tuning indicator, and resistance-capacity L.F. coupling. Energised loudspeaker, and provision for gramophone pick-up and external loudspeaker.

Tuning covers four wavebands: 16 to 52, 48 to 150, 175 to 550 and 750 to 2,100 metres.

Controls: Four; volume control, wave-band selector, combined on/off switch and tone control, and tuning control. The latter has a two-position setting providing two separate gear ratios—12½ to 1 and 95 to 1.

Price: 16 guineas, for A.C. mains.

Makers: Pilot Radio Ltd., 87 Park Royal Road, London, N.W.10.

SUPER-DURATION RUBBER MOTOR FOR MODEL AIRCRAFT

By D. A. Russell, A.I.Mech.E.

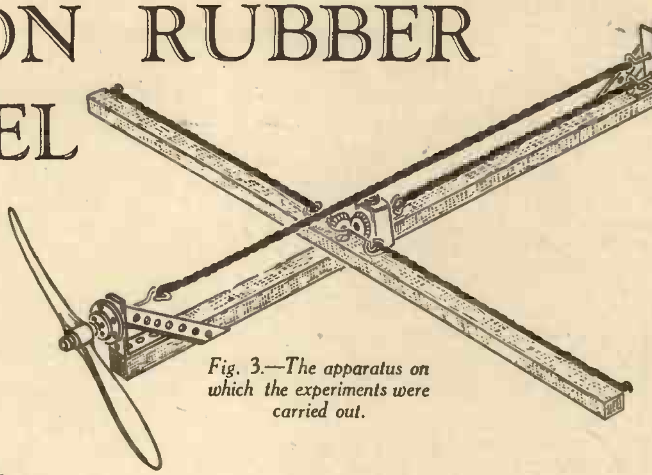


Fig. 3.—The apparatus on which the experiments were carried out.

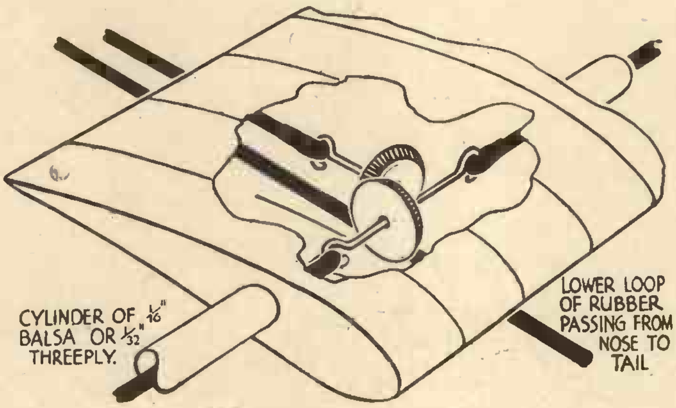


Fig. 1—Showing how the bevel gears link up the elastic.

This Ingenious Rubber Motor will Add Considerably to the Duration of the Flight of A Model Aeroplane

SINCE duration of flight is the main consideration in the majority of model aircraft competitions, the following description of an arrangement for a "super-duration" rubber motor may be of interest, particularly since the idea has been tried out experimentally with very promising results.

Essentially the arrangement of the rubber motor is such that approximately 2½ times the usual length of rubber may be accommodated in the aircraft.

Fig. 1 is a diagrammatic layout of the arrangement, from which it will be seen that only one length of rubber extends from the nose to the tail of the fuselage in the usual manner.

At the tail, instead of a fixed hook to receive the rubber, there is a twin gear, consisting of two ½-in. diameter spur gear wheels running in constant mesh; these carry the drive back to a point at, or near, the leading edge of the main wing, where is fixed a bevel gear, which transmits the drive out to each wing tip.

A High-wing Monoplane

It will, of course, be appreciated that this arrangement calls for a wing with little or no dihedral angle, and also for a "solid" method of anchoring it to the fuselage; but as the machine would definitely be built for competition work, no particular attempt would be made to "beautify" it, and a "high-wing" monoplane, of the type in which the wing is made in one piece and is anchored to the flat top of the fuselage, would be the obvious choice. By having a fairly long landing chassis, the centre of gravity would be kept well down so that, despite the lack of dihedral angle, good lateral stability could still be obtained.

The bevel gear box would be built into the centre of the wing, the under-surface of which would be cut away to allow the loop of rubber from the twin gear box to be brought up to the hook on one of the bevel wheels. The axis of the other bevel, being of course at right angles, would lie across the span of the wing, and the loops of rubber running out to each wing tip would be enclosed in tubes made from sheet balsa or 3-ply birch, 1/32 in. thick. These tubes would, in effect, constitute the main "spars" of the wing.

Fig. 2 is a sketch which indicates the various features mentioned above, whilst Fig. 3 is an illustration of the equipment which was built to enable tests to be carried out to ascertain the kind of results which might be obtained from such an arrangement.

In this apparatus, ball thrust bearings were fitted behind the airscrew to both shafts in the spur gear box and behind the bevel wheel to which is attached the upper rubber motor in the fuselage; thus friction was reduced to a minimum.

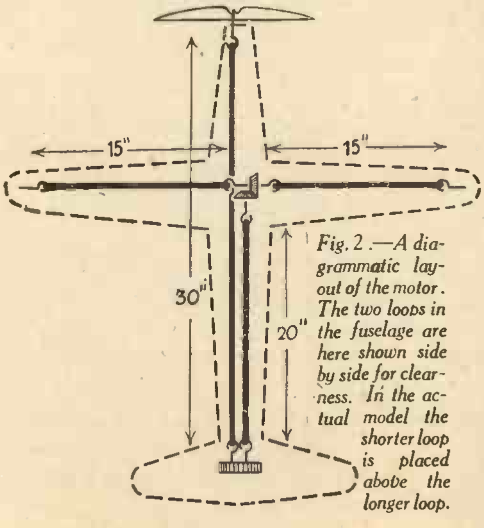


Fig. 2.—A diagrammatic layout of the motor. The two loops in the fuselage are here shown side by side for clearness. In the actual model the shorter loop is placed above the longer loop.

To allow for ease of assembly and adjustment, ordinary gear wheels and spindles were used; but in an actual flying model much lighter parts would, of course, be fitted, enabling the twin gears and the bevel gear box to be constructed for a total weight of not more than ¾ ounce.

The Rubber Motor

The first series of tests was carried out with the apparatus as it is shown in Fig. 3, and on reference to the sketch Fig. 2 it will be seen that the total length of the rubber motor is 65 in., made up as to (*a*) 30 in. from nose to rear of fuselage, (*b*) 20 in. up to the bevel gearbox, and (*c*) 15 in. out to each wing tip (these two loops of rubber of course being in "parallel," and therefore each containing only half the number of strands of the two loops in the fuselage.)

The curve "A," Fig. 4, shows results obtained from using 54 ft. of 1/16 × 1/32-in. flat rubber, arranged in loops of 10 strands between the hooks in the fuselage, and a loop of 5 strands in each half of the wing, i.e. in (*a*) 10 strands each of 30 in. = 25 ft., in (*b*) 10 strands each of 20 in. = 16 ft. 6 in., and in (*c*) 2 groups of 5 strands each of 15 in. = 12 ft. 6 in., making a total of 54 ft., which weighs 2 oz.

Langley's Formula

Using Langley's formula $R = \frac{5L^{1 \cdot 5}}{\sqrt{W}}$ to calculate the maximum number of turns available and remembering that $L^{1 \cdot 5} = L \times \sqrt{L}$).

$$\text{Then } R = \frac{5 \times 65 \times \sqrt{65}}{\sqrt{2}}$$

$$= \frac{5 \times 65 \times 8 \cdot 1}{1 \cdot 412}$$

= 1,850 turns, 90 per cent. of this figure giving 1,665 as the normal maximum to which to work.

The airscrew used for this first series of tests was of 18-in. diameter, and 24-in. pitch, with an efficiency of 75 per cent. at the relatively slow speed at which it was driven.

Referring to Fig. 4, it will be seen that the initial speed is about 450 r.p.m., falling to about 350 r.p.m. during the first minute. After this the rate of fall slows up considerably, and a relatively steady power output is maintained until about the end of the fourth minute, after which the power falls off rapidly.

The performance of this combination of rubber motor and airscrew may be calculated as follows:

Between the end of the first minute and the end of the fourth minute the average airscrew speed is approximately 300 r.p.m., and with a pitch of 24 in. and an efficiency of 75 per cent. the rate of forward travel can be calculated by multiplying the revolutions per second $\left(\frac{300}{60}\right)$ by pitch (24 in.) and dividing by the efficiency (75 per cent.). = 7·5 feet per second, which would be sufficient to fly a model of which the wing loading did not exceed 2 oz. per sq. ft., whilst the initially higher r.p.m. in the first minute would provide that extra power required for "taking off" and a good climb.

However, since the rubber motor and gear boxes would weigh 2¾ oz. a model with a wing area of 2½ sq. ft. lifting surface and a weight not exceeding 2¼ oz. would be required to keep to this low loading; rather an exacting requirement, unless the machine were a freak of balsa and tissue, with a safety factor of 1!

Airscrew Speed

Of course, by putting up the speed of the airscrew, a larger wing loading could be sustained, but this would only be obtained at the expense of cutting down the length of flight, thus defeating the purpose of the whole idea.

It appears, therefore, that to obtain the greatest benefit from this arrangement, not too small a machine should be built; and after a further series of tests had been carried out, the following specification for a model was developed, of which the particulars given of the performance of the rubber motor and airscrew may be relied upon—should a machine be built—since they were obtained from the apparatus already described, which was altered to conform to the revised measurements given in the specification, which is as follows:

Weight of model aircraft (less gears and rubber), 3¼ oz.

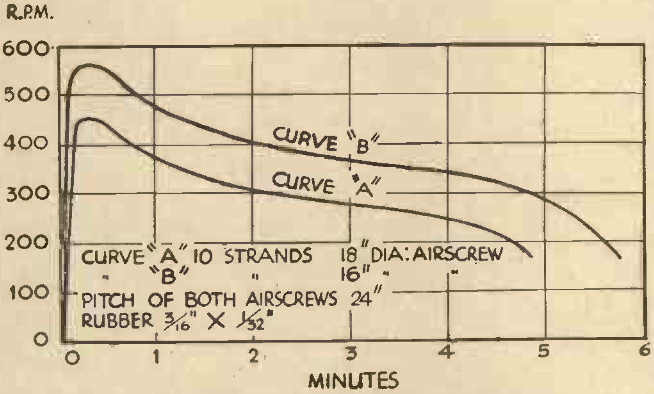


Fig. 4.—The graph shows the result obtained with the motor.

2 gear boxes, ¾ oz.
68 feet $\frac{3}{16} \times \frac{1}{32}$-in. rubber, 2½ oz.
Wing area = 364 sq. in. = 2½ sq. ft.
Size of wing, 52 × 7 in. = Wing loading 2·6 oz. per sq. ft.
Minimum flying speed, 11 ft. per second.
Length of fuselage, 37 in.
The rubber motor was arranged as to
(*a*) 10 strands 35-in. long = 29 ft. 4 in.
(*b*) 10 strands 23 in. long = 19 ft. 4 in., and
(*c*) 2 groups, each of 5 strands 23 in. long = 19 ft. 4 in., so making a total of 68 ft. of $\frac{3}{16} \times \frac{1}{32}$-in. rubber.

The total length of the motor was therefore 81 inches, and by calculation as before, the maximum number of turns available is found to be 2,300 $\left(\frac{5 \times 81 \times \sqrt{81}}{\sqrt{2 \cdot 5}}\right)$; working number of turns (90 per cent. of full) = 2,070.

Tests Made

In this series of tests, an airscrew of slightly smaller diameter (16 in.) but with the same pitch of 24 in. was used, the results being as shown in Fig. 4, Curve "B."

After the initial "fall off" during the first minute, the average speed for the next 2 minutes is just over 400 r.p.m., which gives a calculated forward speed of a little under 12 ft. per second. The extra power available during the first minute would ensure a quick take off and a good rate of climb, and thus in the following 2 minutes very little, if any, height would be lost. It will be noted that the power continues to be sustained at a very useful figure until after the fifth minute, which should ensure a very slow rate of descent and an overall time of flight duration of anything up to 6 or 7 minutes, depending on how high the aircraft can climb in the first minute.

A NEW HEIGHT RECORD

Squadron-Leader F. R. D. Swain, R.A.F., in the cockpit of the special Bristol "Pegasus" Monoplane.

THE Air Ministry recently announced that the Royal Air Force experimental high altitude aircraft, the "Bristol 138" with a special "Pegasus" engine, piloted by Squadron-Leader F. R. D. Swain of the Royal Aircraft Establishment, Farnborough, Hants, reached an altitude of 49,967 ft. (15,230 metres), thus breaking the present world altitude record of 48,698 ft. (14,843 metres) by 1,269 feet (387 metres).

This result is particularly gratifying, especially as it is the first occasion on which the Royal Air Force has attempted to beat the altitude record, and the development o the aircraft and the special equipment has been undertaken during a period when the first preoccupation of the Air Ministry and of the constructors was necessarily the expansion of the Royal Air Force.

High praise is due to the pilot for his meritorious flight, and to the constructors of the aircraft, engine and special equipment—all of which are of British design and manufacture—for their share in the achievement.

Total Flying Time

The aircraft took off from the aerodrome at Farnborough, Hants, at 7.30 a.m. and landed at Netheravon, Wilts, at 10.50 a.m., the total flying time being 3 hours 20 minutes. During the ascent visibility was good but there was a cold north-easterly wind of considerable strength at lower levels and of hurricane force in the upper air. The performance of the aircraft and engine was entirely satisfactory and the sealed pressure suit enabled the pilot to remain at very high altitudes for nearly two hours while he endeavoured to attain the maximum height possible.

The attempt was observed by an official representative of the Royal Aero Club, and the height attained has been officially communicated to the Ministry by the Club; it was arrived at from an examination by the National Physical Laboratory of the sealed barothermographs which were carried in the wing of the aeroplane. The figures are subject to the usual confirmation, and acceptance by the Fédération Aeronautique Internationale to which it is necessary to make application for homologation of the record.

