MARVELS OF THE "MONOTYPE" MACHINE

NEWNES

PRACTICAL MECHANICS

FEBRUARY 1939

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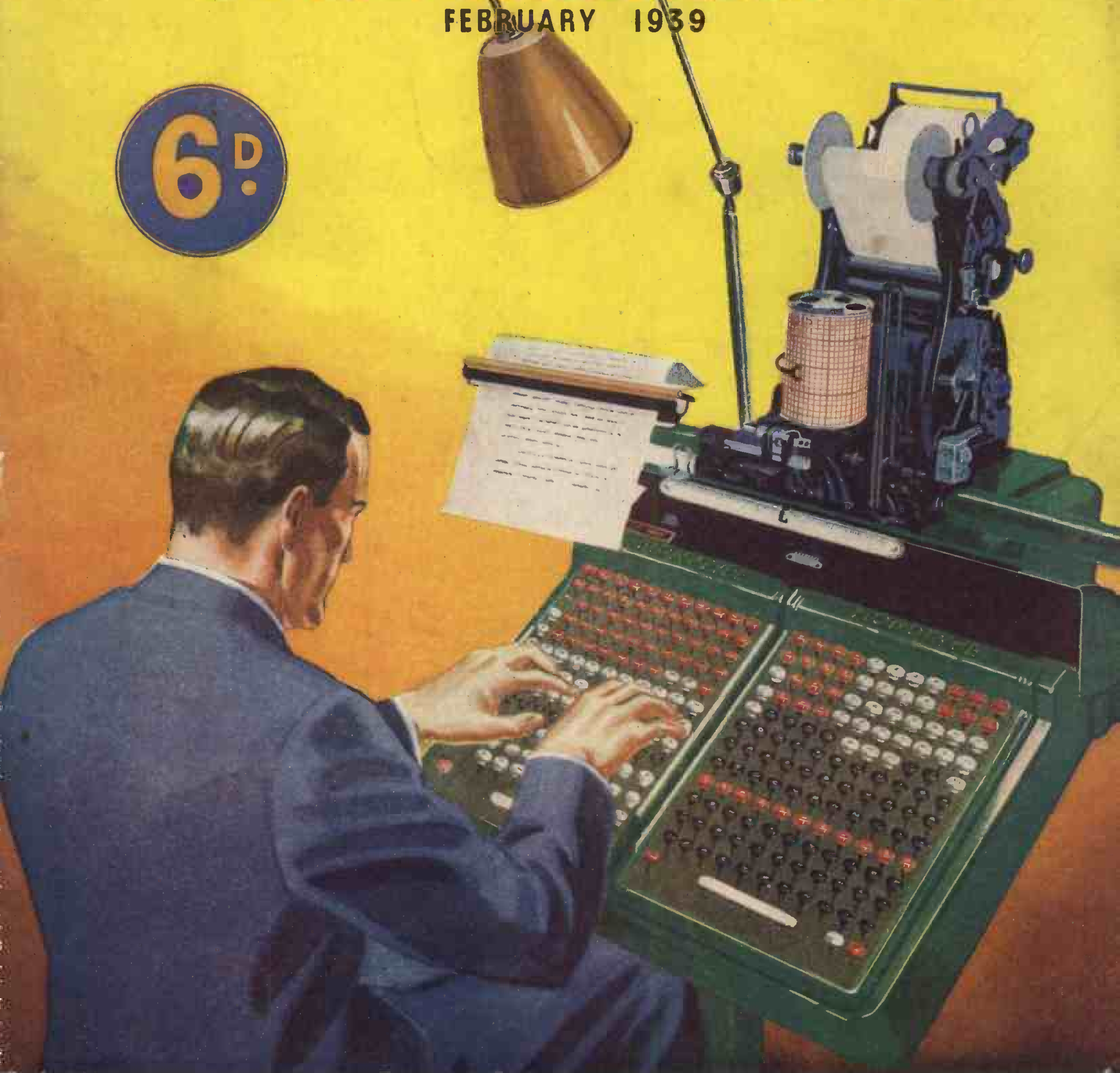

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PRACTICAL MECHANICS

Editor : F. J. CAMM

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FAIR COMMENT

Is There More Room At The Top?

By The Editor

Skill and its Reward

THE industrial and political events of the past few months have revealed a situation in this country which is both grave and urgent. It is not the policy of PRACTICAL MECHANICS to enter into any political controversy, and my remarks must not be taken as having political bias. I am referring, as I have referred on a number of previous occasions, to the extreme lack of skilled labour in this country, and the remissness of those to whom the matter should be of the greatest moment, in not instituting methods to remedy this disastrous state of affairs.

The plain fact is that there is not enough skilled labour to go round, and as I see it, if this shortage is not remedied the pendulum will swing the other way, and the largest salaries will be commanded by those with practical skill. It would be idle to deny that the majority of young men to-day with a higher standard of education than was possessed by youths of similar age twenty-five years ago, train for the higher posts, and presume that they can short-circuit the hard work of starting at the bottom. They have applied that mis-used adage, "There is more room at the top" to mean that they should, from a most early age, endeavour to obtain posts normally filled by those with from fifteen to twenty years' experience of all branches of the particular industry or profession they wish to enter.

The Youth of Today

THE proverb I have quoted is intended to mean that there is more room at the top for those with the necessary experience. Too often an individual is content to remain at the bottom and makes no effort to gain that additional knowledge and experience which will lift him stage by stage to the better-paid position. Most people to-day seem to be training for the top, with the result that the top is somewhat overcrowded, and that most of the opportunities occur at the bottom. A youth who wishes to start engineering by avoiding a works training, and going straight into the drawing-office is, in my opinion, destroying the possibilities of promotion. Unless you have a knowledge of the fitting shop, the lathe, the drill press, the tool room, the foundry, the pattern shop, the sheet metal shop, milling machine, the planers and shapers, you cannot design successfully.

We must admit, too, that the old order of considering that manual labour was something of which to be ashamed, has passed. We must encourage those who have obtained General School Certificates, those who have matriculated, and those who have qualified for B.Sc., to go through the works. It is true that in some industrial circles our young men are not set a very good example. Almost daily we see examples of people given first-class positions in works because of "influence," even though they have no knowledge of the job. This holds true for engineering as well as for other industries. Few Government leaders have experience of the departments they are expected to direct. The recent crisis has shown that that game is up, and that in future, men will be selected because of their special ability to do a particular job. Had that been so, indeed, it is possible that a crisis would not have arisen. The A.R.P. and Balloon Barrage farce is a typical example of incompetence.

Demand Will Increase

THE demand for skilled labour will increase intensively during the next few years, and it is my advice to those with ambition to take up a course of practical training and thoroughly to master the elements of a job before aspiring to the higher posts. You can never satisfactorily fill a higher post unless you have an intimate knowledge and understanding of the lower. A designer cannot be successful unless he has a knowledge of the machines, and the factory equipment which will ultimately turn out the article he has designed. The Works Manager cannot manage a works unless he has been through it. The buyer will not be able to buy in the keenest markets nor purchase the best material unless he has practical training.

Works directors on their side must encourage the individuals who are prepared to indulge in this intensive training by selecting for the better posts those who possess it. Such a practice would be most stimulating in their business, and on the contrary the selection of an individual because he is a relative of the foreman, or the son of some titled person, will act as a deterrent to those with ambition employed in the same organisation.

I said at the commencement of this article that the matter was a grave one, and I am so certain of what I write and I feel so strongly on the matter, that I urge my readers to act in accordance with the advice I have given. In future I am positive that the best jobs will only go to those with the necessary ability. Possess yourself of that ability and your future is assured. Do not neglect your studies in the pious hope that some "influence" will see you through; and remember that even though you do gain a temporary advantage by some influence, once that influence is removed your job will go with it.

THE MONTH IN SCIENCE AND

Reading the "radio-edition" of the "St. Louis Post-Dispatch" "hot" off the receiver.

Newspaper Transmitted by Radio

WHAT is claimed as the world's first radio newspaper has made its appearance. In Missouri, U.S.A., the *St. Louis Post-Dispatch* have broadcast their first edition. Details of experimental transmissions were, however, given in "Practical Mechanics" dated May, 1938.

After months of experiments, they installed receiving sets in the homes of many of their employees. The first edition consisted of nine pages, 8½ in. long, and four columns wide, using the newspaper's regular type. On the first page were the leading articles of the day, then followed sports news, several pages of pictures, the editorial cartoon, a summary of radio programmes, and a page of financial news.

The original copy of the facsimile newspaper, after being printed by normal process, was placed one page at a time on the transmitting apparatus, the cylinder of which revolves at the rate of 75 times a minute. As it revolves, a small beam of light no larger than a pin point and a photo-electric cell, commonly known as an "electric eye," moves across the page. The amount of reflected light reaching the "electric eye" varies with the black and white pages of type and with the depth of shading in the photographs. The light variations control the amount of electric current flowing through the "electric eye." The varying electric current is amplified by the transmitter and the outgoing radio waves change in intensity with the reflected light of the copy in the electric "eye."

The aerial of the receiver set in the home picks up these waves. The illustration on this page shows an employee reading the "radio edition" of the *St. Louis Post-Dispatch* "hot off the receiver." The paper is broadcast in such a way that it can be read in the same way as the normal newspaper. It is unnecessary for the reader to be on hand during the broadcast, as the set switches on at a scheduled time and stops at the end of the broadcast, taking 15 minutes to transmit one page.

The "Drunkometer"

IT is no good telling the chief of police in Evanston, Illinois, that you haven't been drinking if it is a lie, for he has an uncanny machine called the "drunkometer" that will prove the lie. You are required to blow up a toy balloon, and the breath in the balloon is then sent through a red fluid. If you have had a drink the fluid turns proportionally lighter in colour until, if you are drunk, the liquid turns colourless.

The machine is the invention of Dr. R. Harger, of the Indiana College of Medicine, and is in use in the Evanston Police Department.

The first all-welded armour-plated tank, which can travel at 114 m. p. h. on a level road.

A Radio Robot

THE first all-wireless robot with "aerials growing out of its ears," and its interior a mass of mechanism, has recently been perfected by Mr. A. Huber, a Swiss engineer of Niederteufen, in the Canton of Appenzell, after 10 years' work.

The robot, which is fitted with an ultra-short wave receiver, performs actions from commands received by radio from many miles away, and answers to questions delivered in person to the robot and picked up by a far-distant microphone. In addition to the aerials which seem to grow out of the ears, microphones are also fitted inside the ears. Batteries concealed in the legs supply current for the twenty motors with which the robot is equipped, and which enable it to walk, talk, sing or yodel. The robot's lips synchronise with its speech, and this seven-foot marvel weighs 400 lb.

A Speedy Monster

AMERICA'S latest is the introduction of the first all-welded armour-plated tank, which will travel at the rate of 114 miles an hour on a level road, and will reach a speed of 78 miles an hour over a rough road.

The tank weighs 10,000 lb. complete, and is 2,000 lb. lighter than the present conventional type U.S. Army tank. The machine carries one driver, a machine gunner and a cannoner. Besides machine guns, it carries an anti-aircraft gun, which is capable of piercing a 1-inch armour plate 500 yards away.

Giant Gas-grid Pithead Plant

MORE than 4,000 tons of coal a week, providing employment for 570 miners, will be the capacity of an immense pithead gas-producing plant—one of the largest of its kind in the world—on which construction has been begun by the £4,700,000 United Kingdom Gas Corporation at Hemsworth, Yorkshire.

This gas production unit, which will cost £350,000 to complete, will mark the first major step towards the establishment of a vast underground Gas Grid serving nineteen thickly populated areas in Yorkshire. In the first stage alone this Gas Grid will represent a total capital investment of well over £2,000,000, and will form the nucleus for a system that may eventually extend throughout Great Britain.

With this scheme it is hoped to provide the means for making industry in this country not only entirely independent of imported fuel supplies, but immensely more economical through the use of the more efficient gas fuel.

The Hemsworth carbonising unit will comprise a battery of 28 huge silica ovens arranged in parallel series. In these the coal is distilled. Coal will be carried straight from the pit washeries to eight huge 200-ton bunkers adjoining the ovens, from which it will be automatically fed to crushing mills and thence conveyed in the form of fine dust to an immense 1,000-tons master bunker. From this master bunker the coal will be fed into the carbonising ovens, to emerge as gas, smokeless fuel, coke in graded sizes, tar, benzole, ammonia, sulphur, disinfectant fluids, and many other valuable by-products.

The main function of the Hemsworth undertaking, which will be followed by the erection of sister pithead plants in the Grid area, will be to produce, by the most efficient and economical methods, coal gas of pure and consistent quality, and to pump it through high-pressure pipe-lines to the sixteen distributing centres which form the key points of the Grid. The distributing centres will in turn supply it, with their own output, to industrial and domestic consumers in their areas. The initial Hemsworth capacity, geared to suit the industrial response to the Grid plan, will be some 8,500,000 cu. ft. a day.

According to present plans the Hemsworth plant will be completed in the early spring. In layout and outward appearance it will be one of the most modern and attractive plants in the country.

The Radium Problem

BECAUSE he has spent £500,000 on the purchase of radium, the Minister of Health has come in for a good deal of criticism. The main reason for this is that he has made no provision for research into the radio active substances which are being used so successfully in the United States.

A promising substitute for radium is the use of neutrons, which are produced by the cyclotron machine. There are only two of these machines in use in this country, one at Cambridge and one at Liverpool, and they cost £25,000 to build. Large quantities of neutron beams can be produced easily on these machines.

New Air Liner

THE Fairey Aviation Co., of Hayes, Middlesex, are constructing what is considered to be the largest and fastest air liner in the world. It is for use on the British Airway's South Atlantic service, which, by the summer of 1940, will be in regular operation.

The range of the machine will be such that it will be able to fly to any European capital non-stop, and will have a top speed of about 275 m.p.h. At 10,000 ft. it will have a cruising speed of 220 m.p.h. Sealed pressure passenger cabins suitable for sub-stratosphere flight at 25,000 ft. will be incorporated in the new liner, and it will accommodate 30 passengers. The weight of the machine fully loaded will be about 70,000 lb., and it will be fitted with four 1,800-2,000 h.p. engines.

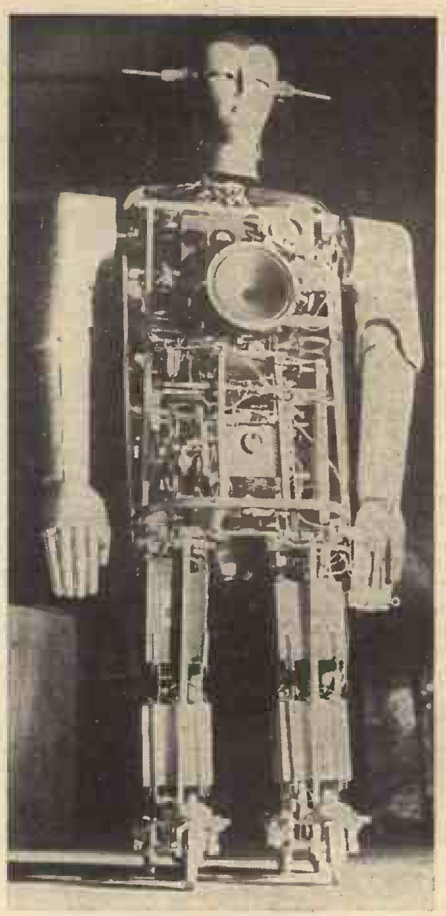
A low-wing all-metal stressed skin monoplane, the craft is fitted with a retractable tricycle undercarriage.

Fire-fighting Equipment

A DEMONSTRATION of a new compressed air-breathing apparatus by the London Fire Brigade was recently held at the Fire Brigade Headquarters in London.

This apparatus, which is widely used on the Continent, especially in France, consists of a face mask into which air is fed at a pre-determined rate from two cylinders carried on the back of the wearer. The present apparatus now in use is of the oxygen type.

THE WORLD OF INVENTION



With aerials growing out of its " ears " and its interior a mass of mechanism, this modern marvel is the first all-wireless robot.

The new compressed air apparatus (right), compared with the old oxygen type (left) at a demonstration at the Fire Brigade Headquarters in London.

A Turbo-alternator

AN order for a 20,000-kilowatt Brush-Ljungstrom turbo-alternator, costing approximately £70,000, has been secured by the Brush Electrical Engineering Co., Ltd., Loughborough, from the Halifax Corporation.

Work has already begun on the construction of this machine. It has been specially designed for the Corporation's power station extensions to the order of Mr. G. A. Vowles, engineer and manager, and will be installed there for augmenting the electricity generation supply at a rate of anything up to 400,000 units a day, or sufficient to supply 292,000 domestic consumers. Industrial and other large-scale users would, of course, absorb most of the output.

A noteworthy principle of the Brush-Ljungstrom is the provision of two steam rotors revolving in opposite directions, as a result of which the relative speed of the blades is made equal to twice the running speed, and so an enhanced efficiency is achieved.

A Marine Trailer

EVERYBODY has seen on the roads, during the summer months, caravans trailing along behind a car, these caravans when a suitable spot is reached are disconnected from the car, and sleeping quarters for as many as four adults is provided.

Now a New York boat-building firm are putting on the market a marine trailer. Normally to live on the river would necessitate the use of a large motor-boat, whereas these trailers, fitted with two large cabins, bathroom, with shower and large closet, an electric lighting plant, and a freshwater tank of 1½ tons capacity, with a length of 30 feet and a width of 8 feet, can be towed along by a small tender fitted with an outboard motor, and will be much cheaper than a motor boat with the same accommodation.

U.S.W. Radio-Phone

THE efficiency of the experimental radio link between Belfast and Stranraer, which is of the 9-channel type, has resulted in the Postal Authorities placing an order with Standard Telephones and Cables and Le Matériel Téléphonique for a similar but improved system for communication across the English Channel. Each group of 9 circuits will have independent aerial systems designed to give a gain of approximately 18 db. over the normal half-wave aerial. The aerial will be polarised vertically for England-to-France transmissions and horizontally for the opposite direction. The transmitters will be remote-controlled from repeater stations.

New Astronomical Camera

THE strongest astronomical camera in Europe has just been put into service at the Sonneberg Observatory, Thuringia, Germany. The new instrument, made at the Zeiss works, is a marvel of the German optical industry, and with it it is possible now to photograph stars so far only achieved in U.S.A. The new Zeiss instrument has a focal distance of 1.6 m. and takes a 30 by 30 cm. photographic plate. For convenience in operation and in following the daily movements of the stars, the tube of the camera is set up on a specially designed mounting running on ball bearings and standing on a knee-shaped column. The automatic movement is achieved with the aid of an electric motor controlled by an astronomical clock. The inventor of this giant new camera is Dr. August Sonnefeld, of Jena.

Danish Ship-to-Shore Radio

A NEW installation has been ordered by the Danish Post Office for use at station OXB, to maintain communication between the shore and ships at sea. The new station will have five wooden masts located half a mile from the three masts now in use. There are four transmitters in the new station, the main telegraphy transmitter operating on the 400-850 metre band with a power of 900 watts. In addition there is a stand-by telegraphy transmitter of 500 watts. The telephony transmitter has an output of 500 watts with a 60-watt standby unit.

A SUN-DRIVEN MOTOR

Development of such a motor, which is Driven by the Force of Light Rays, paves the way for Greater Things with the Photo-electric cells which make this possible

SUFFICIENT electric energy to operate an electric motor can be obtained directly from sunlight with a new photo-electric cell, far more sensitive than usual ones of its type, that has been produced in an American research laboratory. Even the light from an incandescent lamp, falling on such cells is sufficient to operate the motor.

Four of the cells, connected together, operated a motor that is rated at four ten-millionths of a horse-power. Enough light energy is converted into electricity when a 75-watt incandescent lamp is lighted at a distance of 8 inches from the cells so that the motor, using three ten-thousandths of an ampere of current, turns at good speed.

Selenium Cells

THE photo-electric cells are of the selenium type, with light-sensitive surfaces which measure approximately two square inches each in area. Over the selenium is a film of platinum, so thin as to be semi-transparent. This film decidedly increases the sensitivity of the cell in its response to light. Such "cells" differ from photo-electric "tubes" in that the cells convert light energy into electric energy, whereas photo-electric tubes do not themselves generate electricity but instead, control the amount of current permitted to flow through them according to the amount of light they receive. The efficiency of the photo-electric cells is of such order that one watt of power can be obtained from about 20 square feet of cell area in direct sunlight. The cells have about 20 per cent. of their effectiveness in the ultra-violet region, and the remainder in the range of visible light.

Jewel Bearings

THE motor, direct-connected to the cells, is of special construction, with jewel bearings and other features to reduce frictional and other losses to a minimum.

In the laboratory the cells have been connected in parallel when used to operate the motor with incandescent light, and in series when used in sunlight.

The speed at which the motor turns depends on the amount of light, received by the cells. Direct sunlight whirls the motor at about 400 revolutions per minute, but even sky light on a cloudy day through a laboratory window is sufficient to turn the motor rapidly.

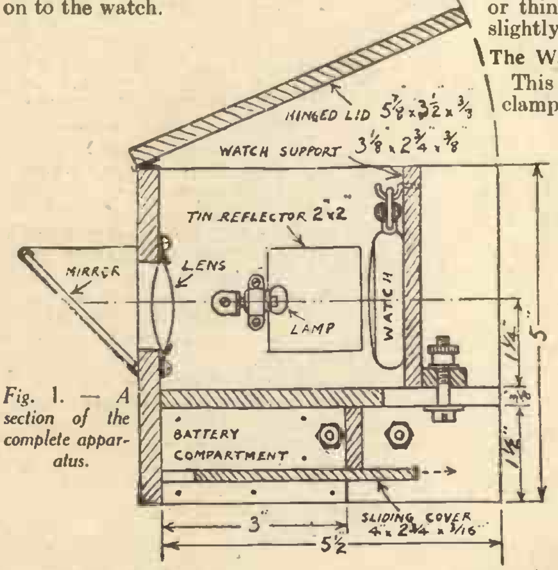
No practical applications for the sun-driven motor have been undertaken, for its rating of four ten-millionths of a horse-power—which might be likened to one flea-power, or less—is too low to be of immediate practical use. There remain, however, many practical applications of the photo-electric cell itself.

Dr. Hewett, an American research engineer, demonstrating the "sunlight" motor. It is four ten-millionths horse-power.

PROJECTING
Time on the Ceiling

An Ingenious Watch Stand Which Throws An Enlarged Illuminated Image Of The Watch And Time On The Ceiling

THE object of this contrivance is to throw an illuminated image of your watch, much enlarged, on to the ceiling, so that as you lie in bed, wondering whether it is time to get up, you can see the time with a minimum of inconvenience simply by pressing a pear switch which may be kept under the pillow. This switch is connected by means of a yard or so of "flex" wire to the apparatus (shown in Fig. 1) which stands upon a bedside table. The watch is simply hung up on its hook, and when the button of the pear switch is pressed two small lamp bulbs, worked from an ordinary flashlamp battery, shine on to the watch.



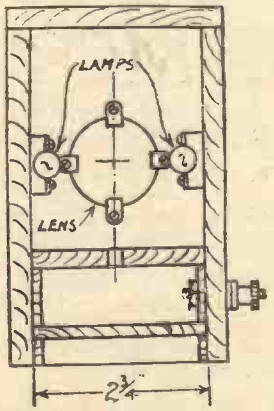


Fig. 1. — A section of the complete apparatus.

Focused on the Ceiling

A lens arranged right in front of the watch face focuses a picture of the dial and hands on to the ceiling, the light being bent upwards by means of a mirror. Focusing is done by sliding the watch support to and fro until a sharp image is thrown on to the ceiling; once this is done, the focus is always correct, unless a watch of different thickness is used, or unless the distance to the ceiling is altered by placing the apparatus on a higher or lower table.

The body of the apparatus should first be made of ⅜ in. wood to the dimensions given in Fig. 1. If wood of a different thickness is used, be careful to modify the dimensions where necessary to allow for this. The sliding cover for the battery compartment works in a groove formed by tacking ⅛ in. wood on to the side walls, the space between two pieces of the ⅛ in. wood forming the groove. Most amateurs will find this easier than cutting a groove.

For the lens use a small reading glass, about 1¾ in. diameter and about 4 in. focus. Such a glass in a celluloid holder can be obtained from a chemist's shop for about a shilling. If one of these is used, the holder should be discarded and the plain glass fitted into place, as shown in Fig. 1, by means of four small clips of brass or thin wood. The lens hole should be slightly smaller than the lens, of course.

The Watch Support

This is quite a simple affair. It is clamped in position by means of a single bolt with a knurled nut, and this bolt works in a slot in the floor of the watch compartment so that the watch support can be moved backwards or forwards to its correct location. A small nick should be cut across the top edge for the chain, which hangs outside; this avoids detaching the watch from the chain every night. Care should be taken when fixing the hook that the centre of the watch comes right opposite the centre of the lens.

Two ordinary flashlamp bulbs are used for illumination, one on each side. They should be about half way between the lens and the watch; if too close to the watch the illumination will be uneven, while if the lamps are too far away the light may not be bright enough.

You may either buy two suitable screw lamp holders or you can fix the lamps as shown in Fig. 2. This sketch explains itself, and the arrangement is quite simple and effective. A flat piece of bright tin screwed to each side of the watch compartment as shown in Fig. 1, will make a good reflector and improve the illumination.

The Mirror

The mirror is arranged opposite to the lens on the outside and is held in position by means of the support shown in Fig. 3. This is cut out of thin sheet metal bent to shape and screwed into the required position. The mirror itself should be cut to the correct size—by means of a wheel cutter or a diamond—after the support is screwed into place, and held in position by means of the two lugs shown in Fig. 3, which are bent over the edge of the mirror as indicated. The mirror should be of good quality flat glass, for some cheap mirrors have a more or less undulating surface, which in this case would spoil the sharpness of the picture on the ceiling.

Two terminals are required, and these should be fitted into the position shown by Fig. 1, while Fig. 4 is a part sectional plan showing how the battery connections are arranged. The short brass strip from the battery is bent so as to press directly on to one terminal, while the other battery strip is bent over to press against a special contact plate.

Wiring up is the final operation. Use insulated wire of about 22 gauge, and be careful to scrape off the insulation at the connections so that a good metal-to-metal contact is obtained. Connect a wire to each of the brass angle pieces which press against the central connections of the lamps, run these wires neatly through holes in the bottom of the watch compartment, and connect the other two ends to the contact plate shown in Fig. 4. The connections may be made simply by pushing the bare ends of the wire under the plate and screwing the latter down tightly. Now connect a wire to each of the strips which clamp the lamps in place (Fig. 2), and run both of these wires to the terminal (outside the battery compartment).

This completes the apparatus except for finishing, and this is left to the reader's own ideas.

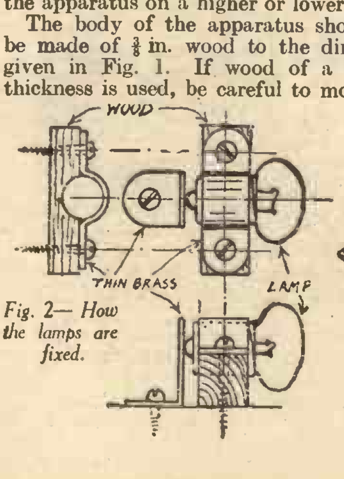


Fig. 2— How the lamps are fixed.

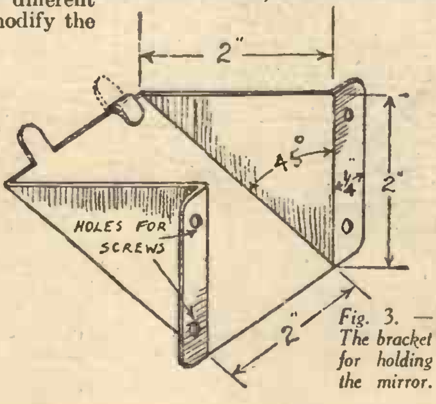


Fig. 3. — The bracket for holding the mirror.

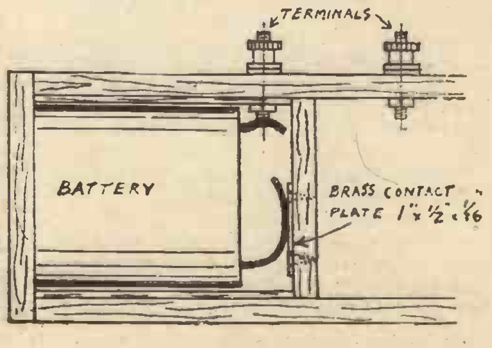
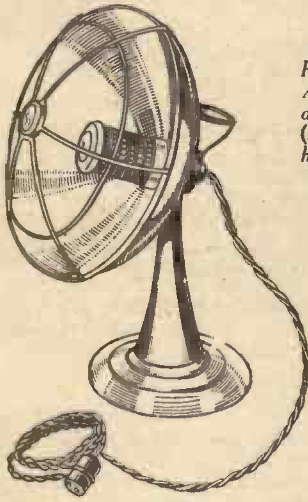


Fig. 4. — The battery connections.

Repairing Domestic



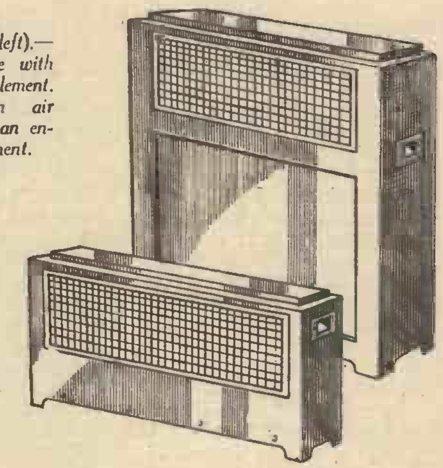


Fig. 10 (left).—A bowl fire with an exposed element. (Right) An air heater with an enclosed element.

IN hospitals small sterilizers are very common and are in constant use. These are fitted with robust overload relays generally incorporating a mercury switch. Through over-use the contact spring goes and often needs replacing; minor adjustments to contacts and strip are often required as well.

Electric Fires, Toasters, Etc.

These are the easiest to repair, because the elements are exposed and very accessible; here we include the fires, toasters, hair dryers, furnaces, soldering irons, and so on. In the bowl type the element is protected by a small wire screw of about two turns. This is clipped over the edges of the bowl and is easily removed. Unscrew the element and former. This is a fire brick former fitted with a G.E.S. cup. It often happens that the centre contact of the holder becomes weak through over-heating. Arcing occurs here, with a result that the fire burns intermittently and finally goes out altogether. The contact can be replaced by a strip cut from the longer pole of a flash-lamp battery. Make this exactly the same size as the original or it may touch the edges and cause a short. If the element has burnt out, this is obvious because the spiral will be slack and broken. Each spiral is wound for a definite voltage. Do not cut the spiral, but pull it out to the required length by trial. One connector is made first and the wire pulled out to fill the grooves, and then joined to the other screw. Slight tension only should be felt in the spiral when both ends are connected. To make a connection, double over one end of the wire and hoist it up tightly, then pass this round the screw, between the two washers, and do up tightly. If a contact becomes loose, the wire will arc here and finally burn through, and once an element has broken after being in use, it cannot be rejoined. The wire becomes brittle and breaks when bent. Screw back the former tightly before switching on.

Elements

A similar element is found in toasters—a small spiral—but here the spiral is arranged in rows vertically. Attachments and replacements as before. In the hair dryer the element is wound on a light former of mica. It is of single wire. To examine the element, remove the cap at the end of the air tube and then pull the element out. The former is plugged into a holder in the base. An element easily burns out when the fan fails, so before replacing an element in a dryer in which the fan has failed, repair the fan first, then the element. The element is wound of single wire.

The bowl fire is rarely found in loadings over 1,000 watts.

When replacing broken elements in larger fires, remove the old former and wire by disconnecting at each end—this is a simple screw—and replace with a new one. When ordering spares, quote the fire make and type, the loading in kilowatts, and the line voltage. There is a type of fire with two spiral elements, wound on flat fire-brick formers, each of a loading of 750 watts. Either one or both may be used, depending on the switching arrangements. A further type has for the element a carborundum rod of special manufacture. Replacements are very easy, but fairly expensive. In furnaces two rods are generally used in series, and it is advised that when replacing one rod to replace both. Two old rods may be used together, but not one old and one new. We have found that if a controlling resistance is used in series with the furnace, then any combination may be used, providing that the furnace is allowed to heat up slowly. This effects quite a saving, since the cost of one rod is 25s.

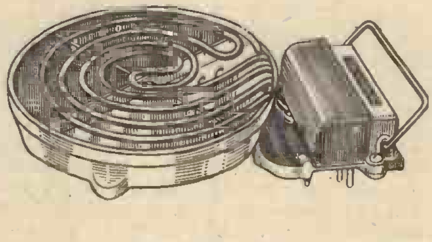


Fig. 12.—Left a hot plate. (Right) a four heat boiling plate.

Fire "Glow" Fans

Most modern fires have a supplementary lamp to cause the "glow." The flicket is caused by a small fan revolving above the lamp. This fan is really a two-bladed shutter that revolves in the hot air rising from the lamp. If the fire receives a blow, the fan may jam or come off its pivot. It is easily replaced. Do not lubricate the fan, but a little blacklead—a few strokes with a B.B. pencil—on the pivot will be found effective.

