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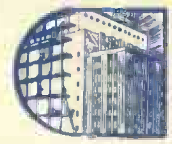

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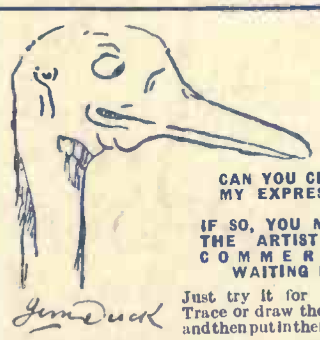

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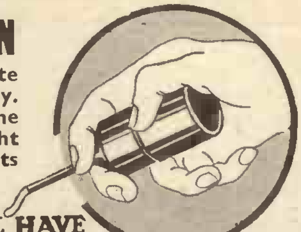

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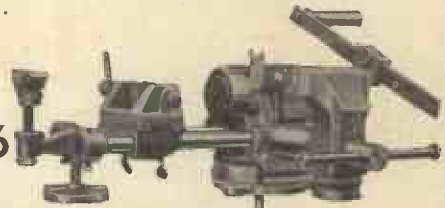

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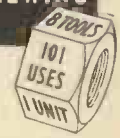

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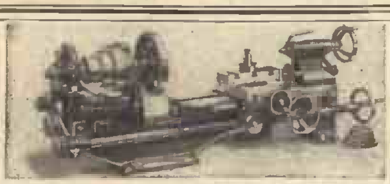

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PRACTICAL MECHANICS

Editor : F. J. CAMM

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FAIR COMMENT

On Working Too Hard

By The Editor

I HAVE received a large number of letters as a result of the leader I wrote last month entitled "Is There More Room at the Top?" Most of these letters express approval with my point of view, but a few of them draw attention to anomalies in our industrial system which, the writers think, render nugatory any personal effort for advancement on merit. I am very much afraid that these are exceptions which prove the rule, for, of course, there are exceptions to every rule, otherwise there would not be need for a rule. Hard work should bring its own reward, and the object of my comment was to draw attention to what I considered to be an unhealthy desire on the part of young men, not to master the fundamentals of any trade or calling, but to start half-way up the tree. I emphasise here that it is not possible to become really capable, and to hold important and well-paid positions on the limited knowledge obtained say, from a first job in a drawing office, where you will probably be put on tracing for a couple of years before you are allowed to draw simple fittings.

Marked Advancement

NOW education has made marked advancement in all directions, and knowledge which formerly could only be obtained at colleges is now available for almost a trifling fee to the man in the street. There is no excuse for lack of knowledge to-day, and there is no excuse for lack of experience. Yet, it is a most surprising fact that we are unable to fill really big jobs with people with the necessary knowledge, experience and ability to fill them. In fact, it is the complaint of many employers in all trades that it is not possible to get a really skilled day's work out of a large percentage of their employees. I do not know whether this duplicates the experiences of my readers, but even the simple jobs connected with your home which you place in the hands of builders are only in a small proportion of cases properly carried out. Yet the cost of doing those jobs has gone up out of all proportion, so we are really paying more money for inferior work. Something must be wrong somewhere, and I am quite certain, as I indicated last month, that it is due not only to the failure of the apprenticeship system, but also to the ambition which many of our schools wrongly inculcate that you can short-circuit the hard work associated with starting at the bottom. It is correct to say that nearly every one of our important industrialists and captains of industry have started from the bottom, and it is unlikely that, in these days of keener competition, you can succeed in any other way.

The Art of Delegation

ANOTHER aspect of the modern tendency is to believe that once having obtained a post you should practise the art of delegation. This, in my view, is a most insidious doctrine, and presupposes that any ability you may possess can be delegated to a subordinate. If that were possible well-paid jobs would not exist, because anyone would be able to do them.

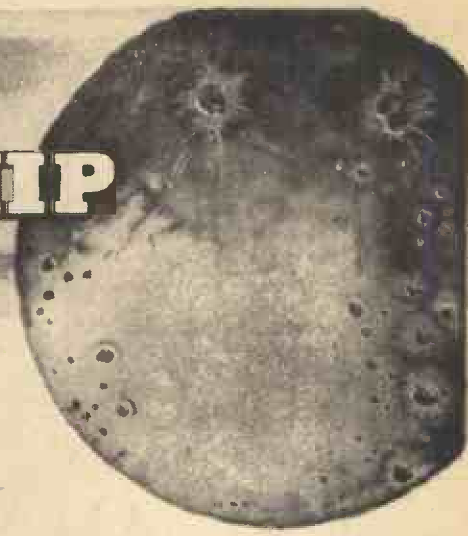
Another aspect of modern outlook is that every five or six weeks we should be permitted to have a holiday to recover from our exertions. I know that I am expressing an unpopular point of view when I say that we have far too many holidays. A fortnight's holiday per year should be sufficient for anyone, particularly as many of the holidays were instituted for a purpose unconnected with work. Many of the holidays were instituted to give the average citizen the opportunity of following his religious beliefs. I express no opinion upon that, except that people do not use those holidays for the purpose for which they were introduced. I think it is also correct to say they do not use them for the purposes of rest, for many of them tear away to the seaside or the country the moment the holiday commences and arrive back by the last available train. The day after the holiday, when they have returned to work, is used for recovery from the exertions of the holiday. It would, indeed, seem that not only has the working week shortened, but each working day has shortened, and there seems a general disinclination to put in the hard work formerly associated with equipping oneself for the better positions and for the the battle for life.

Beware!

BEWARE of the individuals who tell you that you are working too hard. Such remarks are usually made by those who do not work particularly hard, and judge you by their own modest output. Hard work is even more necessary to-day than it was a quarter of a century ago, for qualifications are advancing, and even the lowest jobs in the future will demand a higher standard of intelligence and knowledge, even than they do to-day.

You cannot work too hard, for there are physical limits to what you can do, and only the individual concerned knows his limit. Thus, it is inevitable that some can work harder than others, for nature sets that limit. Those correspondents who feel that, in spite of their hard work, they have not reaped the reward which they feel is their due should take comfort from the fact that by waiting long enough everything comes to him who *tries*. There are many at this period of the year who are at the threshold of life, and wrong advice as to the selection of a career and the method of entering it, spoils the chances of success for ever; and I write with considerable knowledge of this subject.

TO THE MOON IN A SPACE SHIP



The Shortest Space-Ship Voyage is the Journey to the Moon, and Below is Given Details of a Suitable Ship that might be Capable of Accomplishing the Journey

IN designing a space-ship the designer has a completely different problem from that involved in the design of any other means of transport. A motor car, railway train, aeroplane or ship consists basically of a vessel and a fuel tank, in the tank being placed the fuel required for a journey or journeys. The shortest space-ship voyage, however, is the journey to the moon, and with the most optimistic estimates of the fuel energy and motor efficiency the quantity of fuel required will still be such that the fuel tank would require to be much larger than the rest of the ship. Consequently, we must revert to the old system of petrol cans, so designing our ship that the cans can be attached outside the ship and thrown away when empty. We find by careful calculation that with the best fuels and motors that we can afford it will require about 1,000 metric tonnes (a metric tonne is roughly equivalent to an English ton) of fuel to take a 1 tonne vessel to the moon and back, so our designers' problem has been to design a 1 tonne space-ship with containers for 1,000 tonnes of fuel attached outside and detachable.

Rocket Motors

The nature of rocket motors has also affected the design considerably. With such motors as aero-engines, a larger unit can be made lighter in proportion to its power than a small unit, but in the case of rocket motors, quite the reverse is the case; in fact, the proportionate weight of rocket motors rises so steeply that a motor of more than 100,000 h.p. is hardly feasible, and as the lifting of the 1,000 tonnes at the start calls for many millions of h.p. this requires a considerable number of small units. Again, since the cost of the motors is less than the cost of the fuel required to bring them back, and as only a few small motors will be required to land the one tonne ship on its return against over a hundred large ones at the start, the motors are jettisoned after use.

For a maximum fuel economy, anything which is to be jettisoned should be jettisoned as soon as possible, and this has led to the cellular space-ship design, with hundreds of small units each comprising a motor and its fuel tank, and each so attached that as soon as it ceases to thrust it falls off. This early detachment of all dead weight has resulted in an enormous increase of efficiency over earlier designs, and has reduced the fuel required for a return voyage to the moon from millions of tonnes to thousands of tonnes.

Solid Fuel

Owing to the large number of small units, it is possible to start a motor and run it until its load of fuel is exhausted, controlling both thrust and direction by the rate at which fresh tubes are fired. This makes it possible to use solid fuel for the main thrust with consequent considerable saving in weight, and giving the additional advantages that the strength of the fuel helps to support the parts above and its high density makes the ship very compact. Liquid fuel motors are, however, provided for stages requiring fine control, and also steam jet motors for steering.

Fig. 4 shows a section through the head of the space-ship. The approximately hemispherical portion (to the downward pointing cone) is the life container. The portion between the two cones contains the air-lock, air-conditioning plant, heavy stores, batteries and liquid fuel and steam jet motors, etc. Below this are the solid fuel tubes for the return voyage. The whole of the remainder of the vessel (Figs. 1 and 3), consists of the tubes for the outward voyage, which have to be jettisoned by the time of arrival at the moon.

Not Streamlined

It will be seen that there has been no attempt to streamline the ship. The form of the ship has been largely dictated by other considerations, and as compared to the terrific power needed to lift the vessel out of the earth's gravitational field the total air resistance is quite negligible (less than 1 per-cent.), but this does not matter greatly. The diameter of the front of the ship is determined as being the smallest reasonable size for the life container. (It should be noted that this design is for a very small space-ship, about the overall size of a large barge. On larger ships this restriction will be somewhat modified.) The diameter of the rear of the ship is determined by the firing area required. Too small an area calls for excessive pressure in the motors, and consequently excessively heavy construction. The two diameters being approximately the same has led to the straight-sided form. An increase in central diameter would mean improved streamlining, but this would only decrease the resistance below the velocity of sound, and this is only a small proportion of the whole.

The Design of the Nose

On the other hand, the straight-sided form gives the greatest strength, which is of major importance, and also serves to minimise frictional heating. The main body of the space-ship, comprising the motor tubes, is hexagonal in shape; this form giving the closest possible stacking of the tubes.

The form of the nose is intended not so

much to reduce the resistance at low velocities, as to split the air at high velocities (several times the velocity of sound), so as to maintain a partial vacuum along the sides. The frontal paraboloidal portion seen in Figs. 1, 3, and 4, is a reinforced ceramic carapace, capable of withstanding a temperature of 1,500 degrees Centigrade in air, and by its form the frictional heating is made a maximum on this portion and minimised on the sides. The carapace (which, of course, has no portholes) is detached once the vessel has got away from the earth.

The tubes are stacked in conical layers for greater structural stability, since, apart from the vessel proper—the top portion—the whole strength lies in the tubes, and these are not rigidly fixed together, but simply stacked and held in position by one-way bolts and light webs.

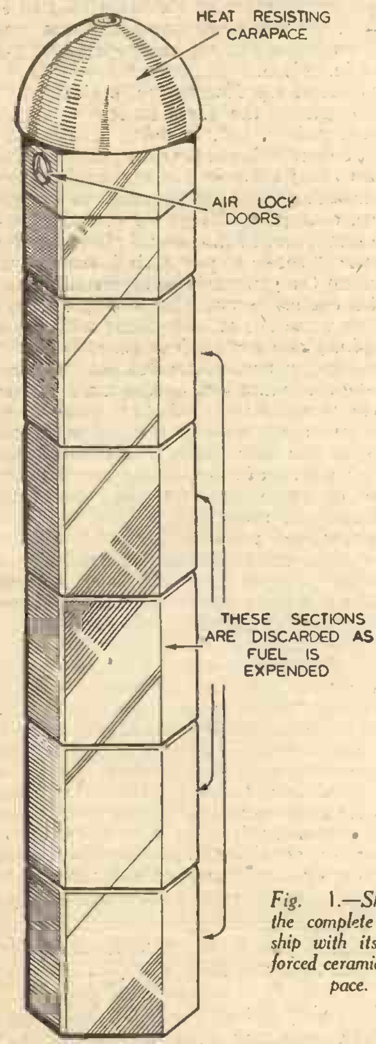


Fig. 1.—Showing the complete space ship with its reinforced ceramic carapace.

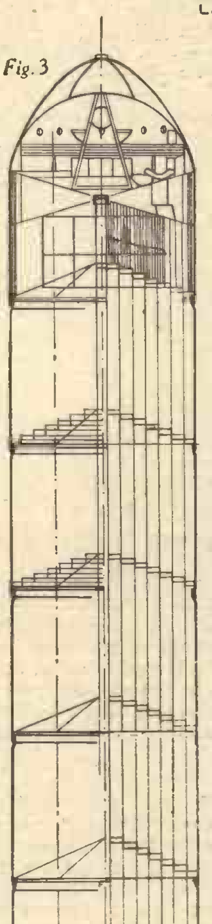
Firing Order

The firing order of the tubes is in rings starting from outside and progressing inwards towards the centre. While the motors are firing their thrust holds them in place; when expended the acceleration of the ship causes them to be released from position and they drop off. Those in the inner rings of the bank not yet used do not position themselves for release until their firing thrust carries them a fractional distance up the release bolts. A light metal sheath embraces the outermost ring of tubes; this and the webs are discarded when the whole of the previous bank of motors has been jettisoned.

Fig. 2 shows maximum periphery of the carapace. The top half of the diagram (Fig. 2) represents a section through the large motor tubes stacked in banks; these are used to obtain release from the earth. The lower half, Fig. 2 shows the medium and small tubes used for deceleration at the moon (the ship, having been turned end to end, approaches stern first). Fine control for the actual landing is provided by the vertical liquid fuel motors seen within the two cones in Fig. 4 and about the hexagon angles in Fig. 5. The upper bank (Fig. 4), is used for the return journey.

Artificial Gravitation

Adjacent to the top of the liquid fuel motors are shown four of the tangential tubes. These are necessary in order to provide the crew with artificial gravitation, which is achieved by rotating the ship (approximately 1 revolution in 3½ seconds). The g. value desired is therefore under control of the crew. Not only is this artificial gravitation considered a necessary precaution (the physical affect of long periods of no-gravitation being at present unknown), but in any case haphazard rotation of the vessel would almost certainly take place, making navigational observations impossible. Hence control of rotation is essential. Again, before the moon landing can be attempted it is necessary to stop rotation in order to prevent disaster to the ship when it touches ground.



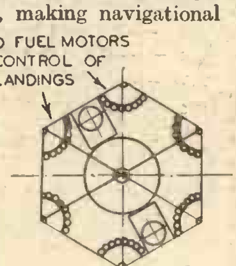


Fig. 5

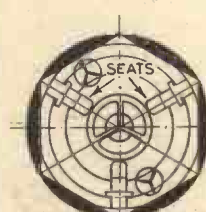


Fig. 6 PLAN OF SEATING

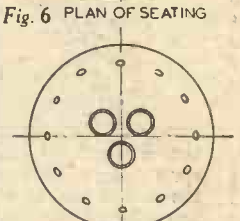


Fig. 7 PLAN OF PORTHOLES

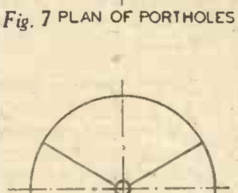


Fig. 8

Figs. 3 and 5 to 8.—A sectional view of the space ship showing the liquid fuel motors, plan of seating, plan of the portholes and the segmented carapace which is discarded after passing out of the earth's atmosphere.

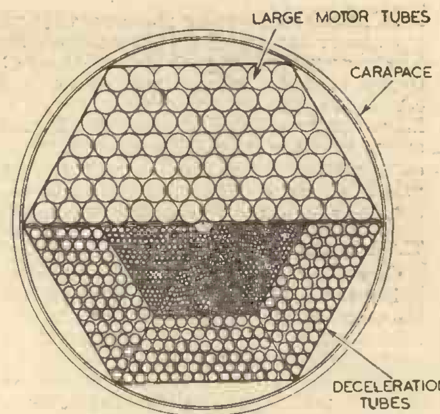


Fig. 2

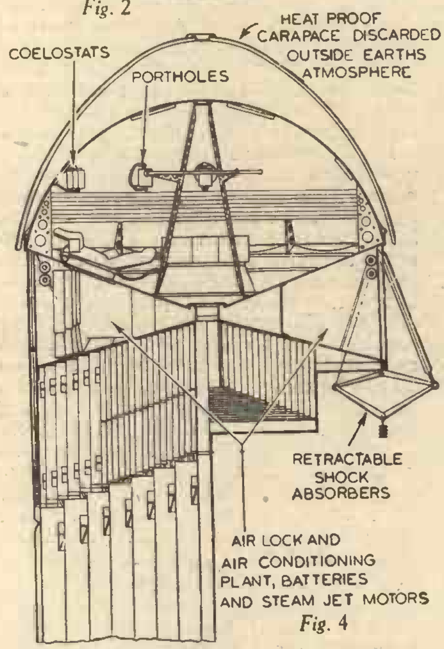


Fig. 4

Figs. 2 and 4.—(Above) Showing the large motor tubes and deceleration tubes. (Below) A sectional view showing the living quarters of the crew, etc.

It is not anticipated that the space-ship can be so accurately manœuvred that its landing will be without shock. Hydraulic shock absorber arms are, therefore, incorporated; one of these being shown attached to the frame on the right-hand side of Fig. 4. These are normally collapsed within the hull, and are extended just prior to landing.