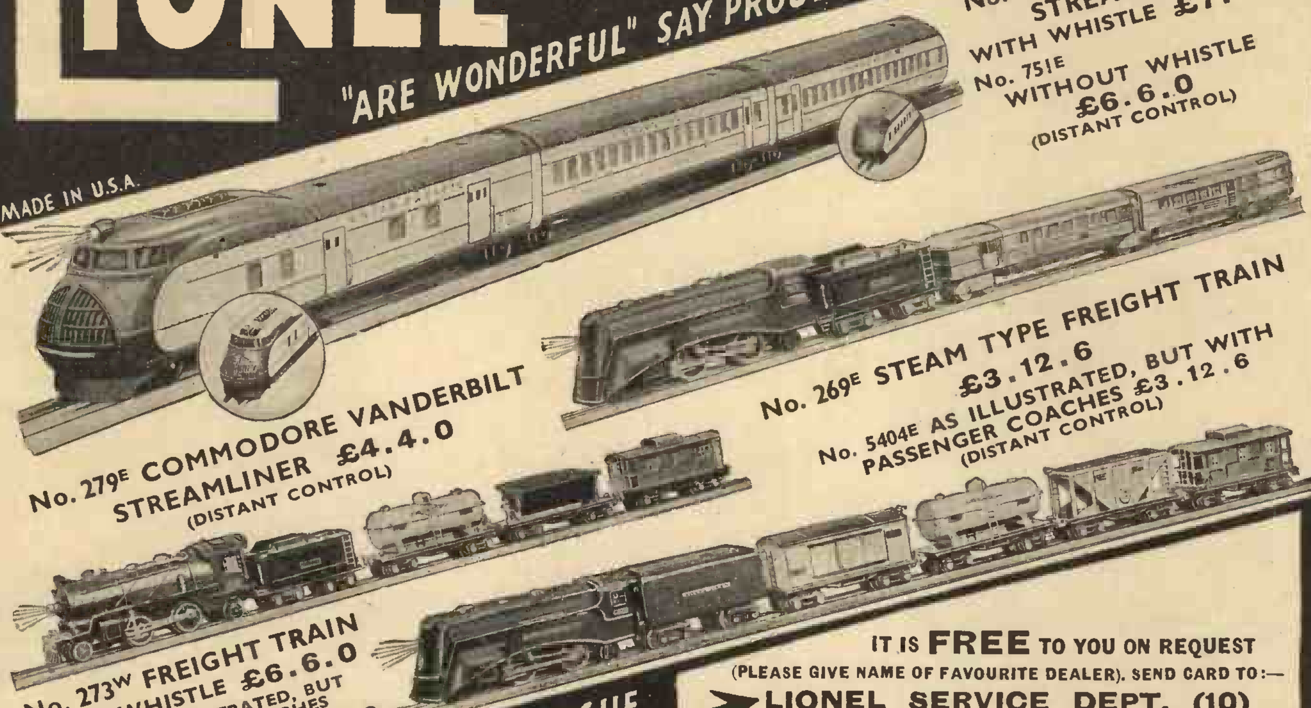
Essential Researches

The minimum pressure measured during the flight was 92·0 millimetres of mercury, and the lowest temperature was −49·8° centigrade; both those measurements were at the highest point attained.

LIONEL ELECTRIC TRAINS

"ARE WONDERFUL" SAY PROUD OWNERS

MADE IN U.S.A.



No. 751W UNION PACIFIC STREAMLINER WITH WHISTLE £7.7.0
No. 751E WITHOUT WHISTLE £6.6.0 (DISTANT CONTROL)

No. 279E COMMODORE VANDERBILT STREAMLINER £4.4.0 (DISTANT CONTROL)

No. 269E STEAM TYPE FREIGHT TRAIN £3.12.6
No. 5404E AS ILLUSTRATED, BUT WITH PASSENGER COACHES £3.12.6 (DISTANT CONTROL)

No. 273W FREIGHT TRAIN WITH WHISTLE £6.6.0
No. 274W AS ILLUSTRATED, BUT WITH PASSENGER COACHES £6.6.0 (DISTANT CONTROL)

THE 1936/7 CATALOGUE IS NOW READY

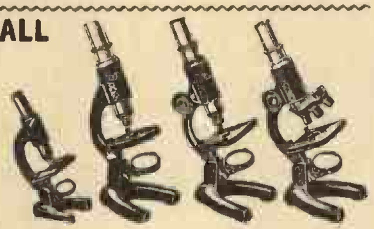
IT IS **FREE** TO YOU ON REQUEST
(PLEASE GIVE NAME OF FAVOURITE DEALER). SEND CARD TO:—
LIONEL SERVICE DEPT. (10)
35/6 ALDERMANBURY, LONDON, E.C.2
CATALOGUE SHOWS COMPLETE RANGE FROM 32/- AND GIVES COMPREHENSIVE DETAILS OF ALL TRAINS AND PARTICULARS OF INTRODUCTION OF REALISTIC RAILROAD WHISTLE

MICROSCOPES FOR ALL

SPECIAL OFFER OF 4 MODELS

Each instrument has inclinable body, swing mirror, stage clips, and is nicely finished in Black Crystalline Enamel and bright Nickel Plating.

SHARP DEFINITION IS OBTAINABLE and GOOD WORK CAN BE DONE



Model C.	Height 5½ in., sliding focus, magnification 25×linear .. Price	5/-
Model D.	Height 7 in., sliding focus, circular stage magnification 50× linear .. .. Price	9/6
Model E.	Height 7 in., rack and pinion focusing, magnification 50× linear, square stage .. .. Price	12/6
Model F.	Height 7 in., rack and pinion focusing, triple nose-piece, 3 lenses, magnifications 25×, 50×, 100×, in wood case, with set of Dissecting Instruments .. .. .. Price	30/-

IMMEDIATE DELIVERY FROM STOCK. Post Free in Great Britain.

BROADHURST, CLARKSON & CO. 63 FARRINGDON ROAD, LONDON, E.C.1.

PRACTICAL AND INVALUABLE

JUST READY. In The Technical Press Manual Series.
Fourteenth Printing - 4/-

THE SLIDE RULE
AND HOW TO USE IT

Containing: **Full, Easy and Simple Instruction to perform all Calculations with unexampled rapidity and accuracy.**

By CHAS. HOARE, C.E.

IMPORTANT! A Slide Rule is presented FREE to all purchasers of the Book.

To The Technical Press, Ltd.
Please forward me a copy of THE SLIDE RULE. Postal order for 4/2 enclosed.
NAME ....
ADDRESS ....
THE TECHNICAL PRESS LTD., 5 Ave Maria Lane, Ludgate Hill, London, E.C.4

WIZARD POWER TOOLS

TRADE MARK

for the Cabinet Maker, Carpenter, Model Maker, etc.

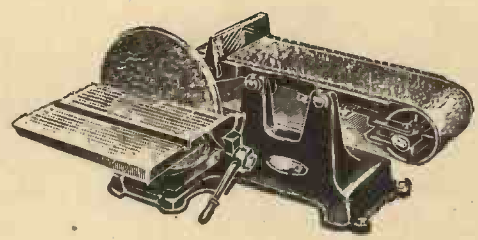


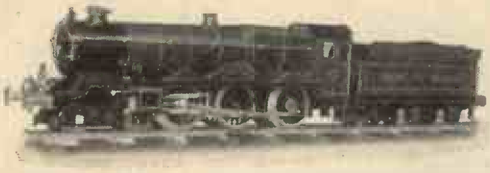
Illustration shows our Belt and DISC SANDER

£5 - 12 - 6

Write for illustrated priced catalogue No. 136C. of Jig Saws, Circular Saws, Band Saws, Lathes, Jointers, Shapers, Drill Presses, Grinders, Buffers, Sanders, Tools, and Accessories.

WIZARD MACHINERY Co.
13 VICTORIA ST., LONDON, S.W.1
Telephone: ABBEY 3018

THE PROGRESS OF MODEL RAILWAYS . . .



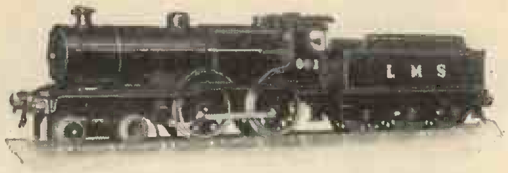
A G.W.R. 4-6-0 Express Locomotive "KING GEORGE V" No. 6000, clockwork and electric d.c. 6-8 volts, 8 Gns.; a.c. 20 volts, £9 18s. 6d.

VERY few of us have not had the burning desire to be an engine driver in early years. Our first wooden or tin engine has given place to a model that "runs by itself," and then the primitive "working model" in its turn is displaced by the "Scale Model," correct in every detail.

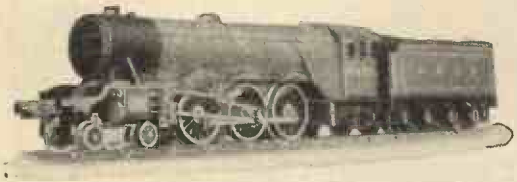
What was first an amusing toy has grown into an important hobby, bringing out the best powers of observation, initiative and resource, and in being "Superintendents of our own Lines," we can cover a wide diversity of interests—mechanical, civil and electrical engineering, signalling . . . in many cases this fascinating and absorbing hobby is not allowed to get beyond the "wooden engine" stage. . . . Why? With so many fine locomotives and accessories available this season, every boy can achieve his heart's desire—a good layout at a reasonable cost.

Bassett-Lowke's New Model Railway Catalogue A-12 containing descriptions of the new productions of the season is now ready.

Amongst these are the new L.M.S. 4-4-0 locomotive No. 601 illustrated, the rebuilt L.M.S. COMPOUND, costing only 32/6 in clockwork—the super-detail "SILVER LINK," and locomotives "ARSENAL" and "CONQUEROR," besides new rolling stock, a new "Esso" Oil Wagon, etc.



New L.M.S. 4-4-0 Locomotive No. 601 (Class 2P), clockwork 42/-; electric d.c. 6-8 volts, 47/-; a.c. 20 volts, 54/-.



L.N.E.R. "FLYING SCOTSMAN" No. 4472, clockwork and electric d.c. 6-8 volts, 84/-; a.c. 20 volts, 90/-.

For those who love **SHIPS** a new catalogue of these is ready with details of **BASSETT-LOWKE'S** new productions —S.12, 6d. post free. Among these are attractive sets of parts for building waterline models of the "NORMANDIE," "QUEEN MARY," and the famous Clipper Ship "CUTTY SARK," each with full instructions, costing only 12/6 (postage 6d.).

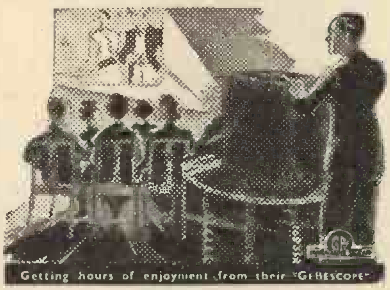
Model Motor Yachts. "AZALEA," clockwork and electric, 30 in. long £9 9s. 0d. "NETOKRIS," 39 in. long, electric £18; steam £21

BASSETT-LOWKE LTD., NORTHAMPTON

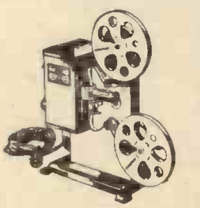
LONDON: 112 High Holborn, W.C.1 **MANCHESTER: 28 Corporation Street**

HOME TALKIES

Have you considered this splendid new home entertainment? We have the finest stock of talkie outfits of every make. Gebescope from £95, also Bell-Howell, Marshall, R.C.A., etc. Expert advice and demonstrations given at any time. We specialise in synchronising existing silent-film with sound and speech commentary. Why not get in touch with us?



. . . and Home Movies, too!



Any outfit can be bought on nine equal monthly payments. We have every projector in stock from about 15/- down, including: Pathescope, Ensign, Bell-Howell, Zeiss Ikon, etc., for 8 mm., 9·5 mm. or 16 mm. films.

KODASCOPE EIGHT-80. 300 watt. lighting. Gives brilliant pictures up to 30 × 40 in. or larger if desired. Motor rewind, still picture device. Fan-cooled lamp house. Takes 200 ft. of 8 mm. film.

£33. Nine monthly payments of 77/-.

Good allowance on your Surplus Apparatus.

Write now for latest Catalogue—Free and Post Free!

CITY SALE

& EXCHANGE (1929) LTD.

59/60 CHEAPSIDE, LONDON, E.C.2

'PHONE: CITY 1124-5-6.

A NEW HOME FOR THE NEW HOME HOBBY

HAMBLINGS

THE OO GAUGE EXPERTS HAVE MOVED TO

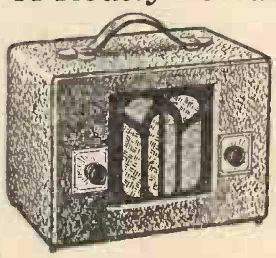
10 CECIL COURT, CHARING X ROAD

(Opposite Cameo News Theatre) LONDON, W.C.2 Telephone: Temple Bar 4704

Write for our 20-page illustrated Catalogue and samples, sending 4d., or if in London, VISIT OUR NEW SHOP. We shall be pleased to see you.

Start this OO Gauge Hobby now. Our parts are simple to assemble, cheap to buy and we can give you plenty of ideas.

A Really Portable ALL MAINS SET!



A.C. and D.C. 110-250 Volt. 5 Valves—Moving Coil—No Earth required—Self-contained Aerial—Long and Short Wave.

The latest thing from America, fine tone and excellent range. Attractively covered in washable Fabrikoid Leather in several colours, or in Polished Walnut Cabinet.

MEASURES 10" × 7" × 6" **SPECIAL PRICE £3.15**

***Special Bargain*: KADETTE** 3-valve AC/DC, 110-250 Volts—No earth required, self-contained Aerial. These Sets retail normally at £3. 17. 6. OUR PRICE **55/-** White or Mottled colour, 2/6 extra.

DOUGLAS HOLT Estd. (1919) Ltd. (Car and Radio Accessories) **9 Little Turnstile, Holborn, W.C.1.**

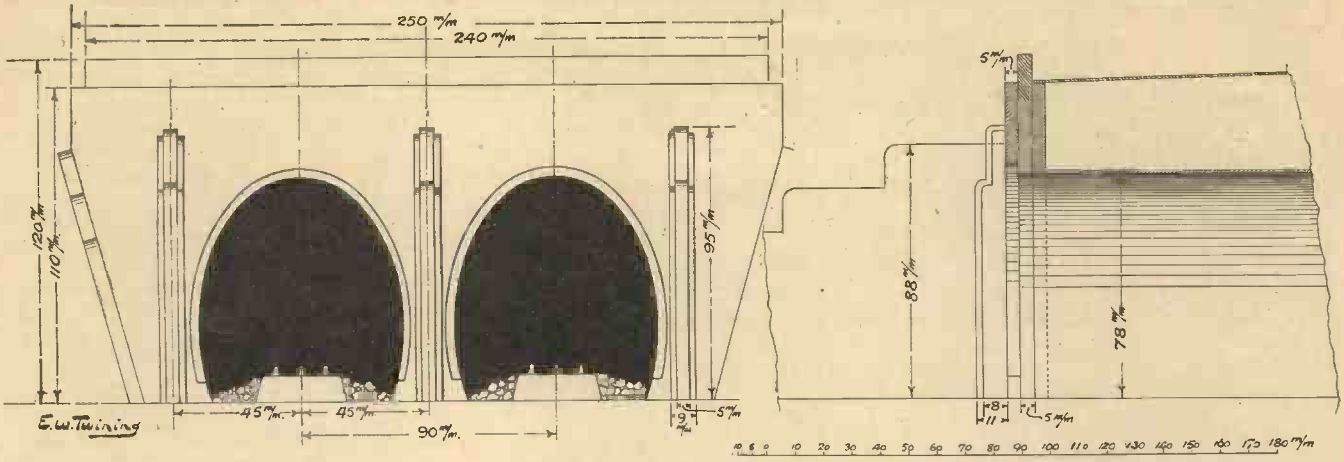


Fig. 21.—A design for a tunnel front.