Hot plates are rewound, as are toasters and bowl fires. Some hot plates have a concealed and embedded winding; but these cannot be repaired at home and must be returned to the maker.

The domestic cooker falls in the same class as the fire, but here there are several points that may go wrong. Elements can burn out, but are easily replaced, as they can be obtained and fitted just as a fire element. A cooker is a high-load piece of apparatus, and as a result the switches are quite large and, due to the arrangement of the elements, complicated.

These switches are of the rotary type, having generally either two or three positions and off. Switch failure is due generally to burning of the contacts, with consequent arcing and finally open circuit on some points. The contact blades cannot be replaced, so a new switch is required Disconnect the leads, but do not disturb their relative positions; there may be four, five, or six terminals on the switch, with as many as twelve leads connected to them, hence care is necessary. If you are in doubt, before removing any collection of leads, tie together and label. Take care so as to avoid crossing of the leads.

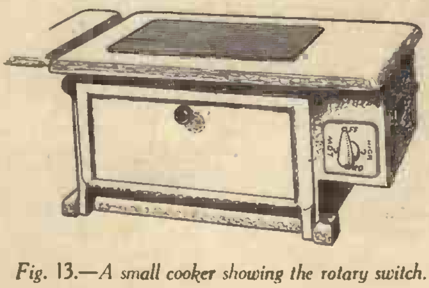


Fig. 13.—A small cooker showing the rotary switch.

Fire Hum

Some fires and heaters have a very nasty habit of humming, like a transformer, but louder and more penetrating. If an old fire starts this, then it is generally due to a loose connection, or even a loose bolt on the fire case. Tighten up all nuts and bolts and connections. If a new fire does it, look for the possible loose connection or bolt, but failing this you are advised to change the fire.

So far we have only mentioned the all-important question of earthing and not given it the importance it deserves. We cannot over-estimate the importance of a good earth on all portable appliances especially those near water pipes, etc. Some

Electrical Apparatus

appliances are not provided with an earth connection, but one can be easily made. If a fire, then drill a $\frac{1}{4}$-in. hole in the case, push through it a $\frac{3}{16}$-in. bolt, put on two large washers, and clamp the earth wire tightly between. An iron may be earthed by passing a lead under one of the cover securing nuts. A hair dryer, if made of bakelite, need not be earthed, but most have a metal sleeve over the heater, and the earth wire may be passed under one of the screws securing it. All fixed apparatus will be earthed, cookers, fires, etc., but periodically examine them. The earth must be capable of carrying the maximum load of the appliance; it is possible for a few strands of an earth to corrode through and yet the appliance be earthed. It is not safe, however, because the cable would fuse at the weak spot and leave the cooker still "live." The same can apply to fires. The earth wire is always regarded by the layman as being quite unnecessary and put on for fun. The regulations say that the earth wire must be protected if necessary. This may not be necessary when the appliance is first installed, but later it becomes apparent.

The Concluding Article On The Upkeep And Repair Of Domestic Electrical Appliances, And How To Avoid The Many Pitfalls That May Be Encountered By The Home Electrician

Domestic Motors

Domestic motors are generally of one main type series commutator. Others in use are repulsion-induction and squirrel cage, but, fortunately, repairs in these are rarely if ever necessary, because there are no electrical moving parts to wear.

The main types of motors have been dealt with in an earlier article, and we will not repeat here. Running repairs consist of oiling and greasing and cleaning the commutator. This work is easy and does not need the dismantling of the machine.

With commutator machines, and especially those small ones that are frequently overloaded, the brushes require constant care and attention. Sparking is always present; it is not necessarily a bad sign, but when the sparks extend right round the commutator, stop the machine and examine. New brushes are fitted by lifting the tension springs and extracting the old ones. Fit brushes of exactly the same type. Never be tempted to file up any scrap carbon and use this as a brush. It will damage the commutator and cause excessive sparking. We have used this method in cases of emergency, but have replaced the makeshift brush with a proper one immediately. The brush position in some machines is often obscure, and it is necessary to dismantle the covers and cases on vacuum cleaners and hair dryers, etc. The replacing of a brush spring is quite easy. First draw out the brush and then make a new spring from stiff brass wire of a similar gauge.

Commutators must be cleaned with soft rags. Don't try to smooth down with sandpaper or emery. If a commutator is badly fitted and worn, it must be repaired by an expert. If a machine is over-oiled and oil gets on the commutator, this must be cleaned and dried. It may be necessary to separate the bars and remove carbon. Do this with a pin or needle, and smooth down the rough edges with a steel burnisher. Too much grease is as bad as too much oil,

By "Home Mechanic"

and if this gets on to the winding, may cause, like oil, a short or a fire.

A "Burn-out"

In the case of a burn-out of either armature or field, carefully dismantle and inspect all connections. Examine and test both armatures and field to discover in which the connection has gone. It will probably be the field, so carefully remove one coil and strip off the insulation tape. Now take a sample of the wire and find out its gauge. If you have not a micrometer, then take a sample with you to the shop when you get the new supply. Also count the number of turns. There will be the same amount of wire on each pole, but as an additional check examine the other pole as well. Weigh the total amount of wire and get slightly more than this from the suppliers. Rewinding is now a simple matter. Take the usual care with insulation and other problems.

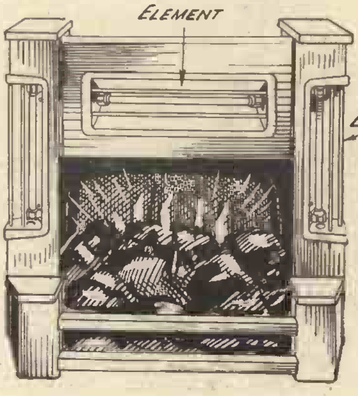


Fig. 11.—A "coal" fire.

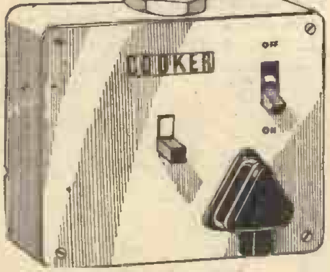
If the trouble lies in the armature, this is not so easily remedied. First test by examination, as a burnt-out armature is always obvious. Here, again, strip one coil, and *very carefully* note the connections. Draw these on paper and pin the paper on the wall over your bench. You might have been unlucky and picked a coil that will not unwind, therefore leave this and examine the armature closely until you find the coil that was put on last, and start from this and count the number of turns. Weigh the total amount of wire. When dismantling, keep count of the turns on each coil, as they should be the same. Observe the relation of the slot to the commutator segment and the brush line to the inter-pole line. Find the gauge of wire on the armature and obtain new as before.

New Insulations

New insulations must be used on both the armature and field, and this must be identical with that removed. If it is thicker the correct number of turns cannot be put in each slot. It is essential that exactly the same amount of wire is put on each coil in order to balance the armature both electrically and mechanically. Unevenly wound coils cause excessive sparking and noisy running. Great care must be exercised in soldering the connections to the commutator bars, and a non-corrosive flux must be used. This method of rewinding by counting the original turns is superior to a purely theoretical one based on calculations, etc. We advise readers to use the above, even when the windings are charred and burnt quite badly. Most insulation is double cotton, and if this is used in all cases, it will suffice.

Re-winding Heater Elements

Readers may wonder why we have given no details for rewinding heater elements and fires, etc. The chief reason is that manufacturers will not supply small quantities of these wires. A pound reel is generally the smallest, and as this is in the region of 30s. a pound, it is beyond the average reader. Secondly, elements are all standard now and can be obtained from the makers at all prices from 6d., and at this price it is not worth while making them. Thirdly, mica of sufficient size and quality is difficult to obtain. When one considers the above, it is obviously not worth while to consider rewinding an element.



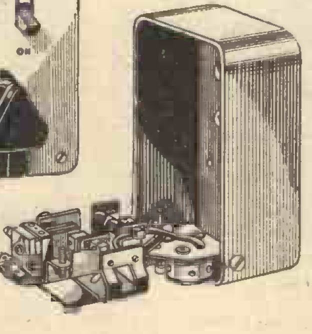
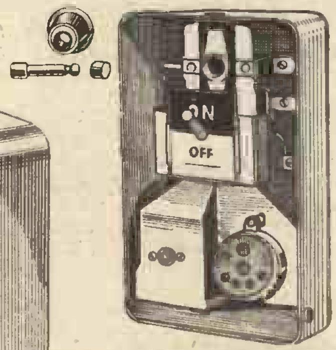
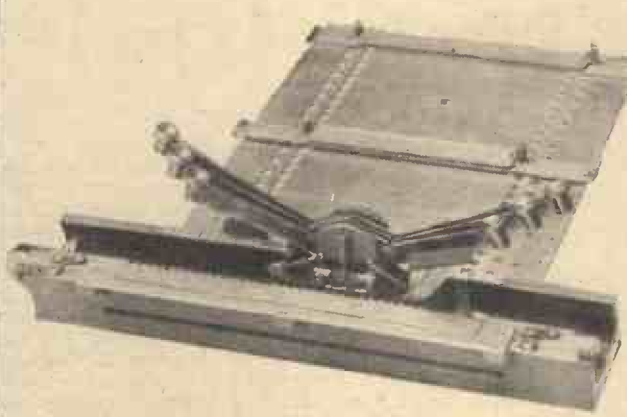


Fig. 14.—(Above) A modern cooker control switch. (Right) The mechanism is hinged to give access to the terminals and—



—the switch open showing the construction and connections.

(Left) Making a note on the margin of a Braille magazine by means of the Braille Margin Marker. (Right) The new machine for embossing aluminium plates with the Braille characters by hand.

APPARATUS FOR THE BLIND

How Science has Enabled a Blind Person to Acquire Skill and Craftsmanship hitherto believed to be impossible

DARTS in the dark ! Blinded in the Great War, a member of the High Wycombe British Legion club shows fellow dart-players where they "get off" when it comes to a spirited contest. He only needs to be told where his first dart has struck home to land his next throws as near as makes no difference to the numbers he requires. Uncanny? It's that "other sense" which the sightless develop and which frequently enables the trained blind man to put one over on the sighted.

Mechanical devices and scientific methods of training have to-day reached such an astonishing pitch of perfection that one suddenly robbed of vision or denied it from birth—there are more than 69,000 in this country—can acquire skill and craftsmanship hitherto believed to be impossible. Organisations devoted to their interests have become world-famous : St. Dunstan's, for the war-blinded; the National Institute for the Blind, a voluntary society 70 years old, whose patrons are Their Majesties the King, the Queen, and Queen Mary; the School for the Blind, at Swiss Cottage, under the patronage of Queen Mary, which celebrated its centenary this year; and others.

Talking Books

"Talking books" are the latest. A book of average length can be recorded on ten double-sided records and the gramophone discs be sent by post; 2,000 recorded copies of 183 books have been circulated by the National Institute, without charge, to 800 blind members during the past twelve months. A good deal of experimental work has been put in here, and some success has been attained recently with flexible records; the ordinary ones are naturally fragile and suffer somewhat during handling and in the post. We referred to them as "ordinary," but they aren't. These twelve-inch records each carry fifty minutes of reading-matter. Which indicates that the sound-grooves are tightly-packed—200 to the inch.

Considerable skill enters into the recording, a very great deal depending on the voice and staying-power of the sighted reader of the book; men are much better suited to this service than women. In one of a pair of adjoining rooms sits the reader, open book in hand, a microphone before him, waiting for a light to flash as signal that the engineer in the next room is about to put his recording apparatus into action. A window in the sound-proof dividing wall allows each to see what the other is doing. The fifty minutes' reading is divided into two equal periods, the break being necessary to enable the engineer to turn over his record.

De Braille—the little device for teaching the different Braille characters which are all arrangements of six embossed dots.

Turning the Record

To ensure that the turn-over is conducted without an awkward break in the reading, the engineer again causes the light to flash in the reading-room just before the twenty-five minutes interval, thus giving the reader warning to prepare for the temporary stop. Have you ever tried reading aloud for that length of time without faltering or allowing a weary note to creep into your voice? That explains what we meant just now by "staying-power." It would indeed be remarkable if even the practised reader did not feel an urge to sneeze or cough at some time during his ordeal—an urge which, if put into action, would mean the ruin of the record. Therefore, provision is made for him to suspend the recording, automatically, in case of necessity, by pressing a button located by his side for that special purpose, the recording apparatus remaining "dead" for so long as the button is depressed.

When the wax record is completed it is coated with copper, in a chemical bath, then a shellac record is prepared from it. This is "played" on the gramophone, and if approved by a blind listener on the operating staff, library copies, to whatever number required, are pressed from it

The Braille Bible

In the last twelve months the National Institute for the Blind have also produced 23,681 bound volumes in Braille type—a system of pinhead-size raised dots read by touch—and 18,535 pamphlets. The Braille Bible is available in 74 small volumes. Scientific subjects are well to the fore, and books on aircraft, wireless, electricity and magnetism, chemistry, physics and so on are kept up-to-date. Pattern books for woodworkers, rug makers and knitters, almanacs, tear-off calendars, and diaries are produced on the same system. All are supplied at a fraction of the cost of production. Printing is done from Braille-embossed metal plates prepared by blind machine-transcribers. Electrically operated transcribing machines are now coming into use, and an improvement on the old "proof"-pulling method (for securing first proofs for checking purposes) is a rotary power-driven press.

For those who have lost their fineness of touch, or who find it difficult to learn Braille, there are books in Moon type—a simplified version of ordinary Roman type, set by hand; 10,511 bound volumes and 10,462 pamphlets, etc., were produced last year. Touch-reading of Moon type is from left to right to left, the first line starting in the normal way at the left of the page, the "blind" finger tracing it to the right, then travelling via an embossed arc straight down to the second line, the reading continuing from there and along to the left, then down to the next line, and so on. As the finger does not have to be lifted from the page (as would be the case if every line started at the left) there is thus no possibility of a line being missed.

Pages of Moon type are set up from Braille copy by blind operators, with remarkably few mistakes. The drawback to the system is that much more space is occupied than when Braille is used. The Moon type Bible, for example, in 58 big volumes, fills a shelf-space of 12 feet, which is nearly double that taken up by the Braille version.

APPARATUS FOR THE BLIND

Some of the many special appliances, etc., supplied to the blind.

25 Periodicals

From the National Institute also come 25 " blind " periodicals—total circulation last year, 755,131—including four weekly newspapers, and a Braille edition of the *Radio Times* to be used in conjunction with a wireless set fitted with a Braille-marked tuning dial. The Students' Library of the Institute, valued at £30,000, contains 12,000 volumes. There are 6,000 musical works printed in Braille, and the institute runs an employment bureau for blind composers, instrumentalists, vocalists, piano tuners and—perhaps most surprising of all—expert shorthand-typists.

Dictation is taken down, at normal speed, by the sightless stenographer on a Braille machine—a sort of portable typewriter but with a paper ribbon or tape on which the Braille shorthand characters are embossed; transcription is done from the embossed type on to an ordinary typewriter, the result being a letter or folio equal in every way to the work of any shorthand-typist blessed with full sight.

There are training schools for blind masseurs, who on qualifying secure hospital appointments or start in private practice; and for blind babies and older children, who are taught how to squeeze the last ounce of happiness and usefulness out of their lives and grow up into skilled workers by way of gymnasiums and swimming-baths and expert training generally.

Mr. Stuart Hibberd, the B.B.C. announcer, reading into the microphone during the recording of a book.

Blind craftsmen who are able to work in their own homes are assisted, where necessary, to purchase the tools and equipment of their chosen trade and then dispose of their products—machine-knitters, makers of baskets, mats, brushes, nets, and carpenters and boot-repairers represent some of the activities. The efforts of amateur cobblers blessed with keen sight are bumble-fisted compared with the work turned out in the shoe repair departments of (among other institutions) the School for the Blind, at Swiss Cottage, where 60 sightless craftsmen are employed to deal with 150,000 pairs of shoes in the course of a year, the expertly repaired footwear being returned to their owners inside 40 hours. There also machine and hand-knitting by blind women are in full swing; 6,000 garments of all kinds were produced and sold last year. The value of the basket-work—from factory hampers to picnic baskets—sold in the same period, was £7,000.

OUR BUSY INVENTORS

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

More Illuminations

AN application has been made to the British Patent Office for the patenting of a combined 'bus and tram stop indicator and advertisement exhibitor. The object of the invention is to furnish an improved structure in the nature of a hollow obelisk or column with means for the display of indicating or advertising matter, which may readily be changed. There are windows with transparent or translucent panels and the interior can be illuminated. The column is constructed in such a manner that it may be applied to an existing post so as to surround such post.

If this device be generally adopted, it will add its quota to our already radiantly illuminated highways.

Eyelash Curler

FROM time immemorial the fair have been accustomed to impart an undulating effect to their hair. Although the Puritan, who condemned curly locks, would not have approved, there is no reason why a pleasing curve should not likewise be given to the fringe of the feminine eyelid. I note that an eyelash curler has been patented in the United States. The apparatus includes a stationary jaw and one that is slidably guided. This will enable the ladies to train their lashes in the way they wish them to go. However, I have no authority for announcing that a " perm " is possible.

Poison Gas Excluder

AMONG air raid precautionary measures, in view of poison gas, one has been advised to lay in a stock of cellophane. This is to be utilised in stopping up all the apertures in our rooms, through which noxious gas might gain admittance. In this connection, it is interesting to note that an inventor has patented a new method of rendering buildings and rooms proof against the ingress of toxic gases. His invention consists of narrow strips of prepared rubber, or the like, to be fixed on to doors, shutters, flaps, window sashes and casements. The surfaces of the strips of rubber have a hollow or groove to engage doors when closed into or on to frames, and it is maintained that this will exclude the offensive gases. It is added that the strips would be made more effective if the parts of the doors or frames which come in contact with the rubber were smeared with petroleum. In time of peace, the rubber can always be used to minister to the comfort of those folks who feel the draught.

Irritation for Car Thieves

NUMEROUS ideas have been proposed for protecting cars against theft, in which an alarm signal is operated when unauthorised persons endeavour to start the vehicle. In one case, for example, smoke or gas-emitting cartridges inconvenience the thief.

A recently announced invention relates to a similarly acting contrivance and supplies, opposite the key starting button, easily breakable containers charged with an irritant fluid. These containers are protected from damage while the vehicle is in normal working condition. But when it is locked, the unprincipled person who presses the key starting button, will fracture the container charged with the irritant fluid. And he will need to wear his anti-gas respirator, if he wishes to be saved from much unpleasant irritation.

Pellucid Panes

THE condensation of steam on his windows is a source of annoyance to the shopkeeper. When, owing to this cause, visibility is low, the unprecedented bargains cannot tempt the prospective customer. Gas burners are sometimes used, and electric fans are employed to provide air circulation. An inventor, dissatisfied with these methods, has applied for a patent in this country for what he contends is a more effective means of anti-steam condensation. His plan for preventing or removing condensation on windows or elsewhere in a room, comprises quick lime or other moisture-absorbing compound in moulded or compressed form, and a container for holding the same in an unexposed condition for storage. Part of this container is tray-like and in it the compound stands without a cover for holding it in an exposed condition adjacent to a window or in the moisture-affected spot.

How to Come Unstuck

TRUE to its character, sticking plaster emulates the limpet, so that when a divorce is necessary, the separation is sometimes painful. In the past, surgical adhesive tape and plaster have either been simply pulled off the skin or the removal has been assisted by a volatile substance such as ether. Both these methods, I am informed, cause the patient pain. In using anything highly volatile, there is also a risk of fire.

A patent has been applied for, in this country, for a composition which it is claimed will enable the adhesive tape and plaster to be removed painlessly and without danger. This composition is an admixture of tetrachloride and white oil. In future, if you are a patient about to be unplastered, it should not be necessary for you to " screw your courage to the sticking-place."

DYNAMO

MASTERS OF MECHANICS

No. 41—The Man Who Aimed High

The Eventful Story Of Gustave Eiffel And His Famous Tower

The Eiffel Tower and its designer, Gustave Eiffel.

HIGH buildings and other structures seem ever to have fascinated mankind. Undaunted by the disastrous failure of the Tower of Babel, constructive minds of succeeding generations have almost invariably given much thought and consideration to the problem of erecting a building which, seemingly, if not in actual fact, would reach upwards to the clouds.

It is, perhaps, only natural, after all. For the high building, towering far above all the others, is at all times symbolical of man's victory over his environment. It creates a permanent sense of achievement in even the mind of the observer or the user of the structure, whilst, naturally enough, the ultra-high edifice can be put to a number of highly desirable employments.

Trevithick's Idea

Not until the nowadays renowned Gustave Eiffel turned his attention to the construction of an iron tower of colossal proportions and hitherto unheard of height had the question of erecting any such structure been regarded with much seriousness. True it is that Richard Trevithick, the Cornish engineer and creator of the first high-pressure locomotive, had suggested and actually designed an iron tower to be erected in London in order to celebrate the passing of the Reform Bill in 1832. This tower, which was to have risen to a height of 1,000 feet above the Thames, might actually have come into being and thus forestalled Eiffel's famous ironwork tower in Paris by many years had it not been for Trevithick's lack of influential support and, still more, his untimely death.

Again, at the time of the Philadelphia Exhibition, in America, in 1876, the construction of a gigantic iron tower was mooted, there being a good deal of public discussion in the newspapers concerning it. The project, however, was finally abandoned, no engineer in that country apparently having the courage to clinch his designs with the requirements which had been laid down.

And so we get on to the time, just ten years later, when Gustave Eiffel, the renowned French civil engineer and bridge builder, first suggested the notion of erecting an enormous ironwork tower in Paris to commemorate in permanent form the Paris Exhibition which was to be held in the year 1889.

A Builder of Bridges

Few people outside France had heard of the name of Eiffel. Despite the fact that he had built bridges galore—many of them highly spectacular structures, too—in various parts of his native land (and also outside of it), his retiring disposition and seeming dislike for publicity had, up to the time of his stupendous achievement of the Eiffel tower, successfully kept him out of the world's limelight.

Alexandre Gustave Eiffel was born on December 15th, 1832, at Dijon, in France, the son of middle-class hard-working parents. From his earliest years he showed a decided bent for engineering and mechanics, so much so that, after his preliminary schooling, he was sent to Paris *Ecole Centrale*, which was then a noted technical training college for engineering students and other young scientists.

At the *Ecole Centrale*, Eiffel remained until he was well over twenty years of age. He specialised in civil engineering, particularly in the mathematical side of structural design, in which direction he acquitted himself with much distinction.

Almost after leaving his training-college Eiffel seized his first opportunity for drawing success down upon himself. He had been able to secure a government engineering post, and a year afterwards, in 1858, he was entrusted with a portion of the design and the general superintendence of the great ironwork bridge which was being thrown across the river Garonne at Bordeaux.

For a young man of only just twenty-five, the responsibility might have seemed too great. Eiffel, however, had serene confidence in his own abilities, both theoretical and practical. Not only did he accept the commission for the superintendence of the bridge building which was proffered to him, but, in carrying out the actual construction of the Bordeaux bridge, he actually brought into being a system of bridge-building which was destined well-nigh to revolutionise that branch of civil engineering.

A Compressed Air Chamber

It was his employment of compressed air in laying the under-water foundations of the bridge pillars. By means of Eiffel's compressed-air system, men were able to work at the pillar foundations in iron cylinders or caissons, the river water being kept out of these working enclosures simply by the pressure of the air within them.

By means of his compressed-air system, Eiffel succeeded in driving piles into the bed of the river at a depth of 82 feet below the water level. As a result, the Bordeaux bridge turned out to be a brilliant success. It earned for its engineer national fame, and, in some circles, international celebrity; whilst, on the material side, it resulted in his being entrusted with the design and construction of numerous other bridges throughout France.

These various bridge-building feats we do not intend to enumerate, since they are, in themselves, of little interest to the general reader.

One peculiar constructional feat of Eiffel's, however, must be recorded. This is his building of the huge dome of the French astronomical observatory at Nice. A dome of hard steel was required. It had to be movable so that it could be rotated around its own axis. Naturally, the structure weighed many tons, yet, despite its enormous weight and severity of design, Eiffel installed the dome in such a manner that it floated upon a liquid surface and was capable of being moved by one man's hand alone.

"Bread and Butter Works"

In 1865, Eiffel founded the famous French ironworks at Levallois-Perret, near Paris. That, as he afterwards explained, was his "bread and butter works." A man could not conjure into being spectacular engineering structures all the days of his life. Yet he must live. And so it was that the Levallois-Perret ironworks managed to provide the indefatigable Eiffel with, at least, a large slice of his livelihood.

Eiffel was a prosperous civil engineer when, in 1886, he first mooted his scheme for the erection of a 300-metre tower above the Seine in Paris.

At first the scheme was derided. People said that not only would it be dangerous, since no tower of such colossal height would stand safely upon its foundations, but that, in any case, the structure would have an ugly appearance which would be detrimental to the beautiful city of Paris as a whole.

Opposition to Eiffel's suggestion went so far as to take the form of an organised petition of protest which was submitted to the Government.

However, the French Government, mindful of its forthcoming World Exhibition in Paris in 1889, and realising the stupendous nature of Eiffel's proposed tower, gave the designer its official blessing, together, of course, with its permission to carry on with his work.

At dawn on the cold winter's morning of January 28th, 1887, the construction of Eiffel's great tower in Paris was begun. The tower was to rest upon an area of 100 metres square and was to be supported upon four great latticework uprights, situated at the corners of this square.

Foundations

The digging and construction of the tower's foundations was a task which occupied several months. Deep down in the earth, Eiffel laid concrete foundations some seven feet in thickness. Bolted to these he erected the first sections of the four iron pillars upon which was to rest the enormous weight of the entire superstructure.

Six or seven months after the commencement of the foundation work, the first sections of the gigantic "feet" of the tower began to show themselves above the ground level. Slowly—with almost irritating slowness, some thought—the feet of the tower grew higher and higher until, at last, there was laid upon them the first platform of the colossal edifice from which the great lifts were eventually to ascend.

Then, quicker and quicker, as the cross-sectional area of the tower above its first platform decreased, the huge structure of latticed iron girders and stays soared up skywards. In all, Eiffel placed some twelve thousand separate girders and other pieces of metal work into his tower, each of which had been, at his works at Levallois-Perret, separately designed with mathematical exactitude and drilled with the required rivet holes to an exceedingly high degree of precision.

In all, there are seven million rivet holes in the Eiffel Tower, in Paris, and the rivets used in uniting the various pieces of metal together reach the total of two-and-a half millions. If, by any chance, the rivet holes of a girder, a strut or a brace, when it was hauled up the growing tower and placed into its predetermined position, did not exactly coincide with those in the portion of metalwork to which it was to be united, the faulty portion was sent down to ground level again and ultimately scrapped.

A Big Scare

The great tower had nearly been completed in readiness for the opening of the 1889 Paris Exhibition when, suddenly, a scare arose which was taken up far and wide. Eiffel's nearly completed tower was beginning to lean. It was several degrees out of the perpendicular and it seemed to be in imminent danger of crashing to the ground if the slightest gust of wind arose.

The Statue of Liberty. The enormous weight of stone forming the statue is supported by an ingeniously designed framework of steel designed by Eiffel.

The scare had been viewed as constituting the last stroke of Eiffel's enemies. Whether this was the case or not we cannot pretend to discuss here. But it was perfectly true that some of the main outlines of the tower did actually seem to be out of perpendicular. Eiffel, however, quickly proved that the appearance of these uprights was due to a peculiar and unfortunate optical illusion. He brought in Government engineers to confirm his statements. The tower was most scrupulously examined from head to foot by the latter experts. They pronounced it perfectly safe and free from any lean or inclination out of the perpendicular.

After that, the completion of the tower, and the erection of the lighthouse at its upper extremity proceeded without further delay.

On 13th March, 1889, just a little more than two years after the commencement of its foundations, the Tower's highest point was reached.

The Lifts

Lifts were afterwards installed. So thorough was Eiffel's concern for the essential safety of these appliances that before the lifts were put into public commission, he had one hauled three-quarters way up the tower and then tied with strong ropes to the sides of the lift shaft. The high tensile-strength steel cables supporting the lift were then disconnected, leaving the lift carriage supported merely by the ropes which had been attached to it.

Workmen stationed at the sides of the lift shaft at a given signal, severed by axe blows the supporting ropes of the lift. Immediately the huge lift compartment began to crash down the shaft to ground level. But its headlong progress did not continue for more than a few seconds. Gradually and almost imperceptibly the brakes with which the lift was equipped came gently into action, resisting its fall and ultimately bringing the lift car to a complete standstill.

After this severe preliminary test, Eiffel declared the lift system safe for public use, and it is noteworthy to observe that it has been employed ever since without loss of life.

The successful building of the great Tower at Paris naturally enough brought to Gustave Eiffel world-wide fame. He was honoured by his Government and applauded by engineers the world over.

Actually, of course, the Eiffel Tower, at Paris, still remains by far the highest structure which has ever been erected. It is 300 metres, or 985 feet high, and its weight approximately 7,300 tons. Electric lifts take the passengers up from the first platform to the topmost stage of the tower, above which is surmounted the wireless, astronomical and meteorological laboratories for which the Tower has always been famous.

Blackpool Tower

The famous iron latticework tower at Blackpool, Lancashire's noted seaside resort, is, to some extent, a copy of the Eiffel Tower, and in its design Eiffel himself had some part. But Blackpool's tower is only half as high as the Eiffel Tower at Paris and it is far less massively constructed.

Besides his creation of his famous Paris tower, Eiffel was, in part at least, responsible for the construction of another mammoth monument.

Within America's colossal Statue of Liberty which announces to all incoming vessels the approach and entrance to New York harbour, there is an ingeniously designed steel framework which supports the enormous weight of stone forming the statue which encloses it.

This steel structure was designed by Gustave Eiffel. Up to the present it has endured the severest gales which blow in the region of the New York harbour and, after recent careful examination it has shown no signs of disintegration or even deterioration.

Eiffel's life achievement was his creation of his famous tower. It brought him fame, but, strangely enough, that fame did not remain with him. Entering into retirement, he shrunk more and more from the world until, at the termination of the Great War in 1918, he was more or less an unknown man.

He died in 1923 at the ripe age of 85.

TOOLMAKING AND TOOL DESIGN—4.

The Principles and Methods of Making Press Tools, Jigs, Gauges and Fixtures

By W. H. DELLER

Methods of Work Location

As mentioned earlier in this series the work is positioned in the jig in such a manner that the holes when machined through the guide bushes are correctly located in every respect. In order that this object may be achieved it is necessary to provide in the jig stops against which previously machined surfaces may abut or fit. In many cases the choice of locating surfaces is automatic, and where two or more separate jigs are required for one job the original datum faces are maintained throughout the operations.

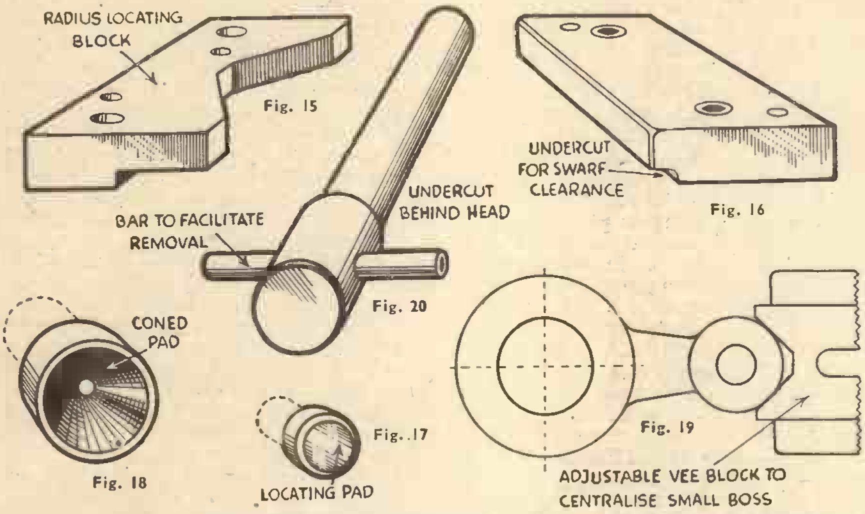


Fig. 15.—A vee block for locating work from a radiused end. Fig. 16.—A block for the location of plane surfaces. Fig. 17.—Where it is not possible to use a block form of location pads are used as shown. Fig. 18.—A female coned pad. Fig. 19.—A bossed lever. Fig. 20.—A hardened and ground locating pin.

It will be realised that it is not possible to deal exhaustively with this particular subject as so much will depend upon the actual shape of the part to be handled, but a few methods used singly or in combination will briefly be described. These should cover the classes of work most commonly encountered.

Vee blocks provide the means of locating work from a radiused end. Such a block is seen in Fig. 15. The depth of the block is made to suit the job, but provision should be made for swarf clearance in the manner shown.

The block shown in Fig. 16 is for the location of plane surfaces. Here again the face is cut away at the bottom to prevent swarf building up in the corner. Where it is not convenient to use a block form of location one or more pads as shown in Fig. 17 may be employed. These may have plain ground shanks for pressing into a drilled or reamed hole or screwed to fit into a tapped hole. In either case the underside of the head is undercut to permit grinding and the face of the head ground to give a predetermined thickness after hardening.

Illustrated in Fig. 18 is a female coned pad. This is suitable for the location of spherical-ended work. Where the work is slotted a bar is arranged in front of the pad but clear of it and clear of the bottom of the slot.