Stability Control

The firing of the motor tubes is carried out by an automatic electrical selector system, but manual control is used for navigational corrections. The ship, being in rotation, is kept thrusting in the correct direction, but this does not prevent "wobble" if firing is not equal on all sides. Manual control of stability is maintained during the first few seconds of ascent, and after that a pendulum contactor automatically controls stability. The main wiring cable to the tubes is led down a central column, provided at each bank level with a plug connection which breaks away when its purpose has been served and is then jettisoned.

The hemispherical front of the life-compartment (Figs. 3 and 4), is of very light nature; this being made possible on account of the protective carapace above. The segmented carapace (Fig. 8) is, of course, discarded after passing out of the earth's atmosphere, and protection of the life-compartment shell is not needed for the ascent from the moon. The return into the earth's atmosphere will be done at low velocities, hence heating of this shell will not be excessive.

The Life Compartment

Owing to the small scale of the diagrams it has not been possible to show many of the fitments and accessories within the life-compartment, but the following can be noted. Fig. 4 shows one of the seats for the crew of three. These can also be seen pointing radially in Fig. 6. The controls for firing are placed on the arms of the chairs, and the chairs themselves move on rails round the life-compartment. The crew recline on these chairs with their heads towards the centre of the ship and a circular catwalk is provided for them round the circumference of the chamber (Figs. 3 and 4).

For observation purposes, ports are provided in the dome of the life-compartment (one shown in Fig. 4 and twelve in Fig. 7). Under the flange of the carapace, in the rim of the floor of the life-compartment are the back-viewing ports; these are covered during thrusting periods. Three forward-viewing ports in the top of the life-compartment shell are also provided (see Figs. 4 and 7). It should be noted that observation of direction cannot be made during the initial thrusting period in ascent from the earth—it being impossible to look backwards through the tail-blast of the ship—the carapace prevents vision in other directions, and in any case the period is too short to allow of stellar observations. Therefore navigation during this period must be done entirely by means of internal instruments, which consist of an altimeter, speedometer and accelerometer.

Essential Instruments

Another essential is, of course, a chronometer, and a gyroscope ensures maintenance of direction. A suspended pendulum provides indication of "wobble" and modified sextants and range-finders are used to determine position. These instruments are placed in convenient juxtaposition to the crew. The cylindrical objects shown just above the catwalk, against the ports (Fig. 4) are coelostats. These are synchronised, motor-driven mirror devices something similar to a stroboscope, and it is by means of these that a stationary view of the heavens is provided for navigational observations while the ship is in rotation. The girder structure in the centre of the life-compartment is a support for the light shell and also serves to carry navigation instruments. In Fig. 1 beneath the carapace and in Fig. 6 can be seen the spidered outer and inner doors respectively of the air-locks shown in Fig. 5.

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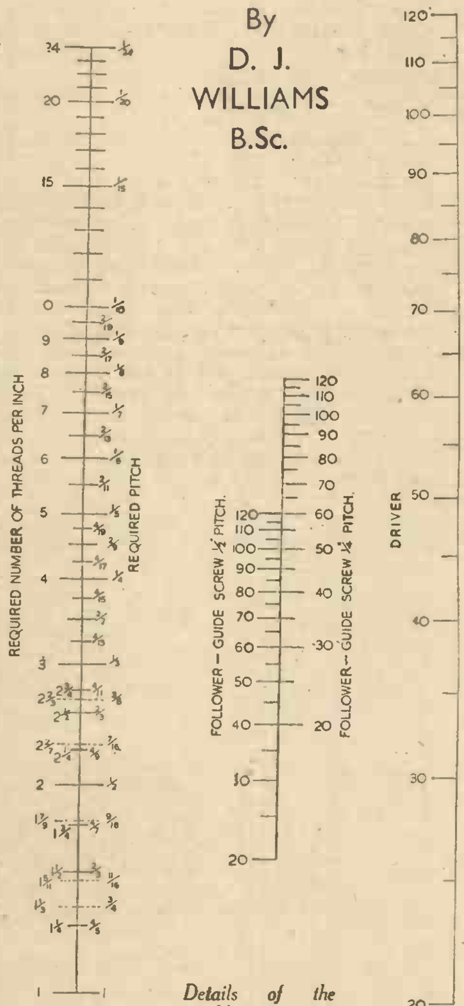
THE USE OF THE NOMOGRAM FOR SCREW CUTTING

By D. J. WILLIAMS B.Sc.



Details of the Nomogram.

THIS Nomogram gives the required combination of change wheels to cut from one to twenty-four threads per inch on lathes having guide screws of ¼-in. or ½-in. pitch. In accordance with the principle of the Nomogram, a straight line drawn across the three scales joins three related points, but, in using this chart, it must be remembered that the portions of the scales lying between the graduations have no meaning. This is because, in the first place, change wheels go up in multiples of five teeth, and in the second place, portions of the "threads per inch" scale, lying between the graduations, represent threads which cannot be cut with a simple train of wheels when the lathe is fitted with a ¼-in. or ½-in. guide screw. The chart is correct, therefore, only when the straight line passes *exactly* through a graduation mark on each of the three scales.

When the thread given by a certain combination is required, a straight edge, or better, a strip of celluloid carrying an inked line, is made to join the appropriate graduations on the "driver" and "follower" scales, when it will cut the third scale at the corresponding graduation which may be read as "threads per inch" or the "pitch."

When it is required to find the combination of wheels which will give a certain pitch, a method of trial and error must be used. The graduation representing the required pitch is joined to that representing a "driver" chosen at random. If the straight edge passes exactly through a graduation representing a "follower," then that combination is the correct one to use. If not a new "driver" should be tried. A little practice makes this process an easy one, especially if it is remembered that, generally speaking, fine threads require small "drivers" and coarse threads big ones.

SCIENCE NOTES

A Clean Sheet

THE cinema screen is, in this country, every week, the cynosure of at least 40,000,000 eyes. That takes into account the usual allowance of two eyes to each patron of the picture theatre. It is, therefore, important that a screen should be used which makes a good impression. The devisor of an improved screen has aimed to produce one which is non-inflammable, non-resonating, and insensitive to moisture. It is suitable for daylight projection or may be tinted to correct the colour impinged on the screen by the illuminant used in projection, and to transform it so as to throw a light similar to that of daylight.

The sheet has, as a base, woven translucent spun glass. Its appearance resembles that of artificial silk. Being composed of spun glass, which does not absorb humidity, the screen can be washed with water, and no further treatment, we are told, is required to keep it at all times in first class condition from the points of view of both light and sound.

Giving Cameras Time

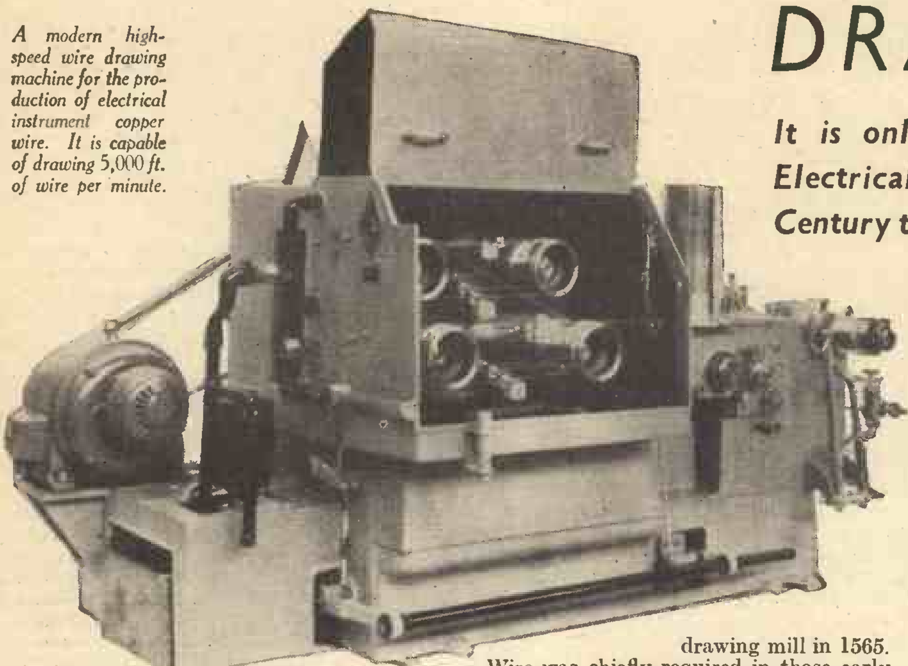
A RECENT development in connection with the camera has for its object the regulation of the rotating disc. I understand that the rotary shutter at present in use gives, in addition to time exposures, only one fixed speed for instantaneous exposures. This, in a poor light, may be inadequate. It is, therefore, desirable to furnish means for increasing the duration of a snapshot exposure. With this end in view, the inventor has devised a camera with a rotary disc shutter having at its edge one or more corrugations. There is also a timing lever to engage the corrugations, so as to reduce the speed of rotation of the disc. And the timing lever is forked to form a jaw, between the teeth of which the disc is loosely held.

Make-up for Pictures

THE colouring of photographs, prints and lantern slides requires an implement which will not scratch. It also needs one which is particularly adapted to deal with a glossy surface. A new non-abrasive colouring pencil has been patented in the United States, and it is claimed for it that it has the necessary qualifications for picture-tinting. There is a stick of fibrous material capable of absorbing moisture. The stick is impregnated with an aniline dye in absorbed condition and soluble in water. This is capable of penetrating the glossy surface of the object to be coloured. Consequently, the stick may be used after the manner of a brush simply by dipping it in water. By means of this fountain pencil, if I may so term it, pictures can be treated somewhat in the style in which the ladies make up their faces.

DYNAMO.

THE WONDERS OF WIRE DRAWING



A modern high-speed wire drawing machine for the production of electrical instrument copper wire. It is capable of drawing 5,000 ft. of wire per minute.

It is only with the Growth of the Electrical Industry during the last Century that Wire-Making has become a Mass Production Business

WIRE has been known and used by mankind from very early ages. Long before the Christian era, wire for jewellery and other ornamental purposes was made by cutting up sheets of the softer metals, such as gold, silver and copper, into narrow strips and by beating out these strips into long threads which were subsequently rounded by further hammering treatment.

So far, however, as we can ascertain, the first people who actually commercialised the making of wire for utilitarian purposes were the Vikings of Norway who, it will be remembered, invaded our country in the eighth century A.D.

The Vikings seem to have hit upon the fundamental method by means of which even present-day wire is manufactured, namely, that of drawing thin rods of the metal through small holes or "dies" in hard iron or other material, the diameter of the metal rods being successively reduced after a series of these treatments until a fairly thin flexible wire is obtained.

England's First Mill

The first to manufacture wire in this country were some Continental artisans who came over to England for that purpose in the days of Queen Elizabeth and who, it would seem, erected the first English wire-drawing mill in 1565.

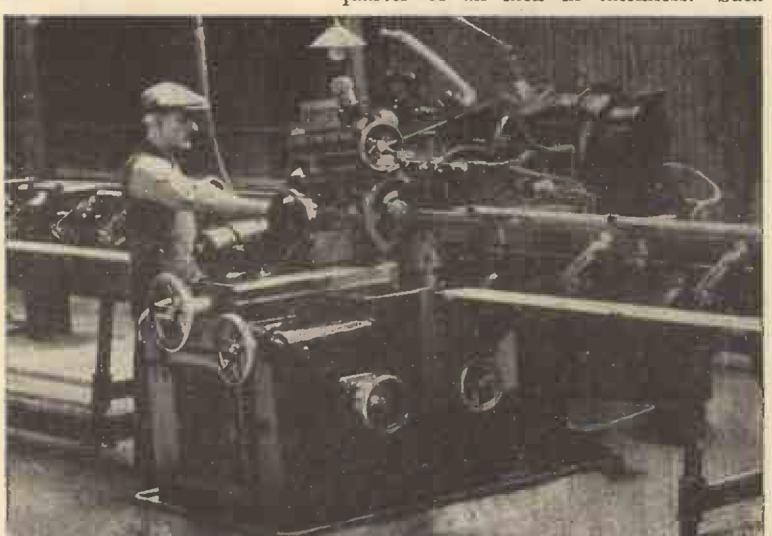
Wire was chiefly required in those early days for use in the woollen trades and, also, to a smaller extent in the cotton trades. It is only, indeed, since the growth of the electrical industry during the last century that wire-making has become in any way a mass-scale business, for, previous to this, all types of wire were but slowly and laboriously brought into being by the very crudest of methods.

The fundamental basis of wire production is, as previously mentioned, extremely simple in principle. Thin metal rods are merely drawn through "dies" or annular openings in blocks of hard metal, whereupon the diameter of the rod is decreased, the rod being pulled out into the form of wire.

A diagram of a modern "die" for the production of copper wire is illustrated. It consists merely of a tapering hole in a block of metal, the angle of taper being between 11 and 16 degrees. Thick wire or thin rod when mechanically pulled through this die is reduced in diameter, the reduction in cross-sectional area being, in practice, of the order of thirty per cent.

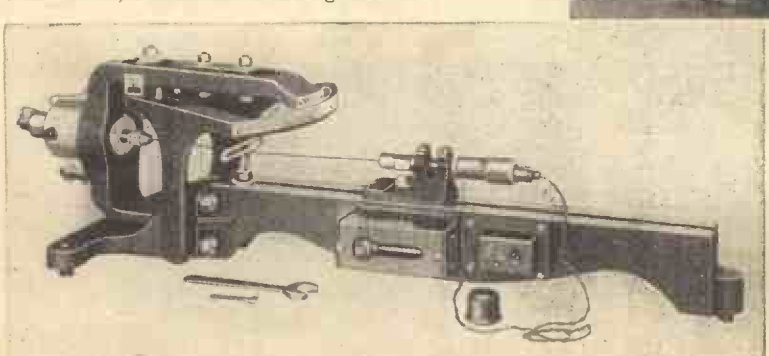
Wire-Drawing Factories

Most of the wire-drawing factories obtain their raw material from the smelters in the form of coils of metal rod, each coil being about 30 feet in length and about a quarter of an inch in thickness. Such material is immersed in a bath of strong acid to remove surface scale, after which it is passed into neutralising baths and finally washed and dried. Subsequently the coils are electrically welded together into continuous lengths.

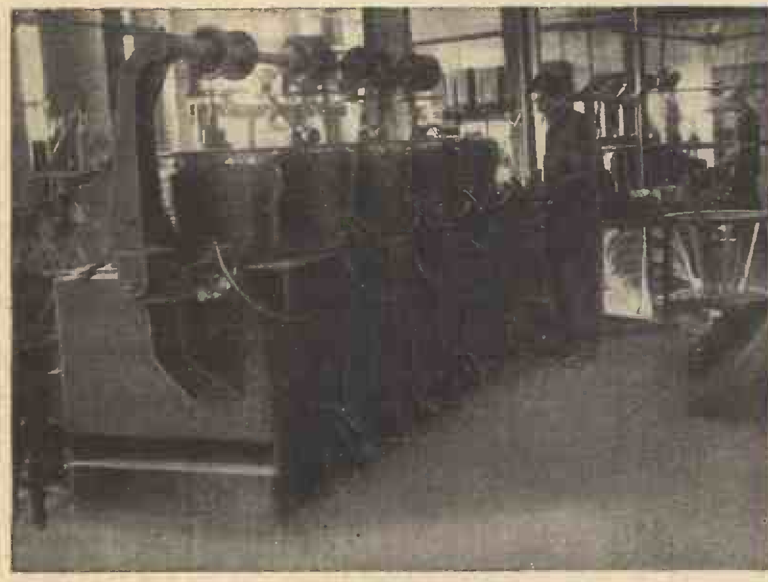


A centreless grinding machine for giving a finish on wire or rod and sizing it.

The metal rod is now ready for the drawing process. To this end, it is fed into a machine containing six or more dies, each die being of smaller diameter than the preceding one. By a simple arrangement of pulleys and dies (see sketch), the metal rod is step by step drawn out into thin wire, the wire emerging from the mechanical drawing machine being automatically wound on drums. Such wire, if it has not



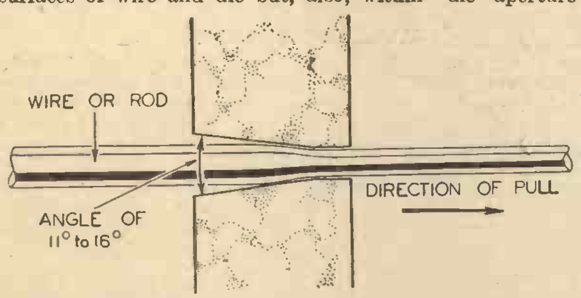
A fatigue testing machine for wire.

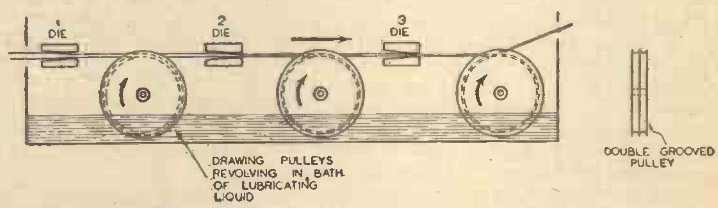


A wire-drawing bench.

been reduced to the required diameter, is then fed into another drawing machine containing dies of smaller sizes, and it may even be made to undergo a third drawing-out process before its required diameter or cross-sectional area is reached.

When a metal rod or wire is drawn through a die, a tremendous amount of heat is generated owing to the enormous amount of friction set up not only at the contacting surfaces of wire and die but, also, within the wire itself. If this unwanted heat were not immediately and continuously removed, the die would quickly heat up beyond red heat, thereby deforming itself and melting the wire.