Adapting the Twin-Train Table Railway

By E. W. Twining

(Concluded from page 600, July 1936 issue)

IN my last article I gave some designs for terminal station buildings and in this I propose to make some suggestions for engineering works, following the same architectural style; that is to say, a style which is quite modern and so up-to-date that the reader may not be able to find anything approaching the modernity of the design in the tunnels, bridges, etc., on our main line railways. On the Tubes, however, around London where the structures are carried out in concrete similar severely plain formation has recently been followed. It is, therefore, quite appropriate that we should carry the style of buttress as was introduced into the stations through to the engineering works for the Twin Train Railway. These for our model will be wholly carried out in wood, and this material for the walls can everywhere be plywood. I am proposing to deal with tunnel fronts, a single arch bridge, and a viaduct only, because Mr. Beal in his series of articles has already given a large number of other accessories, in fact he has catered pretty fully for the model railway enthusiast.

Tunnel Fronts

I have already referred to the matter of single and double tracks, that is to say, up and down roads, and explained the reason why, with double track, the rails have to be so widely separated that the centre rails, or 3rd rails, are 90 mm. apart. Now if we were to attempt to make one tunnel embrace both roads, the shape of the opening would have to be a horizontal ellipse or a portion of the same. This would look bad because tunnels are never made this shape and therefore it will be very advisable to follow what is quite usual full-size practice under certain conditions, and make a separate tunnel for each road. In the tunnel fronts, therefore, there will be two openings, side by side, as shown in Fig. 21. The reader can quite imagine from this drawing how bad it would look if one flattened arch were made to cover both sets of rails. Tunnels are always bored with the major axis to the ellipse in a vertical direction, because this is the best form which the arch can assume to carry the weight of the soil or other material forming the hill through which the tunnel is cut.

I venture to think the reader will agree that the architectural style which I have shown is eminently suitable for severely practical engineering work. Each tunnel front, I am assuming, of course, that there will be two faces to our tunnel, will be made of three thicknesses of 5 mm. plywood, arranged as shown in the cross section through one of the arches on the right-hand side of the drawing. The innermost plywood will be rebated back about $\frac{1}{16}$ in., that is to say, the elliptical opening will be made that amount larger than the middle ply. This is to provide for a sheet of stout cardboard which, bent to the shape of the ellipse and glued and pinned to the innermost plywood, will form the lining of the tunnel, that is to say, the part which in a full-size tunnel would be of brickwork. It will be obvious that the sheet of cardboard should be large enough to extend from one end to the other of the tunnel. If the tunnel is required to be longer than any cardboard obtainable, a third piece of plywood will have to be cut to go somewhere between the tunnel fronts to provide a means for securing the cardboard.

In the event of the tunnel requiring to be laid on curved track, the cardboard can only extend for a short distance in from each tunnel front, since it will not be possible to bend the cardboard in two directions.

To form the surface of the hill for the tunnel a second sheet of cardboard can be nailed down. To represent the grass on the top of this the surface can be painted, or better, enamelled grass-green, sprinkled with sawdust while the enamel is wet and when this is all dry, painted again with, preferably, flat colour of the same grass-green.

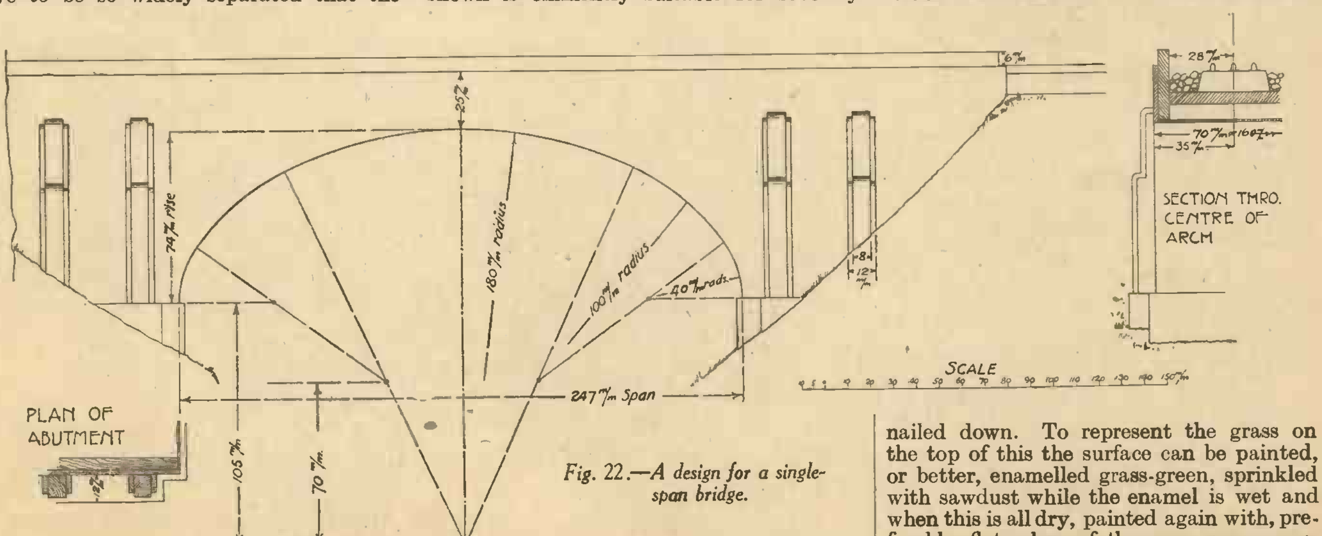
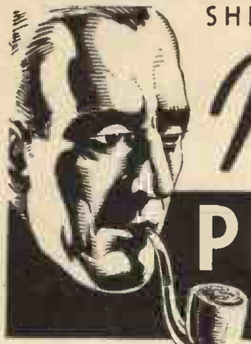


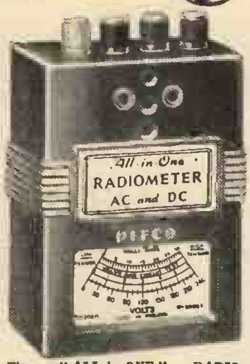
Fig. 22.—A design for a single-span bridge.



SHERLOCK HOLMES SAYS..

No Guessing

PIFCO *makes certain ...*



The "ALL-in-ONE" RADIOMETER for A.C., or D.C.

For electric or battery radio sets. Finished in black bakelite, size of dial $1\frac{3}{4}$ in. by $\frac{7}{8}$ in., complete with leads Price 12 6d.

Your radio has no secrets from the Pifco Radiometer. Anyone, however inexperienced, can trace faults with this wonder instrument. Any radio set can be tested—either A.C. or D.C., Mains or Battery operated. Solidly constructed, with fine bakelite case, the Pifco Radiometer has readings for high and low voltage, milliamperes, continuity test, and a special socket for testing valves.

12/6 *Get one of these amazing instruments from your local dealer to-day, or write for Testmeter Folder, post free from*

PIFCO LTD., WATLING STREET, MANCHESTER, or London Office, 150 Charing Cross Road, W.C.2

PIFCO

ROTAMETERS and RADIOMETERS

PIFCO ON THE SPOT WILL TRACE YOUR TROUBLES LIKE A SHOT

ECONOMIC ELECTRIC CO.

TWICKENHAM, LONDON, S.W.

GENERATE YOUR OWN CYCLE LIGHT

and forget all lamp trouble. A fully guaranteed complete set, absolutely foolproof:—comprising heavily plated Head and Rear Lamps, foolproof Dynamo, connections and spare bulb.

NOTE THE PRICE **12/6** *Post 7d.*

ELECTRICAL CONSTRUCTIONAL CLOCK SET

Set contains all parts necessary for constructing a Modern Electric Clock. Complete with all parts and full instructions for A.C. current only, 50 cycles. Price 15/6. POST PAID.

Good quality **ELECTRIC SOLDERING IRONS** with 3 interchangeable copper bits. A sound job. Price 4/6. Post 4d.

SHOCKING COILS. Complete with handles. Prices 2/6, 5/6, 9/6.

LIST.—Send for our Illustrated Catalogue containing 70 pages, fully illustrated, of all that you are likely to require—Meters, Motors, Telephones, Coils, Fittings, Transformers and parts, Lighting Sets, Tools and Workshop Material. It costs 6d. to print, but we send it to you for **2d.** *post free.*

Extraordinary Bargain Offer

Brand New 200 c.c. S.V. J.A.P. air-cooled Petrol Engines.

Latest type, complete with automatic oil pump, magneto platform, and enclosed magneto drive, magneto sprockets, main driving sprocket ($\frac{1}{2}$ x $\frac{5}{16}$) induction pipe exhaust union, etc., etc., as illustrated.

These engines are suitable for all purposes, including Motor Cycles, Motor Boats, Invalid Chairs, Lawn Mowers, Lighting Plants, Air Compressors and Power Plants. Manufacturers' actual price £8 10 0. An exceptional purchase enables us to offer these Engines at the ridiculous price of **35/-** each

Case and Packing 2/6

Also 350, 500, and 600 S.V. and O.H.V. Engines at absurd prices.

Send for Complete List.

Marble Arch Motor Supplies, Ltd.

286-292 Camberwell Road, London, S.E.5

(Opposite Camberwell Green)

A Real Motor-Driven Wood Planer for your Home Workshop

SPECIALLY DESIGNED, COMPACT FULLY ADJUSTABLE MOTOR-DRIVEN 4" PLANER BANISHES TEDIOUS HAND PLANING. 3 HIGH-SPEED STEEL KNIVES

RIGID

SMOOTH AND QUIET AT TOP SPEED

THE CHEAPEST PRACTICAL PLANER ON THE MARKET

PRICED WITHIN REACH OF EVERY HOME WORKER

It's **DRIVER** No. 525

Send the coupon and know more

E. P. BARRUS, LTD.

35-37 UPPER THAMES ST., LONDON, E.C.4

COUPON

SEND ME

DRIVER

MOTOR-DRIVEN TOOLS CATALOGUE

MR...

....

(P.M.) ....

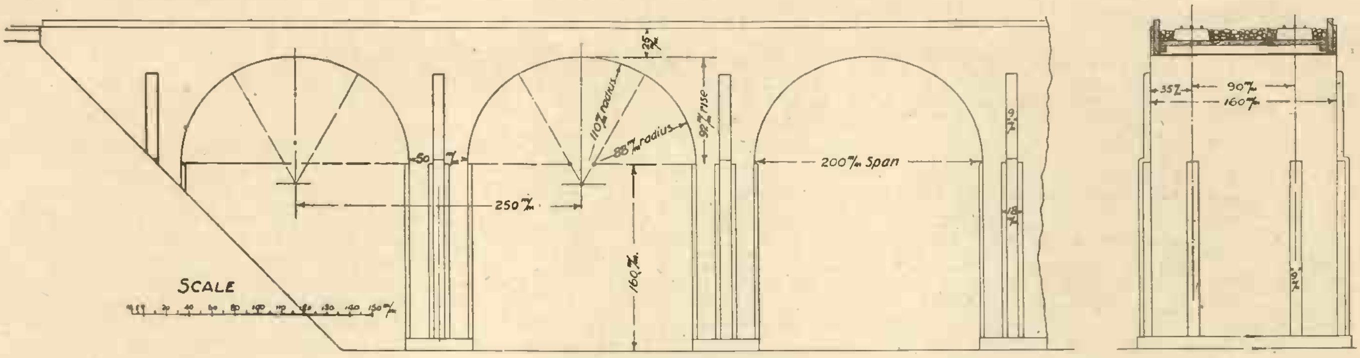


Fig. 23.—A design for a viaduct.

In Fig. 24 I give a diagram by means of which the reader will be able to set out geometrically the correct form for the tunnel arch. Here it will be seen that the curve on each side of the centre-line is struck from three centres with a compass, I have given the measurements of each radius in millimeters, and the heights above the table level at which the curves stop.

A Bridge

The type of bridge selected is the very usual one which carries the railway over a wide road or river; it will have a span of 247 mm., which represents in a full-size bridge approximately 62 feet. It will have a rise from the springing to the soffit of the arch of 74 mm. The springing is the horizontal line on the pier or abuttment where the curve of the arch commences. The crown is the highest point of the arch; the span is, of course, the horizontal distance between the springing points. The soffit is the underside of the curve of an arch, and the rise, the vertical height from the springing to the crown.

Buttresses

In this bridge, which is shown in Fig. 22, the buttresses are again of the same design as was introduced into the stations and also into the tunnel, but the proportions are somewhat heavier. I do not think that the details shown in the drawing call for further comment, the construction will be exactly the same as that of the tunnel. The width of the bridge between the parapets will depend upon whether single or double track is to be laid over the bridge. In any case the centre rail will be 28 mm. from the inner face of the parapet, the width of the bridge measured outside will, for single track, have to be 70 mm. and for double track 160 mm. The method of setting out the semi-ellipse of the arch is given in the drawing and the reader should have no difficulty in copying the curves by means of his compass on to the plywood from which the arch is to be cut.

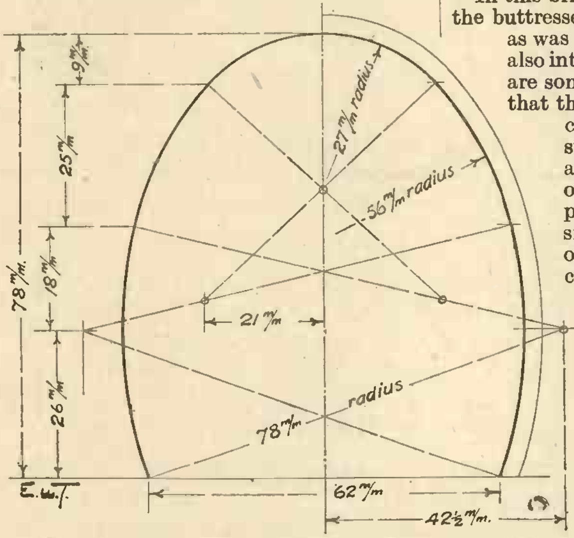


Fig. 24.—The geometrical setting out of the tunnel opening.

A Viaduct

Here again as I have drawn it in Fig. 23, the design is very similar to the other structure, except for slight differences in the form of the buttresses. These are merely introduced to give the reader a little variety from which he can make a selection. He can adopt just which ever shape he prefers and use the same form in all the works, or perhaps what would be better would be to let the differences remain just as I have drawn them.

The span of each of the arches I have made 200 mm. This measurement is, I consider, about as small as one could reasonably adopt, for if the arches were reduced in size below this the viaduct would not have that imposing appearance of importance which it should have, for obviously in actual practice it would not be there at all, but embankment would take its place.

As will be seen, I have not drawn both ends of the viaduct because the number of arches of which it consists will depend upon the space which the reader has on his railway for such a structure. If room is limited it can be given say, three arches, with only two piers reaching to the lower ground level. The width over the outside walls will of course be the same as the bridge shown in the last figure. On the inside of the piers I have drawn thin buttresses which are merely decorative; they can be omitted if the reader prefers to do without them. On both the bridge, the viaduct, and in fact on the whole of the track, assuming it is permanently laid, I strongly recommend that a fine gravel shall be laid up to the level of the sleepers.

WIRELESS AND THE NEW EMPIRE AIR SCHEME

FROM the earliest days of civil aviation, when the first experiments were being made with wireless telephony between aeroplanes in flight and ground stations, wireless has played a vital part in the operation of commercial air services.

From pioneer stations operating on the Continental routes, the wireless network has grown till it now stretches link by link from England to Egypt, Africa, and India, and on thousands of miles eastward to China and Australia.