Here again such a pad may have a parallel ground shank pressed into a reamed hole or a thread provided in addition and the pad secured in position with a nut.

Fig. 19 represents a bossed lever. This is located from the large bored hole by means of a plug. The smaller boss is positioned centrally by a sliding vee block working in guides and backed up by a cam or an adjusting screw. As will be seen in this arrangement the location so far as the centre distance of the holes is concerned is governed by a plug fitting into the bored hole, the vee block positioning the smaller boss in a lateral direction. A great deal of machined work can be located from bored holes or registers for drilling.

In certain circumstances such as where a long bored hole passes through the work from a machined face, the opposing sides of the jig body are bored to receive a hardened and ground locating pin such as that shown in Fig. 20. This pin is chamfered at the front end to assist in leading it into the work. The head may be knurled or provided with a cross pin as illustrated to facilitate its removal.

When locating from a male or female register the jig body is usually appropriately bored or provided with machined projection to suit the work. The question of swarf clearance has to be studied carefully and for this reason the mouth of the hole or recess in the jig used as a register requires to be chamfered, or where a male plug or insert provides the location the base of the plug should be undercut to avoid loose metal chips, likely to prevent a proper seating, from being trapped in a sharp corner.

Seldom is it necessary to jig parts entirely from surfaces as cast or forged. While it is true that machine-moulded castings and drop-forgings generally are produced approximately uniform in size, some form of adjustment or compensation should be allowed for in the locating points of the jig in which such a part is to be handled. Flat surfaces should be supported where dimensions depend from such at three points on raised pads.

So far, the parts comprising an average jig have been dealt with briefly so as to impart a general idea of requirements covering different classes of work, but it will already be realised that many of the details such as bushes, clamps, latches, studs and pins can be standardised.

In jig designing each problem, however, presents its own difficulties, but there are recurrences of familiar types of work, and where a scheme has proved satisfactory on a similar job it may be re-adopted with perhaps small improvements or modifications.

It is now proposed to suggest methods of dealing with a few examples of drilled work, and wherever possible the solution suggested will have a wide range of

(*Continued on page 287*)

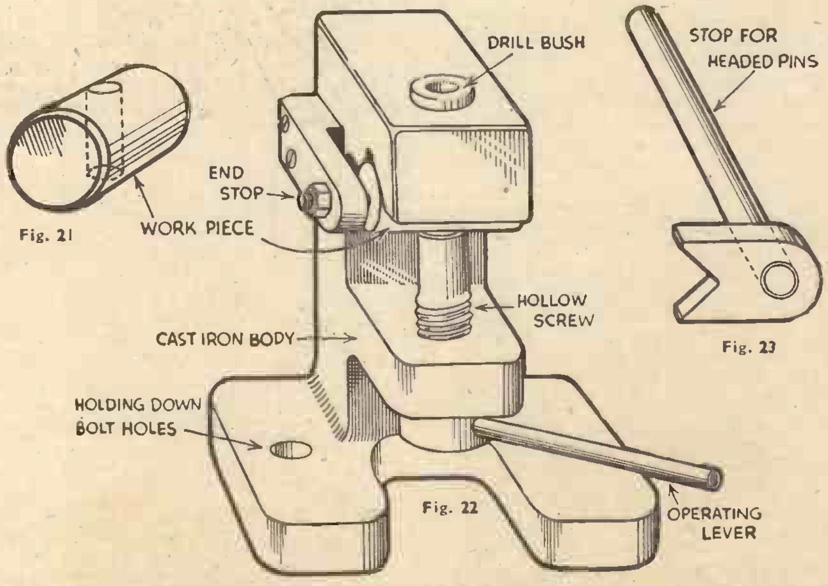


Fig. 21.—A jig may be utilised to deal with jobs similar to that shown. Fig. 22.—Details of the jig. Fig. 23.—An adjustable stop.

A Model Plank-Built

This Model has been Specially Designed, may be used throughout except for

Fig. 1—The finished model in full sail.

THE construction of a model yacht with a planked hull is a long job, and the reader who intends to make such a model must be prepared to spend many evenings on making the hull. Experience and skill are not so much required as care and patience, and a reader commencing this model now will have an interesting occupation during the coming months, and a fine model when the spring arrives.

The model described below has been specially designed, so that fretwood may be used throughout, except for the spars. A schooner was decided upon as looking nicer in the water (see Fig. 1) than the more usual "Bermuda" rigged boats. Schooners sometimes have a reputation for not sailing well, but this model, being designed as a schooner from the start, instead of merely rigging a cutter hull with two masts, puts up a very good performance and has surprised several experts by its ability to sail close up to the wind.

Full-size Drawings

The first thing to be done is to make full-size drawings. The model is 40 in. long on the deck, by 9 in. beam, and has a displacement (*i.e.* total weight of complete model) of 9½ lb., but if all dimensions are reduced in proportion a smaller model should give satisfactory results.

Make a full-size drawing of the hull shown in Fig. 3, as accurately as possible; the vertical lines are 4 in. apart and the dimensions given are above and below the water line. Put in the water line on all drawings, and mark it on every part made, as it is the datum line from which measurements are taken. Also number the vertical lines from 1 to 9; these represent the positions at which sections are made. Having drawn in the profile, the shape of all the separate pieces forming the central layer of the composite keel should be drawn as shown in Fig. 4; the notches and tongues are to ensure a watertight joint. The shapes should now be traced down on to ¼ in. mahogany and cut out with a fretsaw, taking care that the grain runs in the direction indicated.

The five pieces should then be laid on the full-size drawing, to check their shape when assembled, and altered if inaccurate. These five pieces are held together by other pieces fitted on each side, sandwich fashion, as shown in the sectional view. Fig. 5. These side pieces should be drawn in on the full-size drawing as indicated by dotted lines in Fig. 4, then traced on to ¼-in. mahogany and cut out. The grain should run along the longest direction of each piece in this case, the joints between each piece being of a simple "step" type. On one side layer the joints come between sections 1 and 2, also 5 and 6, but on the other side make the joints between sections 2 and 3, also 7 and 8.

The joints are indicated in Fig. 4 and they can also be seen in the photograph. Fig. 6. The profile of the side layers is ⅛ in. smaller along the bottom, increasing to ½ in. at the bow, to allow for the thickness of the planks, the allowance being greater at the bow because the planks approach the keel at an acute angle.

The Composite Keel

Now varnish each of the eleven pieces all over with thin shellac varnish, which will dry very quickly. This varnish can be made by dissolving flake shellac in methylated spirits. The composite keel can now be permanently screwed together with countersunk brass screws ½ in. No. 3. Adjoining surfaces should be painted over with *thick* shellac varnish (about the consistency of cream) and screwed together while the varnish is wet. This forms a kind of glue not as strong as ordinary glue, but absolutely waterproof. Don't use ordinary glue anywhere on the yacht, and avoid the use of a single piece of iron or steel.

While assembling the hull the fin should be held together by a flat piece of wood, say, 2 in. by ½ in., screwed temporarily on one side. This must not be stuck on with shellac, of course. The finished keel must be quite free from cockling or twist, or the hull will not be symmetrical.

The ribs are the next item; a pair of these is required at each of the numbered sections. The contour of each rib is obtained from Fig. 7 and nine full-size complete sections of the hull should be drawn similar to Fig. 5.

The dotted lines of Fig. 7 represent one inch square, so there should be no difficulty in transferring the shape

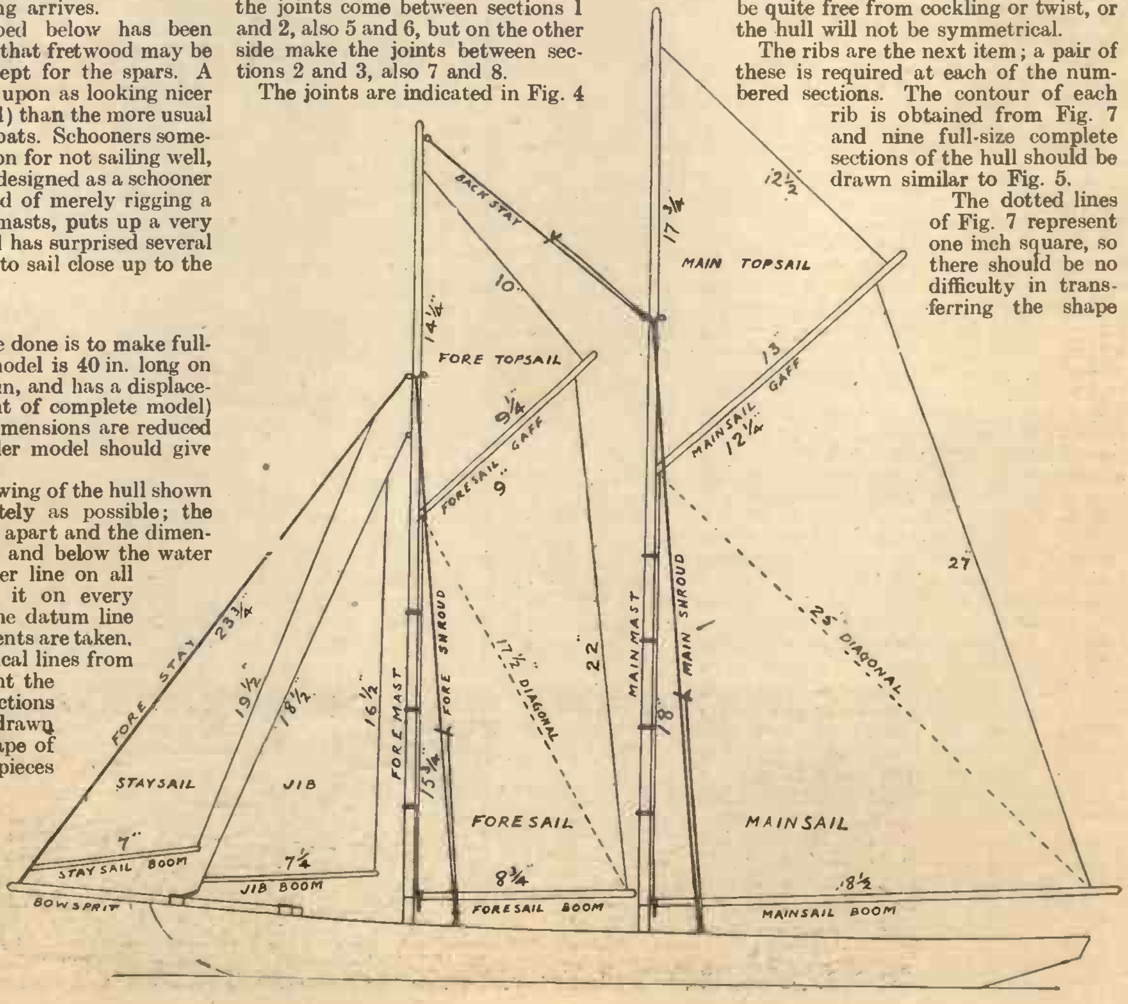


Fig. 2—The general arrangement of the yacht, showing the sail plan.

Schooner Yacht

so that Fretwood
the Spars.

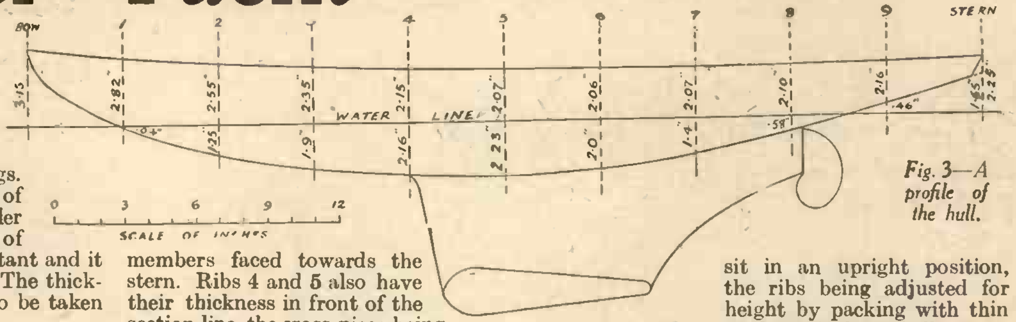


Fig. 3—A profile of the hull.

correctly to the full-size drawings. Note that Fig. 7 shows sections of the *hull* so the ribs must be smaller by ⅛-in. to allow for the thickness of the planking. This is very important and it is easy to make a mistake here. The thickness of the deck (⅛ in.) must also be taken into account.

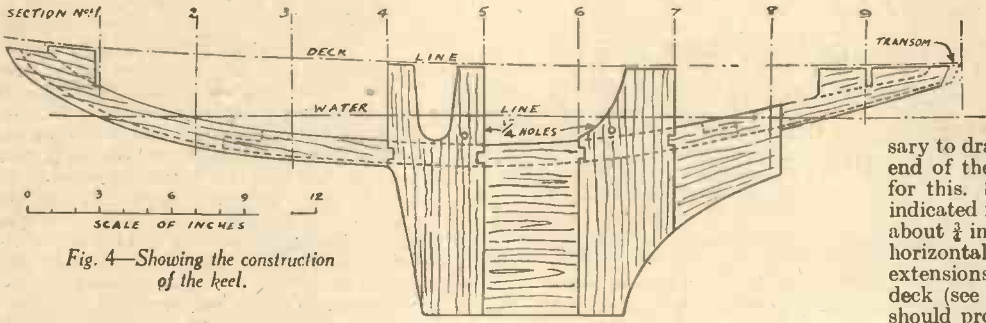


Fig. 4—Showing the construction of the keel.

The deck is cambered on top, the centre being 3/16-in. higher than the edges amidships and less towards the bow and stern. Figs. 3 and 7 show the shape to the edge of the deck, so that the height of the camber must be added on the centre line when drawing the sections.

Fig. 5 will show that the ribs are each made in two pieces, held together by a cross-member and a deck beam, and are positioned on the keel by a single ½-in. screw.

The Ribs

Trace the shape of the ribs on to ¼ in. sycamore with the grain running in the direction indicated on Fig. 5. Number them all and cut them out. Numbers 1 and 9 are different from the others and are shown in Fig. 8 and 10. Don't omit the holes in No. 9 or else you will have a steel compartment in the hull, this is not desirable. When the ribs are cut lay each pair on its full-size drawing and get an assistant to hold them there while you fix them together accurately by means of the cross-piece which is simply a length of ⅜-in. by ¼-in. sycamore. Use ½-in. No. 3 screws for this and apply a touch of thick shellac to the joint before screwing together. Don't fit the deck beams at this stage.

Now screw each pair of ribs to the keel by a single screw. Ribs 2 and 3 should be fitted so that their thickness is in front of the lines you should have drawn on the keel to show the position of the section, and their cross-members faced towards the stern. Ribs 4 and 5 also have their thickness in front of the section line, the cross-piece being in front of No. 4 and to the rear of No. 5. Ribs 6, 7 and 8 are all behind the position line, the cross-member of 6 and 8 being towards the front, and that of 7 towards the stern. Be careful to fix them as described or complications may arise later. See that the contour of the ribs finishes flush with the rebate of the keel to form an even bed to the planks. It will be necessary to chisel a small flap inside the keel to make the ribs sit in an upright position, the ribs being adjusted for height by packing with thin card (soaked in shellac varnish) if low, or by chiselling the inside of the keel a little more if high.

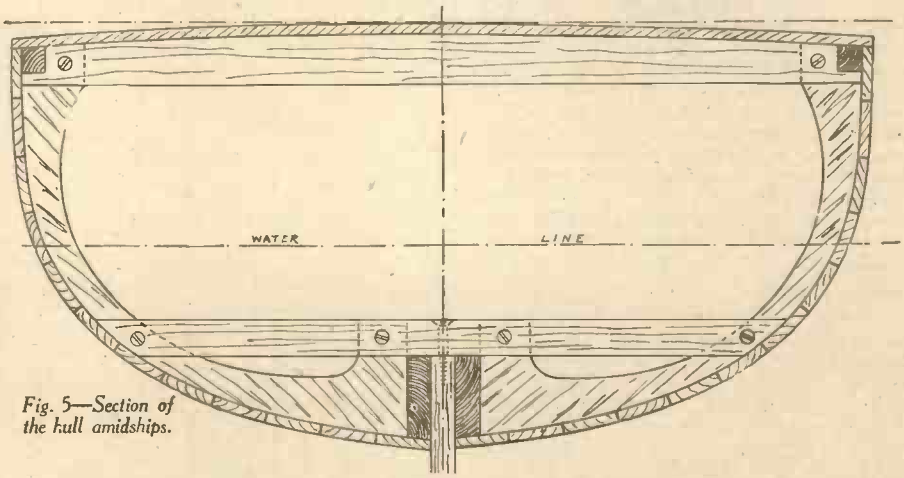


Fig. 5—Section of the hull amidships.

The Bow

Cut out the bow reinforcement to Fig. 9, from ½-in. sycamore. It will be necessary to draw out a full-size plan of the front end of the deck to find the correct angles for this. Screw this piece into position as indicated in Fig. 8. Fix a piece of sycamore about ⅜ in. by ¼ in., and length as required, horizontally on each side of the upper extensions of the fin where they meet the deck (see Fig. 6). These horizontal pieces should project above the fin extensions by the amount of the camber, say 3/16 in. for the front and 5/32 in. for that nearest the stern. At this stage the structure should appear as a skeleton like Fig. 6.

The deck should now be cut from a single plank of pine or sycamore ⅛ in. thick. Pine makes a lighter job, but if any difficulty is experienced in obtaining a suitable thin plank, sycamore fretwood will do very well. The drawing for the deck may be made direct upon the wood by first drawing the

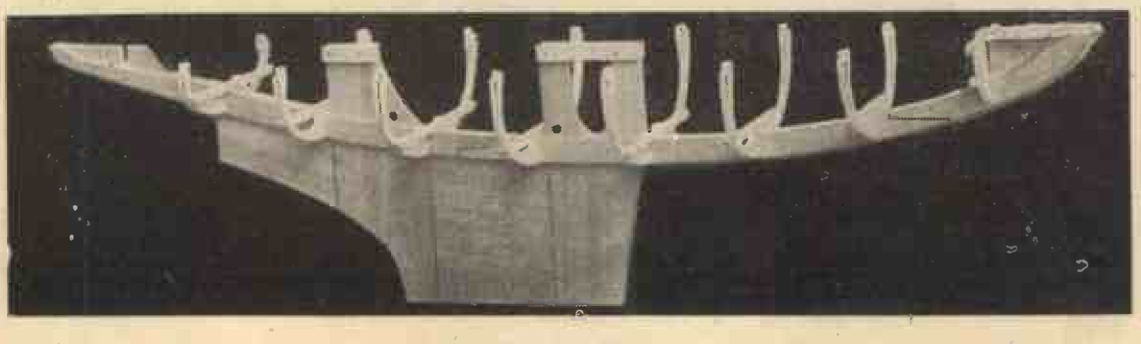


Fig. 6.—A skeleton of the hull.

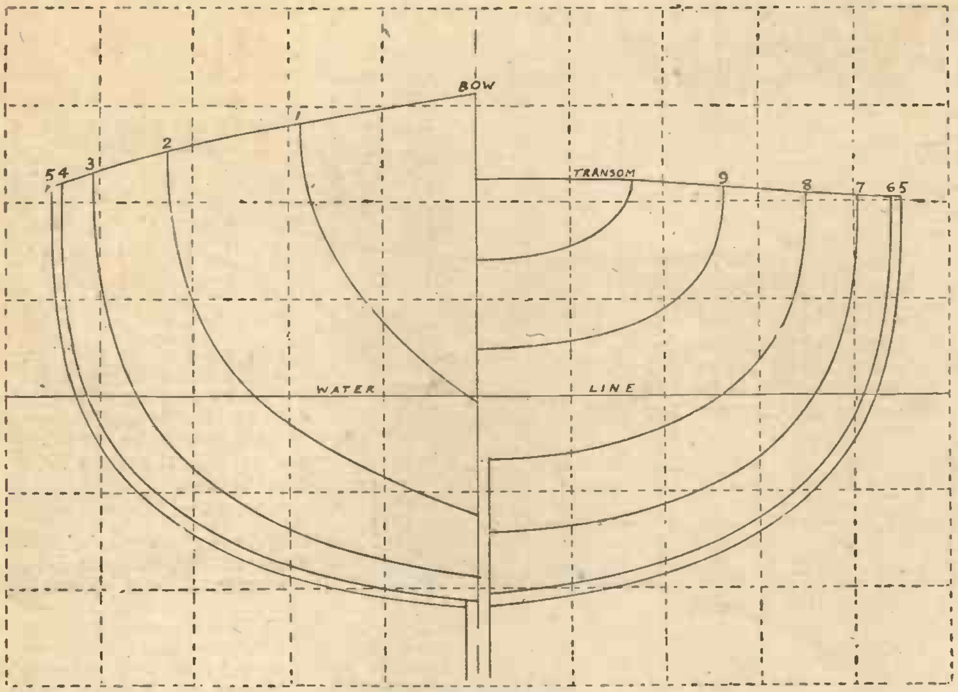
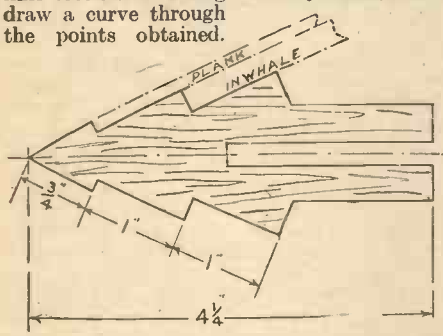
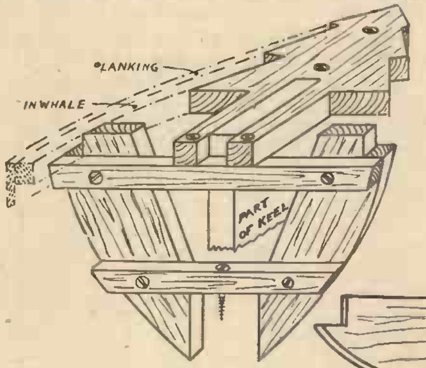
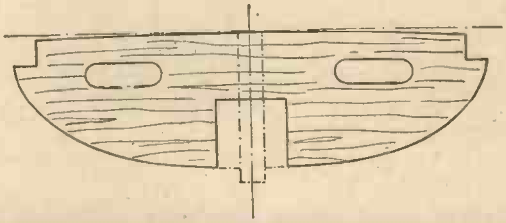


Fig. 7.—The body sections.

centre line (on the side which is eventually to come underneath), then drawing the section lines exactly at right angles and 4 in. apart. Mark off the full width of the hull at each section, measured from the nine sectional drawings already made, and draw a curve through the points obtained.







Figs. 8 to 10.—(Top right) Ribs at section No. 1 and the bow reinforcement piece. (Above) The bow reinforcement. (Right) The ribs for section 9.

Cut roughly to shape about ⅛ in. larger than required. The deck beams should be cut from ¼ in. sycamore, the shape being obtained from the sectional drawings; mark the centre line of the hull on each beam.

The Beams under the Deck

Now screw the beams underneath the deck by small screws (⅜ in. No. 2 countersunk brass), put in from above the deck. Put in two screws for each beam and position them neatly, as they will show on the finished model. Centre each beam exactly on the centre line of the deck. Beams Nos. 2, 3, 5, and 7 should have their forward sides flush with the cross lines on the deck (*i.e.*, the thickness of the wood comes behind the line), and Nos. 4, 6, and 8 have the back face flush with the cross lines, so that the thickness comes in front of the line. The deck will now show its camber; at this stage it must be fixed on to the hull skeleton and positioned so that its centre line coincides with the centre of the skeleton and the fore and aft position is right. Don't forget to put No. 9 section into place first; this need not be screwed on, however. Put one screw in loosely through the deck near the bow and one near the stern, then pull the middle of the deck down by screws into the side pieces on the fin vertical extensions. Position all screws through the deck neatly.

Each rib should now be screwed to the side of its proper deck beam with a ½ in. No. 3 brass countersunk screw driven in a fore and aft direction; these may be seen in Fig. 5. The ribs may require a little persuasion to make them fit accurately, but if they are much out the fixing screw in the rib crosspiece should be slackened slightly to allow the rib to take up its correct position.

The transom or stern piece (Fig. 11) should be now cut from ⅜ in. mahogany; this needs making very carefully, because it is fitted on a slope. The best method is to level off the top edge at 60 deg., and cut the notches for the inwhale (referred to later), then mark off the shape on each side and cut out rather larger than required, leaving a surplus to be trimmed off later. (*To be continued*)

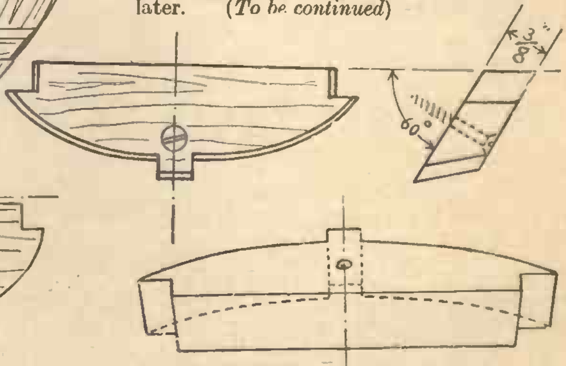


Fig. 11—The transom.

Fig. 12—The framework ready for planking.

MODEL AERO TOPICS

Current News from the World of Model Aviation


These two pictures show one of Major Bowden's petrol low-wing monoplanes.

A Scottish Competition

THE Glasgow M.A.C. (not affiliated to the S.M.A.E.) propose to organise a competition open only to Scottish enthusiasts. The competition will be held on lines similar to the Wakefield Cup Competition.

Lancaster and District M.A.C.

THIS club is now operating as a separate body, and will in future be known as the Lancaster Model Aero Society.

Competition Rules

THE S.M.A.E. Council state that from a vote taken it appears that clubs are in favour of cash prizes rather than goods to the value. Notwithstanding this vote we hope that the S.M.A.E. will refrain from approving the principle of cash prizes. In all forms of sport the payment of cash to amateurs is prohibited, and in view of my letter on the subject of professionals and amateurs which will be considered at the annual general meeting of the S.M.A.E. it is undesirable that they should give further encouragement to a method which has many drawbacks.

The Council has passed a rule that all unattached entrants for 1939 competitions shall pay 5s. entrance fee. Affiliated club members will still pay 1s. for senior members, and 6d. for juniors. It should be noted that the prize value for 1939 competitions has been doubled.

Automatic engine starters will be allowed in 1939 petrol competitions, but those competitors not using such starters will be given extra points.

Indoor Stick Record

THE Indoor Stick Record is now held by Mr. C. S. Rushbrooke with the time of 12 mins. 4 secs.

The Baby Gnome

THE Baby Gnome can be recommended to those desirous of building a lightweight model. The kit for this model is marketed by Model Aircraft Supplies of 171 New Kent Road, London, S.E.1. The kit contains ample supplies of first quality balsa wood, birch, bamboo, tissue, dope, cement, rubber lubricant, and a specially shaped propeller blank. The model is of 28 ins. span and weighs only 1½ ounces. The best recorded flight made by the model constructed from a kit of parts is 7 mins., and the price of the complete kit is 6s. 6d., carriage paid.

Down Thrust

THE problem of down thrust is one that confronts every model builder who builds a flying model. The builder's general attitude is to accept the method of using it, but very few enthusiasts have analysed the problem scientifically. Since it is of paramount importance to all who aspire to such trophies as the Wakefield Cup, I will endeavour to explain thoroughly and simply to the layman, the different aspects of this problem. Let us work from first principles. There are four main forces that act on the aeroplane during flight under power. These are :—

1. Lift, e.g., the lifting force that is derived from the wings in their passage through the air.

2. Weight, e.g., the weight of the aeroplane itself which acts through the centre of gravity.

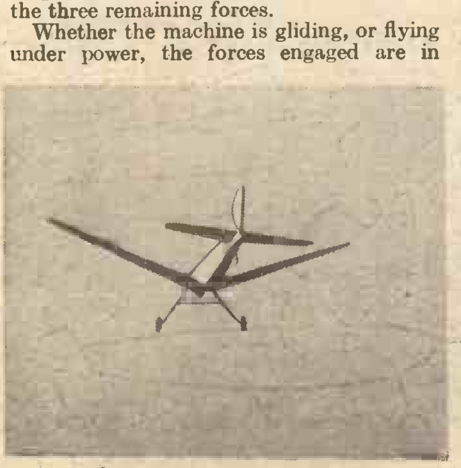
3. Drag, e.g., the resistance, offered by the air against the motion of the aeroplane.

4. Thrust, e.g., the force given by the motor and propeller which tends to pull the aeroplane through the air.

These forces act on the aeroplane in the directions shown in Fig. 1, when the aeroplane is in normal horizontal flight.

When the power is cut off, the thrust no longer exists and the aeroplane glides on the three remaining forces.

Whether the machine is gliding, or flying under power, the forces engaged are in equilibrium. That is to say, they neutralise one another. Bearing this in mind, let us examine the general procedure of trimming a model.



The low-wing monoplane in flight.

The model is first adjusted to have as flat a glide as possible, this being achieved by means of careful positioning of either the wing or the tailplane, or both. Once the glide is obtained, the thrust line, or the line along which the propeller shaft lies, is adjusted until the power gives the model a smooth and steady climb.

In high-wing and mid-wing models, we find that this thrust line has to be inclined down towards the front to give the desired flight. This is known as down thrust.

The reason for this is as follows :—

We know that in the glide, the three forces, lift, weight and drag, are in equilibrium; if we apply another force, e.g., thrust, it is obvious that there is only one position and direction that it can be applied without upsetting the equilibrium.

In Fig. 2 we see that by applying the force in a horizontal line, we tend to pull the nose of the aeroplane up, and therefore stall it, because the thrust line is below the drag line. Thus, the nearer we have the thrust line to the drag line, the less tendency there will be for the model to nose up and stall.

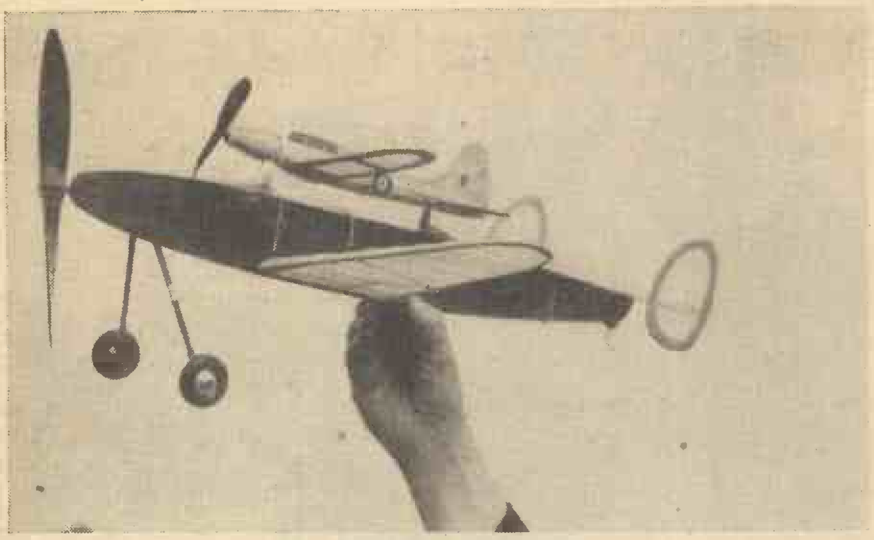
Just what the actual position of the thrust line should be I cannot tell you, since the centre of drag, or that point where the total drag acts, moves about according to the attitude of the model in the air. Therefore we naturally have to find that position which gives the best all-round results, by experiment.

Although the model will fly quite well if we use down thrust, it will not be efficient because the angle at which the model flies to the horizon, in horizontal flight, will be greater; that is to say, the angle of attack will be greater, as in Fig. 3.

It will be seen that this greater angle will increase the drag both of the fuselage and of the wing and thus decrease the efficiency.

We can overcome this need for down thrust by careful design; either : 1, by moving the position of the propeller and thus lifting the thrust line until it is in the same horizontal plane as the drag line; or, 2, by moving the wing and other parts of the aeroplane until the drag line is in the same horizontal plane as the thrust line.

There are other methods of overcoming down thrust but these are more complex



A fine flying model of the composite type.

and require full understanding of lifting tails, slipstream behaviour, etc. However, let us discuss these two aforementioned methods.

While we are at present debating the downthrust question, in overcoming it, we must not forget the other factors which govern the stability of the model. That is to say, lateral (e.g., side to side) and directional stability (e.g., stability of direction, either in a straight line or in a turn). If we do, we will find our model will not fly properly at all.

The first method is the easier for those enthusiasts who have not been building models long. By placing the propeller higher in the nose, the design of the fuselage will not be materially affected and the model will retain its good flight characteristics. Just how high we should lift the propeller, depends on the individual model, and in designing the nose of the fuselage, provision can be made for two or more nose blocks with the propeller in a different position. We will find that $\frac{3}{8}$ in. variance is easily allowed for. It must be understood that it is practically impossible to estimate the exact positions of these parts, since it would require a laboratory and wind tunnel to carry out the necessary experiments. Therefore we must carry out the final trimming on the field. This first method has only one drawback, and that is that it tends to give the fuselage an inefficient shape; but this effect is very slight, in comparison to the advantage gained by the correct positioning of the thrust line.