(Left) A cross-sectional diagram of a wire-drawing die. (Above) Diagrammatic view of a wire-drawing machine, showing the manner in which wire is drawn through a series of dies of successively decreasing diameter.

Lubrication

A wire-drawing machine, therefore, needs continuous lubrication when it is in action. Until recent times this lubrication was commonly obtained by running the pulleys over which the wire passed in a bath of warm tallow, soapy water and stale beer. Lubricants similar to this are, indeed, still employed, but in the latest models of high-speed wire-drawing machines, a synthetic lubricant is employed and this is forced under pressure into the dies so that each die is continuously swilled all over its bearing surface with the lubricating fluid.

In the olden days, dies of hard iron were employed for wire drawing. Nowadays, of course, much superior materials are used for die-making. Among these may be mentioned alloy-steel, and, in particular, tungsten carbide, a steel-like material which is characterised by an extreme degree of hardness and toughness. These tungsten carbide dies have been found very satisfactory in the modern high-speed machines which are in operation for many hours each day, since the day-by-day wear on them under such "forced" conditions is extremely small.

For the drawing of wire of less than ⅛ inch diameter, dies consisting of rubies or even of diamonds are widely used. Such jewel dies are highly efficient in action, and, particularly in the case of diamond dies, they may be used for very lengthy periods without apparent wear or deformation setting in.

Nevertheless, all dies used for wire-drawing eventually show signs of wear. Usually, this wear takes the form of the die aperture becoming oval instead of perfectly round. When such wear becomes manifest, the die is removed from its holder and is put on a lapidary's lathe, where its aperture is lapped out or enlarged to the next larger size of die aperture by means of a steel rod charged with carborundum powder and continually kept moist with turpentine. In this way, a diamond, ruby, or a metal wire-drawing die, beginning its working life with an aperture of the smallest size, has its aperture successively increased until, finally, it is given the largest-size aperture. After this, when the die shows signs of serious wear, it is finally rejected.

Modern wire-drawing machines frequently contain a dozen or more dies of successively decreasing aperture sizes, and so efficient are they under actual working conditions that average wire speeds of between 3,500 and 6,000 feet per minute are attained.

Actually, the wire does not pass through the drawing machine at one constant speed. During the first stages of drawing, when the wire or rod is relatively thick, the drawing speed is comparatively slow. As the wire is thinned out in diameter, however, a higher drawing speed becomes permissible, whilst in the case of very thin wires, drawing speeds of nearly 8,000 feet of wire per minute have been attained.

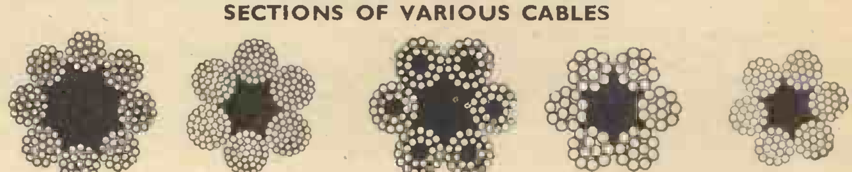
Not all varieties of wire can be drawn at the same constant speed. Copper, which is a ductile metal, can be drawn at maximum speeds. So, too, can aluminium and some of its alloys. Iron and steel wires, however, cannot be so treated. For them a slower drawing speed must be employed, whilst for the "springy," hard-resistance wires of nickel-silver and similar alloys, only a relatively low rate of drawing is permissible.

World's Finest Wire

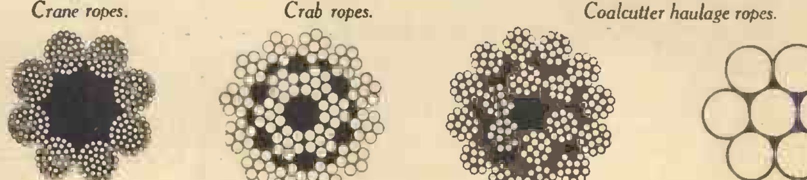
By using composite wires, it is possible to produce wire filaments of exceedingly small diameter. Perhaps the finest wire which has ever been drawn was a length of pure platinum wire which measured only 1/30,000th of an inch in diameter. This wire, which was many thousand times smaller than a human hair and, of course, quite invisible to the human eye, was made by encasing a platinum wire within a silver wire, the latter being ten times the diameter of the former. By careful drawing, the composite wire was pulled out to a diameter of 1/3,000th inch, after which a length of it was immersed in nitric acid. The acid dissolved away the silver, leaving the inner core of platinum intact. In this manner the world's finest wire was obtained.

Very thick wires are frequently produced by hot rolling rather than by drawing. For this purpose, "wire bars" consisting of about 4-inch square-section metal are heated to redness and then passed through a series of grooved rolls, whereupon metal "wire" or rod of from ¼ to ⅝ inch diameter is produced. Particularly in the case of hard alloys is this method of producing thick wire employed.

SECTIONS OF VARIOUS CABLES



Crane ropes. *Crab ropes.* *Coalcutter haulage ropes.*



Crane ropes. *Kilindo ropes.* *Seven rods.*

The Noiseless Typewriter

HOW IT WORKS SERIES

Whilst Most Typewriters Print by Hammering The Type Against The Paper, Pressure Printing Is The Secret Of The Noiseless Machine

A modern noiseless typewriter.

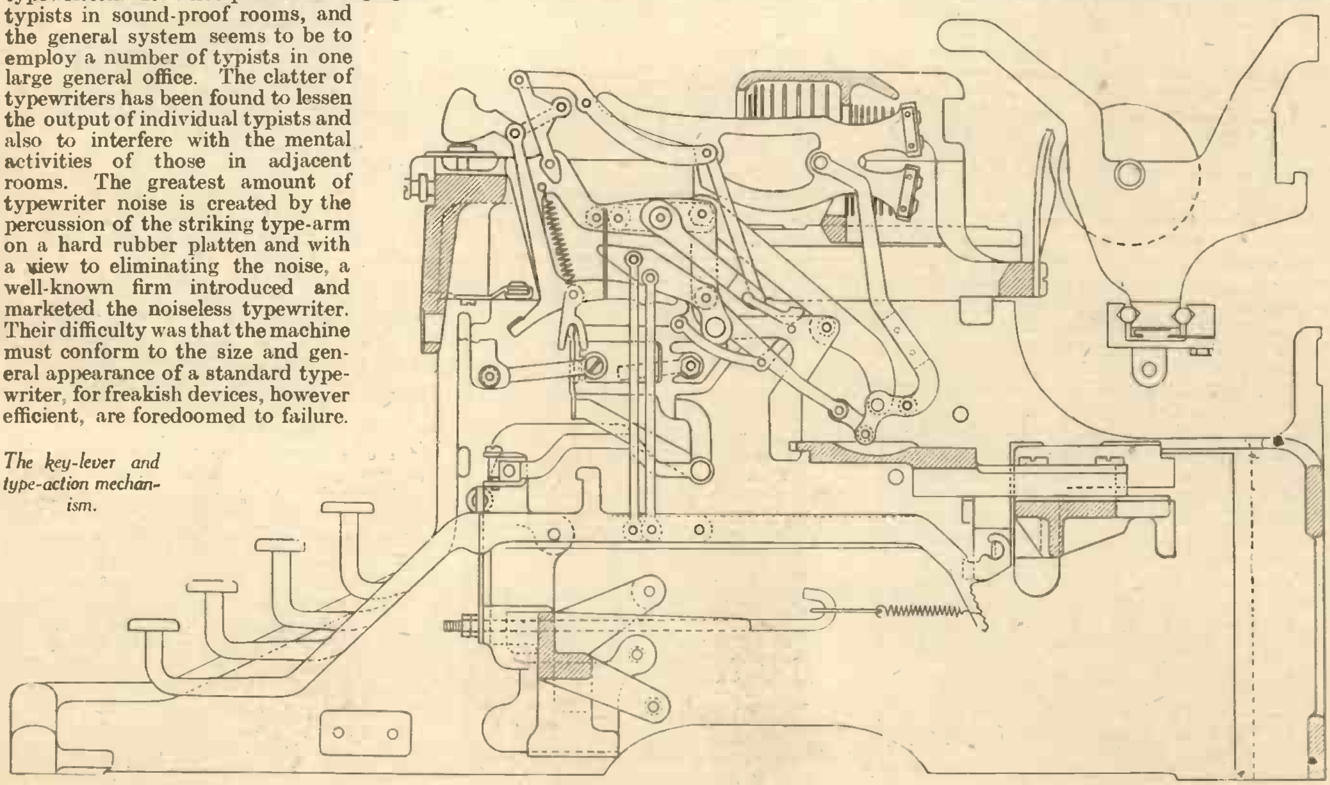
THERE is a vast amount of medical opinion to support the argument that noise, no matter whether intermittent or rhythmic, not only has a negative effect on the efficiency of employees, but also a negative effect on health. The distraction of noise destroys the ability to concentrate, and a vast amount of experiment has been conducted to reduce noise. Car manufacturers, for example, are continuously experimenting to reduce the noise of gears, tappets, transmission, and exhaust, whilst a fortune awaits the man who can invent a reasonably silent aeroplane.

Its Use In Offices

It is particularly necessary that office workers such as managers, journalists, draughtsmen, and clerks, whose work is mental rather than manual, should be able to operate in a reasonably silent atmosphere. In all large works there must essentially be a large number of documents which need to be typed, and a large number of letters which need to be dictated and typewritten. It is not possible to segregate typists in sound-proof rooms, and the general system seems to be to employ a number of typists in one large general office. The clatter of typewriters has been found to lessen the output of individual typists and also to interfere with the mental activities of those in adjacent rooms. The greatest amount of typewriter noise is created by the percussion of the striking type-arm on a hard rubber platten and with a view to eliminating the noise, a well-known firm introduced and marketed the noiseless typewriter. Their difficulty was that the machine must conform to the size and general appearance of a standard typewriter, for freakish devices, however efficient, are foredoomed to failure.

Importance of Accuracy

Noise can be due not only to percussion but also to inaccurate moving parts not made to sufficiently close limits of accuracy. It can also be due to wear. So the designers of the noiseless typewriter tackled the problem from the point of view of manufacturing the parts which go to make their typewriter to very close limits of accuracy and to select materials which were not subject to rapid wear. They added to this special mechanism which enables the impression of the type to be made on the paper without consider-



The key-lever and type-action mechanism.

able percussion, for, of course, the typewriter can never be really noiseless.

It is, however, practically so, for four of them working together make even less noise than one typewriter of orthodox type.

High Standard of Workmanship

To be noiseless the typewriter must be frictionless and only engineers and tool makers who understand microscopic precision can be employed. As each part is made it is placed under a powerful microscope which enlarges it from 12½ to 50 times its actual size, and in this way any faults are instantly detected.

Many of the tests of finished parts are made by what are called "indicator gauges" which positively show by means of a sensitive revolving indicator hand or pointer on a graduated dial any variance of a finished part to within four-tenths of a thousandth of an inch. These tests, which are so vital to the quiet performance of the assembled machine, are not made merely at intervals in a run of work to see that parts are coming through according to specifications but they are applied to each part after each operation. This is called 100 per cent. testing.

All materials are tested in a special machine before they are put into use. This testing machine automatically, under a pressure equal to 150 kilograms (about 330 lbs.) forces a penetrator with a diamond point into the surface of the metal to be tested. When the diamond point slowly penetrates to a certain depth (not enough to mar the metal) the pressure automatically ceases, and a dial on the machine registers the exact degree of hardness. If the reading is above or below the standards required for different materials, the raw stock is rejected. This testing machine is also employed for testing the hardness of rubber used for covering the cylinders and feed rolls.

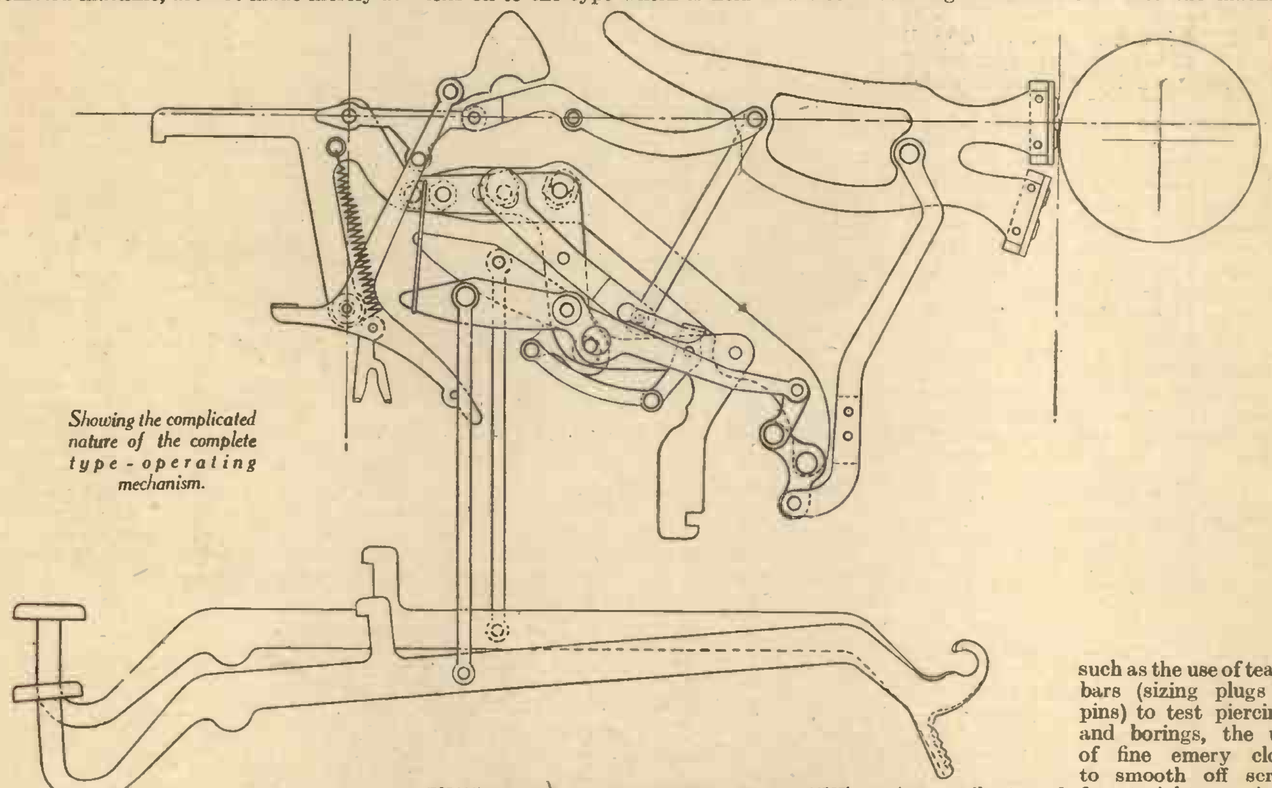
Type Action Hangers

Each hanger is made to fit into milled slots cut into a cast-iron plate—one front (which supports the type action) and one back (through which the type bar is guided when printing). These slots are cut at a radius from a common centre, which centre is the printing point. Here an indicator gauge registers zero and proves the depth to be correct. The other test to see if the front and back slots are in perfect line and of proper width is made with a flush pin gauge.

A minute plus sign is embossed on to every type piece when the characters are rolled. This plus sign, which can be seen with the naked eye, is the true centre from which all microscopic measurements are taken. When the piece is located and held in the vice it is placed in a milling machine. This machine automatically cuts the type piece to proper angles. While this is being done another piece is located in another vice, and the operation repeated. When the type bars are finished they are inspected through a projectoscope. Through an opening in a tin shield a powerful electric light is thrown through a miscroscopic lens on to the type which is held in a vice. On a screen inside the projectoscope is projected or reflected, to ten times its actual size, a picture of the type. The operator, looking through a lens, sees a large plus sign, which is marked in the lens. If the type is in exact position, the plus sign embossed on the type piece will be in perfect agreement, and will prove the side and up-and-down alignment or position of the type.

There must be no chance of type being wedged or squeezed out of position by riveting machines. The edges of the type piece must be tight and true against the type bar, otherwise the type would not print squarely on the paper. The printed letter would be light or heavy at the top or bottom or at one side or the other. This fault could not be corrected in a finished machine, for these type bars cannot be bent into correct positions.

Many other neat and precise necessary things are done with special instruments in building "noiselessness" into the machine, such as the use of teazel bars (sizing plugs or pins) to test piercings and borings, the use of fine emery cloth to smooth off screw points, rails tested for straightness, indicator gauge test of escapement wheel teeth and paper feed rolls tested for concentricity or roundness to within one-thousandth of an inch.



Showing the complicated nature of the complete type-operating mechanism.

In Operation

The machine, except for being noiseless, differs very little from other machines. It has the customary four rows of keys and every other approved operating feature. With pressure printing, a Pressure Indicator is used to maintain the same degree of pressure in all classes of work, such as manifolding, stencil cutting, card work, addressing thick envelopes, etc. The use of the Pressure Indicator tends to correct uneveness in the touch of the operator and ensures sharp and uniform impressions. Its use also prevents pounding the keys to make carbon copies. The effort to make many copies is no greater than the effort to make one copy.

Other features with this type of machine are permanency of alignment, light or dark printing can be done with the same ribbon, and the type is non-filling.

WIND MOTORS

By V. E. Johnson, M.A.

Aiding the Growth of Plants by Electricity

The windmill for driving the Wimshurst machine.

NO one will, I think, deny that the food question is one of the most vital questions of the hour, and anything that will increase the output over a given area is worth careful consideration and study.