As a part of the improved ground organisation for the big new Empire air scheme which comes into operation next year—and by which first-class letter-mails are to be flown in bulk, without aerial surcharge, between England and distant parts of the Empire—many developments and improvements are taking place in wireless communication.

Throughout the Empire air-lines approximately twenty new wireless stations are being established; while both on the ground and in the air the equipment will embody the latest devices evolved by scientists and technicians.

Most Up-to-date Equipment

The wireless installations now being fitted in the new Empire flying-boats are, it is claimed, the most modern and efficient ever constructed for use in commercial aircraft. One feature of these improved installations is that a direction-finding apparatus is embodied in the main set, and is not a separate piece of equipment, as has been the case hitherto. By the use of this direction-finding equipment the wireless operator will be able to tune in to any ground station that may be operating within range, and plot out th air-liner's position at any time during a flight.

In addition to the new apparatus that is being installed in aircraft, and at ground stations, the amplified air scheme is naturally calling for increases in the highly-skilled wireless personnel. In addition to pilots entering the service of Imperial Airways, and whose studies at the Company's instructional school include the obtaining of official certificates in wireless, specially-chosen operators are being drafted from the marine service into that of the air, and are being given the additional and specialised coaching necessary to enable them to pass their examinations for obtaining, as air-liner wireless men, the aviation equivalent of the official certificate which has to be held by ocean-liner operators.

Tuition

Pupils at the airway wireless "school" have fascinating equipment with which they work, in addition to their tuition in theoretical matters. The latest types of aircraft gear are provided for the making of practical tests. Installations are arranged so that pupils can originate and receive messages just as they would if they were in an air-liner in flight. They are also able to listen to the exchange of messages actually taking place between the airport and machines in flight on the Continental routes.

Clocks of the Past

by A. Millward

Clocks with a History, some of which are Still Working To-day

IT would appear that clocks moved by wheels and weights in contradistinction to water clocks, which were of a much earlier date, were first used in the monasteries in Europe about the eleventh century. It is recorded that the Sultan of Egypt in 1232 sent a "horologium" to the Emperor Frederick II.

Horologia signified dials as well as clocks so that too much credence must not be placed on the "horologium" of 1232.

The first author who refers to "horologio" that struck the hour, and consequently could not have referred to a dial, is Dante, born in 1265 and died 1321.

The Earliest Clock

The earliest clock in England is stated to have been set up at Westminster Hall in 1288 and paid for out of a fine imposed on the Chief Justice of the King's Bench, Ralph de Hengham. However, as this fine is first recorded in the Year Book during the reign of Richard III (1452–1485) it is not at all proved that a clock was actually installed in 1288, it is more probable that a tower in Palace Yard, Westminster, was built out of the fine and a clock installed at a later date. It is clear however, that Judge John Southcote, who became a Judge in 1563, referred to the tradition that the clock existing at that time had been paid for out of the Chief Justice's fine. During the reign of Henry VI (1422–1461) the clock at Westminster was considered to be of such consequence that William Warby, dean of St. Stephens, was paid sixpence per day for the keeping of it according to Stowe's Account of Westminster.

There is a record showing a sum of £30 being paid in 1292 for a clock at Canterbury.

A Famous Clock

Froissart records that in 1332, Philip the Hardy, Duke of Burgundy, removed from Courtrai to his capital at Dijon a famous clock which struck the hours.

In 1368, Edward III granted letters of protection to three clock makers of Delft so that clock-making was apparently a well-known art on the Continent at this date, and in 1370 or 1379 the great clock at Paris was installed, being the work of a German —Charles de Wic (? Henry de Wyck).

According to *Cathedrals of England*, by R. J. King, published by John Murray 1861, the clock which occupies the north side of the transept of Exeter Cathedral is celebrated, and is probably the one that existed there in 1317. This clock is attributed to Peter Lightfoot.

The "All-by-One"

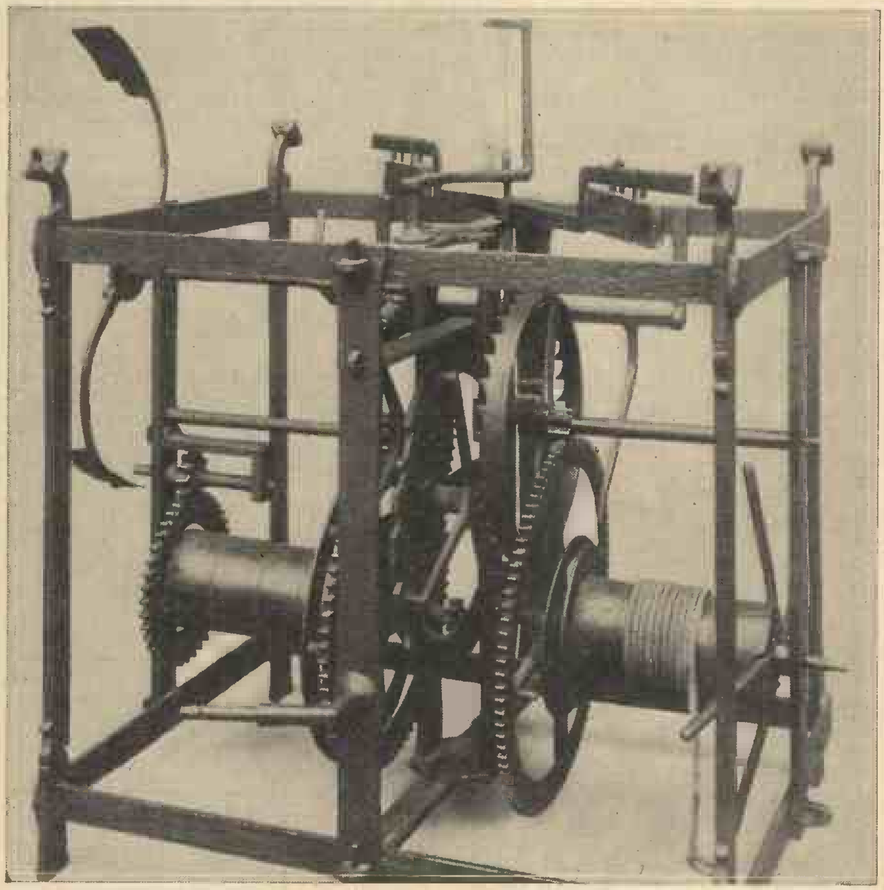
John Ireland, the celebrated antiquary, records that in the fourteenth century Richard of Wallingford constructed a clock which he called "ALBION" (all-by-one). Richard of Wallingford, born *circa* 1292, was reputed (by the Hon. Daines Barrington) to be the son of a smith, and lived in the town of Saint Albans, ultimately becoming Abbot of St. Albans, and died in 1336. The clock was an astronomical clock, but the date of manufacture appears uncertain probably about 1326. (Barrington is obviously wrong in stating it was made in the reign of Richard II and E. B. Dennison in referring to the inventor as Robert Wallingford.)

Peter Lightfoot who was a monk of Glastonbury besides being the reputed maker of the Exeter Cathedral clock, the clocks in the Church of Ottery St. Mary, and Wimborne Minster is better known as the maker of the original clock of Wells Cathedral, also known as the Glastonbury clock. This clock was presented to the Abbey of Glastonbury by Adam de Godbury and afterwards came into the possession of Wells Cathedral. The date of manufacture is probably about 1325. It is thought to be the first recorded example of a clock striking the hours automatically with a count wheel. It is also noteworthy as employing lantern pinions and a crown wheel or recoil escapement, which is the same balance adopted by de Wyck in the Paris clock.

According to William of Worcester, this clock was originally in the south transept of Glastonbury Abbey but was removed to Wells Cathedral at the time of the dissolution of the Abbey by Henry VIII, when the Abbot was executed, in 1539.

The present clock at Wells is in the north transept of the cathedral and has a 6 ft. 6 in. dial marked with twenty-four hours, and shows the age of the moon and position of the planets. Above the dial plate are mounted four "Knights" on horseback who at the hour, ride circularly round in opposite directions. The hour is preceded by a chime struck by the heels of a sitting figure some distance from the dial, and the hour is struck by the arms of the same figure on different bells. According to Mr. J. B. Planché, a student of heraldy and costume, the "knights" are probably not those of the original clock, since two appear to be Jesters and another is a civilian of the reign of James I or Charles I.

Probably the only part of the original clock now at Wells is the dial plate and the present clock was reconstructed in 1835.



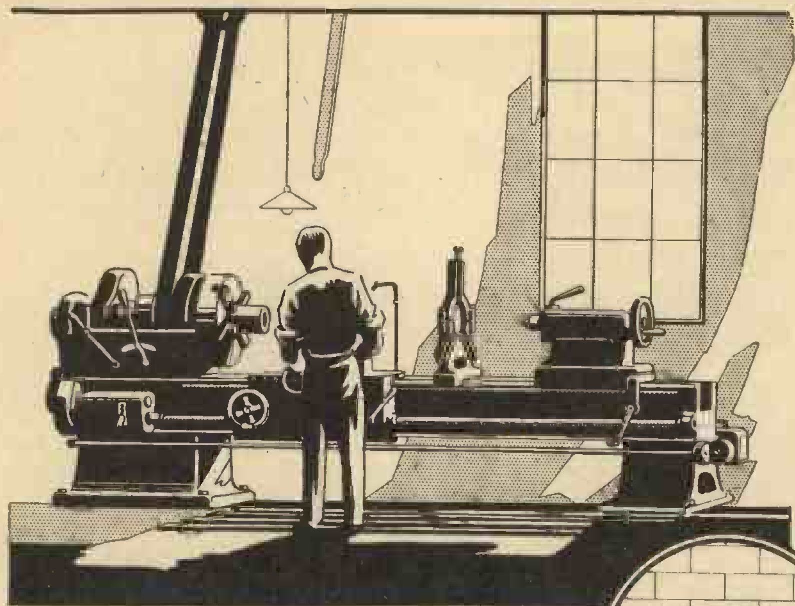
The Dover Castle Clock which is still in working order at the Science Museum, South Kensington.

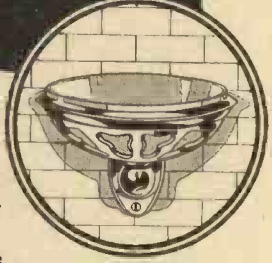
The original works were for some years in the crypt of the cathedral and were removed to the Patent Museum, now the Science Museum, at South Kensington, in 1871. The original verge escapement has, however, been replaced with an anchor escapement.

The Dover Castle

In the same museum is another ancient clock that was originally in Dover Castle and dated 1348. It was removed from Dover Castle in 1872 and is probably of Swiss origin.

According to Derham in his *Artificial Clock-maker*, published in 1714, the oldest clock in England which was going well at that time was the well-known astronomical clock at Hampton Court Palace made in 1540.





For every fixing job LARGE OR SMALL use RAWLPLUGS

RAWLPLUGS will enable you to fix any article quicker and neater, no matter what kind of material you wish to fix to. For heavy work, such as fixing machinery, large-size Rawlplugs (Nos. 20-30) with coach screws should be used.

If you want to fix a sink or cistern, there are medium-size Rawlplugs (Nos. 10-18), and for small household articles, such as a soap dish, there are the small Rawlplugs (Nos. 3-8). There is Rawlplug for every size of screw or coach screw. Anyone can use Rawlplugs ; no previous experience required. Sold by Ironmongers, Stores, etc., in complete Outfits at 1/6, 3/6 and 5/6.

Millions of Rawlplugs are used annually by the Admiralty, War Office, G.P.O., Big Contractors, etc.

B200

THE RAWLPLUG CO., LTD., Rawlplug House, LONDON, S.W.7

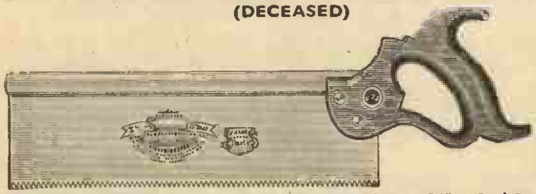
GEORGE ADAMS

(DECEASED)

BUSINESS CLOSING DOWN SALE

OF THE WHOLE STOCK OF MACHINERY & TOOLS

Here are a Few of the Bargains



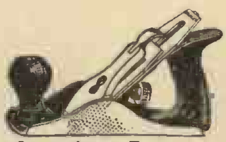
TENON SAWS, London Made, finest quality. 14" Iron Backs. Usual Price 5/9. **SALE PRICE 3/3**
14" Brass Backs. Usual Price 9/6. **SALE PRICE 5/9**

Finest Quality Skew Back Handsaws
22" Blade. Usual Price 9/6 **SALE PRICE 5/6**
26" Blade. Usual Price 11/6 **SALE PRICE 6/6**

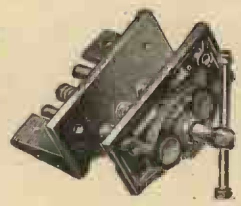
8" Washita - Finish Oilstone
In case . . **SALE PRICE 2/-**

10" Solid Steel, Sheffield Made, with Metal Clad Head, Ball Bearing. Nickel Plated. Crocodile Jaws
Usual Price 12/6 **Clearing at 6/6**

Hand Emery Grinders
3" × 1" Wheel **3/-**
6" × 1" Wheel **5/3**



American Pattern Planes
No. B4. Smooths 8" × 2" Cutters **9/-**
No. B5. Jacks 14" × 2" Cutters **10/9**



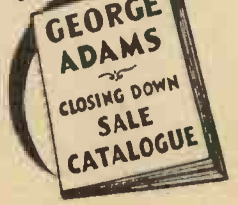
Woodworker's Vice
British Made. Steel Screws. Width of Jaws, 6". All Metal, Hardened **3/9**

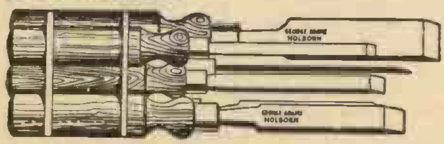
Wood Worker Vices
Sudden Grip and Screw all the way. Jaws 9" wide. Open 12", **each clearing at 12/6**

Jack Planes
$2\frac{1}{4}$" Double Irons **5/11**

Smooth Planes
2" Double Irons **3/9**

Sale Catalogue Free postage 2





Bundles of Finest Made **Firmer Chisels**
Handled. Comprising 1 each $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{3}{4}$ & 1" **Clearing at, set 5/-**

GEORGE ADAMS

290-292 HIGH HOLBORN, W.C.1

Valuable New Part Work For Builders and Architects

TO BE COMPLETED IN ABOUT 40 Weekly Parts

PARTS 1 & 2 NOW ON SALE

"Modern Building Practice" 1/- Weekly Parts

Edited by PERCY E. THOMAS, Pres. R.I.B.A.

THIS great new Part Publication provides an up-to-date, comprehensive work of reference for the busy Architect and Builder, and also for the young man in Building or Architecture who hopes one day to hold a position of responsibility.

"MODERN BUILDING PRACTICE" gives you the very latest methods in all branches, from the initial planning and designing to the work of construction and the provision of the final equipment. No matter whether you are mainly concerned with the building of small property, speculative building or important contract work, you will find "MODERN BUILDING PRACTICE" invaluable.

"MODERN BUILDING PRACTICE" will contain over 2,000 practical illustrations, plans, elevations, photographs and diagrams, and many tables and data. CONTRIBUTORS INCLUDE FAMOUS ARCHITECTS AND BUILDING AUTHORITIES.