The second method requires at least a shoulder wing model or even a mid-wing. This is no disadvantage when the model is in the hands of a capable model builder. In fact this type of model is possibly more efficient in many ways.

The design will have to be such that the drag line of the whole model is in the same horizontal plane as the thrust line. If the dihedral is decreased then other methods of stabilising the model, from side to side, will have to be used, but the drag line of the wing will be dropped, thus helping us.

The result might be as in Fig. 4.

This type of semi mid-wing model entails a more complicated structure, but lends itself very well to careful streamlining.

So far, we have only dealt with down thrust as applied to ordinary level flight under a steady power thrust. However, one of the major problems of to-day is encountered in the behaviour of the rubber motor. We find that when the propeller is released, after winding the motor up, there is a very strong initial surge of power for the first few seconds until the motor settles down to steady unwinding. A glance at the curve in Fig. 5 will show how the power varies.

That portion of the curve A is clearly the dangerous period.

It is, therefore, evident that this period of high output will require more down thrust than the rest of the motor run, unless the thrust line is horizontal with the drag line. That this is so is very evident at any contest, where models are often seen to stall on taking off, but in the ensuing flight seen to climb quite steadily. We need some sort of automatic control on the thrust line and this we can effect very simply by means of a device first invented by Alfred Van Wymersch of Belgium. This consists of a small strip of rubber or sorbo, that is cemented behind the bottom of the nose block. When the motor is wound up, the tension of the elastic compresses the rubber thus pulling the bottom of the block in and increasing the down thrust. This effect is clearly shown in Fig. 6.

The enthusiast can apply this device to models already built and will find a marked improvement in performance results. The strength of the rubber pad will be found by experiment as each individual model will differ.

Reverting to proposed designs, remember that in the contest, the glide and the climb are the important things and we must endeavour to obtain the best of each. This we can do by fully understanding and then putting into practice, the theory of down thrust.

World's Record

The flight of 33 minutes 9 seconds made by R. Copland in the King Peter Cup contest in Yugoslavia last July has been accepted as a world's record by the F.A.I.

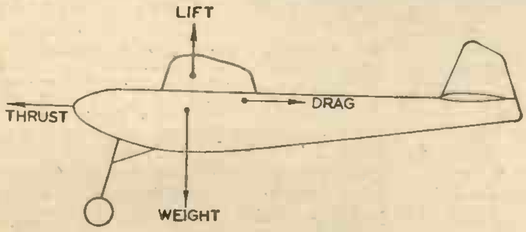


Fig. 1.—The forces acting on an aeroplane.

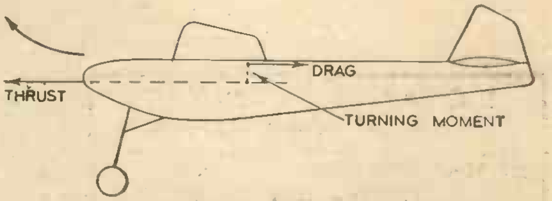


Fig. 2.—Applying the force in a horizontal line tends to pull the nose up.

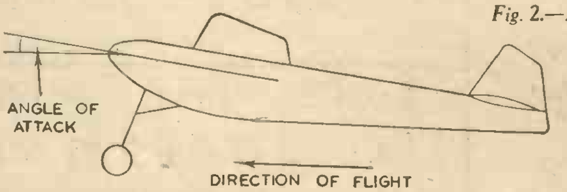


Fig. 3.—By applying down-thrust the flying angle is increased.

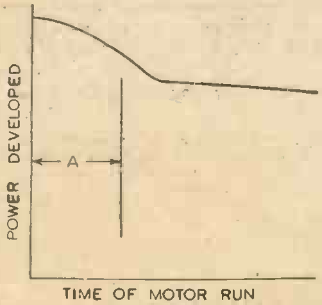


Fig. 5.—Power curve of rubber motor.

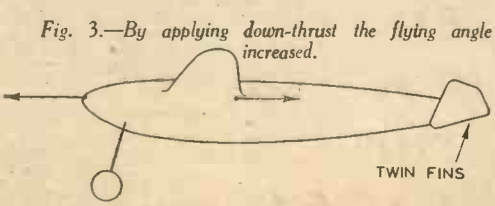


Fig. 4.—The drag line coincident with the thrust line.

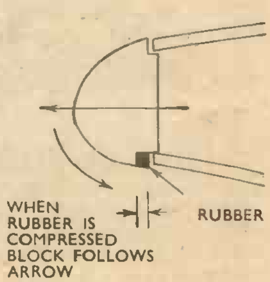


Fig. 6.—Device for providing automatic variation of thrust line.

With the Wolseley "Night Pass" lighting system, the normal method of dipping one headlight has been improved upon. Both headlights are turned off and a separate passlight switched on. The left-hand photo shows the headlights on, and in the right-hand photo the passlight is in action.

NIGHT and FOG DRIVING

Types And Principles Of Special Driving Lamps, Fog Lamps, Passlights And Road Lamps

NIGHT driving has been considerably simplified by the almost universal use of dip-and-switch headlamps and by the remarkable improvements that have been made to the lamps themselves. But as these lamps have been improved, it has become increasingly clear that even the best possible headlamps are rather in the nature of a compromise. For what might be termed ordinary short-distance night driving, they are extremely satisfactory; but when driving in haze and fog, or along roads that are haphazardly illuminated (as far too many roads are), the headlamps are, in themselves, not enough. If they are correctly focused for normal use, there is pronounced back glare due to the light being reflected by the fog particles. In addition, the beams are thrown too far ahead of the car and are insufficiently divergent.

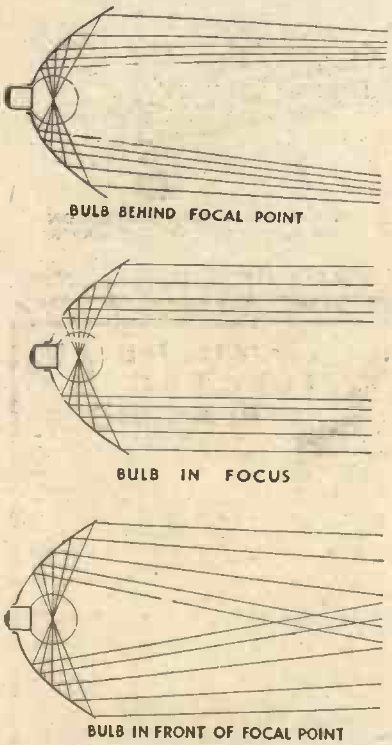


Fig. 1.—These diagrams clearly illustrate the effect of moving the bulb along the axis of the reflector.

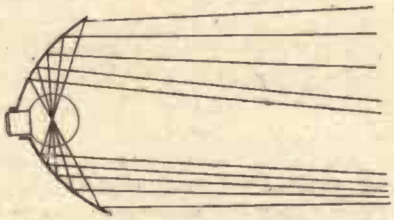


Fig. 2.—Method of obtaining a downward-deflected beam of light from a special road lamp by using a split reflector.

Coloured Discs Reduce Intensity

A few years ago, when this question was faced less scientifically than it is to-day, it became customary to fit so-called fog discs on the headlamp glasses. This gave some relief, but mainly due to the fact that the amber or yellow discs cut down the intensity of light and, by so doing, reduced back glare. For a time it was generally believed that the amber light actually had better penetrating powers in fog than has white light, and it remained for extensive research to prove that this was not the case. In fact, it was shown in many cases that a result similar to that provided by the coloured fog discs could be obtained by using bulbs of lower wattage rating or by cutting down the supply voltage. That opened up new fields for development.

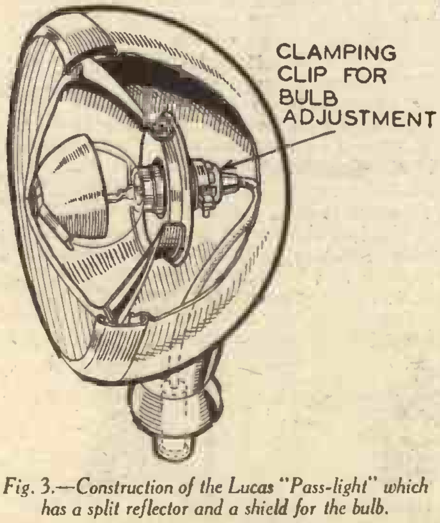


Fig. 3.—Construction of the Lucas "Pass-light" which has a split reflector and a shield for the bulb.

At this juncture it should be made clear, however, that these fog discs are often helpful, and if their operation is based on unsound ideas, experience of their use must be the final deciding factor. It must also be appreciated that they are inexpensive and, therefore, their purchase is fully justified if the owner is not prepared to buy a really soundly designed road or fog lamp.

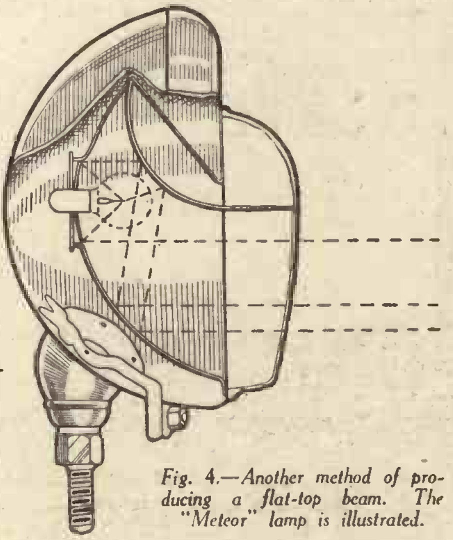


Fig. 4.—Another method of producing a flat-top beam. The "Meteor" lamp is illustrated.

Requirements

What is the best form of driving lamp, for use in all conditions, bearing in mind that it must be additional to the normal headlamp equipment? There is no doubt that it is one which throws a wide beam over the road surface, and which at the same time does not cast any upward rays which can be reflected into the driver's eyes. On that both light engineers and experience are in complete agreement, since a light of that kind is equally suitable in all conditions.

Various forms of construction have been

adopted in order to achieve that result, and only a few can be described in any detail. One of the first arrangements—and one that is still proving extremely successful—is to make the lamp reflector in two halves. Each is a section of a parabola and the two halves are placed one above the other, but with their axes displaced in respect of each other. The bulb is so situated that its filament is behind the focal point of the lower half and in front of the focal point of the upper half. As a result, all rays are deflected downward, except for those projected horizontally, as can be seen from Fig. 1. The result is a flat-topped beam of the form shown in Fig. 2. The beam is also wide because, as can be seen from Fig. 1, the rays from the lower half of the reflector are widely divergent—outward spreading. To prevent any direct rays from the bulb filament from rising, a shield is fitted over it, the general arrangement of the lamp being as shown in Fig. 3.

In another type of flat-topped-beam lamp the reflector is shaped as shown in Fig. 4, where it can be seen that upwardly inclined rays are reflected downwards, back to the lower half of the reflector. Thus, if the bulb is set behind the focal point, the rays are directed downward on to the road in a divergent beam.

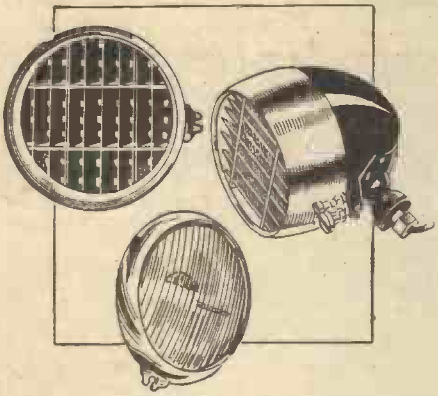


Fig. 6.—The McNaught lamp has interchangeable fronts for fog or night driving.

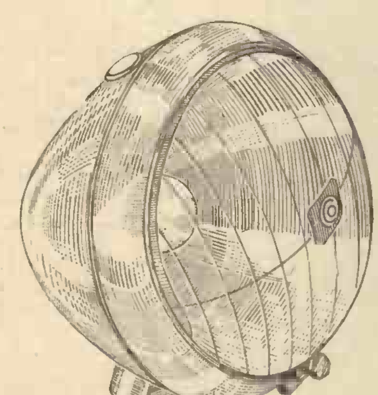


Fig. 7.—The C. and H. lamp has a twin-filament bulb to give a normal or flat-top beam at will.

In the Natek design there is a triple reflector, this being designed to throw a very wide beam with clearly defined outline as shown in Fig. 5. The object is to light a wide area uniformly, the makers claiming that the human eye is insensitive to illumination less than one-tenth the maximum. In other words, if the centre of the light beam is lighted to the equivalent of 1,000 candle-power, any "fringes" lighted to less than 100 candle-power would appear to be in darkness. One advantage claimed for this system is that it is not so dependent upon the actual power of the bulb.

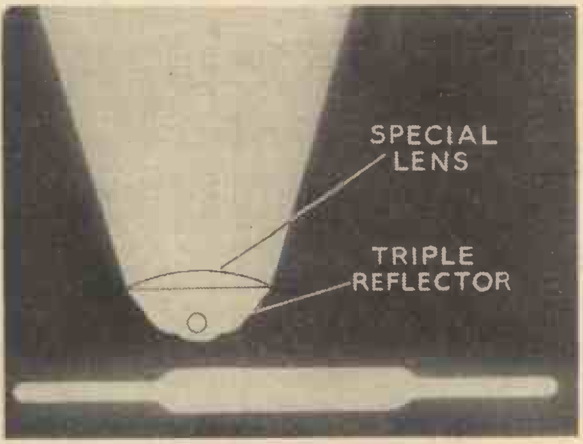


Fig. 5.—By using a special type of multiple reflector, it is possible to obtain a wide beam of uniform brightness.

Fig. 8.—A matched pair of Trippe lamps, which have a light-intensity control.

A special lens is used to co-ordinate the three beams from the triple reflector, and so to prevent the occurrence of any "blind spots."

Simpler Types

The simple basic principles outlined are adopted in several modified forms by a number of manufacturers of the special driving and fog lamps that are now available. There are, of course, other smaller lamps on the market which have the merit only of being easy to focus and swivel; by that means a divergent beam can be provided and, by tilting the map sufficiently on its mounting, moderate close-range road illumination is provided. These lamps are, quite rightly, inexpensive and should not be compared or confused with the specialised devices produced by well-known firms and sold at prices which are commensurate with their sound design and sturdy construction.

Most of the special road lamps are suitable for use as either a single unit—mounted in the centre or on the near side of the front bumper bar—or as a pair, one at each side. In all cases it is desirable to mount them so that their centres are not more than about eighteen inches above the road level, but this precaution is less important the better the design of the lamp.

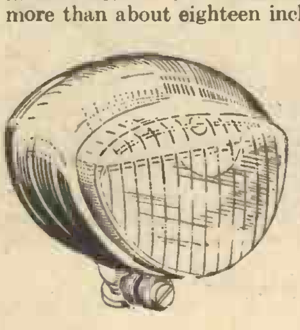


Fig. 9.—The "Meteor" flat-top beam lamp which has a reflector of special design.

Control of Brilliance

At least one manufacturer makes a point of supplying either single lamps or matched pairs. The latter are mounted one at each side of the car, and an interesting feature is the provision of what the makers call a light-intensity switch. This is actually a rheostat, which is included in one lead to the lamps so that the current passed by the filaments can be graded to suit all conditions of use. The control takes the form of a small dashboard-fitting fluted knob; by turning it the light intensity can be varied from full brilliance to a dull glow. This form of control can be extremely effective in fog, for the lamps give all of the advantages of the flat-top beam, in addition to those conferred by the smooth control.

Methods of connecting special driving lamps have been given in our companion paper "Practical Motorist." It is worth pointing out, however, that nearly all makers of these lamps are able to supply a large variety of alternative fitting brackets and clamps for attachment to bumber bars, tie bars, lamp standards, and dumb irons. Difficulty need not be anticipated in this direction, and the makers can always advise on the most suitable mounting when given the year and model of the car.

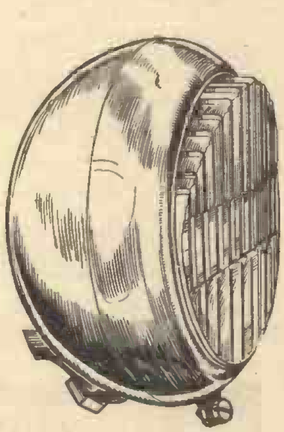


Fig. 10.—This is the Bosch flat-top-beam lamp which has proved very successful.

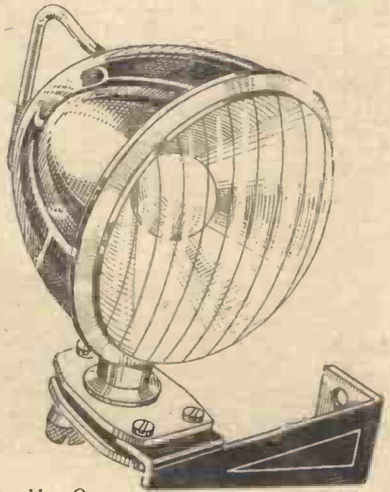
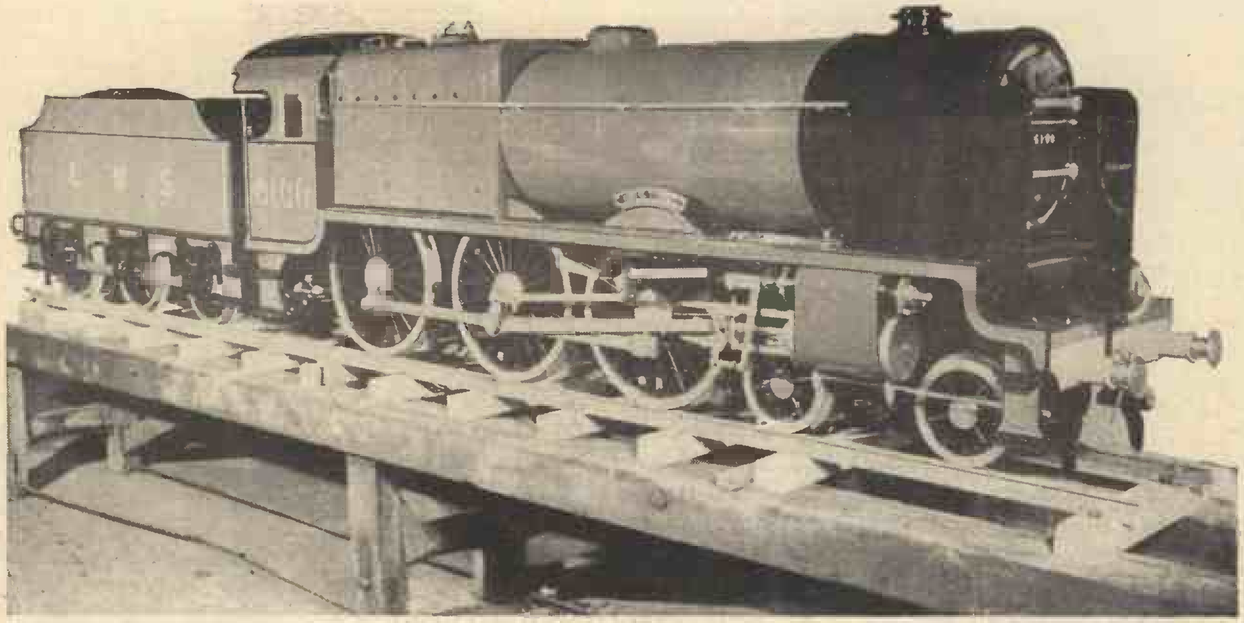


Fig. 11.—One of the "Atlantic" lamps—the handle pass lamp.



The 10½-inch guage "Royal Scot" in all her pristine glory.

The Royal Scot in "10" Gauge

By An Amateur Engine Driver

At the Regulator of a powerful new "Live Steamer"

SOME years ago, when I was only mildly interested in models, a steam engine enthusiast said to me, "You may be as lukewarm as you like old chap about toy engines, but once you get a locomotive that can pull its owner, then——" and *then* I was subjected to so much "hot air" on the fascination and excitement of larger gauge railways, that I was obliged to let him cool off on someone else.

Strange how those words came back so vividly to me recently. I was at the regulator of a 10½-inch gauge "Royal Scot," and during its trials under the skilled instruction of its maker, I drove it for three quarters of a mile round the Radwell Model Railway track near Felmersham in Bedfordshire.

Tremendous Thrill

I don't pretend to be an expert (I only learnt how to manipulate the regulator and brakes—the intricacies of injectors, water gauges and firing are beyond me), but I know enough now to realise my friend's were not just empty words. There *is* an inexplicable thrill about driving a steam engine, a skill, too, in judging when to "give her the brake," or more steam as we enter a gradient, and there are viaducts, stations, tunnels and bridges at Radwell to lend variety to the three-quarter-mile run. Yes, there's more than meets the eye in the garden railway hobby!

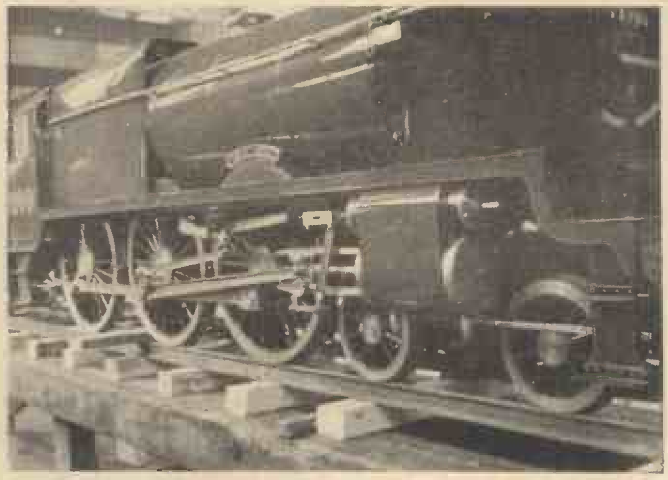
Actually it is possible to pull a person along on so small a gauge as 2½ inches, and it is easier still in 3½ gauge. 7¼-and 9½-inch gauges will pull up to thirty persons, and the engine I am now discussing, a 10¼-inch gauge "Royal Scot" built recently for the Right Honourable Lord Downshire, will be even more powerful when it has been run in.

The General Layout

Last spring Lord Downshire was contemplating the building of a large gauge garden railway, and at that time two members of Messrs. Bassett-Lowke's staff visited Easthampstead Park and advised him on the general layout. Now he has carried out his main idea, which does not in any way affect the main surroundings of his ancestral home.

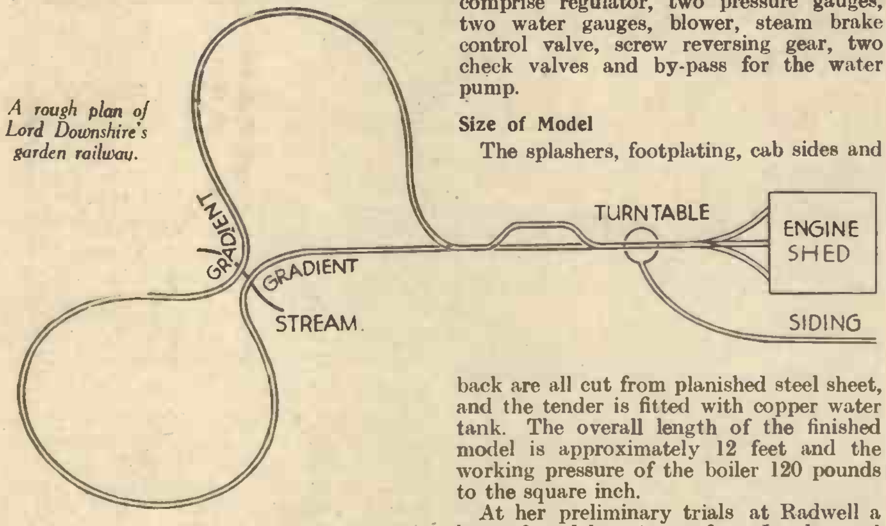
His engine shed is surrounded by rhododendrons and fine old trees and from it the locomotive runs out on to a turntable. The track (of steel vignoles section and with

(Left) Emerging from Radwell tunnel, Lord Downshire driving the engine during her preliminary tests. (Right) Commander A. Lockhart discusses the engine with her builder, Mr. J. Braunston.



(Left) The locomotive, back at Northampton, receives her final livery of paint. (Right) Close-up of the wheels and valve motion.

steel sleepers) is roughly dumb-bell shaped and runs back on to the turntable. It is one third of a mile long and in its course encounters two gradients and some sharp



A rough plan of Lord Downshire's garden railway.

curves for an engine with the 4-6-0 wheel base of the "Royal Scot."

The Engine House

Inside the engine house is a hand-winch, and an engine and tender can be pushed on to a table and then hoisted up by hand so that even the most inaccessible part can be cleaned. This ingenious arrangement was Lord Downshire's own idea.

Now for the locomotive itself. It is a model of the L.M.S. "Royal Scot" complete with smoke deflectors made to a scale of 2½ inches to the foot.

The castings, I was told, were made in gun metal and cast iron—wheels, buffers, cylinders, brackets, angle plates, axles, horn blocks, etc. The engine's cylinders were two, each 3-inch diameter bore and 4⅝-inch stroke with 1½-inch diameter inside admission valves, and all the coupling and connecting rods were steel forgings, finished throughout by hand.

The Steel Boiler

The wrought steel boiler is fitted with copper tubes and has a scale model Belpaire fire-box, correct as on the real engine. It is lagged with asbestos and finished in planished steel, while the smoke box has a double grid pattern brazed superheater, a method of ensuring that the steam is dry when it reaches the cylinders. The boiler is fed by two injectors and an axle-driven water pump. The cab fittings on the model comprise regulator, two pressure gauges, two water gauges, blower, steam brake control valve, screw reversing gear, two check valves and by-pass for the water pump.

Size of Model

The splashers, footplating, cab sides and back are all cut from planished steel sheet, and the tender is fitted with copper water tank. The overall length of the finished model is approximately 12 feet and the working pressure of the boiler 120 pounds to the square inch.

At her preliminary trials at Radwell a host of model engineers from London and Northampton were gathered, as well as Lord Downshire, who came specially from Berkshire to be present.

Trial Run

The locomotive looked well in its coat of priming grey, steam was raised in good time, and Commander A. Lockhart, A.I.Loco.E., works director of Bassett-Lowke, Ltd., took the first run with all available passengers as "ballast." After two rounds of the track the driver pulled up at the station with steam maintained, the locomotive having negotiated most successfully a rather sharp curve with gradient following. His Lordship then took over and under the guidance of Mr. J. Braunston, who is Bassett-Lowke's chief steam mechanic, and the actual builder of the engine, he soon accustomed himself to the handling of the locomotive.

Like all new engineering productions, a new locomotive will not develop its maximum speed and power until it is well run in, but before closing down for the afternoon Mr. Harry Franklin, owner of the Radwell Model Railway, ran a few speed tests with Mr. Braunston, the best being 1 minute 40 seconds for the complete circle of track, which works out at a scale speed of 143 miles an hour.

The cab fittings.

The P.M. Battery Clock

Some Queries—and a Critic—Answered!

Full Constructional details of this Electric Clock and Slave Mechanism were given in our Issues Dated October and November, 1938

THE Master Clock described in our October issue was designed as a separate unit, and a query was raised by one reader regarding the accuracy of timekeeping of Slaves which may be connected to the Master. It appears in this case that the reader was under the impression that the impulses given to the pendulum were at the same time transmitted to the Slaves and he thus assumed that as the battery became discharged, the impulses would occur more frequently and thus although the Slaves would keep time with one another they would not keep " in step " with the Master.

A clock of the type which we described is termed a Master and sometimes a " Master Pendulum." The pendulum is kept in motion by impulses imparted to the armature at the base, and obviously as the battery operating this becomes discharged the amount of energy generated in the magnets will grow less and thus the pendulum will be given impulsing swings at more frequent intervals. It is the property of a pendulum that it will take a given amount of time to travel over an arc according to its length, and it does not matter how far it swings—or how short the swing—the time period will always be the same—dependent upon its length. Therefore, if you start with a 6-volt battery and so adjust the timing contacts that an impulse is given every 2 minutes, when the pendulum is started it will travel over a wide arc. When the battery has run down to 1.5 volts it will still keep the pendulum in motion, but, although it may only travel an inch or so, it will still take just as long and thus is an accurate timekeeper.

This "P.M." electric clock was made by Mr. L. Miller, from instructions given in our October and November, 1938, issues. It is keeping perfect time.

Time Recorder

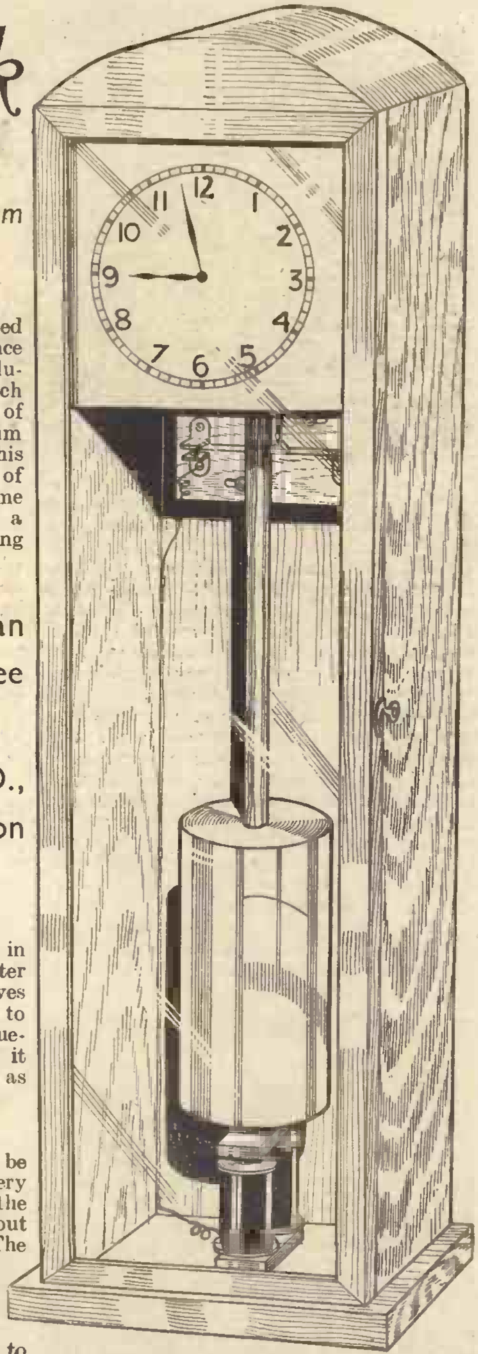
The train of wheels which were illustrated on our Blueprint are merely for convenience in translating the movements of the pendulum into the movements of hands which may be used to observe the passage of time, and are not essential to the pendulum mechanism. It is quite possible to omit this clock-work and to use in place of it one of the Slave movements. In fact in some cases the Master Pendulum is stored in a basement without any indicator being fitted to it, and the Slaves are mounted in the various rooms as required. A Master does not necessarily have to employ Slaves—no more than a master craftsman has to employ assistants. Therefore, our Blueprint accurately portrayed that which it indicated and no confusion should exist as to the purpose of this mechanism.

A Stout Art Board Dial can be obtained for 1s. post free from the publishers :—
GEORGE NEWNES, LTD.,
Tower House, Southampton Street, Strand, W.C.

Operating Conditions

We stated that a trickle-charger could be employed in place of batteries, and a query was raised in which it was alleged that the cost of using such a source would work out at 15s. per annum, at 1d. per unit. The original clock was operated from such a charger with several Slave clocks, and the cost was nil. The charger in this particular case took such a small current that the disc in the supply meter failed to move. As a point of interest in this connection, one reader at Wanstead, who made up the clock and whose effort is illustrated on this page, has worked out the power of operating his model at 1 watt per year! Incidentally the total cost of his model was 12s. By wiring the output terminals of the charger to both sets of contacts the same supply may be used for Slaves and Master Pendulum.

When first setting up the Master every effort should be made to obtain an adjustment of the contact device and the friction of the clock-work train so that impulses are delivered at the longest possible intervals. The original model was eventually made to work so that it required an impulse at every 90 seconds, but when first set up it may be found that it will only make one or two swings before the contact is depressed. Carefully spacing of the lower magnets, the position of them, the position of the contact board and the weight of the gravity arm all play a part in this initial setting up, and from an economy point of view when batteries are used it is well worth while trying to get to the 90-second period mentioned.



The Master Clock which was described last October and November.

A "Monotype" Casting Machine.

THE MONOTYPE INGENIOUS

An Interesting Description of One Machines used in

OUR knowledge of the history of the world and of the thoughts and discoveries of philosophers like Euclid, Pythagoras, Archimedes, Galileo, Newton, and others has depended upon methods of recording thought, and speech. For some thousands of years the crudest methods were adopted, and we have to rely upon engraved stones, papyrus, and similar manuscripts for our knowledge.

Methods of duplicating manuscripts and writing were not discovered until the fifteenth century, and if more than one copy of a manuscript was required it was necessary to have separate copies made. Hence, the word manuscript—which means written by hand. Very few people could read in medieval times, and such work was usually entrusted to the monks, and to clergymen. The growth of education which has brought the art of reading and writing to every citizen throughout the world, is due to methods of mass producing at a very low price, copies of written work. The knowledge which is the world's heritage relies upon the printed word for its dissemination, and the poorest can now take advantage of knowledge formerly available only to the monied few.