Therefore, experiments have shown that it is possible to assist the growth of plants and crops by means of electricity. Man's attention appears to have been led towards it by travellers in the Arctic, some of whom were profoundly struck by the rapid growth of vegetable life during the summer months. One, Lemstroem by name, was led to the conclusion that this growth was greatly assisted by the electrical currents which are especially strong there during the summer months. He afterwards carried out many experiments, using Wimshurts machines as his source of current, and proved beyond dispute that the growth of many plants is helped by such high-tension currents in the nature of point discharges. All that is necessary is a highly insulated wire, fitted at intervals of about fifty centimetres with a number of discharge points projecting downwards. If a series of wires are used, they should be placed about a yard apart, and the distance of the discharging points from the plants should be about fifteen inches. This apparatus should not be used, or, at any rate, is not as satisfactory if used in very dry weather. In wet weather, unless the wires be protected from the rain, the leakage will exceed the charge and there will be no discharge. Also in very dry weather the discharge may be injurious to the plants. The best time for treating is probably the early morning and evening. It has been found especially beneficial during fogs and foggy weather.

We are not concerned here with any attempt to experiment on a large scale, and a Wimshurt machine, with two glass plates 18 in. in diameter, preferably in a glass case, containing an air-drying material—unslaked lime is about the best—is quite suitable for the purpose, and since it generates high-tension electricity, no matter how irregularly it be driven, it can be driven successfully by a windmill running on ball bearings, as little power is required to drive it and even the rough type of windmill shown in the illustration will suffice.

The thicker the wire used, the less the leakage, but wire as small as 20 gauge has been used successfully. All points and roughness, save the bunch (four to six is enough) of discharge points, must be carefully avoided and the wire should be insulated on glass, ebonite, or bakelite rods (not shellac varnish) not less than 6 in. long.

Set the neutralised rods at a large angle, but do not place the collecting combs exactly opposite each other. Place at least five bunches in a row on each neutralising rod, as you require quality, not spark length. Each glass plate should contain 32 sectors.

The glass plates can be mounted successfully without drilling holes in them, in the following manner :

Cut out your 18-in. glass disc, find the centre—I assume glass to be uniform—cut out a disc of stout brown paper 2½ in. in diameter and stick it centrally on the disc. Place the glass on a flat surface and place a heavy weight on the paper disc. Leave at least 24 hours, then stick your wooden boss, already turned and pulley-grooved, on to the paper disc, and again place on a heavy weight and leave for 48 hours. Do the same with the other disc. If carefully done, I can guarantee success and I cannot remember that I have ever had a disc crack.

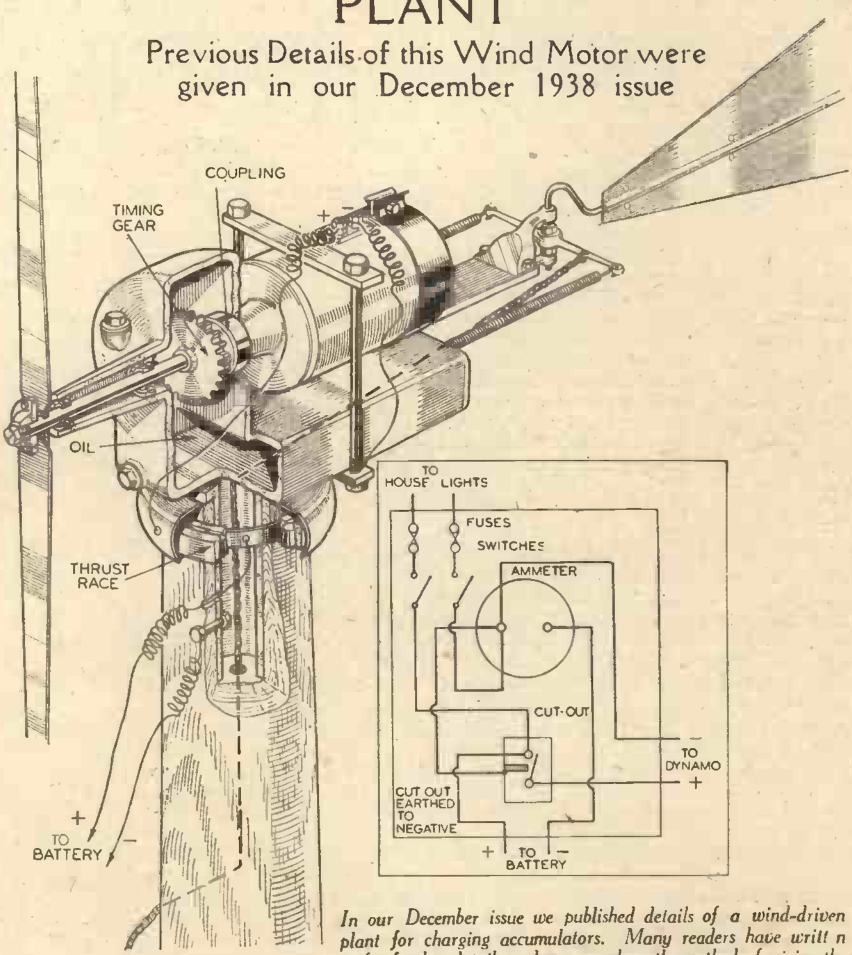
The Electrified Watering Can

This method of assisting the growth of your garden or greenhouse plants, especially the latter, will probably appeal to many gardeners. Everyone knows how plants grow after a thunderstorm, because the drops of water are more or less electrified, but, unfortunately, glass-covered plants do not benefit from these showers. Well, let us have our own thunderstorms and electrified water drops. All that we have to do is to fit an insulating handle on to our watering can, connect the metal part of the can to the Wimshurt machine, and water the plants. Note that the negative pole of the electrical machine should be earthed.

Do not overdo the watering, an hour or two is best to begin with. Under electrical treatment, cucumbers have shown a 17 per cent. increase, strawberries 15 per cent., celery 2 per cent., but tomatoes very little.

A WIND-DRIVEN LIGHTING PLANT

Previous Details of this Wind Motor were given in our December 1938 issue



In our December issue we published details of a wind-driven plant for charging accumulators. Many readers have written in for further details and we now show the method of wiring the device, together with the wiring plan.

The new French electric train prior to departure from Paris recently on her non-stop trial run to Bordeaux.

THE MONTH IN SCIENCE AND

New Use for Wireless Waves

THE Royal Westminster Ophthalmic Hospital, High Holborn, have recently installed a specially designed short-wave generator for use in the treatment of eye diseases. Extensive experiments have proved that ultra-short wireless waves have a beneficial effect on inflamed and ulcerated eyes.

Pain is relieved in this way, and with the gradual disappearance of the symptoms, the eyes are strengthened against recurrence of the disease. The hospital generator is tuned to six metres, which is just above the television band, and, therefore, it does not interfere with television programmes relayed from Alexandra Palace. The patient lies on a couch with a large electrode under the pillow and a small electrode on each eye. The robot hands of the apparatus hold the small electrodes in place, pressing gently on cotton wool pads on the eyes. Short waves then pass in a constant stream through the eyes for from 10 to 15 minutes at each sitting. The only sensation felt by the patient is one of slight warmth in the eyeballs and sometimes at the back of the neck.

New Pursuit Plane

NEW factories are being built at Toulouse for large-scale production of a new type of French plane. The machine which is an army pursuit plane was recently tested out at Sarangezal aerodrome. It is capable of a speed of 344 m.p.h., is easily manoeuvred and has unusual climbing ability.

A Rare Star

A VERY rare type of star, known as a super nova, has recently been discovered by Dr. Zwicky of California. This star suddenly blazes up and gives out in a few weeks as much heat and light as the sun does in a million years.

Actually, the star is so far away that it can only be seen with the aid of a powerful telescope, although in reality it is many million times brighter than the sun. It is so far away, in fact, that the immense explosion which is now being witnessed must have occurred 6,000,000 years ago.

It is estimated that super novae occur at the rate of only one in a thousand years in each stellar system, and when they do they originate in stars of average brightness. For some unknown reason the star suddenly explodes and flares up to its maximum brightness, and many months elapse before its light subsides.

Killing Microbes

MR. DE FONBRUNE, assistant to the director of The Pasteur Institute, Dr. Comondon, has invented an apparatus for the purpose of dissecting and killing microbes. The apparatus which is based on microscopic principles, has very fine "feelers" which serve for moving and dividing microbes. These feelers are made with the use of a micro-forgé employing a very small platinum wire heated by electricity. It allows the forging of metal feelers of 1,000th of a millimetre diameter.

"An 'Eye' to Business"

AN 82-in. mirror has just been completed for the reflector telescope of the new Mcdonald Observatory in West Texas. Optical specialists have been grinding and polishing the huge "eye" during the past four years, until, finally, it acquired a parabolic surface with a deviation of less than one-twentieth of a light-wave, or approximately one-millionth of an inch.

The mirror which is 12 ins. thick and weighs three tons, is made of pyrex glass, and is the second largest telescope "eye" in the world.

World's Largest Peal

THE first of thirteen bells for the Liverpool Anglican Cathedral has just been cast at a Whitechapel foundry. It is the "tenor" bell, and is the largest of this type in existence.

It is hoped to complete the rest of the bells during the next six months, after which they will be taken to Liverpool by road. The peal will cost £4,000 and will be the biggest peal in the world.

600 Miles an Hour

IT is reported that a Curtis Hawk 75 pursuit aeroplane, one of a number now under construction for the French Government, reached a diving speed in excess of 575 m.p.h. during tests at Buffalo, New York State. The plane exceeded the range of the speed indicator during the dive, and it is thought that the machine may have reached a speed of more than 600 m.p.h. After the flight the pilot said he suffered no ill effects.

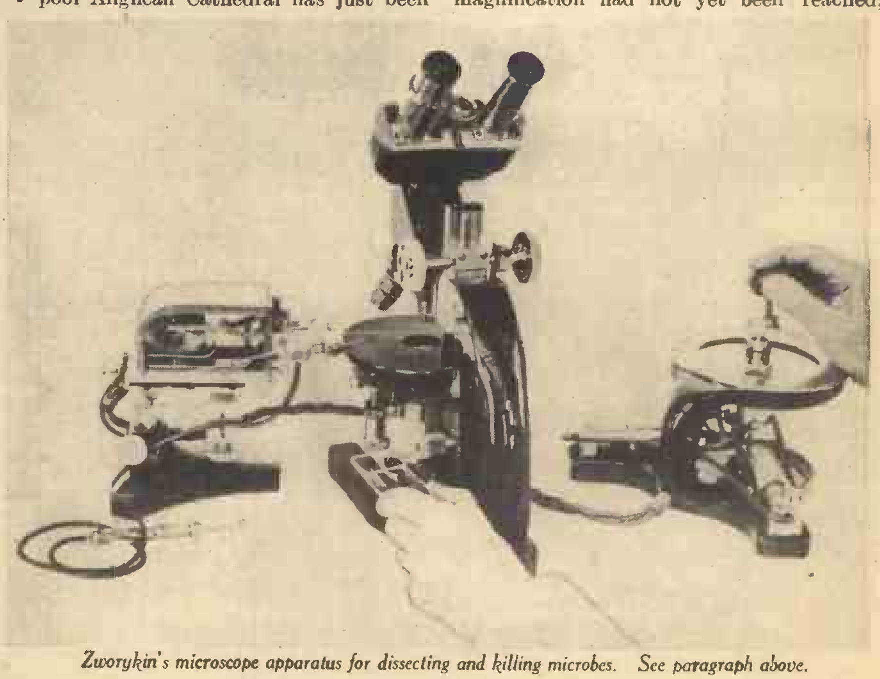
An Ultra-Microscope

DR. VLADIMIR ZWORYKIN, the well-known research worker in the field of electronics and television, recently demonstrated at Richmond, Virginia, a new ultra-microscope which magnifies up to a million times.

The audience were amazed to see an atom represented as a brilliant circular area of light about an inch in diameter, molecules of gas hurling themselves against the side of the vessel containing them and giant pictures of globular bacteria in a minuteness of detail never before achieved.

Instead of light the new instrument uses electrons, in place of the optical lens is a powerful magnetic field and a fluorescent screen plays the role of eyepieces. This enables a large number of people to see the images at the same time instead of having to use separate eyepieces.

Dr. Zworykin said that the limit of magnification had not yet been reached,



Zworykin's microscope apparatus for dissecting and killing microbes. See paragraph above.

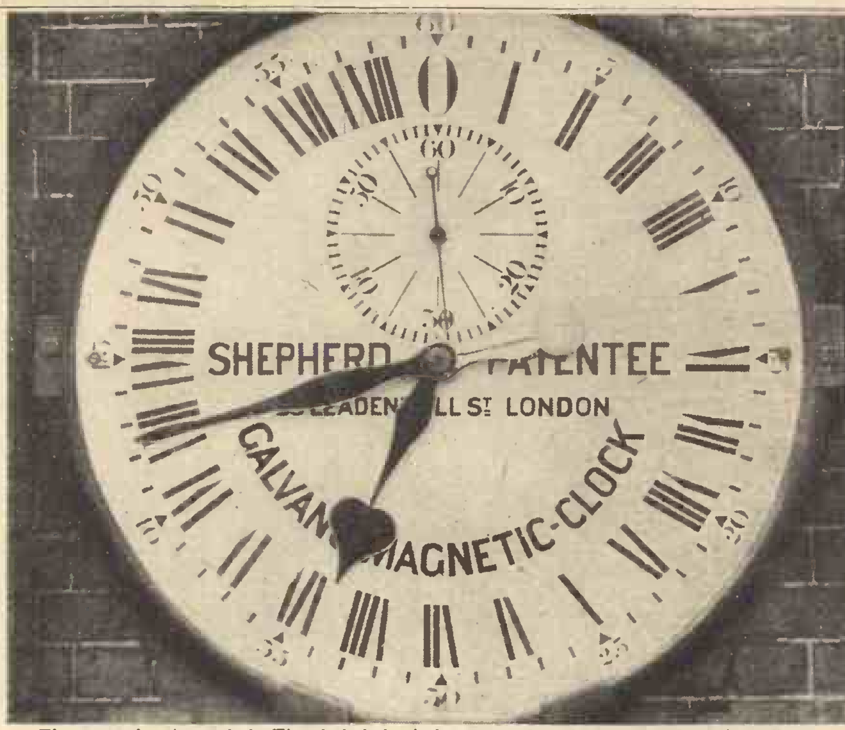
THE WORLD OF INVENTION

and said that in time it might be possible to present to the human eye the actual spectacle of a germ emitting poison into the body, causing disease.

Seeing is Believing

ALTHOUGH the Japanese typewriter was invented about 25 years ago and thousands of them are now in use throughout the island empire, the western world (or the greater part of it) has not the foggiest idea of what the machine looks like, or how it operates. An illustration of the typewriter is shown on this page, and briefly, it is worked in the following manner. The knob shown in the centre is manœuvred until the indicator to the left of it is above the character on the chart below which you wish to type. When you have picked out the character, you press down on the black knob at the left on the front of the machine. A mechanical finger then picks up the type character and makes its imprint on the paper, which, incidentally, is on an endless roll.

It is very simple, but slow, and when you realise that there are 2,500 characters (shown in close-up at the top of the illustration) you can understand the slowness. A good typist can type out 30 characters a minute.



The twenty-four hours clock. This clock dial, which is mounted on the exterior side of the wall near the main entrance to the Observatory, is electrically connected with the Mean Time Clock. It indicates the time which has elapsed since the previous midnight. The photograph shows the clock indicating 13 hours 42 minutes 29 seconds, i.e. nearly 17 minutes to 2 p.m.

An Electric Locomotive

A NEW 3,900 h.p. electric locomotive, built at a cost of 5 million francs and weighing 122 tons, recently had a trial run on the Paris-Hendaye electrified line.

On her non-stop run from Paris to Bordeaux, on which she hauled a full complement of coaches, the new train easily attained a speed of 130 kilometres an hour. At times a speed of 170 kilometres was reached.

"Black" Light

THE Hawaiian number in George Black's current Palladium show, *These Foolish Things*, offers a most interesting example of unusual stage lighting.

The scene opens on a Hawaiian beach in brilliant sunshine. Then while the scene is in progress the normal lighting is blacked out and the whole of the scenery and everybody on the stage appears out of the darkness in brilliant glowing fluorescent colours.

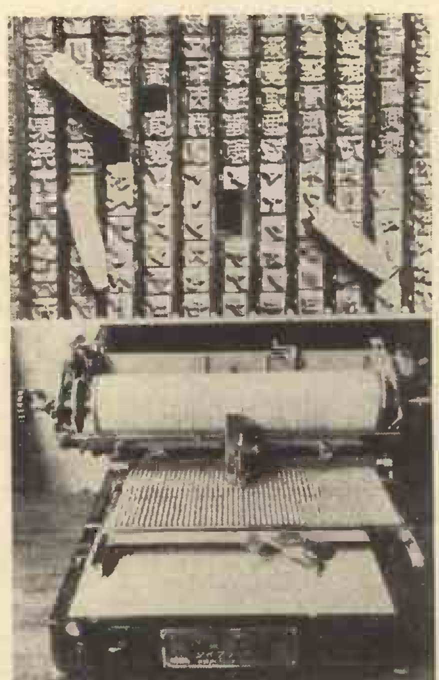
The scene shows what can be achieved by ultra-violet lighting when in the hands of a skilled producer. The normal stage lighting has been augmented by a number of black bulb mercury lamps in a special mounting devised by the Palladium electricians so that they can be brought into action easily and quickly. Six special carbon arcs fitted with special screens are used for spotlighting.