FREE!
PRACTICAL DATA CHARTS
inside each weekly issue.
With Part 1
CONCRETE FOUNDATIONS

A vast amount of authoritative information never before collected together in so convenient a form for the practical man.

GET PARTS 1 & 2 TO-DAY!

SPECIAL CONTENTS INCLUDE:

DESIGN AND PLANNING

Design and Planning of Housing Estates. All types of Houses, Flats, Shops, Stores, Works and Factories, Banks and Offices, Cinemas, Theatres and Concert Halls, Garages, Civic Buildings, Hotels and Public Houses, Aerodromes, Restaurants and Cafés, Swimming Baths, Ice Rinks, etc.—Interior Decoration, Acoustics, Lighting Schemes, Time and Progress Schedule, etc.

BUILDING CONSTRUCTION

Builders' Plant and Power Tools, Foundations and Footings, Cement and Concrete, Brickwork, Masonry, Scaffolding, Flooring, Walls and Partitions, Ceiling Coverings, Fireproof Construction, Doors, Windows, Roofs, Slating and Tiling, Flues and Chimneys, Structural Steelwork, Reinforced Concrete, Bank and Office Fittings, Church Fittings, etc.

MATERIALS & OPERATIONS

Bricks and Brickwork, Timbers used in Building, Metals, Preservation of Metals, Stones, Marbles, Limes, Cements, Mortars, Plasters, Damp-proof Materials, Breeze and Composition Slabs, Concreting, Plastering, Roughcast, Flooring, Special Wall Finishes, Sound and Heat Insulating, Glass and Glazing, etc.

EQUIPMENT OF BUILDINGS

Planning a Drainage System, Sanitation for Rural Districts, Drainage Systems for Motor Garages and Chemical Works, Surveys and Reports, Water Supply, Central-Heating Systems, Ventilation, Gas Fitting, Gas-Heated Hot-Water Apparatus, Gas Fires, Refrigerators, Cooking, Lighting, Electric Supply and Electrical Equipment, etc.

Also Comprehensive Legal Section, the Duties of Clerk of Works, Builders' Estimates, etc.

Here, for your convenience, is an Order Form to hand to your newsagent

FILL UP THIS FORM NOW

ORDER FORM

To ....Newsagent.

Please supply each week until countermanded one copy of Newnes' Important New Part Work, "MODERN BUILDING PRACTICE," 1/- weekly.

Name..

Address..

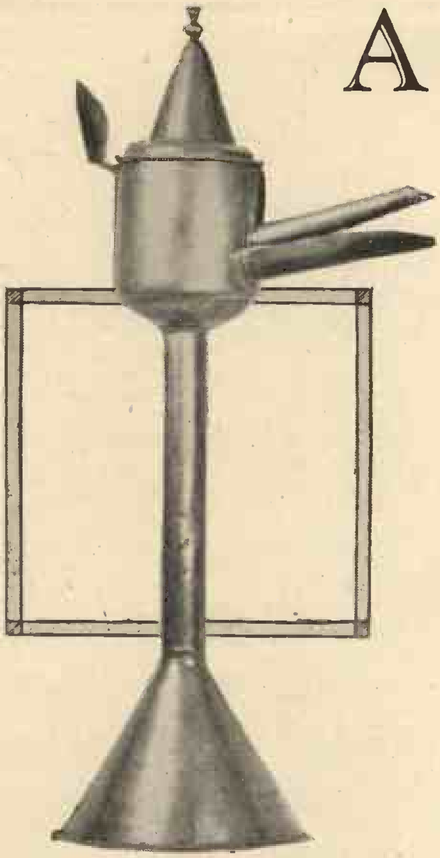
....

"MODERN BUILDING PRACTICE" is also obtainable direct from the Publishers, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2. (1/2½d. each part, post free.)

George Newnes, Ltd

Are Perpetual Lamps Possible?

Probing the Secrets of an Age-Old Mystery



An ancient brass lamp, one of the type supposed to have powers of perpetual burning conferred on them by the ancients.

THE notion of the perpetual lamp is basically an offshoot from the idea of perpetual motion. Just as inventors throughout the ages have devoted enormous amounts of time and ingenuity to endeavours to bring about a perpetual motion machine, so, also, there have not been wanting individuals who have attempted to invent lamps which would go on burning for ever.

Perpetual lamps should not be confused with the many undying flames which we read about in ancient history. The latter were admittedly fed by continual additions of oil or other fuel. A true perpetual lamp, however, is one which either burns an unconsumable fuel (if such a thing were possible) or else it is a lamp which, in the act of burning, automatically replenishes its fuel supply.

An Impossibility.

On the face of it, therefore, a perpetual lamp seems to be an obvious impossibility. Yet there have not been wanting credible inventors who appear to have implicitly believed in the subject of perpetual lamps. John Baptist Porta, the Neapolitan physician, originator of the magic lantern and many other optical and mechanical devices, took a lively interest in the matter of these supposed ever-burning lamps, but although he devoted much time and thought to the elucidation of their mystery, he confessed himself, in the end, beaten by the problems which they presented.

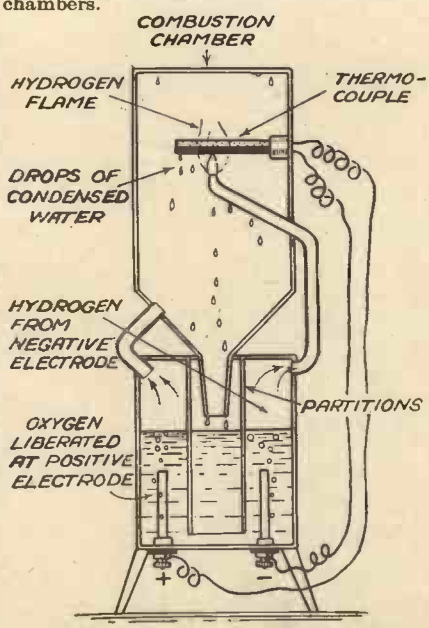
History contains many supposedly authentic relations of perpetual lamps. Such stories date back to Roman times and they are particularly prevalent after the medieval period. To take a single example vouched for by the British historian and topographer, Camden, a vault attached to a little chapel at York was broken into and therein an ignited lamp which had apparently been burning for ages was discovered. Before, however, it could be picked up and examined it went out.

Such is a typical narration of a perpetual lamp discovery. Apparently these wonder lamps, which take the form of the ordinary illuminating devices used in ancient days, are always discovered in tombs, vaults, or in other closed chambers, in which apartments their ever-burning flames were, one supposes, designed for the purpose of dispelling the perpetual gloom. Frequently the sepulchres and other subterranean passages in which these lamps are supposed to have been found have contained the remains of former burials and, naturally enough, the undying lamps have been considered to have been placed there by people possessed of their secret for the purpose of lighting the body of the dead person until such time as the soul re-enters it.

A Fault.

The great trouble with all these perpetual lamps is that invariably they become extinguished immediately they are discovered and, on account of that consideration alone, all such perpetual lamp stories have nowadays come to be discounted.

A little reflection upon the subject, however, may convince us that although true perpetual lamps are in themselves an utter impossibility, there may be certain elements of truth in all the old yarns concerning the discovery of burning lamps in underground chambers.



An ingenious scheme for obtaining an ever-burning flame. It is, of course, a fallacious one, as explained in this article.

The old philosophers, if they agreed with the possibility of perpetual lamps at all, explained the principles of the latter simply by asserting that the lamps burned an unconsumable oil of unknown composition. Bishop John Wilkins, a learned prelate of Chester and an early mechanician who, towards the end of the seventeenth century, prophesied flying machines and trips to the moon, very naïvely suggested that this " unconsumable oil " might be a substance extracted from asbestos, since such material could be used for the making of the unconsumable wicks.

More recent explanations of perpetual lamp yarns have sought to establish a secret connection between such lamps and a natural supply of petroleum or petroleum gas in the immediate vicinity. Such explanations obviously fail, since, in the majority of instances, perpetual lamps are supposed to have been found burning in regions which are far removed from oil-bearing localities.

Other Explanations.

Two other explanations of these supposed perpetual lamps are worthy of our notice. The first of these supposes that the ancients knew how to prepare " pyrophoric metals "; that is to say, metals in so fine a powder form that they take fire immediately they come into contact with air or oxygen. The lamps were originally filled with these metals, together with a quantity of oil or other combustible material.

It is easy to see that if, on the discovery of the hidden burial chamber, the lamp were in any way broken, the pyrophoric metal powder, coming into contact with the fresh air admitted into the tomb, would instantly glow brightly and might possibly serve to ignite whatever combustible material remained in the lamp after the passage of time. The lamp, therefore, would burn for a few moments and afterwards would become extinguished.

Phosphuretted Hydrogen.

The other theory concerning these semi-mythical lamps assumes that the well-known gas, *phosphuretted hydrogen*, is responsible for the observed phenomena. Phosphuretted hydrogen is an evil-smelling gas which may be generated in damp earth from decomposing bones and other matter. There is one variety of this gas which is spontaneously inflammable; that is to say, it takes fire instantly it comes into contact with air or oxygen.

Now suppose that, during the ages, a tomb had gradually accumulated a quantity of this spontaneously inflammable phosphuretted hydrogen. When such a vault was broken into, it is possible that the gas might inflame for a moment or two, filling the chamber with a mysterious greenish light, the source of which might, in the excitement of the moment, be credited to any ancient lamp which was subsequently noticed.

It is pretty safe to assert that all stories concerning perpetual lamps found burning in closed tombs and other underground chambers must be based upon some deception or other, since even if it were possible to produce an ever-burning flame, such a flame would at least require a continuous supply of oxygen to feed it and such an oxygen supply would obviously not be forthcoming in an hermetically sealed apartment.

During the last hundred years a few inventive minds have, from time to time, toyed with the old idea of the perpetual lamp not so much with the intention of explaining away the discoveries of supposed perpetual lamps in ancient tombs and elsewhere, but more directly with the aim of actually constructing a lamp which would burn continuously for ever, or at least for a very prolonged period.

An Idea.

One such notion comprised a plan for electrolysing slightly acidified water in a glass vessel. The oxygen and the hydrogen were to be separately collected and the hydrogen was to be burnt at a little jet placed in a glass chamber, to which the oxygen was to be admitted. The hydrogen flame was to heat a thermocouple and this device was to supply the necessary current for the electrolysis of the water. The hydrogen in the act of burning combined with the oxygen to form water, and this latter liquid dropped downwards from the flame through a funnel-like device into the electrolysing chamber.

In the above manner a continuous action was to be brought about and, once started, it was to go on for ever. Unfortunately, the propounders of such a proposition failed to consider the fact that the heat of the hydrogen flame would not be sufficient to provide enough current, via the thermocouple, for the electrolysis of the water.

If, by any chance, it were ever found possible to devise a thermocouple which would give up a relatively enormous current for a small initial heating, then the above scheme would probably work.

Alas, however, such a notion will never materialise, for it goes directly against the universal law of the Conservation of Energy, which tells us that we cannot make self-operating machines and that we cannot get more energy out of a machine or a system than we put into it.

For such reasons perpetual lamps, in the true sense of the term, are and ever will be impossible, just as perpetual motion and all schemes based upon that principle are not possible.

Nature, throughout her universal realm, has conspired against us to see that never under any circumstances shall we obtain from her, in the words of the Lancashire man, "owt for nowt." Perpetual lamps, like perpetual motion, would elicit from old Mother Nature something for nothing and it is for this reason that all such playthings are for ever denied to us.

WOODWORKING HINTS

In using any kind of saw the chief point to watch is that the first finger should not be used to grip the handle, but should point down toward the tip of the blade where it gives a steadying effect.

Different kinds of saws have their teeth cut to different angles, according to the purpose for which they are intended, and in sharpening care should be taken to retain the exact angle.

All saws are sharpened by holding them in a special kind of wooden vice, with clamping bolts, which is gripped in the ordinary bench vice.

A saw file (triangular in section) is used and is kept at an angle of about 60 degrees to the line of the blade. Alternative teeth are sharpened by turning the file through 60 degrees each time.

The easy and correct working of a saw is governed very largely by the "set" of the teeth. Alternate teeth are bent outwards slightly in opposite directions; the amount of set is dependent upon the type of saw, and is greater for larger teeth—the exact amount can only properly be determined by trial and from experience. There are different ways of setting a saw, one of which is to lay the blade of the tool on a flat hardwood board and to slightly bend over alternate teeth by means of a pin punch and hammer. This method demands a fair amount of skill, and should not be tried on a good saw until some experience has been gained on an old one. An easier and more usual way is to use a saw set and grip the teeth in the appropriately sized notch, and then to bend them over; this is done whilst holding the saw in the sharpening vice referred to above. The simplest way of all, especially for the novice, is to use a special saw set which is rather similar in appearance to a pair of pliers. Such a tool is supplied by several tool makers, and can be adjusted to give any required amount of set. Very little experience is required to use it successfully.

The attractive appearance of the dial of the Enfield clock.

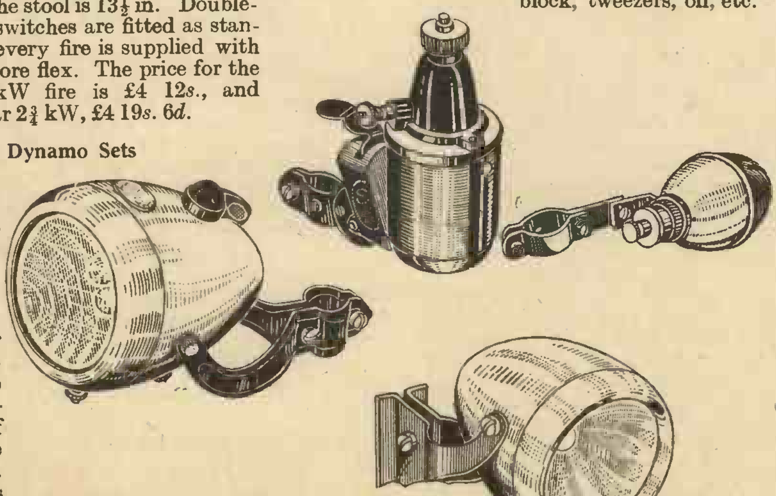
A New Type of Electric Fire

THE principle of the reflector fire is so familiar that it is unnecessary to enlarge upon it here. It has been employed for a considerable while with a fair measure of success, but the outstanding disadvantage is that the angle of reflection has been strictly limited. Consequently the heat has been emitted in a concentrated beam which unfortunately allows a considerable area in front of the fire to remain cold through being out of beam. With a new type of electric fire, however, recently introduced by the Limit Engineering Co., Ltd., 15-29 Windsor Street, Essex Road, Islington, the heat is distributed evenly over an angle of 120 degrees from the centre of the heating element in the horizontal plane. Thus, assuming the fire stands in the fireplace in the centre of the wall, only the fireplace wall will be immune from direct radiant heat rays. This result is obtained through the patented design of the parabolic reflector and the mathematical precision with which these fires are made.