It was one Gutenberg in Germany and Caxton in this country, who were responsible for the process of printing as we know it to-day. They used type which could be set up into lines, and printed on sheets of paper. This, whilst an improvement on previous methods, was laborious and slow, and machinery of the most intricate kind has been invented to speed up and to cheapen the process.

The Compositor

The compositor to-day is a most important individual, and whilst the old hand methods of composing type still remain for certain classes of work, such as display matter, particularly in connection with advertisements, indeed, it is still considered to be the most skilled branch of the profession to work at the case, most works now rely upon setting their type on machines of the Linotype and Monotype class.

The old method of setting each line of type one letter at a time, and then redistributing the type back into the type case, has been substituted by a method of casting the type afresh for each setting. After this setting the type may be subjected to a process of taking matrices for rotary printing, in which case the type is not printed from at all. The rotary printing process, however, is only used for comparatively long runs which normally would mutilate the type.

The layman will be given a clearer idea of how the machine works, if, before reading the following description, he calls to mind the operations of two more familiar machines : the typewriter and pianola. For he will find that the operator composes the copy at a machine which is not unlike an enlarged typewriter; while the actual casting of the type is done by an independent machine, controlled automatically by the perforated "record"—a ribbon of paper—which the operator made when he was tapping the keys of the keyboard machine.

This account will show how it is that new separate types can range themselves in evenly spaced lines, ready for printing. Apart from the interest of watching such an amazing "mechanical intelligence" at work, there is now reason for every reader to learn about the operations of a Monotype

(Left) The Monotype keyboard. Notice the great range of different character keys including independent italic, small caps and bold alphabets. (Right) A paper ribbon, perforated by depressing the keys of a Monotype keyboard, forms a permanent record of the setting. Here the operator is just taking off a perforated spool, containing part of the record of 4 hours' tapping, and this will be transferred to an independent caster.

E—A MIRACLE OF MECHANISM

of the Most Intricate and Fascinating the Printing Trade

The Monotype Note that there are different keys ready for instant tapping without shift or makeshift, for each of 246 different characters and spaces. By depressing the keys the operator is perforating the paper ribbon which is the "record" of the job.

composing machine, because they explain why it is that so much good printing is being done to-day at a composing speed, and at a production cost, which would have been impossible thirty-five years ago. Monotype machines have made printing history, and the great advantage of providing separate type allows every user of printing to enjoy the benefits of instant, inexpensive corrections; of new hard type for each job, and of a world-famous range of perfectly formed type faces.

The Operator

The operator at a Monotype keyboard is given the copy. It may be the wording of a circular, part of a book, an article for a newspaper or magazine, or a table of statistics. He is told the size of the type in which it is to be printed, and the width it is to occupy upon the page. He adjusts a gauge, and proceeds to tap the keys as a typist would do on a typewriter. Immediately a key is depressed two punches rise and pierce their way through a paper ribbon. When the operator's finger is removed from the key, the punches recede from the paper strip, and the strip is then advanced a short distance. This action is rapidly repeated. As some letters are thicker than others (for instance, the m or w is thicker than the i or t), the thicknesses must be registered, so that not more than the correct number of letters may be composed in a line. This registration of the different letter thicknesses is done automatically. As the line approaches completion, a bell warns the operator to finish his word or syllable, and he then glances at a scale which indicates to him the number of two special keys which must be depressed so that the line is the correct width.

Depressing the Keys

As soon as the operator has depressed a key, the rest of the mechanism is operated automatically by the agency of compressed air. For instance, the punches, the registration wheel, and the paper rolls are all advanced by air pressure. All that the operator does by depressing a key is to open air valves, and the air then does the rest of the work. Consequently, a very light "touch" of the key is obtainable.

A Monotype keyboard does not type or print the letters, it simply makes perforations in the paper strip, which act as symbols for the letters; they cause the mechanism of the casting machine to produce lines of newly cast and perfectly finished type. The paper roll (or that portion of it which has been perforated), is removed from the keyboard and transferred to the casting machine.

A Monotype casting machine works at about 150 revolutions per minute, and during each revolution the paper strip is advanced, step by step. Immediately the strip has been advanced, it is clamped over a group of holes leading to pipes, and compressed air passes through the perforations.

The pressure of the compressed air causes two stop pins to rise. The stops which are blown up by the compressed air are arranged in two groups of 15 stops per group. These two groups are arranged at right angles to each other. It is thus possible for the frame containing the dies to be brought to 225 different positions (15 x 15 = 225).

Frame of Dies

A set of tongs, according to the positions at which they are stopped, carry the frame of dies to a corresponding position over a steel mould. The mould has a sliding back, which is automatically adjusted according to the thickness of the letter which the casting mechanism is to produce. This adjustment takes place as the frame of dies is being carried to its required position.

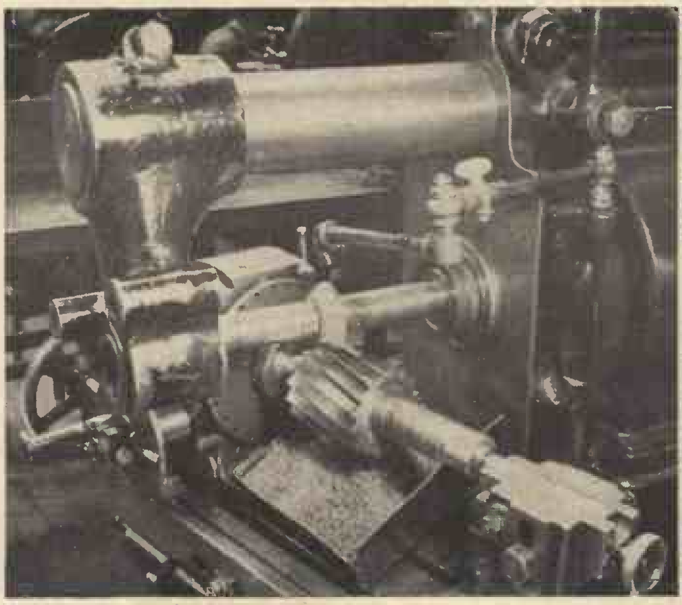
The die is then taken down to the mould, and clamped firmly to it. A pump forces molten metal into the mould, causing a type to be cast which will thus have upon its upper end a replica of the letter contained in the die. Solidification of the metal takes place instantly, as a small stream of water flows through the steel mould to keep it cool. The die is withdrawn from the mould, and the newly-cast letter is ejected into a groove. This process is repeated very rapidly, letter after letter being accumulated until the line is finished, when it is automatically withdrawn from its groove, and placed in a long metal tray called a galley, where line after line is accumulated in the manner described. No hand manipulation is necessary.

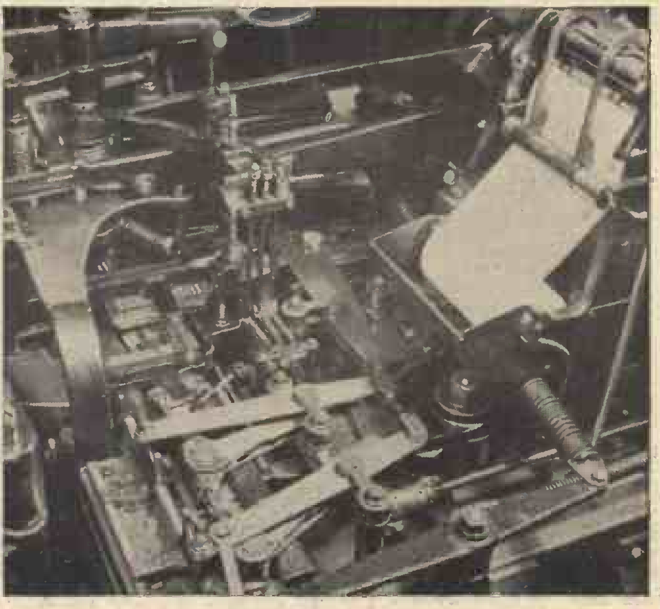
All these movements are perfectly automatic and the machine attendant has nothing to do except to keep the pot of metal replenished and to remove the galleys of type.

Columns of Type

The columns of type are then proofed and carefully read, all errors are corrected, and they are then ready for the press. From this description it will be inferred that if the man at the keyboard touches a wrong key, the casting machine produces a wrong character. Should this happen, the error can be corrected by hand. The operator of the Monotype keyboard quickly acquires the habit of touching correct keys, and the errors in his composition are consequently very few in number.

As the keyboard operator causes the paper ribbon to be perforated, it is automatically rewound upon another spool. When this prepared spool of paper is transferred to the casting machine, the last line that is perforated is cast first, and the





These two illustrations show part of the intricate mechanism of the Monotype machine.

letter of the very first key touched by the keyboard operator is the letter that will be produced last by the casting machine. For instance, if the keyboard operator were to compose a paragraph such as:

Good typography adds to the
drawing power of publicity

the casting machine would first produce the blank spaces of the last line, and then the characters of that line. It would then cast the next to the last line, and so on, so that these lines would appear on the machine something like this:—

Good typography adds to the
drawing power of publicity

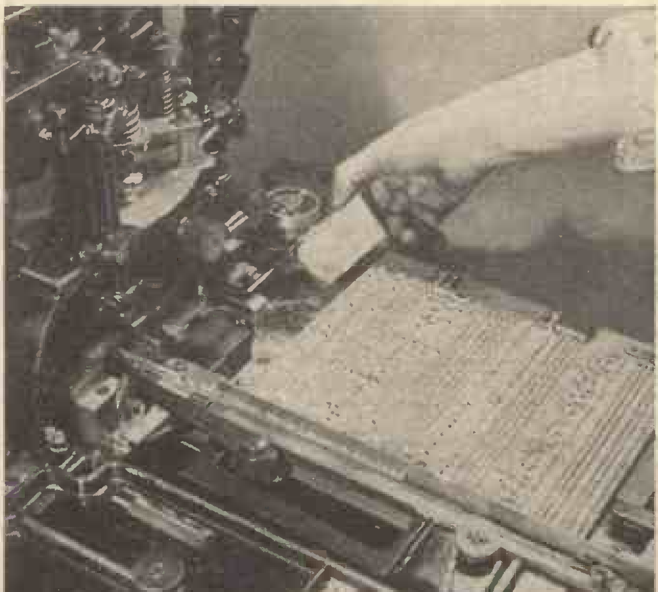
A Monotype casting machine in operation fascinates the watcher, and the speed and the manner in which shining new types are cast in proper order becomes almost bewildering to him, for no matter if just plain lines or complicated table work is being cast, the lines accumulate with mathematical accuracy and precision.

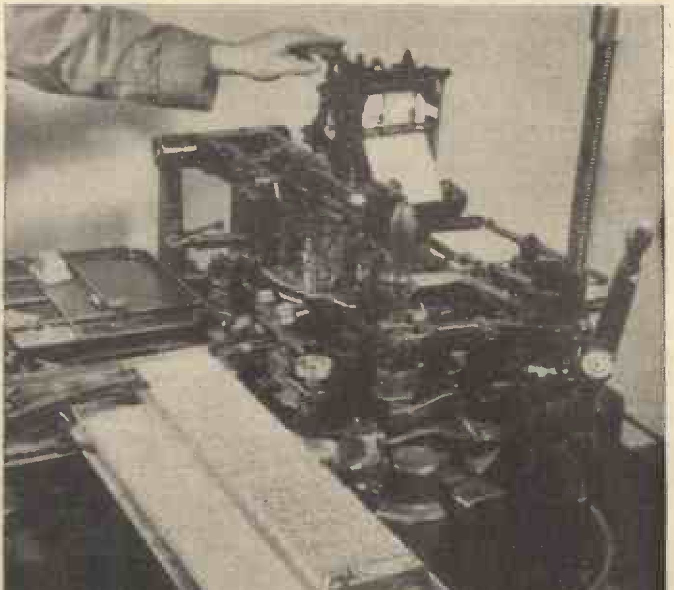
Changing the Mould

By changing the mould any size of type may be cast, and by changing the frame of dies another style of face may be cast. For instance, by changing only the frame of dies, the following results may be obtained:

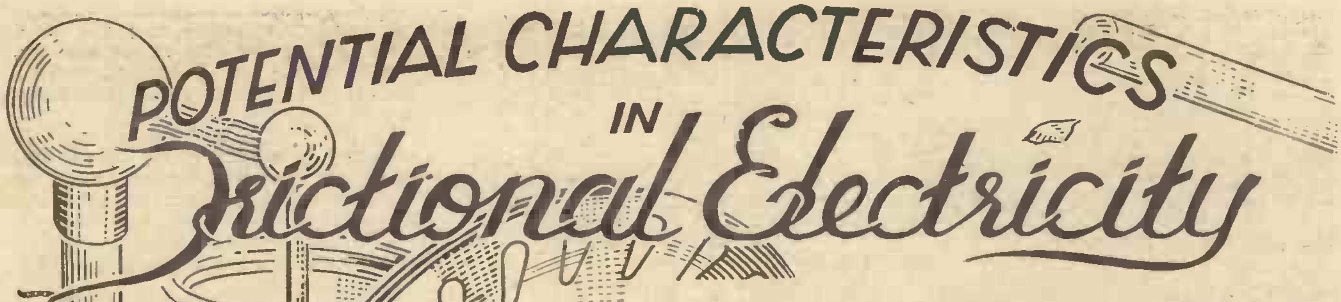
This is "MONOTYPE" face 10 pt.
This is "MONOTYPE" face 10 pt.
This is "MONOTYPE" face 10 pt.

The columns of type produced on a Monotype casting machine are made up into suitable lengths, according to the size of the book, page or other sheet which has to be printed, and these sections are then locked into a strong steel frame and placed in a printing machine, and the requisite number of copies are quickly produced. As the type cast by Monotype machines is always used new, the resultant printing is sharp and clear, and that is why all progressive printers are now users of this wonderful machine.





(Right) The attendant has just come back to the caster, which has automatically cast and set the galley of the new type you see here. (Left) Note the molten metal into which the attendant is feeding an ingot.



POTENTIAL CHARACTERISTICS IN Frictional Electricity

Simple Experiments in Electricity, including the construction of an Electroscope

AT one time the belief arose that matter was fundamentally composed of minute particles, which in themselves had properties individually determining the state of all matter, different classes having varying formations of these atoms, either individually or in unison.

To make conditions still more complicated, it was realised that these atoms must contain some form of nucleus around which infinitely smaller particles of energy existed.

Exhaustive experiments then brought to light the fact that, by upsetting the relationship of these unknown quantities—believed to make up the tiny particles, and which we now term as electrons and protons—electrical energy was obtained.

It was noticed in the frictional tests that, before upsetting the equilibrium of these atoms in two given objects, there existed no apparent influence when these objects were brought close together, but immediately after vigorously rubbing one with a piece of silk, paper, etc., these objects had the property of both attraction and repulsion—depending on the manner of the experiment; thus, it was assumed, and rightly so, that in its normal state the atom was neutral, therefore containing an equal quantity of negative and positive energy. Further tests showed that by apparently removing some of the electrons, by frictional methods, the atoms were thrown into a state of polarity which provided a clue to the reasons for attraction and repulsion with similarly treated objects.

This clue resulted in the discovery of the fact that, on removal of the "Outside" energy which we classify as negative electrons, the nucleus of positive protons constituting the atoms became the determining factor—and, therefore, furnished these particular atoms with a distinctly positive energy.

Now when the matter composing these atoms was brought close to negatively charged matter, the two influences were attracted to each other, and the positively charged atoms endeavoured to get back their full quota of electrons and so restore to a neutral state.

It was then discovered that when two similar charges were brought together a condition of repulsion existed in the matter, and this proved to be the birth of the unvarying characteristic of all electrical functions, whether these be chemically or physically produced.

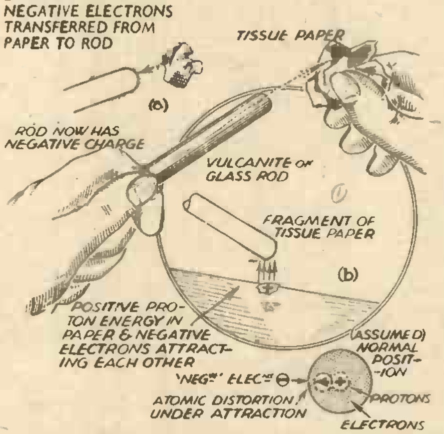


Fig. 1.—Illustrating transference of electrons and polarisation.

An Experiment

In order that the above notes can be better understood, it is purposed to cover a number of simple and practical tests, omitting involved technical data, and so the first observations can be made in conjunction with the illustration given in Fig. 1a, b.

Here is depicted a vulcanite rod being furnished with a few extra negative electrons by rubbing vigorously with a piece of tissue paper. The electrons in this instance are left clinging to the surface of the rod, and being derived from the tissue paper as diagrammatically shown in the inset (*a*).

The rod attracts the fragment of paper on the table owing to the two opposite poles which exist through the derivation of greater negative energy on the one hand, and the balanced atom containing a positive nucleus, on the other hand.

Many of the atoms of the tissue paper or silver foil fragment are already in a slight state of positive charge, as in the very action of handling some of the outside electrons have got transferred from the fragment to the fingers, and, therefore, as these get back their full quota from the supply on the surface of the rod, a neutral state sets in and the attractive influence is lost, the fragment falling away.

Two Like Charges

Now see what happens when two like charges are brought together; for this experiment an ebonite, vulcanite or sealing wax bead should be obtained, and suspended from a thin, silken thread. The bead should be rubbed with a piece of silk to furnish the negative electrons on the surface, then, immediately after rubbing the glass or vulcanite rod and so providing this also with an extra supply of negative energy, the action of bringing these two energies near to each other will cause the bead to be repelled, showing very simply that two like poles repel.

The "electroscope" provides a very good example of this condition for both negative and positive charges, and this comprises an instrument in which are suspended two pieces of exceptionally thin gold leaf, these gold leaves being hung together from the end of a conducting rod which is usually of brass. The other end of the conducting rod is brought out through a suitable point in the housing to provide the charging path for the applied potentials.

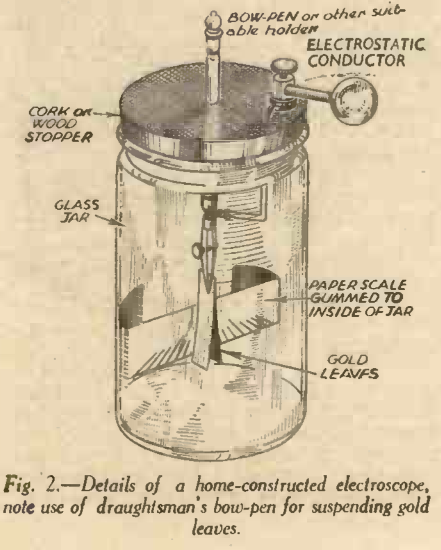


Fig. 2.—Details of a home-constructed electroscope, note use of draughtsman's bow-pen for suspending gold leaves.

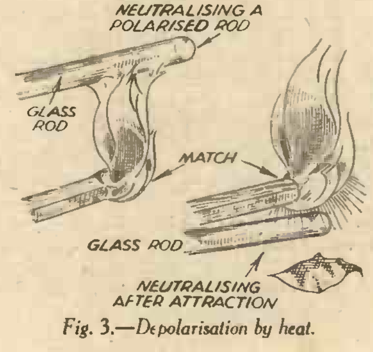


Fig. 3.—Depolarisation by heat.

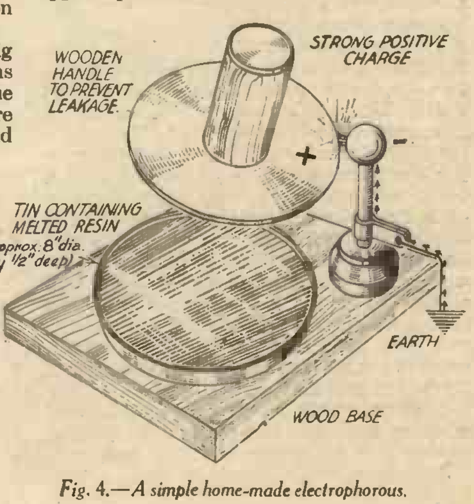


Fig. 4.—A simple home-made electrophorous.

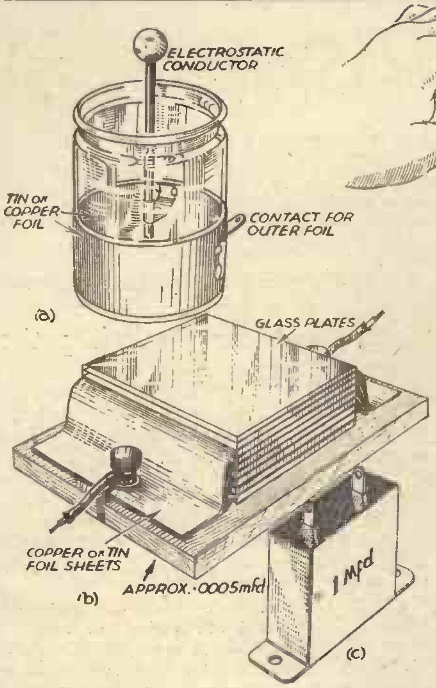


Fig. 6.—Typical examples of condenser giving comparison with the Leyden jar.

When any charge is applied to the conductor (referred to in the illustration in Fig. 2 as the electrostatic conductor) it flows down to the gold leaves and furnishes each one with an equal quota of energy and, of course, of like polarity, the result being that they immediately repel each other and the extent of this repulsion is noted by a suitably marked scale fitted inside the housing

The illustration, Fig. 2, shows a simple homemade instrument and it will be necessary to refer again to this method of electrostatic measurement later in this article. It will prove interesting now to note the effects of heat in the tests just described, and for this observation, a glass rod about 6 in. long will be required.

The Effect of Heat

As before, a fragment of either tissue paper or silver foil will be prepared for picking up (see Fig. 3).

Rubbing the glass rod with some silk, and keeping a lighted match ready to apply in the manner illustrated, the fragment should now be attracted. When this is clinging to the rod, a lighted match can be brought just above so that the heat just influences the rod.

It will be seen that, at a critical point, the fragment falls away, any further attempt to attract the paper or foil proving of no avail. There has been no proved theory advanced as to the reason for this sudden neutralisation of the atoms, but, by reversing the process, it can be proved that a polarised rod, as the one used, actually does loose its charge when subjected to heat, therefore restoring to a neutral state. So now the rod can again be furnished with a negative charge, but before trying to attract the fragment, the flame of the match should be applied to the end. It remains now only to attempt to pick up the fragment to realise that there is not a vestige of attraction evident.

High potentials are possible by frictional methods although the amount of current is very low in proportion, and first considerations along these lines can be with regard to a very early form of static generator, the "electrophorous." This arrangement is capable of supplying quite interesting charges, sufficient to cause a spark and sensation when manually discharged.

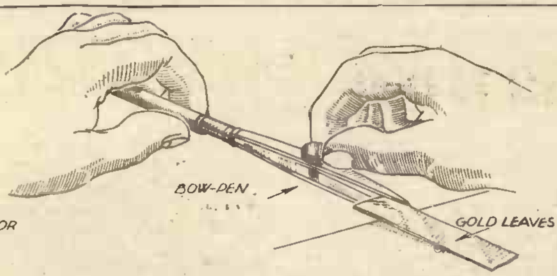


Fig. 5.—Using a bow-pen for picking up the gold leaves for the electroscope.

An Electrophorous

Details of a simple home-made electrophorous are given in Fig. 4, and a brief explanation of the operation is as follows: The resin is first of all furnished with a surface charge of negative electrons in the usual manner with either silk, flannel, wool, or paper, etc., the disc being then placed on the surface. The nucleus of positive protons in the atoms of the disc is drawn towards the resin surface as this, surface is now of unlike polarity (negative).

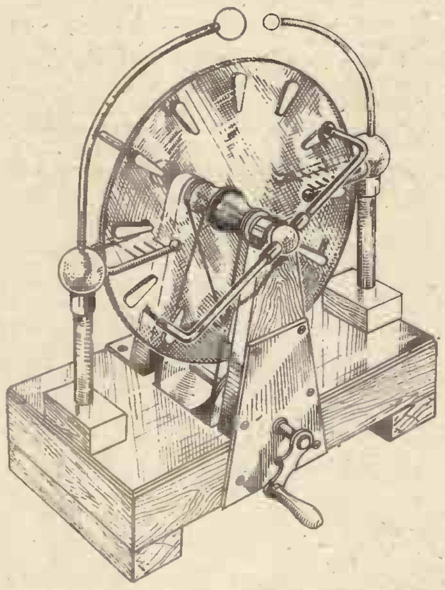


Fig. 7.—A typical model of the Wimshurst generator.

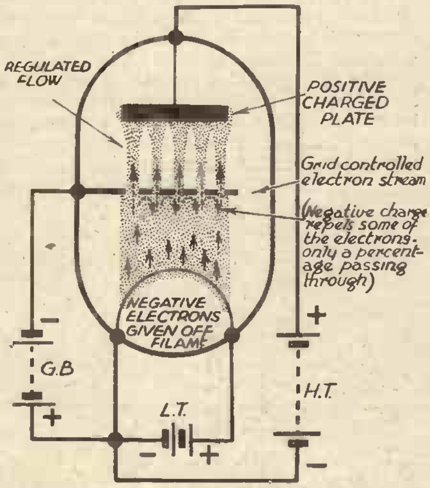


Fig. 8.—Illustrating in brief the electronic function in a modern radio valve.

The electrons composing the outside "casing" of the disc atoms are consequently at the top of the disc, whilst the resin electrons of course remain where they are.

To get the disc positively charged, it is necessary to get rid of the disc electrons on the upper surface, so without removing the disc, this can be touched or earthed, thus dissipating the negative energy.

The disc now has a strong proton charge which remains when it is removed by the insulated handle.

Supposing, after checking these observations by utilising the electroscope, we wish to restore the disc to its original neutrality, this can be carried out by supplying another path from some source of spare electrons to the disc, and so once again balancing out.

This constitutes the second phase in the experiment, and one which it is preferable to carry out in a darkened room, since if the discharge is strong enough, there will be a perceptible spark, and if one's finger is used a prickling sensation will be experienced.

The "Electroscope"

So far as the actual construction is concerned, it can be said that the illustration is sufficiently self explanatory, but there is one important and interesting point to be mentioned regarding the gold leaves. In the production of these leaves, a hand-beating process is usually employed in order to get them down to extreme thinness, and invariably they are sold in book form as the slightest draught or inadvertent handling can spoil them.

When, therefore, it is proposed to suspend leaves in the manner indicated, it is clear that some form of tweezers should be used, and one such method is shown in the use of a drawing pen in Figs. 2 and 5.

The Leyden jar gives an interesting example of the early methods for storing charges of electricity, and no doubt many readers will now be familiar with its functions, but to review briefly the trend of development in condenser design, included in Fig. 6 are two further examples which embody the basic principles of the Leyden jar condenser.

Small charges from say the electrophorous or comparatively large charges from a Wimshurst machine are applied to the electrostatic conductor depicted in Fig. 6(a), whilst the other plate or foil is connected to earth to obtain the negative supply of electrons.

The strong proton charge is obtained on the one plate by repeatedly charging until saturation is reached.

The bluish flash seen when the jar is discharged is actually the resultant ionisation which occurs when the electrons jump across the conductors.

Fig. 6 (b) illustrates one of the forms of condenser used in the pioneer days of the crystal set, and it is interesting to compare this with a typical modern version (c), noting the difference in comparative size and capacity.

Fig. 7 gives a good example of a Wimshurst machine for generating high potentials by friction.

In the early days of radio, this form of generator was tried with various combinations of Leyden jar and induction coil, but it now serves no practical purpose other than for tuitionary purposes. A very fine example of electronic behaviour is found in the basic function of all radio valves, and a self-explanatory diagram of a simple triode is given in Fig. 8.

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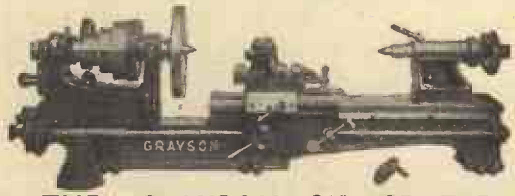

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MOTORISED BICYCLES

The Francis-Barnett Powerbike.

ONE of the most interesting features of the Cycle Show at Earl's Court was the big increase in the number of motorised bicycles, and the fact that no fewer than nine different makes were on view has done much to focus public attention on motor-assisted cycling.

The great majority of these machines—all except two in fact—feature the 98 c.c. Villiers two-stroke engine unit. This little engine has been especially developed by the Villiers Engineering Co., Ltd., for use in motorised bicycles. It is completely self-contained, and can be detached from the frame with very little trouble.

The Villiers Engine Unit

For those of our readers who are not already familiar with the Villiers Junior engine unit, we give the following brief specification :—

Cylinder: Bore 50 m.m., stroke 50 m.m., 98 c.c., Aluminium alloy piston, ball-bearing mainshaft, roller-bearing big end.
Clutch: Running in oil, incorporated in engine unit. Rachet lever control in handlebar.
Carburetter: Villiers automatic, controlled by single lever. Air strangler for starting.
Silencer: Very efficient aluminium expansion chamber fitted under engine, with secondary tubular silencer and tail pipe.
Lubrication: Petroil system (An accurate measure is usually provided in the tank filler cap).
Lighting: Villiers direct lighting for flywheel dynamo. Parking battery in headlamp.
Ignition: Villiers flywheel magneto.

Generally speaking, this little engine is powerful enough to take the average motorised-bicycle rider up any main road hill without pedal assistance, and most of the machines in which it is fitted have a cruising speed of about 25 m.p.h., petrol consumption varies slightly with the different makes, but 140 m.p.g. can be taken as a round figure.

The Coventry Eagle Auto-Ette

The Coventry Eagle Cycle and Motor Co., Ltd., have been experimenting with motorised bicycles for a considerable time and they have now produced the Auto-Ette. It is a smart-looking little machine, finished in the well-known Coventry Eagle colours of red and black, and retails at £17 17s.—which figure has now become more or less the basis price for motorised bicycles.

The Auto-Ette is fitted with a very neat type of tank, while the engine is the Villiers Junior Unit, a detailed specification of which has already been given. Large tyres are fitted, to give the fullest possible comfort, and at the same time to reduce the possibility of punctures to a minimum. An exceptionally comfortable saddle is fitted while the efficiency of the brakes has also been studied in order to give the rider an immediate feeling of complete confidence in his machine.

The new Coventry Eagle Auto-Ette.

The Cyc-Auto

The new models of the Cyc-Auto embody an entirely new 98 c.c. 2-stroke engine, manufactured by the famous "Scott" firm. In many respects this engine resembles the design of the unit previously fitted, but a great advance has been made by incorporating a five-plate clutch in the drive.

Several different models are made—ladies', gent's, and tradesmen's—and there are also de-luxe models fitted with a very neat type of sprung front fork.

The same "Scott" engine is used on all models and this follows the most modern practice in 2-stroke engine design. It is fitted with a flat top cast-iron piston and an oval section connecting rod, with roller-bearing big ends, on a hollow crank pin. The crank also runs on ball-bearings.

The carburetter is an Amal fitted with a strangler for easy starting, and ignition is by flywheel magneto. An independent electric lighting set is fitted.

As in the case of previous models, the new "Scott" engine is mounted transversely in the frame directly in front of the bottom bracket, and the drive is taken to a cross shaft by means of helical gear running in oil. The final drive to the rear wheel is by chain. A further improvement is the adoption of internal expanding brakes on both wheels for the de luxe models.

The Dayton Auto Cycle

The principal feature of the Dayton machine is the special low design of the frame which has been constructed with a view to providing the utmost safety in traffic. Large top and bottom head ball bearings are fitted, while the fork blades are of extra-heavy gauge, and the steering column is reinforced to give additional strength. Internal expanding brakes operated by handlebar levers are fitted to both wheels, and the tyres are 26 in. by 2 in. Dunlops.

The engine is the 98 c.c. Villiers Junior Unit

The Excelsior Autobyk

As a result of a vastly increased demand for the Excelsior Autobyk, the manufacturers have been able to reduce the price to £18 18s. The Autobyk was introduced for the first time at the 1937 Show, and as the machine was one of the very first of this type it created quite a sensation, and has since sold in large numbers.

For this season the design which has proved so successful during the past year remains basically the same, but there are a number of detail improvements on the new model in spite of the reduction in price. These include the fitting of a soft-top fabric saddle if desired, in place of the ordinary saddle, a ratchet clutch lever, and a new and more attractive colour scheme for the petrol tank.

The Francis-Barnett Powerbike

In the motor-cycle industry Francis and Barnett, Ltd., of Coventry, have made an enviable reputation with their motor cycles, in the design of which they have concentrated on providing the best possible weather protection both for the machine and the rider. The remarkable popularity of the well-known 250 c.c. "Cruiser" motor cycle left them in no doubt, when they designed their new motorised bicycle, that enclosure of the working parts was a very desirable feature of any machine intended for utility riders. As a result, the Francis-Barnett Powerbike which was introduced to the public at Earls Court, is not only comfortable, but also clean to ride.

Here again the popular Villiers Junior Engine Unit has been employed for the power unit, and this is enclosed beneath light and quickly detachable shields.