'Greenwich Mean Time'

GREENWICH OBSERVATORY, built on a hill in Greenwich Park, was founded by Charles II in 1675, and was designed by Christopher Wren. Of the 36 astronomical observatories in the British Empire, the Royal Observatory, Greenwich, is by far the most important.

Equipped with a number of the world's most powerful telescopes and clockworks of absolute accuracy, the upkeep of the Royal Observatory costs Britain £20,000 a year. The Astronomer-Royal—who is a Government official—resides and works at Greenwich and has a big staff, engaged year in, year out, in measuring and observing the Universe. Little can happen in the Universe Greenwich would not know about.

With our own planet still very far from being as well-ordered as one could wish, the Royal Observatory at Greenwich keeps a close check on all the other stars of the Universe. As far as can be ascertained, they tell us, everything is running to schedule there.



Have you ever seen a typewriter like this? (See para. on this page "Seeing is Believing.")

All-Purpose Electric Tool

IN recent years the electric tool with its flexible shaft has become very popular both in industrial concerns and in artisans' workshops, the reason being that it is easy to handle, can be put to many uses and will carry out work which cannot be done by fixed machines. All the same, until now the shaft's rate of revolution could only be varied to a slight degree, so that several different tools had to be used for the various processes of milling, filing, polishing and grinding, etc.

A firm which specialises in these goods is bringing out a new all-purpose electric tool. The number of revolutions of its flexible shaft can be varied from 800 to 10,000, and even to 50,000 if additional parts are used. This property enables one machine to carry out all the processes mentioned above. It is, therefore, specially useful for small concerns, and highly suitable for artisans' work. Three models of this all-purpose electric tool, equipped with motors of ¼ to ¾ h.p., are being put on the market. For all the processes that can be carried out with it the manufacturers have evolved special attachable parts, such as files, milling cutters, grinding tools, brushes, polishing pads, etc.—in all 200 different tools.

The Luton Minor Light Aeroplane

The finished Luton Minor built by Mr. J. E. Corine from our articles.

Mr. J. E. Corine, a "Practical Mechanics" Reader, Built the Luton Minor Light Plane in 5 Months From Our Articles, and Then Taught Himself to Fly After Four Hours' Dual Instruction

HAVING obtained the complete set of drawings and the description which appeared in this journal, I studied them very carefully. I realised the soundness of the design and the simplicity of construction, and accordingly ordered the complete set of materials from the makers. My only tools were a few wood chisels, hand brace, a few files, one small plane, a spirit level, a cold chisel, several cramps, and two saws, all of which can be obtained very cheaply.

Building the Minor

The fuselage was tackled first and completed without any trouble, very careful attention, of course, having been paid to detail so that when finished the nose of the fuselage was correctly aligned with the tail. Useful information and suggestions appeared in the articles in "Practical Mechanics" dealing with this component, as also were all other parts completely described in detail. If there was doubt at any point, I merely had to write to the makers explaining my difficulty to receive their practical advice by return of post. This service I found of very considerable help.

The tail unit, consisting of rudder, tail plane, and elevator, was dealt with next, again without any trouble, and then followed the main wing. All ribs were, of course, made in a jig. Being limited for space, I took the makers' advice and constructed the wing in two parts. This later improvement greatly simplifies construction without any sacrifice of strength and also solves the housing difficulty, as it takes only about fifteen minutes to dismantle and assemble for flight, there being no tiresome cables, etc., to be adjusted, with the exception of the aileron control. I strongly recommend this modification to all intending constructors.

All metal parts were first made in scrap tin, carefully marked and drilled on the job (if possible) to eliminate the possibility of holes being out of centre, or line, especially so in the longerons and diagonals. Petrol and oil tanks are of simple construction. The welding of the undercarriage is best carried out on the job and should be done by an experienced worker. Strict attention should be paid to avoidance of overtensioning of the piano-wire bracing in the main wing.

Assembling and setting the wing, tail plane, elevator, and rudder (before covering) is a simple matter, the control cables being inserted during this period. The whole machine was built completely from the set of materials in the spare time of five months, and has since been inspected and pronounced airworthy by the airport chief ground engineer.

Successful Flight Trials

It was, indeed, a great day, as with mixed feelings of excitement and expectation, the machine was transported to the local airport. My friend, Mr. F. Dodd, who is an experienced pilot, promised to test the Minor for me. Everything was assembled in a very short time, a final examination was made, "Contact" shouted, and the engine (Luton Anzani, with impulse starter and dual ignition) fired the first time. After running-up for several minutes, a few short hops were carried out by Mr. Dodd, who then made a slight adjustment to the tail plane. The triumph was complete when we saw him circle the airport several times and make a perfect landing, reporting that everything worked splendidly. He has since completed over six hours' actual flying, subjecting the machine to very severe manoeuvres—certainly all that the amateur pilot will wish to perform. The Minor came through with flying colours.

A thorough examination of all parts was made after each flight and revealed that everything had stood up to the test, which was admitted by the Press and disinterested persons, including air-line pilots, to be very severe.

Learning to Fly

I now had complete confidence in the machine, and it was up to me to learn to fly as soon as possible. After obtaining four hours' dual instruction, so that I would know what to expect when on my own, Mr. Dodd started me off with taxying practice until I was able to maintain a straight course and felt quite at home in the machine. I then tried fast taxying with the tail up until this also became familiar. It was not possible to complete this part of the training in one day, and this enabled me to study my mistakes between the practice lessons.

My first time off the ground was very exciting. I climbed to a height of a few feet only and continued at this height to a pre-arranged mark in the airport, closed the throttle, and let the machine return to the ground, perhaps a little bumpy, but nevertheless on an even keel. After several similar short flights, we "called it a day." On the next occasion I was sent higher, but this time the machine had to be brought down by the use of controls. On these higher flights I was instructed to move the stick gently sideways, up and down, to familiarise myself with the movement of the controls. This I did and was surprised at the little movement necessary to bank, or turn.

Several days of straight flights were gone through before I felt confident to do a complete circuit, but in the end this was accomplished without any difficulty, although I was naturally a little excited.

It is my honest opinion that this is the machine that the enthusiastic amateur has been waiting for, as building costs can be kept low and any part that is considered difficult to make can be supplied by the manufacturers at very reasonable cost, or sets of manufactured parts can be obtained from the makers.

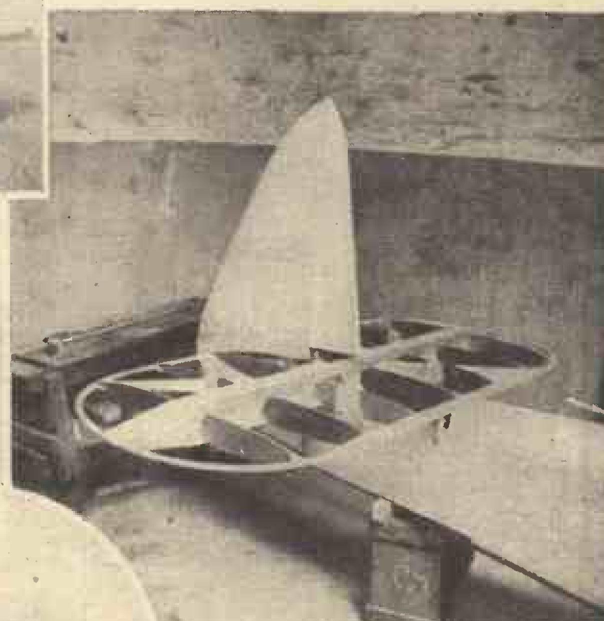
I may state that I am more than delighted with the Minor. My flying time now runs into several hours in all kinds of weather and very high winds. It is delightful and easy to handle. The stalling speed is low, apparently between 35 and 40 m.p.h., the take-off run (over rough surface and long grass in my case) is 100 yards, and the petrol consumption about one and a half gallons per hour.

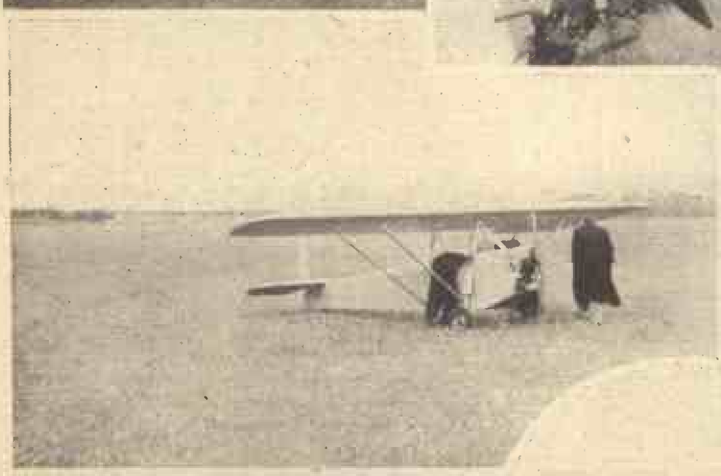
In conclusion, I would say that this machine has a wonderful future, and confidently recommend amateurs to get together and start building. It can be done by anyone who exercises a reasonable amount of care and pays attention to detail. I may also add that I have no connection with, or interest in, Luton Aircraft, Ltd.

Full Constructive Details of this Successful Light Aeroplane, Designed to Air Ministry Standards and Requirements, were Given in Our Issues Dated October 1937 to March 1938 Inclusively

PHOTOGRAPHS OF THE LUTON MINOR UNDER CONSTRUCTION, AND IN THE AIR

(Top Left).—The plane in flight and (right) the plane on the ground. (Centre) The engine, and below it, a further view of the stationary plane, whilst below is shown the construction of the tail.





(Bottom Left) The fuselage and chassis of the 'plane, whilst the other two photographs show the 'plane soon after taking off.

A SIMPLE MILLING TOOL

This Useful Tool is Applicable to Lathes of from 3½in. to 6in. Centre Heights

A VERY valuable adjunct to the lathe is a milling spindle to be held in the tool post for milling keyways in shafts and even for cutting teeth on wheel blanks if a dividing plate is attached to the lathe mandrel. The tool shown in Fig. 1 is for use by hand, no overhead gear being required. It is also applicable to lathes of from 3½ in. to 6 in. centre heights.

The base of the tool is an angle bracket, A, which is cast from a wooden pattern of the shape and dimension shown. It is left rough, except for the bottom surface and the face B, and has a slot down the vertical face centrally disposed. This slot should be ½ in. wide exactly and vertical to the base, and is made by drilling a series of holes along a central scribed line with a $\frac{5}{16}$ in. drill, slotting the sides out with a cross cut chisel and filing up to ½ in. wide for the full length of the slot.

Flat Surfaces

The bottom and the front surfaces can be filed flat with a flat bastard file, followed by a dead smooth file, only taking as little metal as will give a flat surface. A hole is bored in the base at the position shown to take the tool post stud, by means of which the tool is clamped on to the top slide of the compound slide rest.

The body of the tool is shown in Fig. 2 in part section and end view. It is of cast iron and can be cast solid from a wooden pattern of the same shape. No core boxes are required for any part of the tool.

Two studs (½ in. Whitworth) are fitted, screwed hard up in the back at the centre distance apart shown on the drawing Fig. 1. The back (C, Fig. 2) is filed dead smooth to fit on the face B of the bracket A (Fig. 1).

After the back has been surfaced, and before fitting the studs, the body casting (Fig. 2) should be laid on the flat on the surface plate and a centre line scribed at each end, at a distance of 1⅛ in. from the base, with the scribing block, and a vertical line scribed centrally. The intersection of these lines, at both ends of the casting, locate the axis of the bearing for the milling cutter spindle. The diameter of this hole is ⅝ in., parallel from one end and tapered at the other, the included angle of the taper being 20 degrees.

To bore this hole, the casting should be bolted to an angle plate on the lathe face plate, as shown in diagram in Fig. 6. It should be first drilled out by a drill held up on the lathe back centre and fed up by the poppet headstock barrel. It should then be bored by an inside tool to the dimensions shown, since the drill bore will not be good enough for the bearing we want. The drill should be ⅛ in. under the size of the bore as marked on the drawing and the inside boring tool should be very stiff.

The Tapered End

The tapered end is then turned by the same tool, setting the top slide of the slide rest over to give the taper angle marked on the drawing. The same tool can be used to face off the end. The casting should then be chucked on a mandrel and the other end just faced off square with the bore.

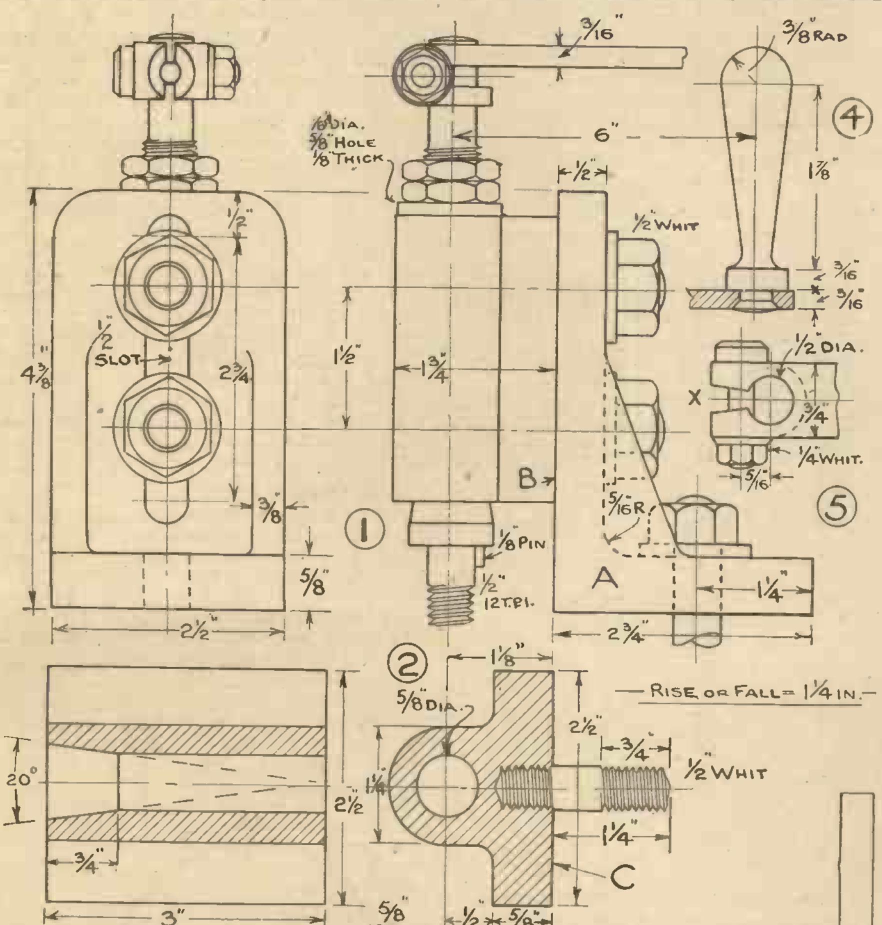
The mandrel, carrying the cutter, is shown in Fig. 3. It is turned from a piece of cast steel bar to the dimension shown. The parallel part fits the bore in the body and the taper is turned at the end with the top slide set over to the same angle as when turning the taper in the bore. The dimensions show the diameters and lengths. The threaded ends are cut with the screw-cutting gear and with a fine pitch. The nose is ½ in., with 12 threads per inch. The top end thread is ⅝ in. (the same diameter as the spindle) and 12 threads per inch.

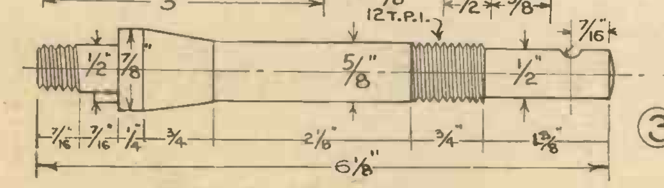
The plain end is fitted with a phosphor bronze washer and a nut and lock nut (shown in Fig. 1), the rest of the spindle being turned down to ½ in. to allow us to slip the nuts along it to screw them on the screwed part. There is a round pin, ⅛ in. diameter, driven in a drilled hole in the face of the shoulder at the milling cutter end. This is to engage the slot in the milling cutters and transmit the drive from the spindle to the cutter.

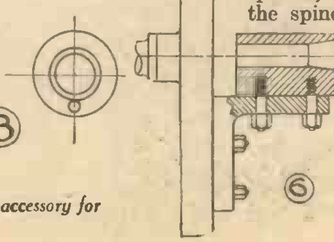
The nut at the cutter end of the spindle should be made of mild steel.

The operating handle is made from mild steel bar ¾ in. wide and $\frac{3}{16}$ in. thick. It is shown at Figs. 1, 4, and 5. It is turned over round a ¼ in. rod at the end, the return being parallel with the main part of the handle or lever. A hole is then drilled through both parts at a distance from the end which will leave a space between the centre of the bend curve and the axis of the two holes of $\frac{5}{16}$ in. This is shown in Fig. 5. The end is then slotted out as shown at X (Fig. 5) and a ¼ in. bolt and nut is fitted as shown. This bolt, as is seen in the plan view Fig. 5, is partly proud of the inside of the hole, and a groove, cut with a round file, will be made across the spindle $\frac{7}{16}$ in. from its end, as seen in Fig. 3, so that the ¼ in. bolt and nut can pass. This bolt and nut, while acting as a cross key and holding the handle so that it cannot rotate on the spindle, will also tighten the handle round the spindle.

The small handle at the end of the spindle is shown in Fig. 4. It is turned from mild steel round bar to the dimensions shown. The shank fits a hole in the end of the lever handle which is countersunk on the underside, and the handle is driven in the hole up to the shoulder and riveted up underneath as shown.







Figs. 1 to 6.—Constructional details of a milling tool which is an extremely useful accessory for the latheworker.