On this page we show the "Windsor" Radiant Radial Reflector which is of ultra-modern design and is available in oxidised silver on oxidised copper finish. It is 28 in. wide, 15½ in. high, and the projection of the stool is 13½ in. Double-pole kick switches are fitted as standard and every fire is supplied with 6 ft. of 3-core flex. The price for the 1-bar, 1¼ kW fire is £4 12*s.*, and for the 2-bar 2¾ kW, £4 19*s.* 6*d.*

New Wilco Dynamo Sets

WILCO dynamo sets for the 1937 season, made by L. Wilkinson, 204, Lower Addiscombe Road, Croydon, are of attractive design. Several sets are made at 21*s.*,



(Top) The Torpedo set. (Bottom) The headlamp of the Torpedo lightweight. The dynamo is the same as in the other set.

AROUND the TRADE

A Review of Items which have recently been placed on the Market.

the Torpedo de luxe, with its all-chromium headlamp, dynamo, and rear light, has two bulbs controlled by a rotary switch on the lamp, which will operate either bulb from the dynamo or stand-by battery.

The Torpedo lightweight, which costs 13*s.* 9*d.*, is an outfit including a headlamp with a 3⅜-in. chromium-plated front and a black body. The chromium-plated dynamo has automatic voltage regulation and can be switched on or off with the foot.

The Radiant Radial Reflector fire described on this page.

The Enfield Construction Clock

WE recently tried out one of the Enfield Clock Construction outfits, a product of the Enfield Clock Co. (London), Ltd., Edmonton, London, N.18. The outfit, which sells at the moderate price of 10*s.* 6*d.*, comprises all the parts necessary for making a novel and really serviceable clock. We found it quite a simple matter to construct the clock from the instruction book supplied, and found it to be an efficient timekeeper. The front of the clock is made to resemble the front of a locomotive, as can be seen from the illustration on this page. The outfit is packed in an attractive red and blue box, together with instruction book, assembling block, tweezers, oil, etc.

DEVELOPMENT OF THE AUTOGIRO

(*Continued from page* 73)

out any undesirable oscillations.

By such gradual developments, the rotor was perfected until, in 1932, the first "direct-control" type of autogiro was introduced. This machine had no stub wings or ailerons as had been used hitherto, and at first it had no tail unit either, the entire control of the machine being accomplished by tilting the rotor axis. The modern machines are all of the direct-control type, and in certain types even the rudder has been suppressed.

The axis of the rotor is carried in a complicated assembly which can rock backwards and forwards and also sideways in response to the movements of the control column by the pilot. Instead of the control column, or joystick, standing up from the floor of the cockpit, as in the case of an ordinary aeroplane, it hangs downwards from the rotor head into the cockpit. By moving this "upside-down" control column, the pilot can tilt the rotor either sideways, backwards or forwards and so cause the machine to bank, turn, climb or dive at will.

The "Jumping" Autogiro

The various developments which I have briefly outlined above have all been important and necessary in the development of the autogiro. But though essential, they dwindle almost into insignificence, at any rate in the popular view, in comparison with the very recent development of the "Direct Take-Off" or "jumping" autogiro, a machine which requires no forward run whatever, and which is capable of taking off from a very confined area. This development must be classed as one of the most important advances in the practice of aeronautics yet made, and it will certainly do more than any other to popularise aviation since there is no longer any necessity for a large aerodrome.

It has been usual for a number of years to set the rotor in initial motion by means of the engine in order to reduce the length of take-off run required. When the rotor nearly reaches its flying speed, the machine is permitted to run forward and the take-off generally requires only a short run. The take-off run could not be abolished altogether, however, for if the rotor was speeded right up to flying speed, the machine itself would momentarily leave the ground, and, the reaction between the machine and the ground having vanished, the relative torque between the rotor and the fuselage would turn the machine in the air and it would at once fall back to the ground. In order to achieve a direct take-off, some means had to be found for keeping the machine on the ground while the rotor was speeded up well above the normal flying speed, and then, simultaneously with the release of the machine from the ground, the driving torque to the rotor had got to be cut off. This would not appear a very difficult problem, but it is one which has taken a long time to solve.

Instead of securing the machine to the ground by some mechanical arrangement, it is prevented from rising by reducing the pitch angle of the rotor blades to zero during the process of starting up the rotor. The generation of lift is thus prevented and the drag torque diminished considerably. Both facts allow the rotor to reach an initial speed very much in excess of the one corresponding to normal flight, and, if, simultaneously with the declutching of the mechanical drive to the rotor, the pitch angle of the blades is suddenly increased to the normal value, lift is instanteously generated and the machine will leave the ground in an almost vertical trajectory.

As the rotor speed decreases, the machine will hover for a moment, but if the pull of the airscrew during the upward motion has imparted to the machine at least the minimum horizontal speed at which it can maintain level flight, the machine will not fall back to the ground but will continue the flight initiated by the jump.

In this way, a direct take-off, without any forward run whatever may now be accomplished, thus giving to the autogiro the one quality which has hitherto appeared to belong only to the helicopter.

The development of direct take-off will enormously amplify the field of application and the gradual attainment of higher speeds will make it competitive for very many purposes with the ordinary aeroplane. Doubt has sometimes been expressed as to the ability of the autogiro to attain speeds of the order of 200 m.p.h. without losing considerably at the slow end of the scale. There is, however, no fear on this account as the standard rotor at present in use on the C. 30 type of machine could be used appropriately on a machine of similar weight, but having an engine capable of developing sufficient power to attain 175 m.p.h., and only slight modification is required to extend this range. Tests have shown that the efficiency of the rotor is practically constant over a very wide range of speeds.

TRANSMITTING "PICTURE" SIGNALS OF COMPASS BEARINGS

(*Continued from page* 74)

within range will pick up a corresponding picture of its own bearings, since the rotating beam carries on its back, so to speak, a visible record of each point of the compass through which it is moving.

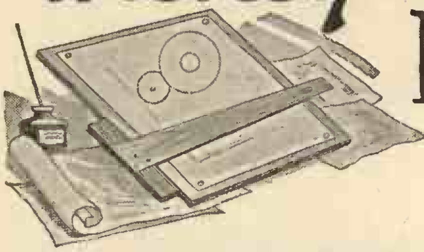
The Picture Signal

Although the system provides a picture signal which can be easily understood by a navigator ignorant of the Morse code, it is open to the objection that the scale markings are slightly "on the move" during the critical moment of observation. For this reason there may be some difficulty in taking an exact reading during the short period of time available.

In order to remove this uncertainty the procedure at the beacon station may be varied, by radiating the picture signals on a broadcast wave, which travels outwards in all directions, instead of putting them on the back of the rotating beam. The latter is, instead, used to transmit a tone signal which has the effect of producing at the receiver a "black bar" or distinguishing mark under the exact scale-reading which represents the ship's bearing at any given time.

In this case, the picture seen by the navigator would be as shown in Fig. 3, where C again represents the compass scale, and AB the stationary identification letters of the beacon station. As before, the letters AB remain "still" on the received picture, together with a special pointer P and an aperture marked L, whilst the compass scale C continues slowly to move round. But at the precise moment when the rotating beam sweeps past his ship, a black bar M appears in the aperture L, and the navigator knows that the pointer P then marks his exact bearing.

Money Making IDEAS



Advice by our Patents Expert

A DEVICE FOR CASEMENT WINDOWS

"I HAVE thought of a device for preventing the entry of rain at the top of casement windows. I enclose drawings of my idea and would like your advice on same, also if you think it would be a paying proposition." (R. M., Surrey.)

THE improved device for preventing entry of rain at the top of casement windows, is thought to be novel and forms fit subject matter for protecting by Letters Patent.

The invention is ingenious and would undoubtedly be efficacious in practice, and provided the invention be novel should have a good chance of proving a commercial success.

The only certain way to ascertain the novelty of the invention is to search amongst prior patent specifications dealing with the matter which, in view of the large number of patents allocated to the class covering such devices, would be a somewhat expensive matter.

You are advised to apply for a Patent with a Provisional Specification, which will give you about twelve months' protection.

A PLUMB RULE AND LEVEL

"I HAVE devised, after considerable experiment, a plumb line and rule, and would like your advice as to its novelty." (R. B., Ayrshire.)

THE improved plumb rule and level is thought to be novel from personal knowledge and forms fit subject-matter for protection by patent. Advise to file an Application for Patent with a Provisional Specification, which will give you protection for about twelve months in the least expensive way.

After the application for patent has been accepted by the Patent Office, you will have about twelve months in which to try and interest firms likely to take up the invention before having to incur any great expense. By approaching firms in the trade, you will also probably be advised as to the novelty of the invention.

The inventor is advised to have professional assistance in applying for his patent.

THREE INVENTIONS

"I WOULD like your opinion on three inventions of mine, details of which I enclose herewith.

"Models are not too difficult to make, and the descriptions for the patent forms can easily be explained.

"As I only wish to patent one at a time, I would like your opinion as to which one to choose.

"I have numbered each description so that there is no need to return them. Reference to the numbers will do." (J. S., Durham.)

INVENTION NO. 1 is thought to be novel, and forms fit subject-matter for protection by patent. It would probably meet with a certain measure of success if properly marketed. It is possible that fountain-pen manufacturers would be interested in the invention as a novelty, for which reason it is thought that this invention is more likely to be readily taken up commercially than the others.

Invention No. 2 is also probably novel, but it would be advisable to search amongst the prior patent specifications dealing with valved containers. It is possible that something similar has been previously employed in connection with oil-cans. The invention, if novel, is capable of being patented, and if it can be inexpensively produced, should be commercially successful.

Invention No. 3 is the least meritorious one. In view of known arrangements employing a roller of felt or like absorbent material for a similar purpose, it is not thought to form fit subject-matter for protection by patent. The mere substitution of one material for another analogous material, unless invention is required to adapt the new material to its purpose, is not patentable.

MINER'S SAFETY LAMP

"I WOULD like your advice as to the novelty of a safety lamp for use in mines, which is ideal for demonstrators and mining students." (W. C., Monmouth.)

THE mines safety lamp model for the use of demonstrators and mining students is probably novel and forms fit subject-matter for protection by Letters Patent, which is the only effective way in which the invention can be protected. Although we think the invention novel, the only certain way of ascertaining the novelty is to search amongst prior patent specifications dealing with the subject.

Unfortunately for you, this ingenious and practicable invention can only appeal to a relatively small and restricted class of persons, so that we do not think it would have any great commercial value, for which reason it is problematical if it would be worth the cost of patenting the invention.

COLOUR IN CINEMATOGRAPHY

"HAVING conceived an idea, probably quite different from any other scheme in connection with the rendering of colour in cinematography films, I am submitting it to you for consideration." (G. L., Notts.)

THE improved method of taking and projecting cinema films in colour is ingenious, but the novelty of the invention is doubtful. The inventor is advised to search prior patent specifications dealing with the subject before going further.

The original "Kinema colour," which only employed two colours, owed its want of lasting commercial success largely to the fact that the film had to be run through the projector at twice the normal speed for ordinary film.

PRACTICAL MECHANICS Replies to Queries and Enquiries

If a postal reply is desired, a stamped addressed envelope must be enclosed. Every query and drawing which is sent must bear the name and address of the sender and be accompanied by the coupon appearing on page 126. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes Ltd., 8–11 Southampton Street, Strand, London, W.C.2.

MAKING BOOT POLISH

"I am about to start manufacturing boot polish for sale, and I need a dye that will blacken a mixture of beeswax and turpentine. I have heard of nigrocine (spirit soluble), but I think it is too dear to use. Is there any cheaper alternative, and where could I obtain it?

"I also need a brown dye to make the polish brown. Could you give me the name of a chemical that will do this for me? The dyes should not take any of the shining properties from the polish." (J. O'C., Limerick City.)

THE dyes most suited to your needs are "Oil Black 500," and "Oil Brown 501." Both of these are obtainable from Messrs. Boak, Roberts & Co., Ltd., Stratford, London, E.15, their cost being 4*s.* and 7*s.* 6*d.* per lb. respectively.

The above colours are completely soluble in turpentine, spirits, naphtha, white spirit, and similar solvents, and they will not interfere with any of the properties of your proposed boot polish.

BATH SALTS

"COULD you please describe a method of making bath salts in either powder form or crystals?" (R. H., Devon.)

ORDINARY bath salts are nothing more nor less than carbonate of soda which has been recrystallised, and had incorporated with it a trace of a dye and a perfume. If the salts are required in powder form, they are gently heated for a period until they fall to powder.

Dissolve carbonate of soda in boiling water until no more will dissolve. Filter away the liquid, add to it a trace of a dye (as, for instance, methyl violet) and also a perfume, and allow the liquid to cool. It will deposit crystals. These are removed, dried, and packed. On further concentration the liquid will deposit another crop of crystals.

NEON TUBES, RADIUM, ETC.

"WOULD you please inform me on the following:

"(1) What are the names of the non-metallic elements?

"(2) Is A.C. or D.C. current used for neon-tube lights and mercury-vapour lights?

"(3) Can any inert gas, such as nitrogen, be used in place of neon in a neon-tube light?

"(4) Is radium deposited from any other substance, and what are the changes it passes through before it becomes lead?

"(5) Of what thickness must an infra-red ray filter be?" (A. V. P., Middlesex.)

(1) NON-METALLIC elements are the following: Argon, Boron, Bromine, Carbon, Chlorine, Fluorine, Helium, Hydrogen, Iodine, Krypton, Neon, Niton, Nitrogen, Oxygen, Phosphorus, Selenium, Silicon, Sulphur and Xenon. Arsenic and Tellurium are half metallic and half non-metallic.

(2) A.C. current is best for neon and mercury-vapour tubes.

(3) If, in place of neon, another inert gas is employed in an electric discharge tube, an illumination will be produced, but it will not consist of the orange-red glow which is characteristic of neon. Moreover, higher voltages will, usually, be required.

(4) Radium is formed by the slow breakdown or disintegration of uranium, an element of higher atomic weight. During its very slow disintegration into lead, radium is converted into the following elements in sequence: Radium emanation (or Niton), Radium A, Radium B, Radium C, Radium D, Radium E, Polonium, Lead. The "life" of some of the radium modifications is only a matter of minutes.

(5) An ebonite infra-red filter need not be more than $\frac{1}{32}$ in. in thickness.

PLASTER CASTS

"I READ recently of gelatine being used to make flexible moulds for plaster casting. I melted some gelatine, which when set again was just as brittle and useless for moulding as before. Can you tell me what to add to the gelatine to make it into a jelly-like mass, capable of being bent to allow extracting a plaster cast? I heard also of plastic rubber being used for the same purpose. Where could I obtain plastic rubber and how should it be worked?" (J. D., Sheffield 3.)

(1) GELATINE dissolved in a small quantity of water and allowed to set should not form a brittle medium. If it does, re-melt the gelatine and add more water. The proportion of water necessary will have to be determined by experiment, since different classes of gelatines vary a great deal in their setting properties. If you wish, you can incorporate a little pure glycerine and/or a few drops of castor oil with your gelatine mixture, but we are of the opinion that a well-prepared gelatine mixture should set in a flexible condition without the addition of such plasticisers.

(2) We doubt whether you will be able to obtain true rubber in a plastic condition for the purpose you require. However, you might write to Messrs. May & Baker, Ltd., Battersea, London, S.W.1, who are manufacturers of plastic materials of various kinds. Also, an enquiry sent to the Institution of the Rubber Industry, Faraday House, 10 Charing Cross Road, London, W.C.2, would bring you the latest particulars on the subject of your requirements.

COMPOSITION OF BAKELITE

"(1) WHAT are the substances employed in the composition of bakelite?