Another feature of this machine is the patented rubber cushioned front forks, while a further item of interest is that the rear brake is pedal operated by a patented mechanism. Internal expanding brakes are fitted to both wheels.

The petrol tank, which occupies the whole of the space between the two front down tubes, is of unusually large capacity and carries 1¾ gals. of fuel. This gives the machine a range of well over 200 miles, without refuelling. The retail price of the Powerbike is £18 18s.

The H.E.C. Power Cycle

There are many novel points about the design and construction of the H.E.C. Power Cycle, and probably the most outstanding of these are that it has the smallest engine of any motorised bicycle at present on the English market, and that without the engine the machine can be ridden as an ordinary pedal cycle.

The Dayton motorised bicycle.

One of the Interesting Features of the last Cycle show was the popularity of the motorised Bicycle, most of the machines on view were powered with either Villiers or Scott Engine Units.

The machine is designed primarily as a bicycle, and has a modern open frame of standard size giving the correct pedalling positions. The compact little power unit has been cleverly designed so that it just fits into the space between the two down tubes and the seat tube. The engine itself has a roller bearing big end, aluminium "Lo-ex" piston, detachable aluminium cylinder head, and a die-cast crankcase, which also incorporates the clutch housing.

The drive is transmitted to the rear wheel by chain through a countershaft clutch of the cork insert type. Lubrication is by the petrol system, and ignition and lighting is provided by a compact flywheel magneto with lighting coils. A large capacity aluminium expansion chamber fitted in front of the engine, with concentric tail pipes, gives very silent running.

The wheels are 26 in. by 1¾ in., fitted with Dunlop carrier tyres. An internal expanding hub brake is fitted to the front wheel, while the rear wheel has a heavy-type rim brake operated by a simple direct acting back-pedalling gear. Hand control may be obtained for this brake if desired.

The finish is in black enamel with the usual bright parts chromium plated, while the tank is enamelled in attractive contrasting shades of blue. The machine has a wheel base of 43¾ in. and weighs approximately 28 lb. fully equipped. The retail price of the H.E.C. Power Cycle is £17 17s.

The James Auto Cycle

Another popular motorised bicycle which has been reduced in price for the coming season is the James Auto Cycle produced by the James Cycle Co., Ltd., of Greet, Birmingham, 11. Here again, a number of detailed improvements have been incorporated, including the provision of a ratchet clutch lever and a reserve petrol tap. Another feature of the 1939 model is a new type of tool box which is neatly housed behind the seat stay, and follows the curve of the mudguard.

This is another machine making use of the Villiers Junior Engine Unit, and its general appearance and performance is, therefore, in many respects similar to that of other Villiers-engined models already described.

The James Auto-Cycle.

The Norman Motobyk

The Norman Motobyk, which was introduced at Earls Court by Norman Cycles, Ltd., of Ashford, Kent, differs from most other machines in this category in that the frame has been specially designed to give a short wheelbase. In addition, instead of the engine bearers forming part of the frame, the lower down tube is looped and continues until it joins the seat tube immediately above the bottom bracket assembly.

The petrol tank, which has a capacity of 9 pints, is tastefully finished, and an oil measure is incorporated in the filler cap. Special dome mudguards are fitted and both wheels have internal expanding hub brakes.

Another useful feature of this machine is the provision of a central spring-up stand, which facilitates the removal of either front or rear wheels.

The power unit is the Villiers 98 c.c. 2-stroke engine already described and the retail price completely equipped is £17 17s. The Norman Motobyk can also be supplied with a special foot-operated rear brake with handle-bar control release for an additional 10s. 6d.

The Raynal Auto

Although the Raynal Auto is yet another machine featuring the Villiers Junior Engine Unit, it differs in many respects from most of the motorised bicycles already described in this article. Two special features of the frame design are the sprung front forks on the de luxe model, and the one-piece engine bracket which is used on both the de luxe and the popular models.

The Raynal spring fork has the two fork blades mounted on a trunnion at the crown, and road shocks are absorbed by a strong laminated leaf spring arranged vertically in front of the column tube. Large diameter friction dampers are also embodied in the design of the fork.

Both the Raynal models are fitted with 9-pint capacity petrol tanks, which occupy the whole of the space between the front down tubes. Other features common to both models are, a large tubular rear carrier, internal expanding hub brakes on both wheels, spring-seat saddle, and a central spring-up stand.

TRICKS WITH THE MAGIC WAND

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Fig. 1.—Shell wands made of paper for vanishing. The one in the hand is fitted with solid wooden ends to make it sound solid when rapped.

Fig. 4.—Wands that defy gravity. The one on the table is a hollow wand with a weight that can be slid to either end. The wand in the hand rises of its own accord through the agency of black elastic. (Shown white in the photograph)

Some Of The Ways In Which The Conjuror's Emblem Of Mystery Helps His Tricks

THE variety of ways in which the conjurer's wand can be pressed into service for the mystification of the audience is almost endless. To simplify my description of the best of them I will divide them into two groups. In the first group are tricks in which the wand itself is the subject of the illusion. The second group consists of wands prepared for the purpose of making possible some trick with other objects. In the second group of tricks the wand does not seem, from the audience's point of view, to be practically concerned in the trick at all.

The most popular trick in the first class is the vanishing wand. The wand is knocked on something to prove it solid, wrapped in paper, and immediately the paper is crumpled into a ball the wand, really a duplicate, is produced elsewhere.

Two Methods

Fig. 1 shows two methods for this trick. In each case the wand to be vanished is a shell wand, made of thin paper. One type of shell, shown lying on the table in the picture, is of paper throughout and is made by rolling black paper round the real wand and then pasting strips of white paper at the ends to represent the tips. The duplicate solid wand is a wooden rod similarly painted and fits easily into the shells, of which a number are wanted as one is destroyed at each performance.

The usual way to do the trick is to have the solid wand in the shell, when both can be banged convincingly on the table. Two long envelopes are shown and one is opened out by inserting the wand into it. The wand is withdrawn. Actually only the shell is withdrawn, the solid wand remaining to be produced later on. The paper shell, which the audience take to be the solid wand, is put in the other envelope and the envelope duly crumpled up (see Fig. 2).

Another Shell

The other type of shell, also of paper, represents only the black part of the wand the tips consisting of plugs of wood which fit tightly into the ends of the shell as shown in Fig. 1. Such a wand can be proved solid by tapping the wooden ends on a glass tumbler or china plate, after which wrapping it in a sheet of paper and making it vanish is a simple matter. The duplicate solid wand is then produced from a pocket, or from the conjurer's trouser leg, back of his coat or anywhere else he pleases, it having been put there previous to the trick.

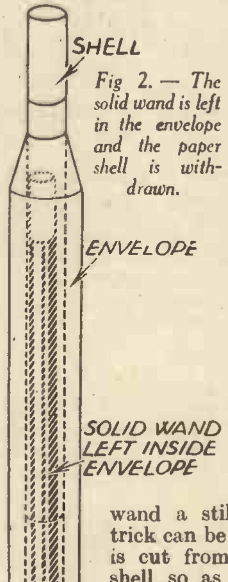


Fig 2. — The solid wand is left in the envelope and the paper shell is withdrawn.

With the white tipped shell and loose inner solid wand a still more convincing trick can be done if a small piece is cut from the centre of the shell so as to expose the solid wand beneath. Some member of the audience is asked to call out his initials, which the performer chalks on the wand. He chalks them on the solid wand via the cut-out opening in the shell. The solid wand is then left in an envelope and the shell vanished as already described with the additional mystery of the initials being still on the wand when it is reproduced, thus apparently negativing any idea of two wands being used. Needless to say the opening in the shell must be hidden after the solid has been left in the envelope.

If the conjurer does not wish to use the envelope idea he can get rid of the solid core to his shell by letting it drop into a long bag behind the back of a chair as he picks up a sheet of paper in which to wrap the wand, as shown in Fig. 3.

Changing Colour

The shell principle can also be applied to making a wand change its colour. The solid wand is red with white tips, the shell black with white tips. Having rapped the black wand on the table the performer

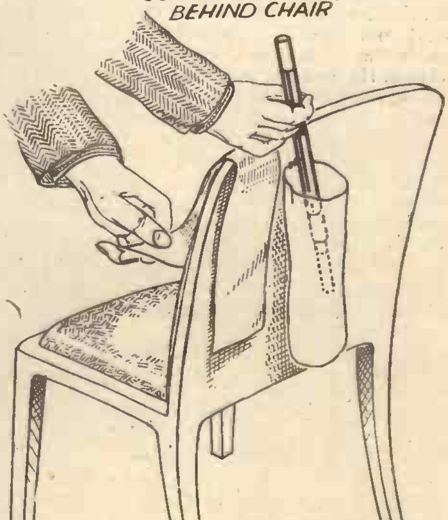
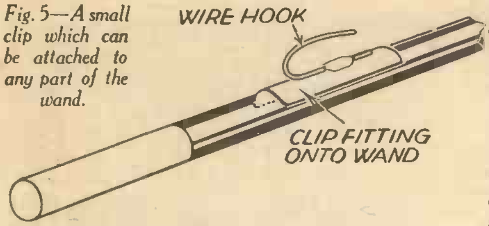


Fig. 3. Another method of getting rid of the solid wand.

Fig. 5—A small clip which can be attached to any part of the wand.



then rolls it in a sheet of paper, makes a pass and strips off the paper, stripping off with it the paper shell and revealing the wand red. For the sake of giving some excuse for the change it is a sound idea to use red paper in which to wrap the wand, or newspaper may be employed and a joke made about the paper being read.

Fig. 4 shows two types of trick wand which defy the laws of gravity. The one on the table is a hollow metal or pasteboard tube inside which slides a short rod of lead. By allowing the weight to slide to one end of the wand it may be made to remain in the most impossible positions

The wand in the hand is also a tube. The top is plugged and to the plug is attached a length of black elastic not quite as long as the wand. The other end of the elastic is tied to a button. Under normal conditions the elastic draws the button against the open end of the wand and everything appears quite ordinary. In use the wand is drawn through the hand and the button gripped at the back of the hand between two fingers as shown. If the wand is held at the opposite end when down in the closed fist it will, when pressure of the fingers is relaxed, rise up through the hand owing to the pull of the stretched elastic. In the photograph the elastic is shown light in colour to make it clear.

A Wand Clip

Fig. 5 shows a small clip which can be attached to any part of the wand and enable it to cling, seemingly without support, to the fingers. The fingers simply grip the hook shaped wire. A highly sensational effect with this apparatus is produced by hooking the wire over the forefinger and swinging the wand round and round the finger. The clip may, of course, be detached at any moment and the wand offered for inspection.

Producing the wand from a tiny purse is another good wand trick. The wand is solid and can be examined. There is a slit in the bottom of the purse. The wand rests in the left sleeve with the end projecting against the palm of the hand. The back of this hand is kept towards the audience while the right hand takes the purse from the right trousers pocket, places it into the left hand and opens it. In the act of putting the purse into the left hand the end of the wand is inserted into the slit. The wand is then drawn through the purse and handed straight out for inspection. Most people will try very hard to find out how it closes up, which of courses it doesn't.

Now we come to tricks in which the wand, though actually responsible for the mystery, does not appear to be more than an innocent accessory.

Making a Handkerchief Disappear

First there is a simple but ingenious wand for making a handkerchief appear, disappear, or change colour. This is illustrated in Fig. 6. The wand is a length of tube with one end plugged. A piece of strong elastic is attached to the plug inside the tube. To the other end of the elastic a ring is attached. The elastic is stretched until the ring will reach to the opposite end of the wand, the elastic passing up inside the tube and down outside it. Another ring, small enough to pass into the tube, is attached to the elastic where it emerges from the tube.

To vanish a handkerchief it is passed through the small ring. By waving the wand and releasing the elastic the silk is carried rapidly inside the tube. To cause a handkerchief to appear the silk is passed through the large ring and bunched up in the hand which holds the wand. Releasing the elastic causes the handkerchief to fly to the end of the wand and be apparently caught on it. To change the colour of a handkerchief one is passed through each ring, one silk vanishing as the other appears.

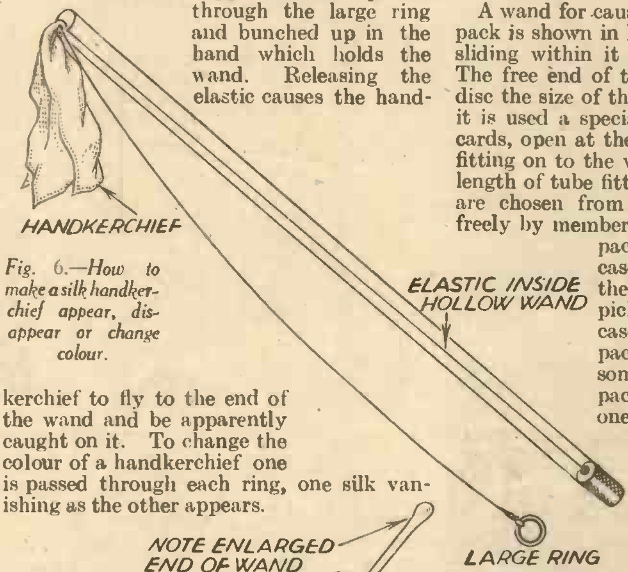


Fig. 6.—How to make a silk handkerchief appear, disappear or change colour.

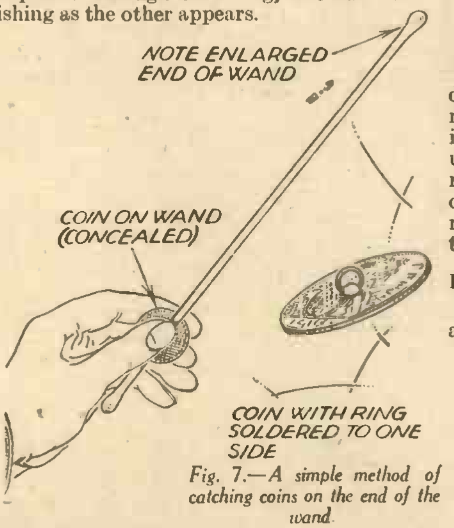


Fig. 7.—A simple method of catching coins on the end of the wand.

Catching Coins

Catching coins on top of the wand is another effective trick. The old method was to use a metal wand with a special coin, cut into three sections and held on strips of clock spring. When a stud at the opposite end of the wand was moved the coin appeared on top of the wand, the sections spreading out into their right places. Reversing the movement caused the coin to retire into the wand. A much simpler method is illustrated in Fig. 7. Here the wand is a mere rod about a quarter of an inch thick swelling out slightly at each end. With it are used a number of imitation coins each with a ring soldered to one side. The rings are just large enough to pass over the ends of the wand when a little force is used but they will not drop off although they will slide freely along the centre part of the rod.

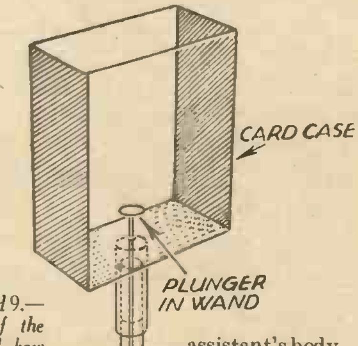
In use the wand is held in the right hand with one of the coins already upon it and concealed by the fingers. A sweeping movement is made with the rod, the coin released and it travels by centrifugal force to the end where the enlarged extremity of the rod stops it. The coin appears to have been caught in the air. It is removed and dropped into a bowl after which other are secretly fitted to the wand and caught in a like manner. Some conjurers prefer to keep the same special coin on the wand all the time, sliding it back to the opposite end under cover of removing it and displaying instead a coin from a secret store concealed in the free hand.

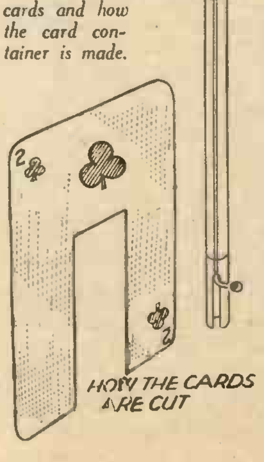
A Wand For Cards

A wand for causing cards to rise from the pack is shown in Fig. 8. This has a piston sliding within it and operated by a stud. The free end of the piston terminates in a disc the size of the top of the wand. With it is used a special case to hold a pack of cards, open at the top, back and front and fitting on to the wand by means of a short length of tube fitted to the bottom. Cards are chosen from an ordinary pack quite freely by members of the audience and the pack is laid aside while the case is shown and fitted to the wand. The pack is then picked up and placed in the case. But it is not the same pack, which remains behind some object on the table. The pack now shown is a special one with only a few cards on the front and back complete, the rest having a portion cut out as shown in Fig. 9. The pack is placed in the case with the cut-out part of the cards downwards. One of the chosen cards is now returned to the pack by the person who chose it, the case is held aloft and, by sliding the stud up the wand the performer makes the card rise from the pack. The piston in the wand of course pushes up the card. The trick is repeated with the other chosen cards in turn.

Boring A Hole

Another useful wand enables the conjurer apparently to bore a hole through his assistant's body. The wand is an ordinary one but fitting loosely on it is a short length of tube painted black with a white tip at one end to match the wand. The tube is about one third the length of the wand. If the wand is held where the join between tube and solid wand occurs, nothing unusual in its appearance can





Figs. 8 and 9.—Details of the cards and how the card container is made.

be noticed. See Fig. 10. To bore the magic hole, the end of the wand not covered by the tube is placed against the assistant's body and held there with the left hand which grasps it and completely hides the white tip. Standing with his right side to the audience the conjurer grasps the opposite end of the wand by the white tip and slowly slides the tube along the wand. The end of the real wand emerging from the performer's end of the tube is concealed by his arm and the effect to the audience is that the wand is being pushed right into the assistant's body. Reversing the movement enables the wand to be withdrawn. If the tube is a good fit and made of thin metal there is no likelihood of its presence being detected except at unusually close quarters.

Another way to use the wand for producing chosen cards from a pack is to use a wooden wand with a recess drilled in one end and a small bar magnet inserted. One or two cards are prepared by splitting them slightly at each end and inserting strips of tin foil. One of these specially prepared cards is forced by any of the methods already explained in this series, shuffled back into the pack and can be found by pressing the magnetised end of the wand on the top edge of the pack and drawing it slowly upwards. A magnet of reasonable strength will pull out the prepared card. Instead of holding the cards, they may be tossed into a hat or small waste paper container and "fished for" with the magnetised end of the wand.

An Ordinary Wand

Finally let me give a few instances of the way in which an ordinary wooden wand may be used to help in the performance of tricks.

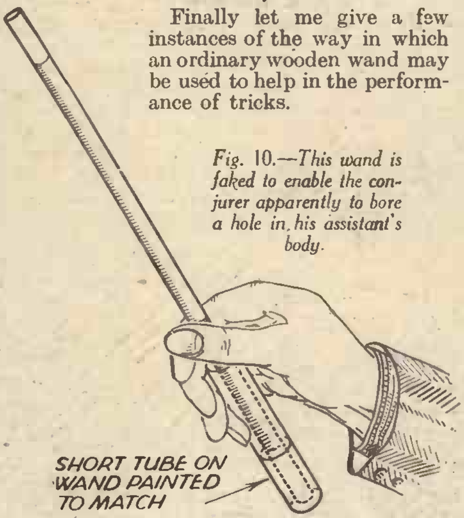


Fig. 10.—This wand is faked to enable the conjurer apparently to bore a hole in his assistant's body.

To produce a handkerchief. Twist the silk ropewise and wind it round one end of the wand, tucking in the end. Come on with the wand in your left hand, the hand covering the silk. Point with the wand to the right hand, showing it on both sides. Transfer the wand to the right hand, keeping the handkerchief concealed behind the fingers, and point to the left hand. Now place the wand under your left arm, keeping the end you are holding sloping downwards. As you draw your hand off the wand bring with it the silk, place the two bands together and shake out the handkerchief.

To vanish a handkerchief. Have the wand on the table with one end projecting over the back edge. Pin the tablecloth up at the back to form a pocket. Show the handkerchief and roll it into a small ball, tucking in the end. Appear to take it in your left hand but retain it clipped in the curl of the fingers of the right hand, moving the left hand away as if containing the silk. As you pick up the wand let the rolled handkerchief drop secretly into the bag. A touch of the wand on the closed left hand now causes the handkerchief seemingly to vanish.

The wand can also be used to conceal the presence of some small object in the hand.

NEW INVENTIONS

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

Seeing Round the Corner

THE toll of human lives upon our roads is still appalling, and any contrivance which will reduce the bill of mortality is worthy of adoption. A mirror enabling a driver to see what is round the corner should make a valuable contribution to the safety of the highway. Such a mirror is the subject of an invention for which a patent in this country has been applied.

The device, consisting of a pair of angularly related reflectors, affords the driver of a motor road vehicle a view of laterally approaching traffic. By means of this invention a driver, entering a cross road obscured by walls and other obstructions, will receive ample warning of vehicles on that road. The principle of the appliance is that of the periscope, but it permits one to inspect objects in a sideward direction.

For Ladies Only

ANOTHER newly devised mirror moves me to make some reflections. This is attached to the powder box which is, invariably, the companion of beauty. In this box, there is usually found a mirror on the inside of the lid. When the lid is closed, the mirror generally lies on the powder. As a consequence, during the jogging caused by its transport in the lady's hand bag, the powder impairs the reflecting power of the mirror. There have been proposed devices which, upon the box being opened, wipe the mirror clean; but it is stated that such arrangements are somewhat complicated and add materially to the cost of production.

Simply and inexpensively to obviate the disadvantage which I have mentioned, an inventor has conceived the idea of an improved powder box mirror. Attached to the glass is a wiper which can be moved to and fro over its surface by means of guiding sleeves and rails. It is fitted with a small knob which can be gripped by the lady's incarnadine-crested fingers.

Anti-tangle Mop

THAT domestic slave, the old-fashioned mop, is the subject of a patent applied for at the British Patent Office. The strands of cotton with which the mop has hitherto been made, have been apt to become matted long before they are worn out. In addition to the adverse effect of clogging upon their usefulness, there is a danger of the strands becoming insanitary.

The inventor of the new mop has striven to reduce the liability to clogging or interlocking of the strands. Separators of woven fabric, or other suitable flexible material, are provided amongst the strands which are divided into groups. The result is a mop that is affirmed to be particularly suitable for hand type mops, as used in floor cleaning machines.

Dame Partington, who tried to push back the Atlantic with her humble mop, would be interested in this revised edition of her household implement.

Razor-Blade Wiper

IN the reign of Queen Victoria, one of the familiar objects on the writing-desk was a penwiper. It seems now as extinct as the dodo or, to use an appropriate metaphor, to be completely wiped out. However, a recently patented article reminds me of the deceased penwiper which flourished in the age of the antimacassar.

Nearly all the male sex in the civilised world use a razor. I have a dreadful suspicion that even the ladies employ a Lilliputian safety razor to exterminate unwelcome hair. Now, after a more or less close shave, the wafer blade has to be cleaned, and a towel is not the most suitable improvised wiper. So, an inventor has evolved a razor blade cleaner. He claims that his device is simple, cheap and efficient. The cleaner consists of layers of moisture-absorbing material, such as blotting paper, and a layer of non-absorbent material, such as india-rubber. After disengaging the blade from the holder, it is pushed endwise through a slit in the pad. The soap and hair are left on the india-rubber, and the blotting paper dries the blade. The soap and hair can be afterwards removed by a sponge.

Long John Silver wiped his blood-stained knife on a wisp of grass. This new razor wiper will clean our uncrimsoned blades.

"PRACTICAL MECHANICS" WIRELESS SUPPLEMENT

1939 ONE-VALVER

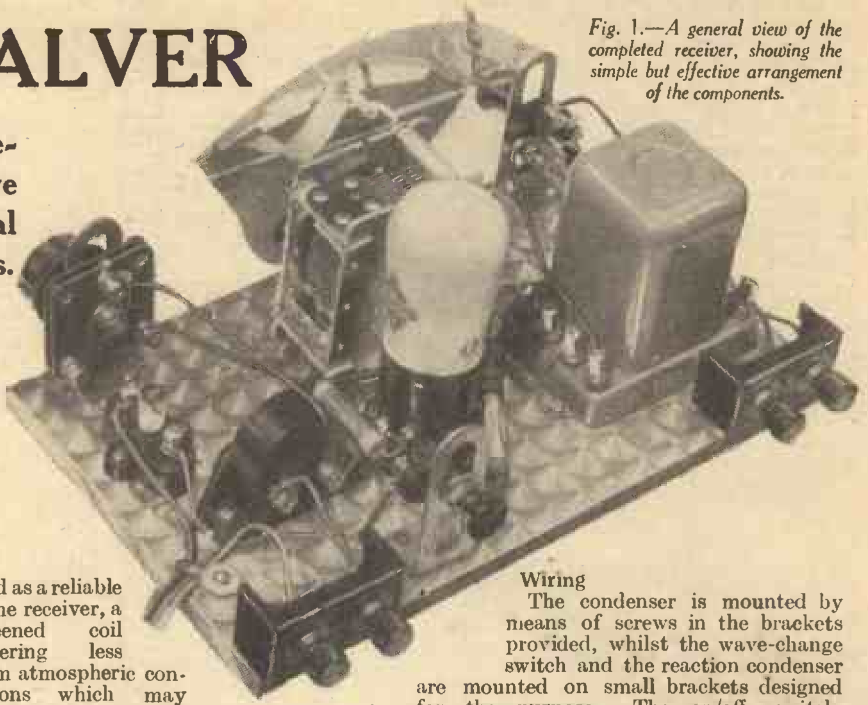


Fig. 1.—A general view of the completed receiver, showing the simple but effective arrangement of the components.

An Easily-made and Efficient One-valve Medium - and Long - wave Broadcast Receiver which is Ideal for Beginners and Experimenters.

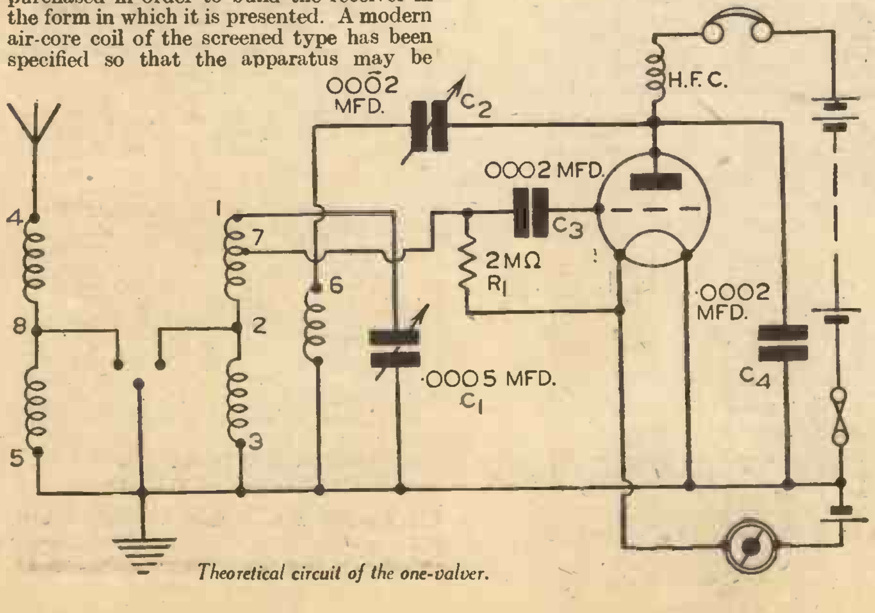
ALTHOUGH the small receiver is apt to be despised in these days of 7 and 8-valve superhets, there is still a very wide field of application for the simple one-valver. Many schoolmasters, for instance, have asked for details of a set which may be used as a demonstrating model, either for handycraft instruction, or to explain many of the theories underlying modern radio technique.

There are many interesting sidelines to the simple set, in spite of the fact that such a very small number of components will be found in it. For instance, the tuned circuit will consist of a coil and variable condenser, and it is possible to show the effects of inefficient condensers, either by the loss of volume—either as heard or as measured by means of a meter in the anode circuit—or by the alteration in the tuning range. Thus, in some parts of the country a B.B.C. station may be found at the very end of the dial and when an alternative variable condenser is fitted this may not be located, simply because the minimum capacity is too high to enable the circuit to tune down to the low wavelength.

Components Required

Similarly, the H.F. choke may be exchanged and the efficiency of this demonstrated in a similar manner, volume suffering when an inefficient component is employed, and in some cases it may be possible to show that reaction is erratic or perhaps unobtainable when a certain type of choke is fitted. Thus the one-valver may be made the means of many interesting hours of experiment, and the receiver here described has been designed with this end in view. A complete specification is attached, and the parts mentioned should be purchased in order to build the receiver in the form in which it is presented. A modern air-core coil of the screened type has been specified so that the apparatus may be used as a reliable home receiver, a screened coil suffering less from atmospheric conditions which may affect an unenclosed coil. Furthermore, if the coil is removed from time to time to enable alternative coils to be tried out, the wiring of the coil will not be distorted and thus the coil may be put back and the original tuning positions will hold good.

With an unscreened coil, although the efficiency may, in certain conditions, be higher, constant handling may distort the former or shift the wires on the coil and thus upset previous calibrations. Similarly, the H.F. choke has been designed as a standard component and is not affected by handling. A separate switch will, however, be used with the coil, so that when a home made coil is used in place of the specified coil there will be no difficulty in connecting the necessary wave-change switch. The latter is of the three-point type which may, when desired, be used as a two-point (or on/off) switch by ignoring one of the terminals on it.



Theoretical circuit of the one-valver.

Wiring

The condenser is mounted by means of screws in the brackets provided, whilst the wave-change switch and the reaction condenser are mounted on small brackets designed for the purpose. The on/off switch, by means of which the set is switched on and off has been fitted at the back of the chassis, as it will only be needed at the beginning and the end of a period of listening, and it enables the panel layout to be preserved in a balanced fashion without restricting the scope of subsequent experiments. The grid condenser and grid leak, as well as the anode-by-pass condenser are of the modern type, having wire ends which are used for connecting the components direct in the required position. For the remaining wiring, bare tinned copper wire, gauge 22, should be used, and as this set is intended for the beginner we may point out that the ends of the wire should be turned with the aid of pliers in a clockwise direction so that when placed beneath the terminal nuts the wire will not be forced out as the nut is tightened. If the wire loop is turned in the wrong direction, tightening the nut will force out the wire.

Connect the battery leads to the points as indicated on the blueprint or the small wiring diagram accompanying this article and connect the positive and negative L.T. leads to the positive and negative terminals on the accumulator. Remember that positive is coloured red and negative black. The H.T. battery should be of the 60 or 66-volt type and the negative H.T. plug should be inserted into the negative battery socket. The positive plug should be inserted into the positive socket first of all, but subsequently you may find that you can reduce the voltage and thereby obtain smoother reaction control. Use a good aerial and a good earth and a good pair of headphones—2,000 or 4,000 ohms will be most suitable.

Operating Instructions

Pull out the rear switch, and the set is then in working condition. Pull out the wavechange switch and the set is adjusted for the medium waves. Push this switch in and the set is tuned to the long waves. With the condenser specified, the medium waveband covered will be from 180 to 550 metres, and the long waves from 750 to 1,950 metres. As the reaction condenser is turned in a clockwise direction, you will hear a rushing noise in the 'phones which will gradually increase until a noise aptly described as a "plop" will be heard. In this condition the set is what is known as oscillating and if the tuning dial is turned a whistle will be heard and this whistle is radiated by your aerial and will be heard by all your neighbours over a wide area, so always turn the reaction control back as soon as the "plop" is heard. You will find that this is essential in your own interests, as in the condition in which the set is now placed, speech and music will be distorted and unintelligible. To receive C.W. (continuous wave) morse signals, however, you must have it in that condition.

Improving Selectivity

In the majority of conditions met with in this country, the selectivity of the set should be adequate to separate the local stations, but in some parts it may be found that the two local stations just overlap. Alternatively it may be found that conditions are extremely good in some places and that distant stations are received so well that they afford entertainment value, but the local stations form a background which prevents the satisfactory reception of those stations. The selectivity may be improved by fitting a condenser between the aerial terminal and terminal 4 on the coil, and this condenser may be a fixed component or a variable, or semi-variable device, the latter type affording scope for adjustment to suit varying conditions. A maximum value of .0003 mfd. should be chosen, and if a pre-set condenser is employed it may be mounted by the side of the aerial-earth terminal mount and the lead from the aerial terminal disconnected from terminal 4 on the coil and joined to one side of the condenser, the other side of this being joined to terminal 4.

In some cases it may be found that results are improved if this condenser is joined between the aerial and terminal 1 on the coil unit and this will cut out the primary winding, giving a reduction in selectivity, an increase in volume and a modification in the tuning range covered by the receiver. When this type of connection is employed, the receiver will be more susceptible to differences in aerial size than when the connection to terminal 4 is employed, and in most cases this latter connection will be found preferable.