Watch Repairing and Adjusting—5

Methods of Correcting a Balance and Repairing a Broken Pivot

The split-seconds mechanism of a high-grade chronograph.

ONE of the most common breakages in a watch, apart from main springs, is a broken balance staff. In some instances a fall or blow is sufficient to break off both pivots. In others, only one pivot suffers damage. One or both pivots bent is perhaps a more common fault caused by the endless jolting to which a modern wrist watch is subjected. To straighten a pivot considerable care is necessary. A quick look at the staff will tell you whether it is hard or only medium hard. All high-class watches have hardened and tempered parts, but the ordinary grade are content with a lesser degree of hardness.

A bent pivot can be straightened by placing a suitable sized watch bouchon (that is a short length of brass wire, drilled and turned at each end in the form of a bearing) over the bent pivot, and gently levering until the pivot is straight. To give control the bouchon should be held in a small pair of hand tongs. If the staff is very hard, it will be foolish to attempt to straighten a bent pivot without first reducing the hardness. Remove the hairspring and roller, grasp the balance with an old pair of tweezers, and carefully warm the end of the staff over a small spirit flame until it turns blue. Another method is to heat a pair of pliers, and hold the end of the staff in the warmed pliers for a few seconds.

Straightening A Pivot

An old pair of stout tweezers can be used effectively for straightening a pivot, if they are filed as shown in Fig. 1. When the pivot has been straightened, it will have to be re-polished, for it will have suffered through contact with the jewel hole and endstone. If there are any burrs the pivot file should be used very lightly for a few strokes will soon reduce both length and diameter of the pivot to its detriment. The polisher should be used with long steady strokes, whilst the staff is revolved at an even speed in the lathe. Charge the polisher first with oilstone dust, and finally with diamantine.

Although pivoting—the repairing of a broken staff by drilling and inserting a new pivot—was not tolerated by the old school of watchmakers, it is a popular method of repair when one pivot is badly damaged or broken. It is comparatively easy to pivot the upper half of a balance staff, as this is quite large. In fact, a hole can be drilled in the hairspring shoulder, and a fairly large plug fitted. More care is needed when drilling the lower half, which carries the roller, as this is always of smaller diameter. To pivot a staff, first stone off the broken end with an Arkansas slip and place the staff in a suitable lathe chuck.

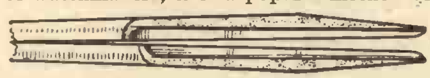


Fig. 1.—A pair of tweezers filed down for straightening a pivot.

Fig. 2.—The type of drill which makes a rapid cut.

Fig. 3.—The tip of the graver should be rounded, as shown.

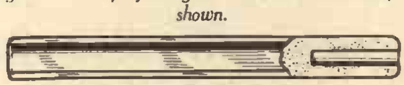
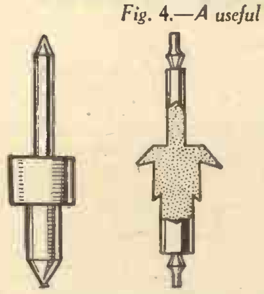


Fig. 4.—A useful punch.



Figs. 5 and 6.—(left) A partly finished staff or "rough." (Right) A modern finished staff.

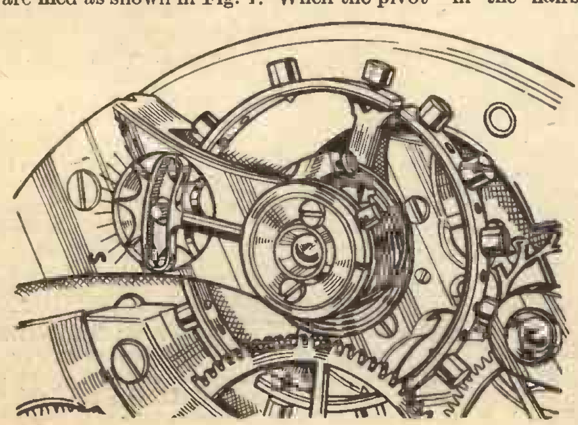
Drilling Operation

With a well-sharpened, long-pointed graver, catch the centre, and make a small sink in the end for a starting point for the drill. It is imperative that there should be no pip in the centre of sink. If there is, the hole will be out of true. Either select or make a drill a little larger than the finished pivot is to be, preferably a short drill with plenty of clearance, for it is surprising how quickly these tiny drills break if there is the slightest binding in the hole. If the staff is hard, the drill will have to be left hard, too, but as hard drills are liable to break off in the hole, it is better to reduce the hardness as described in a previous paragraph, and use a tempered drill.

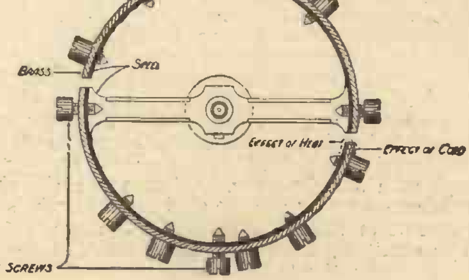
If the drill fails to cut, do not continue the pressure or the surface will become burnished, and impossible to cut. It may be that the drill is not quite hard enough or the cutting edge may be too flat or too blunt. A little experiment with the Arkansas slip will soon give good results. Fig. 2 shows the type of drill which gives a good cut when used with steel. The lathe drill differs only from the bow drill in that it needs only one cutting edge. When drilling, remove the drill periodically, insert a sharpened piece of pegwood, and gently revolve the staff. This will clean out the hole, as well as showing the depth of the hole on the pegwood.

Fitting a Pivot

The hole should be as deep as the length of the intended pivot. File to a very slight taper a piece of hardened and tempered steel wire, small enough to just enter the hole. Then draw file it (draw filing consists of drawing the file up and down instead of the backward and forward movement) until it enters about two-thirds of the hole. Stone off the end, dip it into some dry oilstone dust and push into the hole. Cut the pivot almost to length, stone the end, place the staff on a suitable stake, and complete the operation by driving the pivot home with a few light taps.



Figs. 7 and 8.—(Left) A bimetallic cut and compensated balance with a Breguet hairspring and micrometric regulator. (Right) The principle of the compensating balance.



Replace the staff in the lathe, and turn the new pivot to the correct shape and size. It will be a good plan to round off the tip of the graver as shown in Fig. 3. This will make turning the conical part of the pivot less difficult. The pivot proper must be parallel and should be turned down until it just enters the jewel hole. Polishing should reduce the size of the pivot so that it is free without sideshake. The pivot should be polished on the jacot drum. The jacot drum is a round steel block fitting in the tailstock of the lathe, and furnished with a number of grooves each of which can be centred.

The Polisher

The polisher can be made from a piece of soft steel, the edge of which should be filed to fit the conical part of the pivot. Use oil-stone dust first, then diamantine. Be certain that the polisher and the groove in the jacot drum are clean before changing the polishing medium. Finish with a hard steel burnisher. Some watchmakers prefer to round the end of the pivot, others to leave it flat. When burnishing the end, the burnisher should be used from the pivot over the end. Burrs may be raised if the burnisher is used in the opposite direction.

Fitting a new balance staff to a watch to-day is a fairly simple procedure, for so many watches have standardised parts that it is only necessary to quote the name, size and type of watch to receive a new staff that will need practically no adjustment. Occasionally one does find it necessary to make a small adjustment. The staff may be a little too long, or the lower half of the staff may be a little too large to receive the roller. A little attention with the lathe and a graver will soon rectify matters. A little trouble may be experienced with the shoulder upon which the balance is riveted. I have often found the shoulder a little too small. This unfortunate condition can be improved by using a round-faced shallow punch that just fits over the staff. Rotate punch, balance and staff at the same time as the riveting blows are delivered. When the balance is firm the staff can be given a few sharp taps to swell the head of the rivet. Fig. 4 shows the type of punch.

The Staffs

Interchangeable staffs are not available for all watches, especially some of the older, but, nevertheless, reliable movements, which makes the turning of a new staff still an important section of watch repairing. The first step is to examine the old staff in its position in the movement, and notice the clearance of the balance between the centre wheel and the pallet bridge. Remove the top and bottom endpieces, replace the balance bridge and take the overall length from jewel hole to jewel hole with a measuring gauge. (Watchmakers use a douzieme gauge divided into twelfths of a ligne.)

Turning the First Section

Place the balance and staff in a suitable lathe chuck and with a long-pointed and well sharpened graver turn away the rivet that secures the balance to the staff. Do not turn away any of the balance arms, or the timekeeping will be disturbed. When the rivet has been turned away, place the balance and staff on a block having different sized holes. Choose a hole that will just take the balance shoulder to prevent any distortion of the balance. Rest a small hollow punch on the hairspring shoulder, and rive out the staff with a sharp blow. Select a partly finished staff or "rough" that is a little larger than the old staff. Fig. 5 shows a "rough."

The first section to be turned is the largest, from which is shaped the back slope and balance shoulder. Turn the back slope and polish it. Change the chuck, reverse the staff and turn the lower part of the staff to receive the roller. An approximate idea of the size can be made by measurement, but the roller should be tried before final polishing. A clean-cut effect will be produced by cutting into the already polished portion. Reverse the staff again and cut into the back slope for the balance shoulder, try the balance until it just enters. The actual seat should be undercut slightly in order that the balance sits flat. The top part of the balance shoulder should be well undercut to form a good rivet. The hairspring shoulder is next turned and the back slope for the top pivot and both polished, and the pivot turned until it just enters the jewel hole. Reverse the staff, turn the back slope for the bottom pivot and polish it, and turn the bottom pivot. Measure the staff and turn off any superfluous metal. Fig. 6 shows a modern finished staff.

Polishing and Burnishing

The pivots should next be polished and burnished as previously described. Drive the balance on the staff, but do not rivet. Place the balance and staff in the movement, and examine the truth of the balance The freedom of the pivots can also be tested Replace the endpieces and turn the movement from one side to the other, and listen for the drop of the staff from endstone to endstone. If the staff is free a metallic note will be distinctly heard. Remove the balance and staff and rivet the balance to the staff. A good fitting balance should need little riveting. Neither should there be any need to skim the rivet in the lathe. If the balance has been put out of truth by riveting it should be corrected in the usual way with brass-nosed pliers. A pair of jewelled calipers with an adjustable truing slide with be more convenient than the movement for testing. When the balance is true drive on the roller, replace the hairspring and the staff is completed.

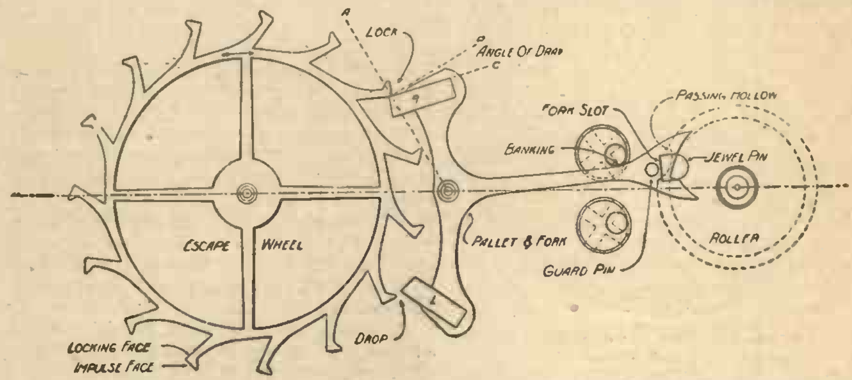


Fig. 9—All good watches have a lever escapement of the type shown here. Note the jewelled pallets.

Centenary of Photography

The Early Days of Photography the Centenary of which is now being Commemorated

Joseph Nicéphore Niépce, 1765-1833.

Louis J. M. Daguerre, 1787—1851.

William Henry Fox-Talbot, 1800-1877.

IT is difficult in these modern times to imagine an up-to-date civilisation devoid of the art and science of photography. Yet photography, despite the many branches and the widespread ramifications which it has acquired, is only at the present time just one hundred years old.

It was on January 7th, 1839, that Louis Jacques Mande Daguerre allowed a description of his photographic method to be read before the French *Académie des Sciences*, in Paris, by the scientist, Arago.

And, curiously enough, it was on January 30th of the same year that an amateur English experimenter, William Henry Fox-Talbot, of Laycock Abbey, Wiltshire, presented to the Royal Society in London a communication describing a photographic process which he had discovered.

Pioneers

Both Daguerre and Fox-Talbot pioneered photography. True it is that experimenters before them had succeeded in obtaining photographs of a sort on various surfaces, but none of these photographic images was really permanent, and, what is more, such images could not be produced very well by means of a camera.

Which of the two—Daguerre and Fox-Talbot—was the more important figure in the early days of photography will never be finally agreed upon. The French, naturally claim their countryman, Louis J. M. Daguerre, as photography's true inventor, whilst, in Britain, an equal claim is made on behalf of William Henry Fox-Talbot for the honour of being photography's originator. The truth of the matter, perhaps, is that Daguerre and Fox Talbot have more or less equal claims to the invention of practical photography, for their individual methods and processes, although totally different, were, in every sense of the word, entirely practical ones.

Daguerre, who was born in 1789, was an artist and a scene painter. In the early twenties of the last century he made a name for himself by devising a *Diorama*, which was a variant of the panorama, the latter constituting a large area of canvas covered with painted views which was stretched across a stage and which was slowly wound from one roller on to another.

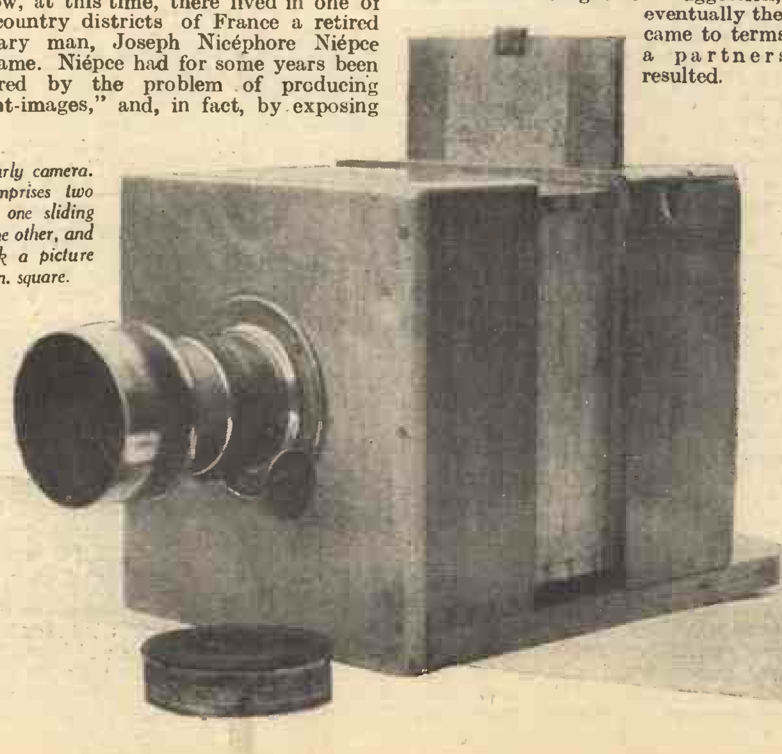
Daguerre, it would seem, in painting his panoramas and dioramas, had been seized with the notion of devising some method or process whereby light itself could be made to fix images upon prepared surfaces. So strongly did this idea take hold of him, that he actually took special lessons in chemistry in order that he might be able to set up a laboratory in which to carry out experiments with a view to rendering his idea practicable.

"Light Images"

Now, at this time, there lived in one of the country districts of France a retired military man, Joseph Nicéphore Niépce by name. Niépce had for some years been inspired by the problem of producing "light-images," and, in fact, by exposing thin films of bitumen to light in a camera over lengthy periods, he had actually succeeded in obtaining images of brightly lit scenes on his bitumen tablets. These images, he called "heliographs," or "sun-writings," and he developed his method for the production of engravings on copper plates.

Daguerre heard of Niépce's work, and, after a time, he approached Niépce, suggesting that they should form a partnership for the purpose of pooling their separate knowledge and resources in order to solve and to commercialise a process of obtaining "light images."

At first, Niépce, always the more cautious man of the two, drew back and refused to fall in with Daguerre's suggestion, but eventually the pair came to terms and a partnership resulted.



An early camera. It comprises two boxes, one sliding into the other, and it took a picture 5 in. square.

Very little, indeed, came of this partnership which was broken by Niépce's death in 1833. Although Daguerre afterwards took Niépce's son into partnership with him, one fears that in his relations with the two Niépces he played a not very just role, for he took advantage of the over-trusting nature of his successive partners in order to further his own interests.

Be this, however, as it may, there is no doubting the fact that Daguerre himself did really invent the process of photography which afterwards became world-known as the *daguerreotype* method.

Silver Plates

Daguerre discovered that when silver plates are exposed to the fumes of iodine for a short time, a yellow film, consisting of iodide of silver, is formed upon the surface of the plates and, furthermore, he found that this iodide film was sensitive to light, so that when the iodised plate was exposed in a camera for several hours, a faint image became visible on the plate.

By washing the exposed plate over with certain chemical solutions, Daguerre was able to "fix" his image, but for years he was unable to make it stronger or more intense. Many, indeed, were the efforts which he made to render his photographic images more clearly visible and, also, to reduce the length of exposure which was necessary to produce them.

At last, however, the problem was solved by dint of one of the luckiest accidents which practical science has to record.