"(2) Is it pressed, moulded, or machined into shape?

"(3) Is it a patented process, or can it be made by anyone?" (S. B., Barnsley.)

(1) THE exact composition of bakelite is unknown. It is made by heating carbolic acid and formalin under certain conditions. A complex chemical reaction sets in between these two compounds and, ultimately, a brown powder results. This, when subjected to pressure and heat, again changes its composition and becomes transformed into the now familiar material—bakelite.

(2) Bakelite and similar materials are press-moulded, powerful hydraulic presses being employed for the purpose.

(3) Bakelite and all similar compounds have been covered by letters-patent, but some of these patents have now lapsed, and it is open to anyone having the necessary skill and experience to manufacture the material formerly covered by patents. Note, however, that the descriptive trade names are, in nearly all instances, legally registered and therefore cannot be used by unauthorised persons.

ANODISING SMALL ARTICLES

"I SHOULD be glad if you could give me a little more information with reference to your pages on 'Aluminium and Its Alloys.'

"Could I anodise articles with a small plant I have for plating and what voltage would I require? Also I have been under the impression that the bath was of chromic acid, not sulphuric. Would you kindly clear up this point for me and tell me the strength of the bath?" (K. D., Herts.)

YOU do not describe the design of your plating plant and hence we are not able to state definitely whether you could convert it successfully to anodising uses. Two types of anodising baths may be used, one containing sulphuric acid, the other containing chromic acid. In the sulphuric acid bath, the moderately concentrated acid has passed through it a voltage of between 10 and 20 volts for a period of 30 minutes. The anode consists of the article to be "anodised," the cathode comprising a strip of lead.

The chromic acid anodising bath is more complicated to operate, but, in the opinion of many, it produces better and finer results. A 3 per cent. chromic acid solution is employed. The cathode consists of a lead or iron strip, the anode again comprising the article or articles under treatment. In this bath the voltage is applied as follows:

During the first 15 minutes the voltage is slowly raised to 40 and, afterwards, it is kept at this point for a further 35 minutes. During the next 5 minutes the voltage of the bath is raised to 50 and it is maintained at this figure for a further 5 minutes, after which time the current is turned off. The bath should be maintained at a temperature of 40-45° C.

L. W. (Dalston).—We are sorry that we cannot give you a full list of the poison gases used during the Great War. You do not mention the make of the microphone so it is difficult to advise you. We recommend you to try increasing the voltage and to use wet cells. The secondary of the transformer should be joined between the grid and grid-bias battery at the correct voltage for the valves in use.

HAVE YOUR COPIES OF "PRACTICAL MECHANICS" BOUND

See the announcement on page 67!

HOW AUTOMATIC RECORD CHANGERS WORK

(*Continued from page* 93)

kick inwards, with the result that the bottom record is moved very slightly to the right. The bent spindle in the centre is not a plain one, as might be imagined from the photograph, but is notched as shown in Fig. 8. When the bottom record is given a slight kick to the right, its central hole passes over the shoulder of the spindle and the record falls downwards on to the turntable.

Another mechanism which depends upon a somewhat similar "notched spindle" is that recently introduced by Messrs. Collaro Ltd. This is shown in Fig. 9, and, unlike the mechanism already described, it will be observed that it is capable of playing a batch of records of mixed sizes. The records may be mixed in any order and the pick-up is automatically dropped into the correct position and biased into the first groove according to the size of the record just dropped.

The Collaro Mechanism

Another mechanism made by Messrs. Collaro Ltd. is not strictly similar to those already described, since it is not intended for the automatic playing of a pile of records but it deserves mention on account of its unique features. It is an automatic gramophone, but it plays single records only. To play a record, it is only necessary to push the record gently into a slot. The mechanism then draws the record right in, plays it automatically, and then pushes it partly out of the slot again. The mechanism which is shown in Fig. 9 is entirely automatic and it plays either 9-in., 10-in. or 12-in. records in any order without any pre-setting or manipulation. The construction is such that the records are treated even more gently than is possible by hand —which is certainly not true of some of the changing mechanisms.

Before drawing this survey to a close, a very brief account must be given of the Autotrope, an automatic record changer invented by John Hopwood. This is perhaps the most remarkable mechanism of its type yet produced, for it is not only capable of playing a series of no less than thirty-three records which may be of mixed sizes in any order, but, unlike any other automatic mechanism, it can play both sides of a record.

Separate Motors Employed

The mechanism is, of course, very complicated, and separate motors are employed for record playing and record changing, but the construction is such that the records are treated very gently and they are never in sliding contact with any part of the mechanism.

The records are taken from a magazine to the turntable by a traverse arm which engages with the central hole of the record, whilst the turning over of a record is performed by a pair of levers which hold the record gently by the edges. After playing, the record is delivered on its edge on to rubber buffers in the rejection chamber and it is then pushed on one side by delicate fingers.

As may well be imagined, such a comprehensive mechanism can only be sold at a luxury price. But there are always those who will pay a high price for the best, and if capacity and capability are the standards of comparison, then the Autotrope is certainly the doyen of automatic gramophones.

BUY, EXCHANGE OR SELL

Advertisements are accepted for these columns at 2d. per word (minimum 12 words at 2s.—advertisements of less than 12 words are charged at the minimum rate of 2s.), subject to a discount of 2½% for 6 consecutive monthly insertions or 5% for 12 consecutive monthly insertions. TERMS :—Cash with order. Cheques, Postal Orders, etc., should be made payable to George Newnes Ltd. *The Proprietors reserve the right to refuse or withdraw advertisements at their discretion.* All advertisements must be received on or before the 5th of the month preceding date of publication and should be addressed to the Advertisement Manager, "Practical Mechanics," George Newnes Ltd., 8-11 Southampton Street, Strand, W.C.2.

CINEMATOGRAPHY

ARTISTIC CINE FILMS. Exclusive 9·5-mm. and 16-mm. productions. List Free. Projectors, Ciné Cameras.—P.M. Dane, 64 Stanley Street, Liverpool, 1.

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

WANTED for prompt cash. Home Ciné-Cameras, projectors, films, accessories, microscopes, telescopes, binoculars, optical and mechanical goods. Mathematical and precision instruments. Small lathes. Modern cameras. Enlargers.—Frank, 67 Saltmarket, Glasgow.

MOVIES AT HOME. How to make your own Cinema Projector. Particulars free.—Moviescope (N), Pear Tree Green, Doddiughurst, Essex.

FILMS, 35 mm. of every description, from 5s.—Baers, 176 Wardour Street, W.1. Est. 1907.

CHEMISTRY

CHEMICALS and apparatus. Elementary and advanced. Bargain prices.—GRAY, 40 Grange Road, Lewes.

CLOCK MOVEMENTS

CLOCK MOVEMENTS of every description ready for cases. Lists and hints on case making post free.—Needham, 25 Stratton Road, Manchester, 16.

ELECTRICAL

ELECTRIC MOTORS, 1/10th and ¼ H.P. A.C. and D.C. 200/240 volts. New and second-hand from 35/-.—EASCO, 18 Brixton Road, S.W.9.

ELECTRIC MOTORS, large stock, guaranteed; cheap.—Electrique, 47 Pitt Street, Glasgow, C.2.

SURPLUS ELECTRICAL and Engineering Materials, low prices.—The London Electric Firm, Croydon.

ELECTRIC LIGHTING, 5/- a point; progressive wiring diagrams and instructions, 6d., materials, wholesale prices; lists free.—P. Symax & Co., 263 Lichfield, Road, Birmingham, 6.

SUPER A.C. MOTORS. New 1/10 h.p., 28/-; ¼ h.p., 36/6, 46/- and 50/-; ½ h.p., 70/-, and larger sizes.—John P. Steel, Bingley.

ENGINES

ENGINES. Build Butler's Practical Model Petrol Engine, ½-h.p., castings, 9/9. Interesting Catalogue 3d. Charging Dynamos, Boat Propellers, Sterntubes, Shafting Blocks.—Write Butler's Profit-sharing Works, Wade Street, Littleover, Derby.

FORMULAS

FORMULAS, RECIPES, SECRET PROCESSES, from shilling upwards. Lists, interesting literature, 4d. stamps. Make Money from old drained motor oil, instructions, 1/-.—"Technocraft," 41 Longford Place, Manchester, 14.

PLEASE GIVE GENEROUSLY

NOV. 11

REMEMBRANCE DAY

ASTOUNDING BARGAIN

FITTED CHESTS OF **GUARANTEED** ~~£6.6.0~~ **TOOLS**

47 Strongly Made Standard Size Tools FOR **50/-**

EVERY TOOL FULLY GUARANTEED

Offer cannot be repeated after present stock cleared.

1 Hand Saw, 24" Blade.	3 Centre Bits.
1 Tenon Saw, 10" Blade.	1 set of 3 Gimlet Bits.
1 Keyhole and Pad Saw.	1 Square.
1 Claw Hammer.	1 Axe.
1 Pin Hammer.	1 Oilstone.
2 Files (Handled).	1 Pair Pincers.
1 Rule.	1 Small Screwdriver.
1 Gouge (Handled).	1 Large Screwdriver.
3 Chisels (Handled).	1 Glass Cutter.
2 Brad Awls.	1 Spokeshave.
2 Gimlets.	1 Punch.
1 pair Pipe Grips.	1 Level.
1 pair Construction Pliers and flat grip.	1 Marking Gauge.
	1 Cork Rubber.
1 Oil Can.	2 Sheets Sand Paper.
2 Pencils.	1 Rawlplug Outfit.
1 Soldering Iron.	1 Instruction Book.
1 Tool Chest.	1 Croid Glue.
1 Smoothing Plane.	1 Tin Fluxite.
1 Brace.	

FREE To every purchaser of the "Zyto" Guaranteed Tool Chest, a handsome 7/6 cloth bound copy of "Home Repairs and Renovations."

DON'T DELAY—ORDER NOW.

List of special offers in wood and metal workers' tools free. Post 2d. Please state which you require.

S. TYZACK & SON LTD.

TOOL SPECIALISTS,

341, 343, 345 OLD STREET, LONDON, E.1.

YOU CAN USE YOUR SPARE TIME

to start a Mail Order Business that quickly brings you a full-time income. Follow the lead of others who are averaging £12 per week net profits. Get away from a drudgery routine job—join the big-money class. No previous experience necessary. Few pounds capital only needed. No samples or outfits to buy; no rent, rates or canvassing. New method makes success certain. Write to-day for FREE BOOKLET to Business Service Institute (Dept. 880c), 6 Carmelite Street, London, E.C.4.

HYPNOTISM & MAGIC

25 LONG LESSONS IN "HYPNOTISM," 2/6. "Ventriloquism," 1/-. "Parlor-Magic," 100 tricks, illustrated, 1/-. "Magic Mind-reading Slips," 1/-. (Get these and be the lion of the party at Xmas.) Professional "Mental-Telepathy" act for sale £1.—Professor Deville, 41 Longford Place, Victoria Park, Manchester.

LITERATURE

JUST IMPORTED. Latest American, Science, Mechanics, Inventions, Magazines. 6 different, 3/3. Lists free. Books, magazines, bought, exchanged.—P.M. Final, 15 Nashleigh Hill, Chesham, Bucks.

MAIL ORDER

"MAIL-ORDER Ideas" and "Directory" where to buy (both for 3/-).—"Technocraft," 41 Longford Place, Manchester, 14.

METALS

MAKE METAL TOYS. Easy, profitable with "Success" moulds. Lists free. Complete trial mould, 1/6.—LEE'S, Bentinck Road, Nottingham.

MISCELLANEOUS

"HOME TOYMAKING" just published with 180 designs and illustrations of practical fascinating toys. Posted, 1/2.—Industries (below).

ALUMINIUM MOULDS for casting lead soldiers, cowboys, etc., at home. Catalogue stamp.—Industries, 13 Gordon Avenue, Twickenham.

MODELS, tools, motors. Send for list.—Queens Engineering, 60 Queens Road, Battersea, S.W.8.

WATCH, CLOCK AND JEWELLERY REPAIRS a speciality. Materials, Tools, Invar Steel and wheel-cutting. Catalogue 6d. Shockproof Watches from 2/3 (overseas excluded). List 1½d.—Young & Son, Material Dealers, Chippenham.

MODELS

STEEL TUBING, Seamless, 1/16" to 4½", 1/32" to ½" thick. Please say lengths you cut to.—Cotes, Church Walk, Brentford, Middlesex.

EVERYTHING FOR electrical rewinds and repairs. Screws, nuts, and washers for model engineers, Lists free.—Lumen Electric Co., Litherland, Liverpool, 21.

PERFECT SECOND-HAND TOYS AND MODELS; bargain catalogue 4½d. Models purchased.—Model Exchange, 11 Friars Street, Ipswich.

MONEY-MAKING

EXCELLENT MONEY-MAKING OPPORTUNITIES constantly occurring, strongly recommended. Send stamped addressed envelope for free particulars.—Messrs. Green, 17 Church Lane, Hull.

MUSICAL INSTRUMENTS

BAND GUIDE. Hints on the Bugle, Drum, Flute, Staff Parade formation, etc. Free, post paid.—Potter's (Manufacturers), West Street, London, W.C.2.

BUY, EXCHANGE OR SELL

PATENTS

REGINALD W. BARKER & CO. (Established 1886), 56 Ludgate Hill, London, E.C.4.—Patent and Trade Mark Booklets Gratis.

PHOTOGRAPHY

"PANTOGRAPHS" make large accurate drawings from small photographs, printed drawings, etc., easily, 1/-, post free.—Cooke, 33 Hawthorn Road, Levenshulme, Manchester.

£500 worth good, cheap Photo Materials, Films, Plates, Cards, Papers, Chemicals, Catalogue and 4 Samples Free.—Hackett's Works, July Road, Liverpool 6.

DON'T TAKE RISKS. Good developers mean good results. Our reliable stock developers keep twelve months after mixing. Satisfaction certain to amateurs and professionals. Best developer ever put on the market. Makes two pints strong developer. 6d. each, 6 for 2/3, 12 for 4/-. Post free.—Hackett's Works, July Road, Liverpool 6.

SITUATIONS VACANT

POST OFFICE ENGINEERING. Good positions open to youths and men, age 17 to 30. Start £3 13s. weekly at age 17. FREE details of vacancies from N.T.O. (Dept. 307), 335 High Holborn, W.C.1.

MODEL ENGINEERS, AMATEUR MECHANICS and others experienced in fine metal work. In these days of mass production and semi-skilled workmen, you represent the only remaining body of craftsmen in hand-finished metal work. Your hobby demands skill, accuracy and attention to detail. Such experience is rare to-day, and is worth several pounds a week to you. Let us show you how you may apply this experience to a spare-time occupation for which only you are qualified. This is the most genuine and straightforward spare-time occupation ever evolved. No repetition work. It is an adaption of your own hobby, but more fascinating than your hobby has ever been. Send 1½d. stamp for particulars to: Artcraft Electrical Products, Nasec Buildings, Manchester Street, Oldham.

RADIO MEN WANTED.