Making a Coil

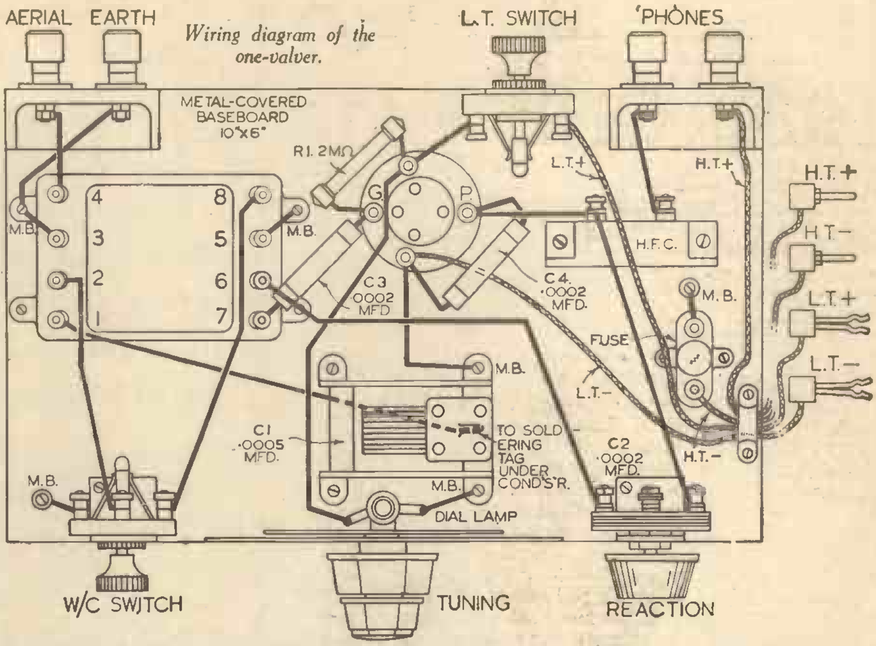
For those who wish to experiment, a very suitable type of coil to make is illustrated on this page and from this it will be seen that two formers are used, one fitting inside the other and kept in position by four fixing screws and distance pieces, the outer former being used to provide connecting points by the terminals shown.

The theoretical circuit is shown below and it will be seen that it differs slightly from the Wearite coil. The tappings are provided to secure the highest degree of selectivity possible with a coil of this type, but it must be appreciated that, efficient as the coils are, they cannot be expected to compare with the specified iron-cored type. For the reaction coil, the winding connected to the terminals "plate" and "reaction condenser," 35 turns of 36 S.W.G. enamelled wire is required, while for the long-wave section, i.e. the coil connected to the "earthy" end of the medium-wave winding and the terminal "switch" and the "earth" terminal, 285 turns of the same wire is necessary.

The reaction and long-wave windings are wound on the inner former, there being a distance of 5 mm. or about ⅕ in. between them. It is advisable to note, at this point, that the actual position of the reaction coil in relation to the medium-and long-wave windings is very important, if smooth and adequate reaction is to be obtained on both wave-bands.

The above remarks also govern the position of the L.W. winding to that of the M.W.; actually the top ends of both windings should be level with each other, otherwise there will be excessive or a loss of reaction on one wave-band.

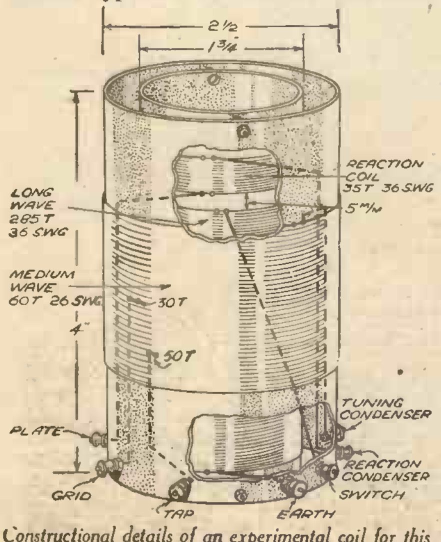
The medium-wave grid coil consists of 60 turns of 26 S.W.G. enamelled wire, and tappings are taken at the 30th and 50th turns from the upper end. Note the connections to this coil; the commencement goes to the "tuning condenser" terminal; the first tap (30th turn) to "grid"; the second tap (50th turn) to "tap" and the end of the coil to "switch" and the start of the L.W. winding.



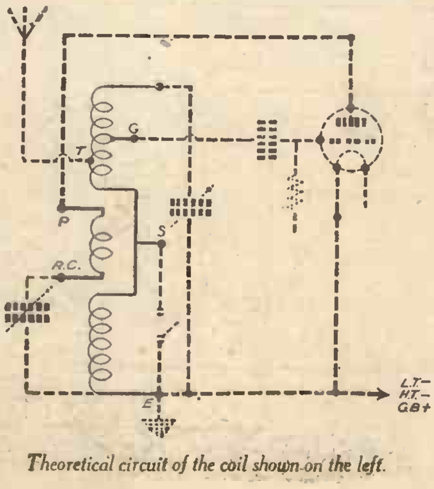
Wiring diagram of the one-valver.

LIST OF COMPONENTS FOR 1939 ONE-VALVER

One "Uni Gen" dual range coil (Wearite).
One .0005 mfd. tuning condenser (Bulgin).
One H.F. choke (B.T.S.).
One .0002 mfd. reaction condenser (B.T.S.).
One 4 pin baseboard type valveholder (W.B.).
One 2 point push pull switch (Bulgin).
One 3 point push pull switch (Bulgin).
Two .0002 mfd. tubular fixed condensers (T.C.C.).
One 2 megohm wire end grid leak (Dubilier).
One fuseholder and fuse, type F.5 (Bulgin).
One metal covered baseboard 10in. by 6in. (Peto Scott).
Two terminal mounting blocks (Belling Lee).
Four insulated terminals, A., E., L.S. and L.S. (Belling Lee).
Three component mounting brackets (B.T.S.).
One 4 way battery cord (Belling Lee).
One D.210 valve (Cossor).
One 66 volt H.T. battery (Exide).
One 2 volt L.T. accumulator (Exide).
One pair 4,000 ohm headphones (Ericsson).



Constructional details of an experimental coil for this receiver.



Theoretical circuit of the coil shown on the left.

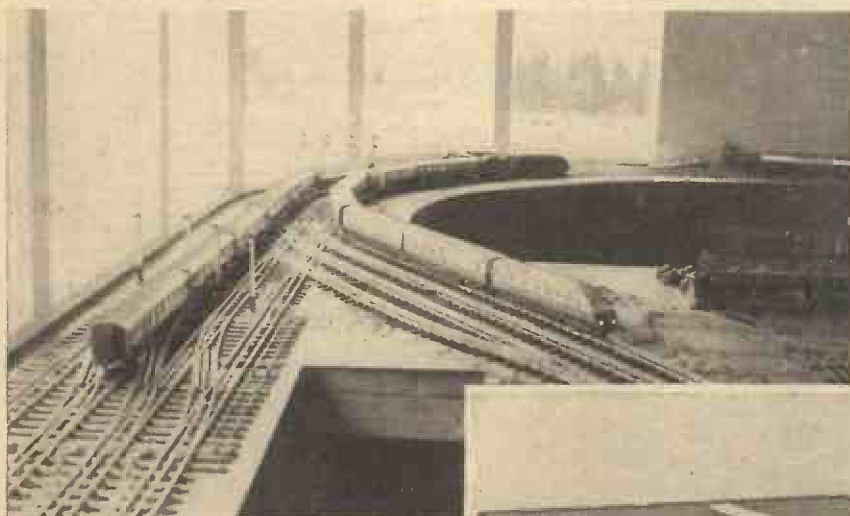
"MOTILUS" PEEPS INTO THE MODEL WORLD

Our New Model Man, Who Always Carries His Camera With Him, Gives a Selection of the Photos He has Collected of the Latest Developments in the Model World

A fine model speedboat ready for a run.

An Electric "Flyer"

ASCENDING the escalator at Charing Cross Tube Station, I found myself in a veritable boys' paradise. A working model railway, of course! However, despite the crowd, I managed to get a peep at the abbreviated edition of the wonderful model railway, built in the first place for the British Railways Pavilion at the Glasgow British Empire Exhibition. It has been cut down to suit available space and the scenery has been "sectionalised." The track, too, has been modified considerably, but the four crack expresses (L.M.S. *Coronation Scot*, L.N.E.R. Silver Jubilee train, headed by the *Coronation*, G.W.R. Cornish Riviera train hauled by *King George V*, and the latest S.R. electric flyer) are working as they were at Glasgow. Model enthusiasts will notice with interest that they have lost some of their pristine glory and now look like seasoned workers, and this is not to be wondered at! Since they made their first trip at Glasgow *each* of these model expresses has run 700 *actual miles*!



(Above) A working model railway on view at Charing Cross station. (Right) A model of Southampton Docks.

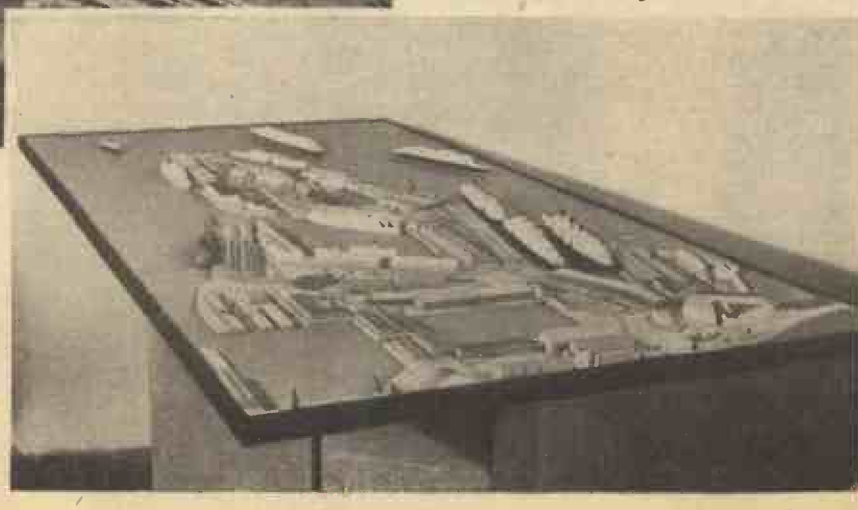
Waterline Models

The craze for waterline models is still as great as ever, both for those who "collect" and those who build from the various sets of parts available, from the inexpensive ones to those producing real scale models.

The other day I saw a very ingenious model that a model ship enthusiast friend of mine has had made of Southampton Docks, to the same scale as the standard modern waterline model, viz., 100 ft. to 1 in., or 1/1,200 actual size. This makes a real setting for waterline models, and I managed to get a picture of this model with some of the world's ocean giants in dock. Perhaps you can distinguish some of the following models berthed alongside: E.S. *Normandie*, R.M.S. *Queen Mary*, S.S. *Bremen*, R.M.S. *Aquitania*, M.V. *Athlone Castle*, and S.S. *Leviathan* (now, alas! sold to the shipbreakers).

A realistic model of the "Duchess of Montrose."

This is really a very easy model to make. All you need is a baseboard about 5 ft. by 2 ft. 6 in., and a piece of plywood to give the dock level. The plan of Southampton Docks is given in the Monthly Southern Railway Shipping Guide, and no doubt the Southern Railway would supply you with an accurate picture of the docks on request. Then you can just cut the buildings out of solid wood and paint them in natural



Girl workers at a Northampton model-railway factory busy assembling illuminated bogie coaches.

colours, and own a Southampton Docks of your own! The same idea could be applied to the docks at Liverpool, London, and Cardiff, and with an up-to-date guide you could show by your models what ships were in port and the berths they occupied.

"Duchess of Montrose"

Passing Bassett Lowke's model shop in High Holborn, I was attracted by a fine new model of the L.M.S. *Duchess of Montrose* in gauge "O." I went inside to examine it, and I think it is one of the finest pieces of gauge "O" commercial modelling yet executed. Small wonder it is mooted as the most popular gauge "O" locomotive this year. When I asked the price, I found it was only £8 8s., with choice of three methods of propulsion, clockwork, alternating current 20 volts, and direct current 8-10 volts, and I was unable to resist the temptation of seeing one run on my line.

Model Railway

I also took the opportunity recently of calling on Mr. Gilbert Thomas, of Harpenden, the well-known writer and book reviewer, and I saw his gauge "O" railway, one of the neatest and most well-kept I have seen. His stations have all been specially designed and built to his own ideas, but his locomotives and stock are mostly the standard pattern available, all in G.W.R. pattern colours. I find Mr. Thomas and his family are shortly moving to Teignmouth, where he will have a slightly larger room to devote to his model railway. He has already planned a re-arrangement of his track to suit this, using his existing equipment, and his railway does not lack realism.

Model Speed-boat

There are sunny days and mild days even in the coldest winter, and here is a keen ship lover taking advantage of the fine weather to test out his "P.M." model speed-boat, *Streamlinia*. He has built this up from a set of parts, and from the articles which appeared in this paper some little time ago, and his model has already done 7½ knots. Now is the time to complete your model racing boat ready for the spring and the Easter holidays, which is the next vacation to look forward to.

Illuminated Bogie Coach

What would the boys of ten years ago have given to have a gauge "OO" scale-model bogie coach that would actually light up? By devious channels I penetrated the zealously guarded sanctum of Northampton's model-railway factory and found these girl workers assembling coaches. On the right a coach body is in the final stages of clipping. The other girl is fitting the bogie carriers to the coach bogies, with eyelets. The partly assembled bogies are mounted on the carrier by a spindle and specially insulated bushes. This insulation is necessary for the lighting units, which the customers can fit to the coaches if they so desire.

Model Shipyard

I had a peep into Northampton's model shipyard again this month, and was just in time to watch the final stages in the rebuilding of a model *Carnarvon Castle.* This ship, though of fairly recent design, has just been altered to bring her in line with her newer sisters, the *Stirling* and *Athlone Castles*. Her two oval funnels have been removed and a single stream-line funnel fitted, and the bow, instead of having a straight stem, now has the more attractive clipper type. The model is ⅛ in. to the foot.

Another part of the shipyard revealed the hulls of three P. & O. liner models, which were being made for American publicity to show the Americans the fine cruising liners which run in the east from Tilbury and from Southampton. The order is for six in all, three of the *Strathaird* and three of the *Strathmore*—most modern of the attractive fleet of "Strath" ships.

Ships' fittings can be most realistic when properly made to scale and fixed in their correct positions. On this page is shown a bollard and ship's ventilator fixed on the deck of a model ship, and I wonder if you could guess what size these are. (No prize is offered!—The Editor.)

A bollard and ship's ventilator on the deck of a model ship.

Final stages in the rebuilding of a model "Carnarvon Castle."

The Piano—A New Method

MAURICE REEVE, THE
YOU HOW TO PLAY THE
METHOD. MR. REEVE ALSO
FROM

This Month the Author

Number of

These four illustrations, similar to those in the scales section, show the positions of the hand and fingers in the four stages of an arpeggio. They are actually being played in key F.

IT is the most natural thing in the world, that any branch of music should be approached by a newcomer in a way which, years after, would appear "gauche" and the reverse of how one would do things, could we have our start over again. Music is a language, just like any other, so far as its rules and construction are concerned. But two vital differences enter into our learning of it, compared with our learning of our mother tongue. With words, we enter into our conscious existence speaking them and we go on speaking them throughout our lives. We are dependent on them for our daily bread, and for making sure that when we want to go to Scotland, we don't go to Devonshire instead. Our very thoughts are based on them—we are never separated from them.

But what to do we find with music? A very different state of affairs, indeed!

Most of us never meet with it until, comparatively speaking, late in life. And then we not unnaturally find it difficult to find anything like the same importance in such sounds as A flat or C sharp, a diminished seventh or a dotted minim. How different it would be if we could all grow up—that is, all who are interested in music later on, and study it when they reach maturity—as familiar with these things as we are with nouns and verbs and the sounds and meanings of the different words we use almost from the cradle!

The same points are to be noted, together with the undoubted fact that an arpeggio is more difficult to play than a scale. The intervals are greater, and, owing to this fact, that there are only three notes per octave, instead of seven, the lateral movement of the thumb, clearly emphasised in the photos, become much more rapid and harder. The arm must be freely used to impel the hand forward, but NOT to lift it at the "pivotal" octave note.

The second element which does not exist with our daily speech, but which actually forms the reason for the whole of these articles, is the fact that we cannot "speak" this language of music, except through the medium of an instrument. This instrument intervenes as a "third party" between ourselves and our auditors, and we can only "speak" the language of music to them through, or on, that third party. Consequently the whole of our ability to make ourselves understood in this strange and won-

# of Learning to Play It

FAMOUS PIANIST, TEACHES PIANO BY A NEW AND MODERN REGULARLY BROADCASTS THE B.B.C.

Describes Arpeggio and a Simple Exercises.

derful tongue of sounds and rhythm rests on the skill with which we can get to handle that instrument. Even the voice is an instrument which must be trained and used with as much skill and care as a piano or a violin; that it is not only a part of ourselves which we carry about with us wherever we go, but actually the same part with which we speak "that other language," doesn't alter the fact that it is one of the musical instruments.

These remarks should serve as a "defence" for those who handle their newly-acquired instrument, on which they are going to learn to speak a new language, in a mistaken way at the commencement of their studies.

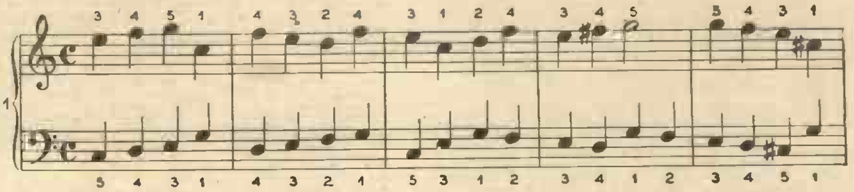
The most common and by far the most important error made by beginners is the separating of the twin elements of a piece of music, mentioned so frequently in these pages, sound and time. Almost everybody, on opening a piece of music, makes it their first business—and in a regrettably large number of cases, it remains their first, last and only business—to "read the notes." What comes afterwards? Does the mere sound of a sequence of notes, with little or no form, shape, rhythm, accenting, satisfy them?

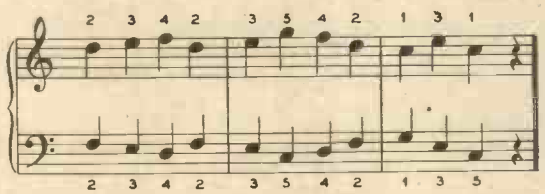
Every note that is read *must* have a value as well as a sound. When you see D or E on the score, you *must* cultivate the habit of reading its value as well. If it is a crochet, for example, that means that you have one crotchet's worth of time *in which* to read the next note, find it on the keyboard with the correct finger, and prepare that finger so as to make sure that it will be played with the proper tone and effect. *Then,* exactly at the expiration of one crotchet's worth of time, not an instant before, and not an instant after, may the note be played. And the sequence must go on throughout the piece, the fingers measuring out time units of quavers, minims, etc., backwards and forwards as the rhythm of the piece dictates. It is difficult, but it is absolutely essential, unless the music is to lose half, and from some points of view, such as in an accompaniment on any ensemble work, more than half its existence.

This leads, as in a sequence of events, to the very common habit of looking down at

Mr. Maurice Reeve.

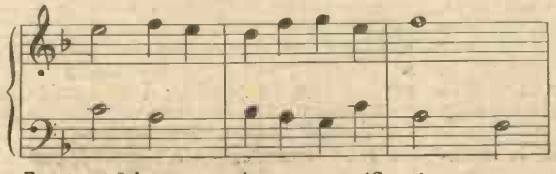
the fingers for the vast majority of notes on the score. It is nothing unusual to sit with beginners, and to see them having to play an ordinary diatonic sequence of notes, such as occurs in thousands of pieces of all grades, look down at their fingers and back again at the copy for *every single note!* Every





time you take your eyes off the copy you run the risk of losing your place when you look back there. And you are bound to lose it in a majority of cases. Couple this with a neglect to join the notes together, on the

keyboard. The equivalent and the complement to joining them up with your eyes on the score, and the resultant losing of your place there, as well, and what results? Let that occur, say, a dozen times per page. Add those dozen fractions

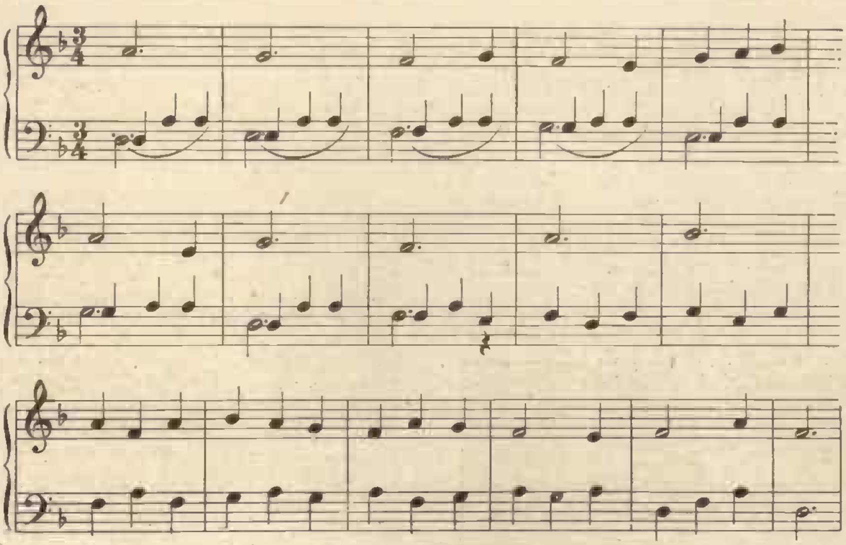


of time to the total time value of the piece and where is the rhythm and balance of the work? Nowhere!

The paper is the job of the eyes, and the keyboard that of the fingers, and, whilst one cannot say that one must

Exercises in the major and minor mode (See also next page)

4



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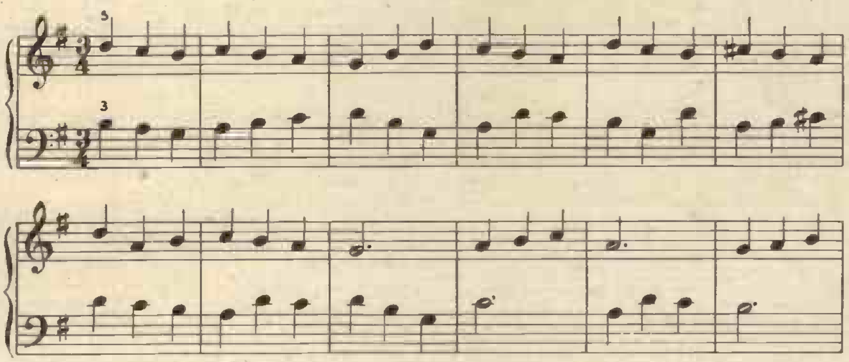
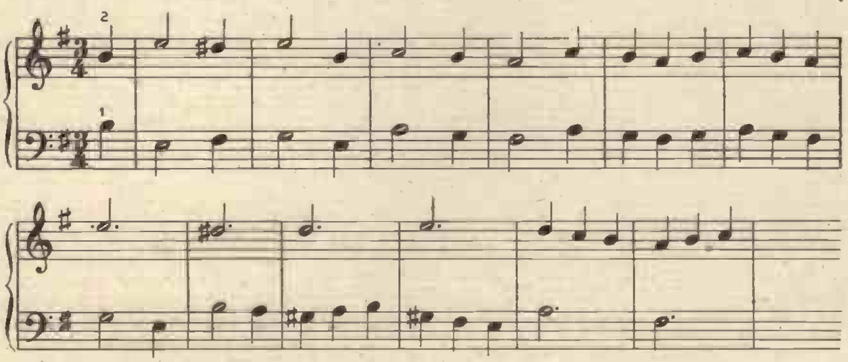


Note! The use of accidentals, whilst increasing the musical value of the pieces through employing an extra note and a modulation does not render their title incorrect.

6



Six studies (three on previous page) in the major and minor mode, based on the five finger positions of one note to each finger.

never look down at their fingers, correct fingering and a proper use of the fingers should reduce the necessity to a minimum, with great benefit to all concerned. If a train waited at every station on its journey for one latecomer, what difference would it make, both to the efficiency as well as the pleasure of travelling? The comparison forms an exact parallel.

The third most common fault in beginners, and one which leads to many troubles and trials, is the playing over of new music with a flabby hand, sometimes with the wrists actually resting on the woodwork of the key frame. When the fact is pointed out as an error, the reply is "Oh, I wasn't supposed to be playing; I was only just trying it over!" Failure to appreciate the importance of rhythm and note values as essential elements, partly accounts for this attitude, else one would at once "use" the fingers in order to play the notes within the framework of the rhythm, set by the composition, instead of in their own sweet time. *The fingers must fit the beat and not the beat fit the fingers.* Never play two successive notes, except by using the fingers in a proper manner. For, in addition to the reasons already given, there is the material reason that, by using the fingers in a proper manner, the whole time one is at the piano, you are training your fingers the whole of that time, instead of only a small part of it. There is no need to confine the "training" part just to your scales and exercises; it is a process that can go on *all* the time, with immeasurable benefit to the whole of your studies.

All the mistakes beginners make, the handicaps they place themselves under, through want of experience in the language they are beginning to learn to speak, springs from these three main causes. Further handicaps are a failure to use the rhythm, and the key of a piece as means to impel them along through the course of the music; insufficient use of the thumb (partly due to the slack attitude of most hands at the keyboard, as already mentioned), and a neglect to use a fingering reasonably comparable to that studied in scale and arpeggio sequences.

Naturally, these criticisms apply to only those students who have had these points shown them, and yet, still tend to neglect putting them into practice; only the most gifted can have the insight which renders it unnecessary to have them pointed out.

Technical Exercises

1.—Exercises should be practised with each hand separately for a considerable time before putting them together.

2.—Nos. 1 to 11 and 16 to 20 should only be practised very slowly, in the manner explained in detail under the "technique" section. Nos. 12 to 15 are quicker exercises, but these, too, can be played slowly with advantage. Increase the speed gradually.

3.—The fingering for Nos. 1 to 11 is the same throughout—"five-finger exercise," the same finger for the same note in each one.

4.—Nos. 12 and 13 are based on the pivotal point in an arpeggio. A similar exercise can be made out of each of the other arpeggios.

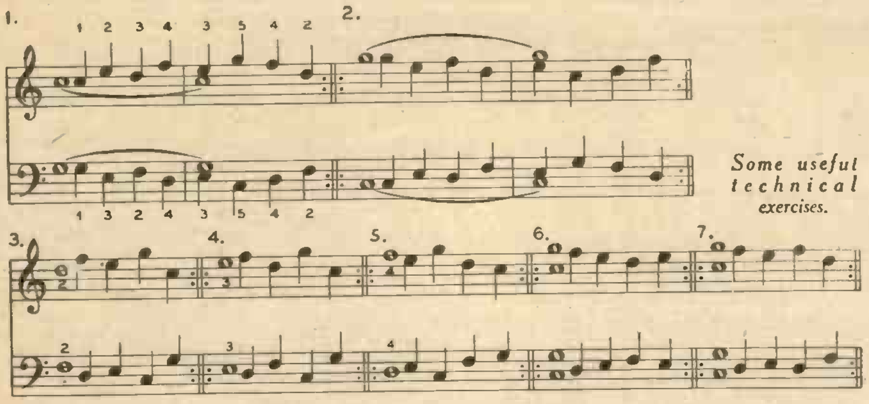
5.—In Nos. 1 to 11, a firm purchase must be obtained on the semi-breve note to enable the other fingers to move freely and to make a perfect join between each two notes or pair of notes. Never forget that the whole point is in doing two things simultaneously: to sustain the semi-breve throughout and to work the other fingers freely. Avoid all stiffness in the wrists.

6.—In No. 15 the secret is to "carry" the hand over on two fingers, notes slurred, in order to maintain the join as in single notes.

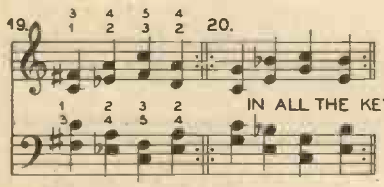
7.—All exercises can be practised in all the keys, with the same fingering, with great profit.

Scales and Fingering

THE study of major and minor scales is so important that the student cannot give it too much attention. We have seen in an earlier section that the notation of all scales is the same, that is, that all the twelve major scales have precisely the same sequence of notes, the



Some useful technical exercises.



twelve harmonic minors and the twelve melodic minors respectively.

Fingering

Whilst there are three different kinds of scales, there is only *one* fingering. If you have mastered one thoroughly it is no exaggeration to say that you should have mastered the lot, providing you can think in terms of the key based on the different tonic notes, and given the knack of, where necessary, starting off on a different finger. Just because one scale may be in three sharps and another, say, in five flats, *do not* treat both as if they were total strangers and unrelated to each other, but treat them both in precisely the same way.

The fingering of each *must* be the same for the simple reason that all three kinds of scale, being diatonic, have seven notes before each octave is repeated and the sequence starts again, and the natural division of seven notes is into two groups of three and four notes alternatively. Therefore, after you have disallowed the first and last notes, the fingers one uses for these being a matter of pure convenience, the sequence must be the same in all scales: a group of three consecutive fingers, followed by a group of four consecutive fingers, or *vice versa*; the first group being based on the first thumb note in the right hand and concluding with the first thumb note in the left. Make absolutely certain that no two groups of three or four notes follow each other.

Arpeggios

Although they are more complicated, the notation is just as simple, easier in fact, as we only have to deal with three notes instead of seven. But they are unquestionably harder to play and to finger.

The major and minor arpeggios are formed of the first, third and fifth notes of the respective scale, followed, of course, by the octave. The fingering varies between each arpeggio according to the keys and intervals. There is no definite system, as with the scales, applicable to all. The great thing to avoid, however, is the playing of the interval of a fourth with consecutive fingers (illustration).

Arpeggios are also based on each individual note of the chord—inversions, under the chords of the dominant and diminished seventh, etc., with inversions. The ones dealt with here are known as being in the root position, i.e. starting on the tonic note of the scale.

In consequence of the fifth note of both the harmonic and melodic forms of minor scale being identical, there is only one form of minor arpeggio.

Scales should be practised with the highest possible uplift of the fingers, thus ensuring the keys being *struck* and the tone at its maximum. The speed should vary, commencing very slowly.

The construction or evolution of scales is explained in the section on "key."

The crux of an arpeggio is the thumb, the passing of the thumb underneath, in one direction, and the swing or span of the hand *over* the thumb in the other. The making of a perfect join here is the great difficulty. (See special exercise.)

Points to Learn in Scales

Sequence of intervals.

Major.—Tone, tone, semitone, tone, tone, tone, semitone.

Melodic minor.—Ascending : Tone, semitone, tone, tone, tone, tone, semitone. Descending: Same as any major descending.

Harmonic minor.—Tone, semitone, tone, tone, semitone, augmented second (three semitones on the keyboard), semitone.

Group system of fingering, *all* scales. Alternate groups of three and four consecutive fingers, 1 2 3-1 2 3 4, based on the first thumb note, respectively, in each direction. The fingers used at either end are pure matters of convenience.

Some abbreviations.

Making an Oil and Grease Gun

A Useful Accessory for the Handyman

AN oil gun is a most useful accessory to have handy in the workshop or garage, and its uses are numerous. You can make a gun, in the manner described here, in an hour or two, and you will be able to use it for oil, water, spirit, and fairly fluid grease. It is not really intended for heavy grease, since no provision is made for charging the gun with this substance. This difficulty can however, be surmounted, as will be explained later.

Most of the material required for the gun will probably be to hand in the scrap box. The exact dimensions given in the drawings need not, of course, be adhered to rigidly. You can alter these to suit the materials which you have by you. The barrel of the gun is a piece of brass tube, cut from an old telescopic camera tripod for the original gun. Cut this to length, taking great care not to crush it, and square off the ends. The ends are to be plugged with 4 B.A. brass terminal heads. There are two types of terminals which are suitable for the purpose, illustrated at A and B in Fig. 3. Here A is the double-ended type, which is normally placed between the head (type B), and the fixed body of the terminal. The two types are also shown in Fig. 2 in their positions in the barrel of the gun, though two of the type A or of type B would serve equally well.

The Plug

The 4 B.A. hole in the terminal for the bottom plug is enlarged and tapped 2 B.A. This plug is then chucked in the drill brace on a bit of 2 B.A. studding, and is turned down with a file until it is a tight fit in the barrel. Tap it home and solder it in position, first cleaning up the inside of the barrel with emery cloth on a piece of wooden dowelling, in order to ensure a perfect joint all round. Turn down the top plug, too, in the drill brace to an exact fit, mounting it for the purpose on a bit of 4 B.A. studding. Then enlarge the central hole to 4 B.A. clearance size, tap the plug into position in the barrel, and mark the positions for the three securing bolts. Drill and tap these three holes, and make a mark with the scriber on the plug and a corresponding mark on the barrel, so that you can be certain of inserting the plug correctly. Drill a 1/32 in. hole in the barrel ¼ in. from the top, and clear away the burr inside. This is the air-release hole, to allow the air in the barrel to escape freely when the plunger is drawn up (Fig. 1).