Chancing to open one morning a chemical store-cupboard, in which on the previous day he had flung a number of supposedly under-exposed iodised silver plates, Daguerre was astonished to find clear and strong images upon them. Plainly enough, thought Daguerre, such images could only have been caused by the action on the plates of some vapour given off by one or other of the chemicals stored in the cupboard. And with this shrewd line of reasoning in his mind, Daguerre proceeded upon a systematic series of experiments, transferring exposed iodised silver plates to his chemical cupboard and, at the same time, removing one bottle of chemicals, until, at last, he discovered the "developing" chemical to consist of a dish of metallic mercury or quicksilver, the fumes of which condensed more abundantly upon those areas of the iodised silver plates which had received the most light action than they did upon those parts of the plate which had received little or no light action, thus reinforcing, building-up or "developing" the faintly visible image which had initially been produced upon the plates by the action of light.

Daguerreotype

In this manner Daguerre brought his daguerreotype process into being. For a year or more he held it secret, and he only consented to divulge it on condition that he was paid a substantial lump sum by the French Government and granted a life pension as well. On these terms he granted the free use of his newly discovered and, as it then seemed, almost miraculous process not only throughout France but, also, "to all the world."

But Daguerre, however, turned out to be anything but a man of his word. As soon as he had been well pensioned by his Government, he proceeded to patent his process in England, and to grant licences in London and other cities for the commercial practice of his method of photography.

Henry Fox-Talbot, the English pioneer of photography, was, on the other hand, a less commercially minded man than Daguerre. Born in 1800, and originally in the army, he was well-to-do and he led the life of a country gentleman at his ancestral home, Laycock Abbey, in Wiltshire.

Fox-Talbot was interested both in science and in art. He distinguished himself as a mathematician, and, in some minor respects, as an amateur artist. It was, in fact, during one of his scene-painting tours in Italy that he first conceived the idea of fixing the images which were thrown upon the ground-glass screen of his *camera lucida*, an instrument in which the image on the screen could be traced over for drawing and sketching purposes.

Fox-Talbot

Eventually, after several years of experiment, Fox-Talbot's process of photography came into being, and, as already mentioned, full particulars of it were first revealed to the Royal Society on the evening of January 30th, 1839. Fox-Talbot termed his process the "Calotype" method, the word being derived from the Greek and signifying "beautiful picture." Subsequently, however, the process became known as the "Talbotype" method of photography in honour of its inventor.

The apparatus used by Nicéphore Niépce for his early work in photography.

Fox-Talbot's "Calotypes," which came into commercial being along with the imported Daguerreotype process, were essentially pictures on paper, the daguerreotypes being, of course, images obtained on silvered copper plates.

Daguerre's process gave greater detail, particularly in its perfected modifications, but Fox-Talbot's "Calotype" method of photography scored not merely on the point of greater cheapness but particularly so in virtue of the fact that it was a negative process, a photographic negative having to be formed before a positive image could be printed from it. Thus, in the case of Fox-Talbot's "Calotypes," an indefinite number of positive images could be printed from the one negative, but with Daguerre's process only one photograph per exposure could be obtained.

Calotype Process

The calotype process consisted of exposing to light in a camera paper which had been impregnated with certain salts of silver, and in subsequently developing the paper in a bath of gallic acid and nitrate of silver. A negative image was thus produced. The paper was then fixed by being immersed in a bath of common salt or of hyposulphite of soda, washed, and, when perfectly dry, it was impregnated with wax in order to render it semi-transparent. It was then printed from one to another sheet of calotype paper in a printing-frame in just the same manner as modern "P.O.P." or "Self-Toning" paper is printed. Subsequent fixing and washing of this printed paper gave a positive image which was, relatively speaking, reasonably permanent.

In 1844, Fox-Talbot published a book which he entitled "The Pencil of Nature," and in which he described the improved details of his calotype process. The book was illustrated with actual examples of his calotypes, and it is now, naturally enough, a much sought-after volume.

Perhaps the greatest exponent of Fox-Talbot's calotype method of photography was a Scotch artist named David Octavius Hill, who, along with his assistant, Robert Adamson, produced in his sun-lit studio on Carlton Hill, Edinburgh, some hundreds of the finest photographic portraits which have ever been taken. These pictures, which were taken between the years 1843 and 1848, are now dispersed throughout the world in museums and in private collections and they form, indeed, perfect testimonies to the truth of Fox-Talbot's chosen name—"calotypes," or "beautiful pictures."

Commercially, the daguerreotype process of photography was more successful than the calotype methods. "Daguerreotypists" set up their studios in every town in Britain, and on the Continent and in America. Despite the fact that guineas were charged for a single portrait and that, sometimes, the necessary period of camera-exposure extended to about half an hour, crowds flocked to be "daguerreotyped" and to obtain examples of the wonderful "sun-pictures" which were produced in the mysterious "likeness-machines," as some of the early cameras were called.

Microscope Images

But photography, even at that time, was not applied entirely to portrait-taking. In the year 1840, John Benjamin Dancer, of Manchester, produced photographs of microscope images on daguerreotype plates —the world's first photomicrographs—and it was not long, also, before the moon had been photographed by the same process.

Curiously enough neither Daguerre nor Fox-Talbot took the first human portrait by photography. That honour falls upon one Dr. John William Draper, of New York University, who, in 1840, produced a portrait of his sister, Miss Draper, on a daguerreotype plate.

Neither, too, did Fox-Talbot or Daguerre coin the now universal word "photography." Such was the invention of Professor Herschel, a noted English chemist, who used it first in 1840. Incidentally, it was Herschel, also, who first discovered the action of the now ubiquitous "hypo" as a fixing agent.

Photography, since the time of its co-discoverers, Daguerre and Fox-Talbot, has had a long and a chequered career. There is hardly a single department of human activity which it has not been applied to, whilst, of course, since 1886, in which year one George Eastman, of Rochester, New Jersey, introduced his revolutionary film camera and coined the magic and compelling word "Kodak," the number of its amateur devotees has increased by leaps and bounds and may to-day be counted in their millions.

MODEL AERO TOPICS

Current News from the World of Model Aviation

The S.M.A.E. Annual General Meeting

A NUMBER of important matters were discussed at the recent Annual General Meeting of the S.M.A.E., after the re-election of officers for 1939. The president is Dr. A. P. Thurston; vice-presidents, the Duke of Richmond and Gordon; Major C. E. Bowden; W. E. Evans; C. R. Fairey, M.B.E., F.R.Ae.S.; A. F. Houlberg, A.M.I.Ae.E.; Percival Marshall, C.I.M.E.; G. G. Smith, M.B.E.; Mrs. A. P. Thurston. It was decided to ask Commander Perrin, secretary of the Royal Aero Club, Captain Pritchard, secretary of the Royal Aeronautical Society, and Colonel Moore-Brabazon, to become vice-presidents.

The chairman is Mr. A. F. Houlberg; the vice-chairman, Mr. L. J. Hawkins; the hon. sec., Mr. E. F. A. Cosh; hon. treas., Mr. L. J. Hawkins; hon. comp. sec., Mr. J. C. Smith; hon. tec. sec., Mr. R. N. Bullock; hon. press sec., Mr. H. York.

Club Affiliations

IT has been decided that any club which, after due notification, fails to pay its affiliation fee shall be struck off the role of the affiliated clubs after the expiration of four weeks. Any member of a club which is in arrears with its affiliation fee shall forfeit the right to receive a prize in any competition organised by the S.M.A.E. unless he or she pays an entrance fee as an unattached person.

It was also decided that in future clubs should provide their members with cards or some evidence that proved that subscriptions to their local clubs had been paid. This identification must be shown to the persons organising both centralised and decentralised competitions before an intending competitor be allowed to enter a competition. This rule has evidently been designed to prevent the member of an affiliated club who had not made his subscription to his local club entering an S.M.A.E. competition.

Timekeepers

GENERAL Rule No. 10 which limits the number of timekeepers to any affiliated club to six, including the council delegate, was amended so that in the case of a Service club, and any exceptional circumstances, this number might be increased. Apparently a maximum number was not set.

At the F.A.I. Conference

A SPECIAL code sportive dealing solely with model aeroplanes was being prepared so it was said, at the recent F.A.I. Conference in Paris, which Mr. Houlberg attended. This is certainly a move in the right direction.

Woman's Cup Competition

SOME of the lists of 1939 competitions which have been published might give the impression that the Women's Cup Competition is centralised. This is not the case.

Centralised Competitions

LAST year, apart from the Western Cup and the Wakefield Cup trials, team events attracted most entries. Centralised competitions, omitting the Wakefield Trials, resulted in an increase of 9 per-cent. over last year; London and district supplied 79 per-cent. and the provinces 21 per-cent. of the total entries, whilst London provided 50-per cent. of entries for the Wakefield trials, and the provinces 43 per-cent. Decentralised competitions increased nearly 100 per-cent. over the previous year, the total being equally divided amongst London and the provinces.

Petrol Regulations

SINCE the introduction of the power-driven model regulations, 147 have been registered. This is not a representative number of the models of this type which are now being flown. We advise all readers who are flying petrol models to register them with the S.M.A.E. and to take out the very cheap insurance policy available.

Records

RECORDS have been made or broken no less than thirty times during 1938. This is a very healthy sign.

The Club Movement

ONE of the outstanding features of the past year has been the large increase in the number of clubs which are affiliated to the Society. There are now 92 affiliated clubs which is an increase of 40 over the previous year, yielding an approximate membership of 2,553, or a little over 28 members per club. The saturation point has by no means been reached.

Recognition of Model Records

THE recognition of model aeroplane records by the Federation Aeronautique Internationale has increased the work of the society and its officials, making it necessary for the society to be represented at the meetings of the model commission of the F.A.I. in order to safeguard the interests of British model flyers.

The Sheffield Society of Aero-modellers

THE Middlewood (Sheffield) M.A.C. and the Sheffield Model Aircraft Society have been dissolved, and the name of the new society is the Sheffield Society of Aero-modellers. It is suggested that June 11 be fixed for the Annual Open Day. A scheme is in hand whereby members can contribute small amounts towards their expenses when visiting other clubs.

The King Peter Cup

THE photograph shows the King Peter Cup which is now on show at the Royal Aero Club. The other photograph shows the Pink Dragon which was presented to Dr. Thurston. The King Peter Cup Contest this year will be for gliders.

These two photographs show The King Peter Cup, now on view at the R.A.C., and the Dragon Trophy presented to Dr. Thurston.

1939 Wakefield Fund

IT will be remembered that the council of the S.M.A.E., in an endeavour to raise sufficient money to send a British team to America to enable Great Britain to regain the cup, set up a committee consisting of Messrs. Blunt, Hawkins, Houlberg, Rushbrooke, Smith and York. To inaugurate the Fund, the S.M.A.E. organised a buffet-dance. Several clubs have since followed this example and the state of the Fund at the moment is given in the table on the next page. I hope that other clubs will organise concerts, dances, and social functions to swell the fund, for some hundreds of pounds are necessary to send our team to America.

	£	s.	d.
S.M.A.E. buffet dance	15	10	0
Northern Heights dinner and dance	15	0	0
Blackheath M.F.C. dinner and dance	9	14	3
Lancs. M.A.S. dinner and dance	5	14	4
Oxford M.F.C. dance	1	2	1
Brighton and Dist. M.A.C. ...	1	0	0
Wakefield (Yorks.) M.F.C. ...		14	0
Profit from sale of S.M.A.E. diaries	7	5	5
P. A. Russell	15	15	1
	£71	15	2

The Croydon and Lancs. Clubs are holding raffles, whilst the Woodford M.A.C. arranged a dance, the proceeds of which will be given to the Fund.

The S.M.A.E. treasurer, Mr. L. J. Hawkins, 25 Granville Park, S.E.13, would be pleased to receive as soon as possible any moneys which clubs and individuals may have for the Fund, so that they can be acknowledged in the press without delay.

Skybird League

THE Sixth Annual Model Rally of the Skybird League takes place this March; the construction of any Skybird model entitles the modeller to membership and participation in this, the premier competition for solid scale models.

Last year 47 awards and certificates were presented; this year there are several additional prizes to be won. A very handsome challenge cup has been presented for annual competition by Henry Channon, Esq., M.P., and a return flight from Croydon to Paris by Imperial Airways, Ltd.; this is in addition to the usual flights presented by British Airways, Olley Air Service, Ltd., and the Air League of the British Empire. In addition, there will also be presented a cash prize of one guinea for the best model of a present-day R.A.F. fighter, built by a competitor under 16 years, also one guinea for the best model any type, by an entrant of any age who at the time of entry is holding any kind of position in the R.A.F. Age of entrant will be taken into account. Entries may be from an officer or from a young apprentice.

Other subscribers to the prize list include: The Fairey Aviation Co., Ltd., De Havilland's, "Flight," Wing-Commander Warne-Browne, and many other important firms and individuals.

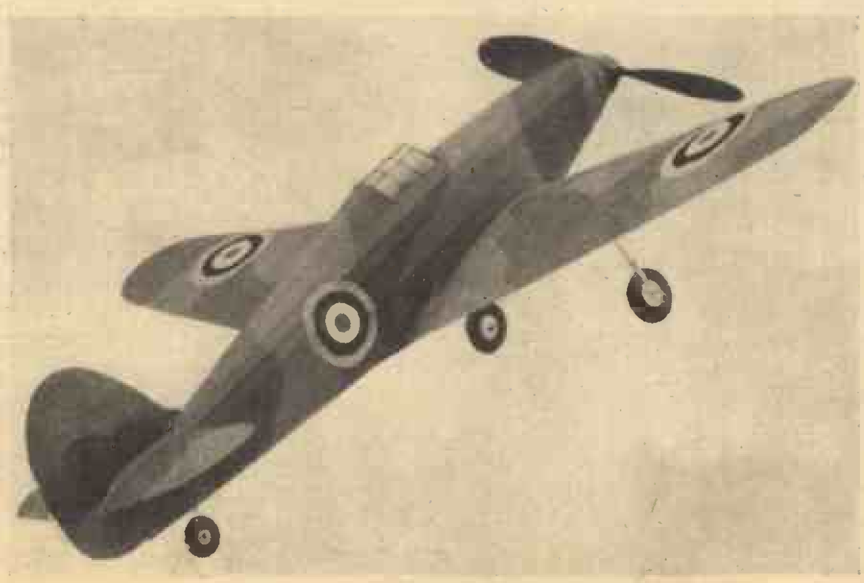
Skybird League Challenge Cup, presented by Henry Channon, Esq., M.P.

There is a class for modellers who have not previously won an award in these annual competitions; here is an opportunity for the beginners. For lady modellers, there is a special section with a challenge cup presented by Lady Stewart. All models must be despatched to Skybird League headquarters by March 18th. Modellers must first of all write and obtain the full particulars and conditions governing this competition. Address:—The Secretary, The Skybird League, 3 Aldermanbury Avenue, London, E.C.2.

S.M.A.E. Headquarters

I LEARN that it is likely that when the Royal Aeronautical Society moves into its new headquarters, the S.M.A.E. will be provided with better office accommodation. In view of the growth of the model aircraft movement, it certainly needs it.

The time cannot be far distant when the S.M.A.E. will have to employ a paid secretary. The present secretary complains that he is hard pressed for time and has been granted a honorarium. The growth of the model club movement will increase his duties.



A fine flying scale model of a Hawker Hurricane.

THE HOBBING PROCESS

To those readers not conversant with the branch of engineering, it will be as well to explain that by this method designs are produced without the aid of milling or die sinking machines, but by the use of hydraulic or other suitable pressure. A punch is made up of good quality tool steel an exact representation of the moulded article to be produced, this punch or male member is then carefully hardened and tempered, and as a precaution to its durability, examined on the hardness testing machine. A piece of the very best quality mild steel of a suitable size is now prepared, and where the sinking is going to occur, it is made convex, also the face polished. The hardened steel punch is now forced into the mild steel to the required depth, the impression being a faithful female reproduction. These mild steel dies are now trimmed up in the lathe, and case hardened by the cyanide process. Moulds for typewriter bottoms are produced by this method, the tool being engraved with the required letter before being forced into the mild steel, which will eventually form the impression. The reason for the convex face previously mentioned is to restrict the run of metal towards the centre or lowest point, minimising the amount to be afterwards trimmed off. Polishing previous to the hobbing operation will be readily understood, and if the hobbing tool is kept perfectly clean, the mild steel will retain its surface throughout.

Barnes and District M.A.C.

A CLUB record for gliders was recently set up by Mr. J. C. White, who returned a time of 108 seconds. Unfortunately his machine was a casualty the following week, being run over by a car.

The Club has been very fortunate to have secured a local gentleman, Mr. Chas. K. Herring, for their president, and he, together with Mrs. Herring, attended our social evening—a very enjoyable and successful affair. Scale model aeroplanes suspended from the ceiling made appropriate decorations. There were a number of competitions, the prizes being kindly presented by Mrs. Herring, also games and dances, the band being provided from hidden talent in the club itself.

Many Wakefield models are at present "in the making" and the chief feature in the club room at the moment is pole flying. A fortnightly competition has been arranged with a small prize offered, and many machines are being entered.