Messrs. Marconis anticipate requiring 200 Marine Wireless Operators in the next few months.
TRAINING PERIOD 8/12 MONTHS.
APPOINTMENTS GUARANTEED.
TRAINING FEE CAN BE PAID AFTER SECURING AN APPOINTMENT IF DESIRED.
BRITAIN'S LEADING WIRELESS TRAINING CENTRE.
COLLEGE ON SEA FRONT. BOARDERS ACCEPTED.
WRITE FOR FULL PARTICULARS:
WIRELESS COLLEGE, COLWYN BAY.
Or London Representative, 4 WINTON AVENUE, N.11.

STAMPS

FREE !! Twenty Unused Colonials. "Neurope," 1½d. Fifty for 9d.—G. H. Barnett, Limington, Somerset.

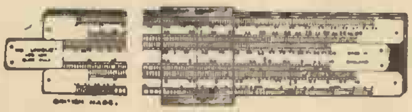
TOOLS

GRAYSON'S Glass-boring Outfits and Tube Cutters avoid risk.—Below.

DRILLS, Taps, Dies, Files, Chisels and Punches. Best quality at keenest prices.—Grayson & Company, 300 Campo Lane, Sheffield.

THE MYFORD 3-in. LATHE. Have you seen our new superior model with additional refinements. Standard model still in production. Economical in first cost. Generous in design. Proclaimed best value on the market. Write for illustrated list and instruction booklet, or ask your local Tool merchant.—Myford Engineering Co., Neville Works, Beeston, Notts.

BRITISH MADE
UNIQUE SLIDE RULES
5/- 3/6 6/6

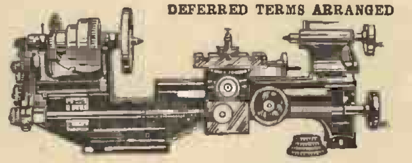


ACCURACY GUARANTEED.

Ten-inch Slide Rule in Polished Mahogany, celluloid faced with log-log scale in addition to Scales, A. B. C. and D. Flexible back. Aluminium framed, view free unbreakable cursor. Size of rule 11½ ins. x 1½ ins. Serviceable as 21/- model. Supplied with case and full instructions, including conversion Tables for Money Calculations. Price 5/- each (post 3d., 3 post free). 5-in. model 3/6 (postage 2d.). 10-in. Universal rule with additional Trig and Reciprocal Scales 6/6 (postage 3d. extra).
THE TECHNICAL SUPPLY CO. (P.M.). Norfolk House, Carden Avenue, Brighton 6.

BE TALL Your Height increased in 14 days or money back. The amazing Stebbing System soon brings 3-5 inches increase and new energy. The first, original and the one GENUINE GUARANTEED Height Increase System. Recommended by *Health and Efficiency*. Complete Course 5/-, or Booklet free, privately
STEBBING SYSTEM, Dept. M.P., 28, Dean Rd., London, W.1

DEFERRED TERMS ARRANGED



"IDEAL-LATHES"
3½ in. S.C.B.G. from £7/18/6. LISTS, Stamp please.
J. WILLIMOTT & SON, Neville's Factory, Chilwell, Notts.

NERVOUSNESS

Every nerve sufferer should send for my interesting book, which describes a simple, inexpensive home treatment for Self-consciousness, Blushing, Depression, Worry, Insomnia, Weak Nerves, Morbid Fears, and similar nervous disorders. This wonderful book will be sent in a plain sealed envelope to any sufferer without charge or obligation. Write NOW and learn how to conquer your nervousness before it conquers you!
HENRY J. RIVERS (Dept. K.D. 6) 40 Lamb's Conduit St., LONDON, W.C.1

MAKE MORE MONEY

£3 to £6 weekly can be earned at home in a wonderful business of your own. No matter where you live you can commence to make money in your spare or whole time. No risk, canvassing or experience required. A wonderful opportunity for anyone wishing to add pounds to their income. Particulars, stamp.
BALLARD, York House, 12 Hambrook Rd., LONDON, S.E.25

FREE ADVICE BUREAU
COUPON
This coupon is available until Nov. 30th, 1936, and must be attached to all letters containing queries.
PRACTICAL MECHANICS, NOV., 1936

TOOLS (*continued*)

NEW POWER TOOLS. 10-in. Bandsaws, 50/-; Jig Saws, 21/-; Bench Drills, 22/6; Circular Saws, Electric Drills, Grinders, Spray Plants, Guns, Air Compressors, etc.—John P. Steel, Bingley.

A.J.W. Gas blowpipes. Invaluable for soldering, brazing. Sample 3/-, approval.—WRIGHT, 10 Mitchell Street, E.C.1.

3 Tons Bright Steel Wood Screws, ¼" to 3" long, a special quick clearance offer, 3 lb. assorted 2s. 6d.; very good value.—Below.

Genuine "Crown" Lathe Chucks, self centring, precision quality guaranteed accurate. Two sets hardened and ground steel jaws, 3", 26/6; 4", 29/6; 5", 36/-; 6", 42/-; 7½", 50/-; 9", 65/-; 10½", 80/-; 12", 105/-. Carriage paid.—Below.

160 Large End Mills, ⅝" to 1½" diameter, clearing at 3 for 4s. 6d.; Nos. 2 and 3 Morse Taper Shank.—Below.

120 Bundles Silver Steel, 1/16" to ⅜", diameter, 16 assorted pieces, 13" long, 4s. bundle.—Below.

Independent Chucks, four reversible steel jaws, best quality, heavy engineers' pattern, 6", 45s.; 8", 57s. 6d.; 10", 72s. 6d.; 12", 90s.; 14", 105s.; 16", 125s.—Below.

Independent Chucks, amateur, light pattern, suitable for small Lathes, Four Reversible Jaws, Hardened and Ground. Fully guaranteed, complete with Key and Face Plate Bolts, 3", 18s. 6d.; 4", 24s.; 6", 32s. 6d. each.—Below.

20 Only 1" Micrometers, decimal equivalents marked on frame, usual price, 27s. 6d. each, an opportunity, 16s. 6d. each, all complete in plush-lined case.—Below.

1" to 2" Micrometers, 23s. 6d.; 2" to 3", 30s.; 3" to 4", 36s.; special quotation for full set High Class Micrometers, 0" to 6", complete on polished wood stand.—Below.

Drilling and Milling Machine Vices, a quantity for disposal at extremely low prices. Send for illustrated lists.—Below.

500 Lathe Tool Holders, ⅜" Square Shank, suitable for Lathes up to 4". Fitted with Super High-speed Tool, 1s. 9d. each, worth double.—Below.

300 Boring Bar Tool Holders, ½" Square Shank, ⅜" Round Adjustable Bar, 3s. 9d. each.—Below.

150 Genuine Norton Grinding Wheels, saucer shape, suitable for small tool and twist drill grinding, 4½" dia., ⅜" thick, ⅞" hole, 1s. 6d. each, 15s. doz.; also 6" dia., ½" thick, ½" hole, 2s. 3d. each.—Below.

30 Bundles Bright Mild Steel, round, ⅜", ⅝", ¾", 1" dia. in 5' to 6' lengths, 10s. per bundle.—Below.

600 High-speed Centre Drills, three assorted sizes, small to medium, suitable for model makers, 1s. for three.—Below.

3 Tons Best Sheffield Files, Flats, Half Rounds, Square, Rounds, in rough and second cut sizes, 6", 8", 10", 12". This is a very special bargain offer, wonderful value, three dozen assorted, 10s.; also large files, 14", 16", 18", dozen assorted 8s. 6d., carr. forward.—Below.

250 Bundles Bright Drawn Mild Steel, approx. 5" length each piece, sizes ⅛", 5/32", 3/16", 7/32", ¼", 9/32", 5/16", ⅜", 7/16", ½" round, 5s. 6d. per bundle of 50; also Square Bright Steel, sizes ⅛", 3/16", ¼", 5/16", ⅜", 7/16", ½", 5" lengths. 6s. bundle.—Below.

5,000 Small Slitting Saws, ⅞" dia., 1/32" thick, clear at 2s. per doz.—Below.

2,000 Slitting Saws, 2¾" dia., 1" hole, 1/64" to ⅛" thick, six assorted, 3s. 6d.—Below

1,300 Sets Hexagon Die-Nuts, Sheffield made, Whitworth, B.S.F., also American thread, U.S.S. and S.A.E. suitable for Ford and other American cars ¼", 5/16", ⅜", 7/16", ½", worth 7s. set, our clearing price, 2s. 9d. set; all the above four sets, 10s. lot.—Below.

300 Drill Chucks, takes to ¼", three jaws. No. 1 Morse taper shank or ½" straight shank, 2s. 9d. each.—Below.

500 Gross Tungsten Steel Hacksaw Blades, 8", 9", 10", 12", 1s. 3d. per doz.; 12s. per gross; also Machine Blades, 12" × 1", 2s. doz.; 20s. gross; 14" × 1", 3s. doz.—Below.

1,200 Best Quality Straight Shank End Mills, standard sizes, ¼", 1s. 3d.; 5/16", 1s. 4d.; ⅜", 1s. 6d.; 7/16", 1s. 9d.; ½", 2s. each. All right-hand, suitable for use in lathe.—Below.

800 Sets 1" Circular Dies. Screwing ¼", 5/16", ⅜", 7/16", ½", Whitworth and B.S.F. Clearing at 2s. 9d. per set. Both sets 5s. Die stocks to suit 1s. 9d. each.—Below.

BUY, EXCHANGE OR SELL

TOOLS (*continued*)

5,000 Small Grinding Wheels, suitable for Flexible Shaft use, etc., ⅜" to 1" diameter, assorted thicknesses, etc., brand new, unused, 2s. per dozen.—Below.

60 Only, Genuine Norton Grinding Wheels, suitable for general shop use, 9" dia., 1" wide, 1" hole, 4s. 9d. each, also few 1½" wide, 5s. 9d. each.—Below.

1,000 Fine Emery Wheels, 2" to 4" dia., ⅜" hole, ⅛" to ½" thick, slightly used, but quite serviceable, 1s. 6d. per doz.—Below.

10s. Orders Carriage Paid except where stated otherwise, steel bars and files carriage extra.—J. Burke, 30 Trippet Lane, Sheffield.

WATCH MAKING

WATCH AND CLOCK REPAIRS. Everything for the watch, clock and model maker. Large stock of watches, clocks, and clock movements, etc. Wholesale prices. List 3d.—BLAKISTON & CO., Ainsdale, Southport.

CATALOGUE, 7th edition, post 3d. Book on Watch or Clock Cleaning and Repairing, 1s. 6d., post 3d. Guaranteed Watch, Clock, Optical and Jewellery Repairs, Wheels and Pinions cut. Clock and Watch dials restored Unbreakable glasses fitted. Per Return Service for Tools, Materials and small jobs.—D. Coburn, 47 Red Lion Street, Clerkenwell, London, E.C.1.

JOHN MORRIS, Clerkenwell, Ltd., Expert watch and clock makers, complicated work and new parts to all Watches and Clocks. Jewellery repairs. Estimates free.

JOHN MORRIS. Best house for all Tools and Materials. Wheel and Pinion cutting. Stamp for list, 64 Clerkenwell Road, E.C.1.

WOODWORK

CABINET HARDWOODS, Oak, Mahogany, Ash, Whitewood, Ply-woods, etc. Lowest Prices. Send Cutting lists. Planing free. Speciality Prime Jap Oak, all thicknesses.—Wilfred Parr & Co., March Works, Lancaster Road, Leytonstone, E.11.

FREE SERVICE FOR READERS

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

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

Post this to

ADVERT. SERVICE DEPT.,
PRACTICAL MECHANICS,
8-11 SOUTHAMPTON ST., STRAND, W.C.2

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

Advertiser	Page No.	Information Required

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

All applications respecting Advertising in this Publication should be addressed to the ADVERTISEMENT MANAGER, GEORGE NEWNES LTD., 8-11 Southampton Street, Strand, London, W.C.2. Telephone: Temple Bar 4363.

"I'll PROVE in Only 7 Days that I Can Make YOU a New Man!"

No other Physical Instructor in the World has ever DARED make such an offer!

— Charles Atlas

Holder of the title "The World's Most Perfectly Developed Man." Won in open competition in the only international contests held during the past 15 years.

I HAVE proved to thousands that my system of building powerful, big-muscled men begins to show real results *in only 7 days*—and I can prove it to you.

You don't have to take my word for it. You don't have to take the word of my thousands of pupils who have added inches of muscle to their chests, biceps, neck, thighs and calves in only a few days. No, sir! You can prove for *yourself*—in just one week—by the change you see and *feel* in *your own body*—that you can actually become a husky, healthy NEW MAN—a real "Atlas Champion."

All I want to know is: Where do *you* want big, powerful muscles? How many pounds of firm flesh do *you* want distributed over your body to fill you out? Where do *you* lack vitality, pep, and robust health? Where do *you* want to take off flabby, surplus fat?

Just tell me, and even in one week I'll show you that I can make a *New Man* of you, give you bodily power and drive, and put you in that magnificent physical condition which wins you the envy and respect of any man and the admiration of every woman.

My own system of *Dynamic-Tension* does it. That's the way I built myself from a 7-stone weakling to "The World's Most Perfectly Developed Man." And now *you* can have a big, balanced muscular development like mine in the same easy way.

I've No Use For Apparatus

You begin to FEEL and SEE the difference in your physical condition at once, without using any tricky weights or pulleys that may harm your heart and other vital organs. I don't "dose" or doctor you. My *Dynamic-Tension* is a *natural* method of developing you *inside and out*. It not only makes you an "Atlas Champion," but goes after such conditions as constipation, pimples, bad breath, and any other conditions that keep you from really enjoying life and its good times—and it starts getting rid of them at once.

Let DYNAMIC-TENSION Do The Work

What my system did for me, and hundreds of others, it can do for you, too, and it's easy my way—*Dynamic-Tension* does the work! Don't keep on being only half of the man you *can* be! Find out what I can do for you.

Gamble a stamp to-day by posting the coupon for a free copy of my new illustrated book, "*Everlasting Health and Strength*." It tells you all about my special *Dynamic-Tension* method. It shows you, from actual photos, how I have developed my pupils to the same perfectly balanced proportions of my own physique, by my own secret methods.

CHARLES ATLAS
as he is to-day

CHARLES ATLAS, Dept. 10-L
Shell-Mex House, London, W.C.2

I want the proof that your system of *Dynamic-Tension* will make a New Man of me—give me a healthy, husky body and big muscle development. Send me your book, "*Everlasting Health and Strength*." FREE.

Name ....
(Please print or write plainly.)

Address ....

....

48-Page Book FREE

It tells you all about my DYNAMIC-TENSION method, and what it has done to make big-muscled men out of run-down specimens. What my system did for me and these hundreds of others it can do for you, too. Don't keep on being only half of the man you CAN be! Find out what I can do for you. There is no cost or obligation of any kind—and no one will call on you. Where shall I send your copy of "*Everlasting Health and Strength*"? Put your name and address on coupon, and post it to-day. CHARLES ATLAS, Dept. 10-L, Shell-Mex House, London, W.C.2.

Published about the 30th of each month by GEORGE NEWNES, LIMITED, 8–11 Southampton Street, Strand, London, W.C.2, and Printed in Great Britain by HAZELL, WATSON & VINEY, LTD., London and Aylesbury. Sole Agents for Australia and New Zealand—Gordon & Gotch Ltd. Sole Agents for South Africa—Central News Agency Ltd. Subscription Rates: Inland and Abroad, 7s. 6d. per annum; Canada, 7s. per annum.