The Plunger

The barrel is now complete, and you can turn your attention to the plunger. Two more 4 B.A. terminal heads are needed for this. Mount them one after the other on a bit of 4 B.A. studding, chuck them in the drill brace, and turn down until they are a nice sliding fit in the barrel. When you have taken off enough metal with a file to

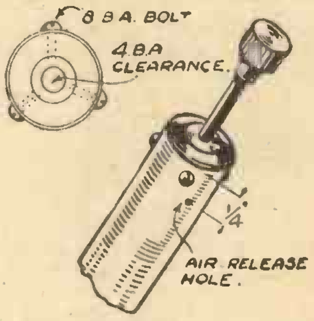


Fig. 1.—The top end of the gun.

allow the heads just to enter the barrel and no more, finish to size with fine emery, so that the bearing surfaces are really smooth. Do not attempt to turn down both terminals together, as you would find it extremely difficult to file the bearing surfaces truly parallel with the axis of the central holes. The washers, two in number, are made of stout cardboard. Cut two squares with roughly ¾ in. sides, and punch a hole in the centre of each of such a size that you can screw them on to a 4 B.A. bolt. Now assemble the component

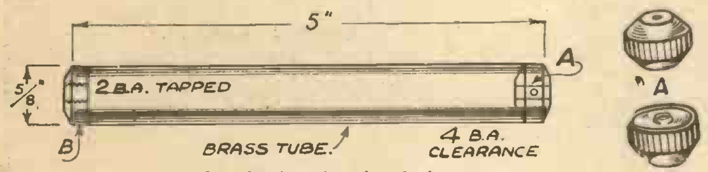


Fig. 2 and 3.—Details of the barrel and plugs.

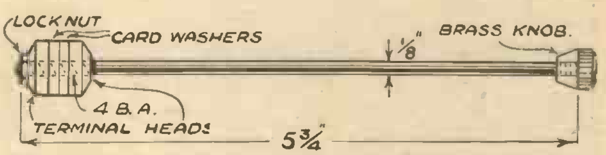


Fig. 4.—The method of constructing the plunger.

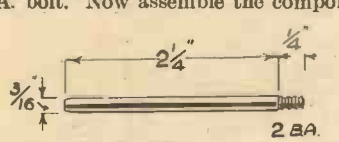


Fig. 5.—The nozzle.

parts of the plunger, first a terminal, then the two washers, and last the other terminal. Screw the second terminal hard against the washers, so that they are gripped firmly. With a razor blade trim away the cardboard nearly flush with the terminals, chuck in the drill brace, and smooth off the surplus cardboard with a coarse file, followed by emergy cloth. Try the fit of the plunger in the barrel frequently, and stop reducing its diameter when it will just go in tightly.

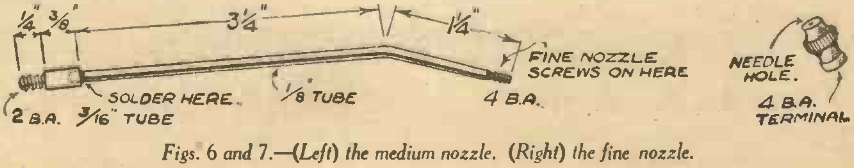
In their present condition the washers would wear very rapidly, but if you impregnate them with oil they will last much longer, and the plunger will run sweetly in the barrel without leakage. Warm up a little bath of machine oil in an old tin. Be careful not to make the oil so hot that it smokes furiously, or it will catch fire. Slacken off the end terminal, separate the washers very slightly, and immerse the whole assembly in the oil for two or three minutes. The cardboard should then be thoroughly impregnated with oil. Tighten the end terminal up hard, put on the lock-nut, and cut away the threaded rod projecting beyond it (Fig. 4).

Assembling the Gun

Push in the plunger, fix the top plug, and screw on the brass knob. The plunger will probably be a bit stiff at first, but this is a fault on the right side, and it will work freer with use. Do not make the mistake of turning down the plunger to make an easy fit to begin with, or the gun will not hold its charge of oil, owing to air leaks past the plunger.

You can fit nozzles to suit your own requirements. Some suggestions are given in Figs. 5, 6, and 7. To make the medium nozzle, a handy size for general purposes, cut a 2 B.A. thread on the piece of 3/16 in. brass tube, as shown in Fig. 6. Clean the inside of the other end, and tin it with the help of a hot iron. Clean and tin the outside of the ⅛ in. tube, bring the two together with about 3/16 in. overlap, hold in a flame for a moment, and the joint will be complete. To make the bend in the nozzle, heat this part of the tube to redness and plunge into water. You will then be able to make this slight bend with your fingers without any risk of cracking or flattening the tube. The fine nozzle is made from a 4 B.A. terminal head, of a type often used on variable condensers. File the closed end until the metal is thin enough to enable you to push the point of a fine needle through from the inside. Carefully remove the burr from the edges of the hole, so that it remains perfectly round, with clean edges. This nozzle screws on to the end of the medium nozzle, a 4 B.A. thread being provided for the purpose, as shown in Fig. 6.

The wide nozzle is simply a straight piece of the 3/16 in. tube, with a 2 B.A. thread at one end to fit the bottom plug of the gun. Since the top plug is not readily removable, the gun must always be charged by drawing in the liquid through the nozzle. Using the wide nozzle, you will find that you can draw up grease which is not too solid. In emergency, you can handle quite heavy grease by taking out the top plug, charging the barrel of the gun with grease, replacing the plunger and carrying on in the usual way with the wide nozzle in position.



Figs. 6 and 7.—(Left) the medium nozzle. (Right) the fine nozzle.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 232, must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the sender. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

MAINS OPERATED PROJECTORS

"I HAVE a small projector for standard (professional) size films and lantern slides which I wish to operate from the mains. Illumination at present is by acetylene gas.

"Would a bell transformer be suitable, using say an 8 volt bulb of the cycle lamp type or motor headlight type or would it over-heat.

"If this is not practical could you advise me where I could obtain a suitable transformer and bulb and voltage etc., required." E.L. (Eltham).

YOU could use a bell transformer and lamp as you suggest but the illumination will not be very great. We advise you to use a 30 watt car headlamp bulb in conjunction with a small transformer. Any of our advertisers can supply transformers suitable for your requirements.

REWINDING A MOTOR

"I HAVE a two-pole Electrolux suction-cleaner motor (105-115 volts); and wish to rewind it for use on 220 volts. I do not wish to use a mains transformer." A.B. (Co. Durham).

BEFORE we can answer this query you must send us a full sketch of the machine, complete with all measurements, etc., etc., and if possible, a sample of wire from both armature and field.

You will have to double the number of turns on both the armature and field.

WINDING AN ARMATURE

"IS it possible for me to wind a 16-pole armature so as to run between a permanent magnet off 225 volt, 50 cycles A.C. current?

If I could, would you please inform me regarding the method of winding." E.L. (Lancs.).

IT is impossible, but you could run a two pole armature if you had some means of bringing this up to synchronous speed, 3,000 revs., before switching on the current.

FIREPROOFING SOLUTION

"I REQUIRE a formulae for making a fireproofing spray for treating curtains, carpets, etc., in a cinema." A.J. (Kent).

IT is not very possible to fireproof a fabric adequately by ordinary spraying, since, for satisfactory results, the fabric requires an actual immersion in the fireproof liquid in order that its fibres may become thoroughly impregnated with it.

We have no data as to the effects of repeated spraying of fireproofing liquid, since this process is very seldom carried out. However, there is no reason why you should not experiment with it and we think that you should obtain satisfactory results by repeatedly spraying your fabrics with a medium-strength mixed solution of ammonium sulphate and sodium tungstate, the exact quantities of these materials dissolved being immaterial. Do not, however, make the mistake of thinking that spraying with strong solutions will give a better effect. As a matter of fact, the opposite will be the result, for such solutions will not penetrate well, but will merely dry on the fabric, leaving a powdery deposit. Frequent spraying with moderately diluted solutions is the better plan to adopt.

This treatment will not, of course, render the fabrics absolutely incombustible. It will, however, result in their merely smouldering slowly when ignited.

If you do not wish to go to the trouble of making up the above solutions, you may probably be able to obtain fireproofing solutions from Messrs. Sir. Wm. Burnett & Co., Ltd., Nelson Wharf, Milwall, London, E.15.

GLASS KNOBS

"WILL you please tell me if the enclosed designs for glass knobs would be novel and worth patenting, and if so, how do I do so and is it costly? Must I produce samples as well as the descriptive sketches of them?"

"The glass knobs are meant for wireless receivers, and I thought that the higher class of radio makers might be interested." K.L. (Surrey).

THE proposed glass knobs for wireless receiving apparatus are neither broadly novel nor fit subject matter for protection by letters patent.

The idea of making knobs or handles from glass is already well known and even if it were novel, would not form patentable subject matter. There is no invention, i.e. patentable invention, in the mere substitution of one material for another, unless invention is required to adapt the material to its new purpose.

Further, providing glass knobs with a mirror-like backing is also old and well known.

It might be possible to obtain a limited amount of protection by registering the particular shape of the knob—if novel—as a design. Such a registration would only give protection for the exact and particular shape or configuration of the knob, and would not cover the method of production, i.e., the mirror-like surface.

PRINTING ON ALUMINIUM

"CAN you inform me on the process of printing on sheet aluminium or tin-plate? I require to print a graduated chart in black on a white background.

"A photographic process might suit, as I require a hundred or so copies" (G. B., Dublin.)

SEVERAL processes are available for obtaining black lettering on metal surfaces. Tinplate, sheet brass and iron is usually white-enamelled in a muffle furnace and then given an "overlay" of black lettering which is printed on from type and again baked in a furnace.

You will, no doubt, not be able to imitate these processes, which require a considerable amount of plant and also experience.

Aluminium, however, can be "matted" by immersing it for a few seconds in a hot strong solution of caustic soda or, alternatively, by brushing this liquid over it and afterwards rinsing it well away with plenty of hot water. This treatment gives a silvery surface to aluminium and, as the surface is slightly rough, it can be printed on with ordinary type.

Another plan is to coat the clean metal surface with a three per cent. solution of gelatine and set it aside overnight to dry and harden. A photographic negative of the required lettering or design is made on a "process" plate and this is printed on one of the "stripping" papers which are available, as, for example, the Ilford "Dry Transfer" paper, which is manufactured by Ilford, Ltd., Ilford, London, E. By following the simple instructions given in each packet of this paper, the design printed photographically on the paper can be transferred permanently to the gelatine-prepared metal surface.

The above two methods are proved ones but, nevertheless, we feel bound to say that you will not succeed in getting a satisfactory plain white background to your lettering unless the metal surface is enamelled white in the first instance. You

A model steam tug made by Philip Scott-Martin. It measures 9½ in. long and is equipped with a working model engine of only ⅛ in. bore and stroke, made by the Editor of this journal.

would probably be able to obtain metal ready white enamelled from either Messrs. Wildman & Meguyer, Ltd., Sandpits Enamel Works, Parade, Birmingham, or Messrs. J. A. Jordan & Sons, Ltd., Beehive Works, Bilston, Staffs.

REPAIRING OILSKINS

"CAN you tell me of a suitable proofing compound for repairing a leaky oilskin?"

"What firm are supplying castings for the 'Elf' engine recently mentioned in 'Practical Mechanics.'?"—G. O. (Enfield).

YOU do not say whether the leak in your oilskins is due to an actual rent, to the material having worn thin in the leaky area or to some failure of the proofing. It is really a very difficult matter to proof oilskins satisfactorily once they begin to leak, for the reason that if compounds containing oil are applied to them the material very readily acquires a permanently tacky condition. We would suggest that you obtained a small stick of Chatterton's compound from a local radio stores and dissolved some of this in a small quantity of petrol so that a dark-brown solution was obtained. Stretch the leaky area of the oilskins out flat and, with a piece of cotton wool, dab the solution over the affected area. After the solution on the material has dried out, sprinkle the area over with French chalk and then iron gently with a warm iron. As a temporary solution to the problem, a piece of candle rubbed over the affected part may suffice. On no account, however, should you apply linseed and other oils to the oilskins.

The "Elf" engine is of Canadian origin and is not manufactured in this country.

LUMINOUS PAINT

"WHAT are the formulas for making celluloid and luminous paint?"—L. W. (London, W.12).

CELLULOID is made by dissolving nitrocellulose in molten camphor. The process is a difficult one, requiring mechanical kneaders and other appliances and cannot possibly be imitated satisfactorily on the small scale.

The easiest method of making luminous paint is to procure a small quantity of luminous calcium sulphide from a chemical supply firm, such as The British Drughouses, Ltd., Graham Street, City Road, N.1, and by mixing a quantity of this with some suitable varnish according to your own individual requirements. The calcium sulphide above-mentioned costs about 1s. 1d. per ounce. From the same firm you can procure compounds containing traces of radium which are permanently luminous, but these are very costly.

You can prepare calcium sulphide for yourself by heating oyster shells (powdered) with excess of flowers of sulphur in a sealed tin can in a bright fire for several hours, but, unless you are expert at chemical manipulations you will find it more convenient and less troublesome to obtain your luminous calcium sulphide ready made and to prepare your own paints from this material.

LIQUID AIR

"WHERE can I obtain liquid air, and what is the approximate price of it?

"Are there any definite compounds of (a) phosphorus with carbon? (b) phosphorus with nitrogen? (c) phosphorus with boron?

"If so, what are their properties and formulae?"—H. S. (Huntly).

LIQUID air may be obtained from The British Oxygen Company, Ltd., Edmonton, London, or from any of the branches of this Company. Its price is approximately 7s. 6d. per litre plus loan charges (about 2s. 6d.) on a suitable container. Liquid air can be sent by passenger train to places within about twelve hours' journey from the area of dispatch.

Phosphorus does not form any well-defined direct compounds with the elements you mention. There is a compound, PN (NH), which is formed in small quantities by the action of ammonia on phosphorus pentachloride, but, of course, this is not a true *nitride* of phosphorus. Phosphorus vapour has some action on redhot boron, but the products are not well defined.

A VEREY LIGHT

"I WOULD like details for constructing a verey light, with a section of the case containing the mixture, and the necessary proportions of the chemicals to give both red and green lights."—S. G. C. (Staffs.).

VEREY lights are small rockets which produce a brilliant white light by means of burning magnesium powder. You can make an imitation of them by building up a cylindrical cardboard case of dimensions, say, 8 in. by ½ in. and by filling the upper half of the case with a mixture of magnesium powder and powdered potassium chlorate, the lower half of the rocket being filled with gunpowder or any other ordinary rocket-propelling powder. For the production of red lights mix some strontium nitrate with the powder and, in order to produce green light, mix a quantity of barium nitrate with the powder.

DENTAL STOPPING

"WHAT are the constituents of white dental stopping? Can the material be obtained commercially?"—P. W. (Kent).

THE so-called "synthetic" or "porcelain" cement used by dentists for filling teeth is a mixture of zinc oxychloride, magnesium oxychloride, zinc oxide and traces of other materials. Its composition is more or less maintained a secret by the large dental firms. The material has to be made with very special care, since it is necessary for the filling to expand very slightly on hardening. If it expands too much it will crack the tooth, while if its expansion is too small the filling will not remain in position. Dental fillings of all types may be purchased from any of the dental supply houses, as, for instance: The Amalgamated Dental Co., Ltd., 5-12 Broad Street, Golden Square, London, W.1, or The Dental Manufacturing Co., Ltd., 17 Newman Street, London, W.1.

SUBSTITUTE FERTILISER

"CAN you suggest a substitute fertiliser or method of soil treatment, in place of horse manure, for a mushroom bed?"—A. L. (Bristol).

ARTIFICIAL manures are of little use in mushroom culture since their "heating" effects are very small. An effective mushroom bed should comprise horse manure and cow dung together with well-rotted straw and we can offer you little hope of cultivating mushrooms successfully unless you can obtain adequate supplies of these commodities. An existing mushroom bed might be "strengthened" by incorporating with it small quantities of sulphate of potash and sulphate of ammonia, but no such artificial fertilisers could be used without the natural manure.

QUICK-FIRING FUSE

"HOW could I make a reliable quick-firing fuse?

"Are there any precautions to be taken in the preparation of "ammonal" from ammonium nitrate, aluminium powder and charcoal? Can this mixture be fired with a fuse?"—A. M. (Birmingham).

A simple quick-fuse may be made by soaking blotting paper strips in a solution containing equal parts of saltpetre and potassium perchlorate. The paper, when thoroughly dry, will carry a hot spark along it very rapidly. Another quick fuse may be made by rolling a quantity of gunpowder into a thin cylinder with tissue paper. Still another fuse may be prepared by dipping a piece of string in saltpetre solution, then in ordinary gum and by finally wiping it over with gunpowder. The string, when dry, will act as a fairly rapid fuse. Other fuses are known, but, as these necessitate the use of powerful detonating materials, their manufacture at home is highly dangerous.

All explosive and quick-firing mixtures should be prepared in very small quantities at a time. There are no special precautions to be taken in the mixing of ammonium nitrate, charcoal and aluminium powder, apart from such common-sense ones as, for instance not carrying out such mixings in the neighbourhood of a light or an open fire. Ammonium nitrate powders can be fired with a fuse. They are, also, sometimes fired by means of detonators.

SEPARATING FROTHS

(1) "IN Partington's 'Inorganic Chemistry' (page 1) it is said that froths may be separated by adding other liquids, such as alcohol to aqueous foams. Can you explain how this is effected?

(2) "Would Chatterton's compound be good enough as a non-conductor of electrical tension of 75,000 volts and upwards? Also bakelite?

(3) "Can bakelite be turned on a lathe? Can it be obtained in sheet and rods?

(4) "Is blue ultramarine, $Na_4 Al_3 Si_3 S_2 O_{12}$ the same as the blue substance used in laundry?"—S. W. (Kent).

(1) WHEN liquids such as alcohol are added to aqueous solutions, the surface tension of the latter is lowered. Every liquid exhibits the phenomenon of "surface tension," in view of which fact every liquid appears to have on its surface a sort of skin which is under a certain degree of tension. This tension effect gives rise to the phenomenon of bubbles, frothing, etc., the greater the surface tension of the liquid, the more readily it being able to produce froth. By adding alcohol (or certain other liquids) to solutions of high surface tension, the latter property is lowered in intensity and the liquid subsides, as it were, from the froth which it has produced. In this way, a liquid and its froth may be separated.

(2) The insulating properties of bakelite and Chatterton's compound are governed greatly by the actual amperage or quantity of the current which is applied to such materials, A current of 75,000 volts (such as, for instance, that produced by an induction coil) at very low amperage would be withstood by the above materials. If, however, the amperage of the current were high, the materials mentioned would not withstand the current strain. You will realise, therefore, that your query cannot be answered precisely unless the actual amperage of the current is given.

(3) Bakelite and most of its associated materials can be turned satisfactorily on a lathe, provided that not too much pressure is brought to bear on the material by the cutting tool. Most of the above materials can also be obtained in sheet and rod form. Write to Bakelite, Ltd., 68 Victoria Street, London, S.W.1, for particulars of various products of this nature.

(4) What we may call "laundry blue" is not usually composed of pure ultramarine. Such "laundry blues" contain adulterants, such as "lime blue," powdered starches, and traces of aniline dyes. Most of these blues, however, contain ultramarine as a basic ingredient.

BOOKS worth READING

KEMPE'S ENGINEER'S YEAR-BOOK, 1939 Revised under the direction of L. St. L. Pendred, C.B.E., 2,824 pages. Price, 31s. 6d. net. Morgan Brothers (Publishers), Ltd., 28 Essex Street, Strand, London, W.C.2.

THE importance of such a book as this will be obvious to the engineer of the present day whose duties cover such a wide field, and the requirements of whose work is so constantly varying. This work, which is the 45th annual issue, is a compendium of the modern practice of civil, mechanical, electrical, marine, gas, aero, mine, and metallurgical engineering. The compiler has carefully brought the subject matter up to date and has included only such modern formulæ, rules, tables, and data as are required by engineers from day to day in the practical work of their calling. The work is divided into forty-eight sections, each section dealing with its particular branch of engineering in a very thorough and comprehensive manner. Many new principles, as applied to engineering, as well as similar particulars of older practice, have been carefully compiled from the leading authorities on the subject and find their place in the present volume, whilst a large amount of original matter is also included.

Amongst the varied contents are sections on Units of Measurements; Properties of Engineering Materials; Surveying; Timber; Reinforced Concrete Construction; Bridges; Highway Engineering; Water Engineering; Machine Tools; Welding and Cutting; Fuels; Steam Engineering; Internal Combustion Engines; There is also a very complete index, and a classified directory of engineering manufacturers. The work is well illustrated with line drawings, and should prove an invaluable reference book for the practical engineer or student.

THE WORLD OF ENGINEERING. By J. L. Dixon. Published by The Scientific Book Club, 121 Charing Cross Road, London, W.C.2. 206 pages. 2s. 6d. net.

THE purpose of this book is to present in simple and interesting form the general principles of civil, mechanical and electrical engineering. Details of too technical a nature are avoided, and with the aid of explanatory diagrams the reader may gain an insight into the theory and practice which form the background of engineering achievement, past and present. The book is divided into twelve chapters, covering such subjects as The Steam Engine; The Steam Turbine; The Internal Combustion Engine; Bridge Engineering; Electrical Engineering; and The Telephone. There are also chapters on Wireless Telegraphy and Telephony; and Television.

TOOLMAKING AND TOOL DESIGN
Part 4

(Continued from page 247)

application.

A common type of drilling job is that shown in Fig. 21. The requirements are that a drilled hole passes through the centre of the work in both directions square with the axis. The simple jig illustrated in Fig. 22 is one that will produce the results desired and is also capable of rapid manipulation. A casting forms the jig body which is machined on the top and bottom faces. The inverted 90 degree vee, with the root terminating in a shallow slot, at the top of the jig is machined parallel with the base. A hole for the drill bush is bored central with the vee and a hole drilled and tapped in the centre lug in line with it to receive the pressure screw.

Holes in the base lugs are drilled for the purpose of securing the jig to the drilling machine table. The headed pressure screw is drilled through its centre to clear the size of drill used for the work. A short tommy bar secured into the head of the screw provides the means of securing and releasing the work-piece. A steel bracket screwed and dowelled to the side of the jig and provided with an adjustable stop in the form of a screw tapped into the bracket and secured with a locking nut affords the means of end location. Where more than one operation is necessary the jig is equipped with a liner and slip bushes, in which case, where the jig is to be operated on a two or three spindle machine the base may be modified and a handle provided.

Where a series of jobs of a like nature to that shown in Fig. 21 are to be handled and differing slightly perhaps in diameter, length, and hole size, one jig may be utilised to deal with them all. When this is intended the end stop will require a range of adjustment sufficient to cover the longest and shortest of the parts. Slip bushes will be substituted for the fixed bush and a series of tommy holes drilled and reamed in the bush head to permit the lever being moved to a convenient position when a smaller or larger diameter of work is being handled.

Should a lot of work have to be drilled or when the jig will see service over a long period, its durability will be enhanced if the vee block portion is made from steel which is subsequently finished by hardening and grinding. This would be attached below the bushed portion with hollow cap screws and dowels. It will be apparent also that this jig lends itself to a built-up form of construction from steel. Naturally this will be the course to adopt where the work is of small proportions, say, below $\frac{3}{8}$ in. in diameter.

By a slight modification this design lends itself admirably to the drilling of pin holes. For the majority of split pin holes in bolts or clevis pins the pressure screw would need to be at a point behind the bush. The form of end location shown could be dispensed with as hole centres for this class of work usually given are from under the head. The edge of the vee block could be used as a locating face, or where length variation has to be coped with an adjustable stop sliding through and clamped in a hole in the back of the jig can be provided. (See Fig. 23).

Reverting to the original purpose of the jig where two holes are required side by side, one solid pressure screw between the holes will form the method of clamping.

BUY, EXCHANGE OR SELL

PHOTOGRAPHY—*Continued*

£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 developers 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.

MODELS

STEEL TUBING, Seamless, ¼ in. to 5¼ in., 1/32in. to ⅜in. thick. Please say lengths you cut to.—Cotes, Church Walk, Brentford, Middlesex.

MONEY-MAKING

SIX WAYS to start a spare-time business in your own home, with a limited capital. No canvassing or experience required. Grasp this opportunity now. Send 5s. only. Avondale, Overstone Road, Harpenden, Herts.

SITUATIONS VACANT

G.P.O. ENGINEERING DEPT. (no experience required). Commencing £3/13/0 per week. Age 18-23. Excellent prospects. Free details of Entrance Exam. from B.I.E.T. (Dept. 579), 17-19 Stratford Place, London, W.1.

DRAUGHTSMEN. Numerous vacancies available in Electrical, Mechanical, Aeronautical and other Branches of Engineering, Building, G.P.O., etc., for men age 17-40. Exp. unnecessary if willing to learn. Details of openings, salaries, prospects, etc., FREE from N.I.E. (Dept. 372), Staple Inn Buildings, W.C.1.

WATCHMAKING

WATCH & CLOCK REPAIRERS. Send 3d. for complete list of material and tools. Blakiston & Co. Ainsdale, Southport.

MISCELLANEOUS

HEADPHONES, CRYSTALS, CRYSTAL SETS, microphones, model aeroplanes, tricks, jokes, etc. Lists with diagrams, FREE, or send 3d. for 40-page ILLUSTRATED CATALOGUE. POST RADIO, 2 COPENHAGEN STREET, London, N.1.

SHADOW PUNCHING BALLS. Boy's 2/6. Junior 3/11. Men's 5/6. Postage 3d. Suitable both sexes. Rowing machines. Exerciser outfits, etc. Interesting illustrated lists free. "Kimbers" Health Department, 105, Queen's Road, Brighton.

SMALL ELECTRIC MOTORS, tools, workshop gear, list.—Scott, 149 Albert Road, Middlesbrough.

FLYING FLEA, completed and tested, with 1,200 c.c. A.B.C. Engine. Sell or exchange for Motor Cycle or Car.—Bassett's Garage, Hartington, Derbyshire.

CASTING MOULDS FOR LEAD SOLDIERS animals and novelties. Sample mould, 2/9. Catalogue stamp.—Industries, 2 Waldegrave Park, Twickenham

TELESCOPES! Reflecting and refracting. Eye pieces, silvering, refiguring, repairs. Equatorial stands. Everything supplied.—Irvings', 258, Kingston Road, Teddington.

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.

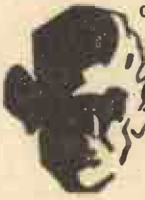
BRAND NEW POWER TOOLS of quality. 10 in. Bandsaws, 54/-. Jigsaws, 22/6. Wood Planing Machines, 80/-. Bench Drills, 11/-. Circular Saws, from 25/-. 3 in. S.C. Toolroom Lathes, from £4 16s. New 1 in. Chromium Plated Micrometers, 12/6. Electric Drills, 32/6. Grinders, Spray Plants, Guns, Air Compressors, etc.—John P. Steel, Clyde St. Mills. Bingley.

MYFORD LATHE SPECIALISTS. Cash or no deposit terms from 10/- monthly. Immediate deliveries anywhere.—Nuttalls, 20 Albert Street, Mansfield.

TOOLS—*Continued*

Special Clearance guaranteed quality Small Taps and Dies, 13/16" Circular Split Dies, British and American make only. Usual price 10d. to 1/3 each. Sizes: ⅛"; 5/32"; 3/16"; 7/32"; ¼"; 9/32"; 5/16". Whitworth, B.S.F. also Model Engineer 40 Threads in all above sizes; also 0, 1, 2, 3, 4, 5, 6 B.A. Clear 6d. each, 5/6 doz.

J. BURKE, 30, TRIPPET LANE, SHEFFIELD, 1.



OUR ADVICE BUREAU
COUPON
This coupon is available until February 28, 1939, and must be attached to all letters containing queries, together with 3 penny stamps. A stamped addressed envelope must also be enclosed.
PRACTICAL MECHANICS, FEB., 1939.

TOOLS—*Continued*

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

Die-Stocks for above Dies, steel throughout, hardened adjusting screws, 9d. each; Tap Wrenches, 0 to ¼" Adjustable, all steel, 9d. each; 3 tons ground bright Tool Steel Pieces, ¼" to ¾" diam., various lengths up to 6", easily hardened in water or oil. Guaranteed the very best quality material actually costing from 1/9 to 3/- per lb. A stock is essential for making Cutters, End Mills, Pin Drills, Punches, High Speed Shafts, etc., etc. 5 lbs. assorted 3/-; 14 lbs., 7/-; also larger sizes, ⅝" to 1½", 10 lbs., 4/-; 28 lbs., 10/-. Also larger sizes 1½" to 3" diam., in blanks and short pieces, not bright, 28 lbs., 6/6; 1 cwt. assorted, ¼" to 3", 30/-; ½ cwt., 16/6; ¼ cwt., 9/-. We guarantee you a good assortment for general use. Below.

700 Cutting Off Grinding Wheels, approx. 7½" diam., ⅛" thick, ¾" hole, 2/6 each; ditto, approx. 6" diam, 1/9 each. Very useful for grinding taps, drills, cutting tubing; or any purpose where a thin wheel is required. Best American make and guaranteed worth more than three times price asked.—Below.

1" Die-Stocks, all steel, 1/9 each. Special thin Grinding Wheels, as used for cutting brass tubes, etc., 6" diam, ¾" hole, 1/9 each; 10,000 large taps, clear cheap.—Below.

Hexagon Die-Nuts, invaluable to all repair shops. Genuine clearance prices: Whit., B.S.F., S.A.E., U.S.S.; also brass 26 thread, sizes ¼", 5/16", ⅜", 7/16", ½". Usual price, 7/6 set; outstanding value, 2/9 set. Also ⅝", ¾", ⅞", 1", in same threads, 4/- set of four. Any four sets ¼" to 1", 24/-, for thirty-six die-nuts.—Below.

1,200 Best Quality Taps, Tapers, 2nds, Plugs. ⅝", 9d.; ¾", 1/-; ⅞", 1/3; 1", 1/6, Whit., B.S.F. Also in gas thread, ⅛", 6d.; ¼", 9d.; ⅜", 10d.; ½", 1/-; ⅝", 1/3; ¾", 1/6; ⅞", 1/9; 1", 2/-.—Below.

12 Only Ball-bearing Double-ended Grinding Heads, to take ¾" bore wheels. Practically new, 15/- each. Six only Stands for same, fitted with rise and fall slide independent each side. Make very good tool and cutter grinders or surface or special grinders. Stands 10/- each, if purchased with grinder.

20 Dozen Double-ended Saw Files, 8", 3/-; 9", 3/6; 12", 4/- per dozen. Also 3", 3½", 4", 4½" Saw Files, 2/- dozen; 5", 6", 3/- dozen.—Below.

700 Pieces Super High-speed Steel, 5/16" square, hardened ready for use, 3" long. Four pieces, 2/9. The stuff for lathe tools.—Below.

2/9 any lot. Eight lots £1.—Below.

- ⅜" **Toolholder** with four H.S. Tools.
- ⅜" **Adj. Boring Tool** with H.S. Tool.
- ½" **Drill Chuck,** taper or straight shank.
- 1/16" to 5/16" **Silver Steel,** 13 pieces.
- ⅜" to ¾" **Silver Steel,** 4 lb., 2" to 4" long.
- **500 Ass. Brass and Steel Screws, etc.**
- **100 Steel Hex. Bolts and Nuts,** ⅛" to ¼".
- **16 H.S. Drills,** 1/22" to 5/32".
- **12 Drills,** 1/16" to ⅜". Carbon.
- **Set 1" Dies,** ¼", 5/16", ⅜", 7/16", ½", Whit.
- **Ditto,** B.S.F. 26 threads or S.A.E.
- **Set** ¼" to ½" **Taps,** same as Dies. T.S. or P.
- **Slitting Saws,** five 1/32" to ⅛" thick, 1" hole.
- **Two dozen Fine and Odd Thread Taps to ⅜".**
- **Three dozen Tungsten Hack-saws to 12".**
- **18 Grinding Wheels,** ¼" to 1" diam.
- **Three H.S. Tap Fluting Cutters,** 1¼" diam.
- **One dozen Ass. Files,** 4" to 12".
- **Six Files,** 12" to 16". Note postage terms.
- **Dozen Toolmaker's Needle Files,** indispensable.
- **Best Carborundum Wheel,** 7" by ½" by ¾" hole.
- **200 Springs** to approx. 6" long.
- **2½" Split Die Cutting,** ⅜", gas.

Small Taps, 7, 8, 9, 10, 12, B.A., 1/16", 3/32" Whit. 6d. each, 5/9 dozen. No dies in these sizes.

Carborundum Wheels, 9" diam., 1" wide, 1" hole, 5/-. Also rougher Wheels, 9" by 1½" by 1" hole, 3/9 each. Good pair for general tool use.

High-Speed End Mills, ½", 2/9; Straight Shank, ⅜" carbon ditto, 1/9.

£1 Orders Carriage Paid, except abroad. Money refunded if not satisfied with any of the above bargains.

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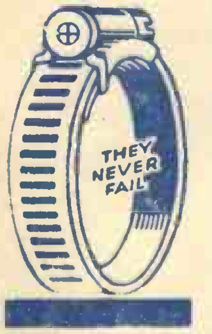

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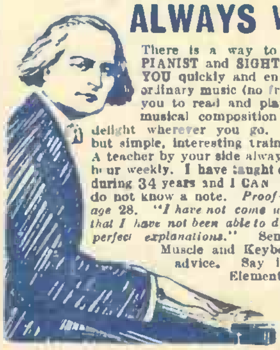

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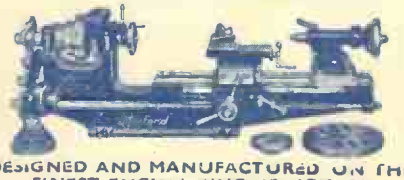

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