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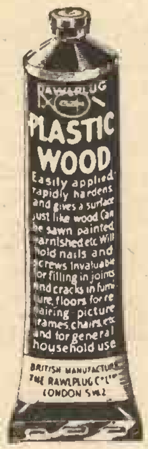

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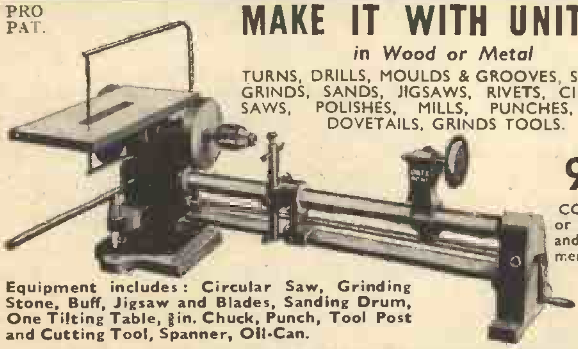

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PRACTICAL USE OF THE SINE BAR

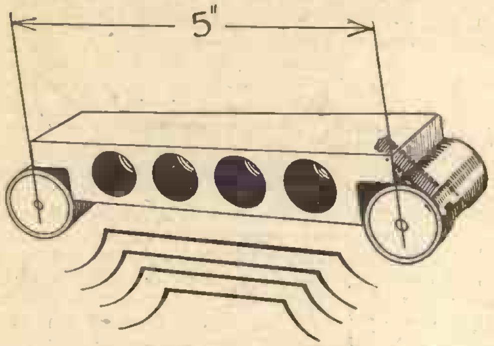


Fig. 1.—A 5-inch sine bar.

A modern scientific measuring instrument which combined with Slip Gauges, acts as a Final Check in the Tool Room.

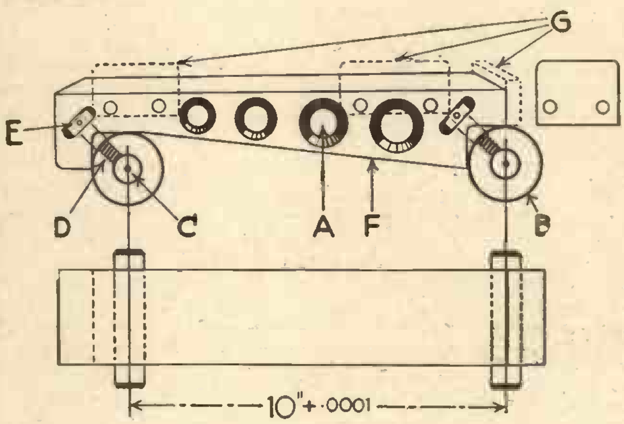


Fig. 2.—An improved sine bar.

IN many modern tool rooms associated with the production of motor car parts and aero engine parts, where a high standard of precision is absolutely necessary, a great amount of overlapping or re-checking occurs. To the unenlightened, also those who have not given the matter sufficient thought, it appears to be time wasted, but to the management and inspeciton departments who have the results and experience of years laid before them, it proves to be economical. The human brain is always liable to error; those little "tricks" of omission that make such a big difference are the facts that must be continually held in check. One result of this is the invention and improvement of modern scientific measuring instruments, such as the precision square, the micrometer, the vernier slide gauge, the vernier height gauge, the protractor and the sine bar. There are many very efficient protractors on the market at present, in nearly every case of American manufacture. Some are just graduated in degrees(°), whilst others more costly are divided up into minutes (′), but no matter how expensive and well finished they may be, there is unfortunately always a chance of minute errors, an accumulation of which make a large error, and this in an angle can so easily occur, increasing by the distance from the axis point, so that it becomes the usual practice in good class tool-rooms to use a protractor in the primary stages of a job, and the sine bar combined with slip gauges as a final check. Standard sine bars are made in two lengths —10 inches and 5 inches—the equivalent measurement to build it up to the angle required is found by multiplying the sine given in engineering text-books by the length of the sine bar being used.

For instance, if one required to set a 5-inch sine bar at 5°, the figure given in the text-book as .08715 in., which represents a 1-inch radius, the amount then required for a 5-inch bar will be .43575 in., which is .08715 in. multiplied by 5, and for a 10-inch sine bar exactly double the amount will be needed.

In Fig. 1 will be seen an ordinary instrument as made by most of the leading precision tool manufacturers. They are rather expensive, because the process of manufacture is lengthy and necessarily costly. In the majority of cases they are made from high-grade cast steel, roughly machined, afterwards being hardened and tempered, and then rough ground. Owing to the fact that all forms of heat treatment machining, and especially grinding, set up stress and agitation in the metal, the component parts are hung out in the open air for a period of from three to six months to enable the steel to regain its normal composure. They are then finally ground and lapped and, if supplied by eminent manufacturers, can be guaranteed to be within an error of .0001 in. Straying from the standard, the design can be considerably improved and in many modern toolrooms this has been accomplished by experience of the requirements. The best design that has come under the writer's notice up to the present is shown in Fig. 2.

A is the bar, with a series of holes F, which are merely for lightening purposes. B are the rollers with a ground hole through the centre C, which will accept a standard mandrel. These rollers are retained in position by a stud D, and nut E drilled to accept a tommy-bar for assembly purposes. The three plates G are to stop the job from sliding off when the bar is set to an angle, and are detachable by removing the screws. This is one of the improvements to this sine bar, and the others are: the roller retaining screws do not go right through as in most models, which are apt to be unsightly and inconvenient; the hole breaking the surface of the roller. Both sides of the bar are flush with the rollers, which in some cases protrude, making it awkward. The ground hole through both rollers is a great advantage, as when a mandrel (a slide fit) is in position in each, the bar can be set with the vernier height gauge, the former being packed up with steel strips or small jacks, if slip gauges are not available.

It often occurs that a job which has to be checked or marked off to an angle is too heavy or dangerous to mount on a sine bar, or probably for the same reason cannot be built up to the angle on a surface plate, and in this case it is usual to first clamp the job on to an adjustable angle plate (made for this special purpose). These angle plates are often fitted with a ring graduated in degrees, which can be adjusted roughly to the required angle before the final adjustment with the sine bar in position (Fig. 3). In very particular cases a sine bar must be built up to the required angle with slip gauges.

Slip Gauges

A slip gauge is a rectangular piece of hardened steel, the thickness of which is

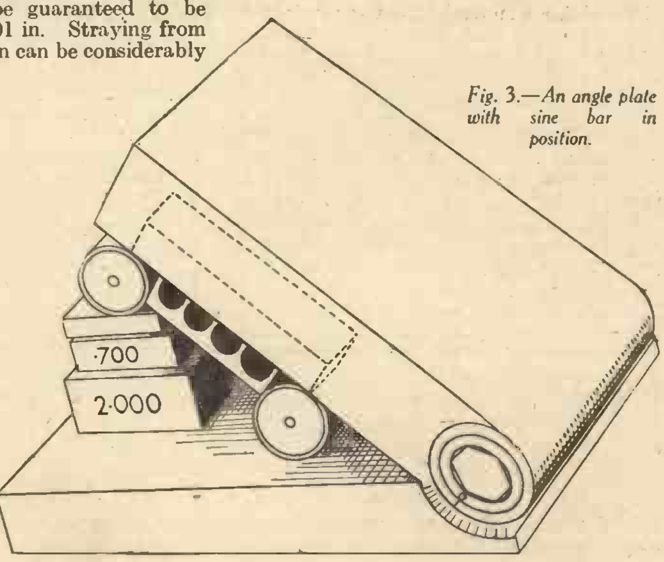


Fig. 3.—An angle plate with sine bar in position.

denoted on one of its faces, which can be purchased in sets fitted into cases. The measurements are so arranged that parts can be built up with extreme accuracy equalling almost any dimension to within 0.0001 in. The first commercial gauges were marketed by a firm of precision tool makers—Messrs. Johansson, who are controlled by the Ford Motor Co., Ltd., of America. The process by which they are lapped to such a degree of accuracy and parallelism was, and now is as far as this firm is concerned, a secret, but at the present time slip gauges are made by several firms all with their own specialised secret process of manufacture. The composition of sets is in most cases very similar, and one standard set contains 81 pieces all of different sizes. In the first section are nine slips, the first one being 0.1001 in., and the ninth, 0.1009 in. In the next section there are 49 slips beginning with 0.101 in. and ending with 0.149 in., then follows another line of 19 slips ranging from 0.050 to 0.950 in. Then there are the four large gauges of 1.000 in.—2.000 in.—3.000 in.—4.000 in. It will be gathered from this explanation that any pack can be built within 0.0001 in. up to the capacity of the set, augmented by the larger size slips, should it become necessary.

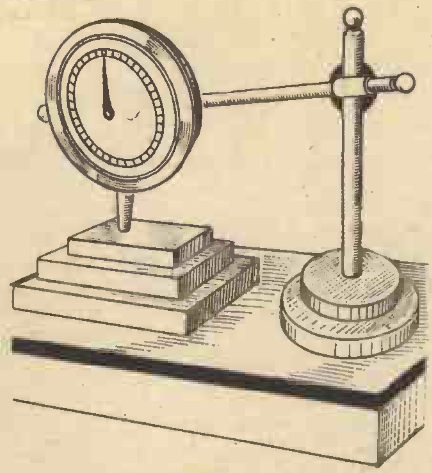


Fig. 4.—A dial indicator set up to slip gauges.

The slip gauges produced by the firm already mentioned, are in several grades. The best quality, which are used by many eminent firms as absolutely standard, are guaranteed to within limits of error averaging 2 to 5 parts in a million.

Slip gauges are in universal use in the majority of tool-rooms at present, not only for setting up a sine bar, but other practices where very fine measurements are necessary—for instance, if a pin projected from a jig or fixture that had to be 2.5005 in. from the base, the usual method of checking this dimension would be on the surface plate with the use of the dial indicator set to the necessary amount of slip gauges and adjusted to zero, and then the point of the indicator passed over the projecting pin in question (Fig. 4).

Very similar to this is the practice of setting up a comparator, a method by which a group of articles is measured with extreme delicacy. This is an instrument with a permanent dial gauge which is adjusted to the required dimension with the aid of slip gauges usually back to zero, the article requiring to be measured is then passed under the indicator as a comparison to the gauges to which the instrument was previously set. It will be seen from this that a group of articles can be infallibly checked with great rapidity.

BOOKS *worth* READING

"Civil Aviation as a Career." By T. Stanhope Sprigg. Published by George Newnes, Ltd. 138 pages. 5s. net.

THIS is a revised edition of the work formerly published in 1934 under the title of "Air Licences." The author's object has been to provide, in a single work of reference, complete and detailed information of the various licences and certificates available to those who wish to embark upon a career in civil aviation. Each of the 21 licences and certificates is dealt with separately, and the information given includes a survey of training facilities, details of official requirements, examinations, and fees charged. Some of the information given has not hitherto been available in printed form.

The book is divided into 11 chapters, dealing respectively with Pilot's "A" Licence, Pilot's "B" Licence, Master Pilot's Certificate, Instructor's Certificate, Navigator's Licences, Ground Engineer's Licences, Balloon Pilot's Licences, Airship Pilot's Licences, Wireless Operator's Licences, Exhibition Parachutist's Licence, and Gliding Certificates. The appendices deal with such subjects as technical examintions, books for study, training centres, and medical re-examination centres. The practical advice and useful data given in this comprehensive book should prove valuable to those seeking a career in civil aviation, and to others requiring information on this all-important subject.

"Trade Marks and Their Protection." By Reginald Haddon. Published by Sir Isaac Pitman & Sons, Ltd. 128 pages. 5s. net.

THIS useful handbook is intended to explain the new law and practice relating to trade marks. As a result of an agitation extending over several years, a considerable alteration of the law has now been embodied in the new consolidated law, the Trade Marks Act, 1938. The principal alterations, and many other minor amendments, including a new classification of goods for trade-mark registration purposes, are clearly set forth in the book.

"The Woodworker." Vol. XLII, 1938. Published by Evans Bros., Ltd. 428 pages. 3s. 6d. net.

EVERYONE interested in woodwork will find much to interest them in this useful volume. It contains a wealth of ideas on making furniture of every description, of modern design, and includes practical articles on the uses of tools, the making of joints, repair work, polishing, workshop practice, and numerous allied subjects. The volume is profusely illustrated with line and half-tone illustrations.

"How to Make Working Diagram Models." By H. R. Langman. Published by The Technical Press, Ltd. 76 pages. 3s. 6d. net.

THIS book gives details of the principles underlying the action of dynamos, electric motors, transformers, mercury arc rectifiers, and apparatus connected with various gases. There are several electrical effects that are more easily understood by the use of diagram models of the kind described in the pages of this book. These specially designed models are intended to elucidate electrical principles and phenomena and their application to the working of some electrical appliances. Many of the models described can be constructed from odd pieces of cardboard or plywood. The student will find the book both interesting and helpful.

"Engineering Mechanics." By Seibert Fairman and Chester S. Cutshall. Published in New York by John Wiley & Son, Inc., and in London by Chapman & Hall, Ltd. 268 pages. Price 13s. 6d. net.

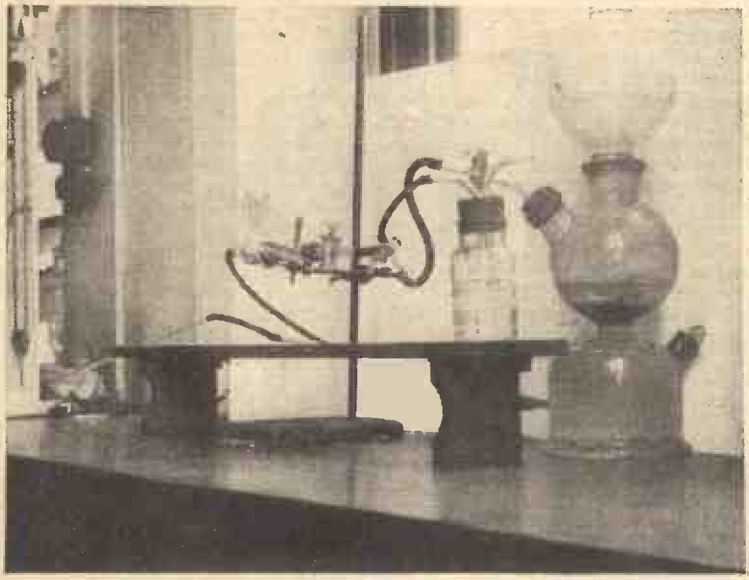
IN this volume the authors have endeavoured to help the layman by treating the subject as simply and interestingly as possible. Thus the various processes for resolving forces into components, combining into resultants, and determining moments are explained for all types of force systems before entering into the discussion of static equilibrium.

In kinetics, the relations between work and kinetic energy are developed at an early point so as to be available for use in the dynamics of rotating bodies.

Whenever possible, the authors have inserted at strategic points in the text, problems of a practical engineering character, as they maintain that at times problems of the so-called academic type have a definite teaching value. A knowledge of the integral calculus is assumed, and this branch of mathematics is employed as the occasion requires.

A three-page index is contained at the back of the book, and the volume also contains 376 illustrations.

The Mighty Molecule



Laboratory apparatus for the production of hydrogen sulphide, carbon, dioxide hydrogen and other gases.

What exactly Makes Molecules Move and Causes them to Remain in Motion is a Question to which Science has still to Provide an Answer

MATTER—and by that term is meant all material substances and things—can exist in three different forms, namely in a solid, liquid and gaseous condition.

Ice, for instance, is a solid. Melt it, and you get water. Heat the water to its boiling point and you turn it into steam. Condense the steam and you reconvert it into water, while, of course, if you freeze the water you will change it back again into its solid form from which you started.

Now, most material things may, given the necessary conditions, be changed at will into any of these three states of matter—solid, liquid and gaseous. Even a hard metallic material, such as iron can be converted into a gas—iron gas—provided that it is exposed to the necessary high temperature, whilst other solids, as witness, for instance, crystals of iodine, are vaporised or gasified by the application of merely moderate heat.

Fundamental Difference

Although substances are changed profoundly in physical properties by being made to assume their various states, they still remain intrinsically the same. Steam, for example, is still, chemically speaking, water; just as much as ice is. And gaseous iron still remains iron, despite the tenuous form which it has been given.

In order to realise the fundamental difference between solids, liquids and gases, we must first of all recollect the fact that all material things are composed of extremely small particles, which are known as molecules. Thus a single grain of sugar is composed of millions of separate molecules, just as, for instance, a handful of sand is made up of myriads of individual sand grains.

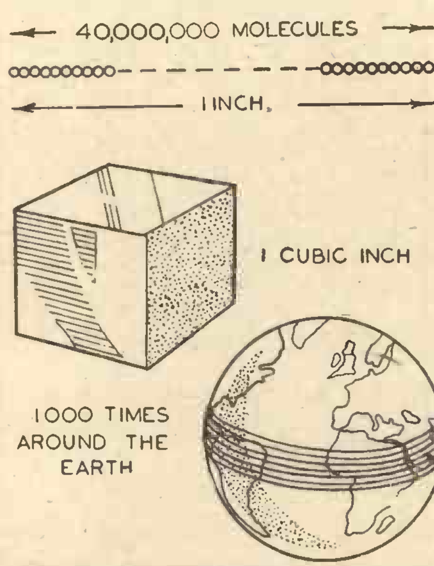
Molecules, of course, are themselves composed of smaller particles still, which we call atoms. They are, in fact, large clumps or groups of atoms. Actually, however, their intrinsic composition does not concern us much here—it is more their marvellous and, indeed, their almost incredible properties with which we must deal.

We should, therefore, imagine molecules as almost infinitesimally tiny particles of matter, round in shape and similar, in many respects, to a billiard ball.

Diameter of a Molecule

Just, however, to give the reader some idea of the size of these wonderful molecules, mention may be made of the following facts :

According to the most recent mathematical calculations, the diameter of a molecule is 0.6 $\mu\mu$, the symbol $\mu\mu$ (pronounced milli-mu) representing one millionth of a millimetre. Hence, the average molecule diameter is just a little more than half a millionth of a millimetre.



Illustrating the size of the molecule. Forty million molecules laid side by side in a row make up an inch, whilst if all the molecules in a cubic inch of air or gas were laid in a row, each touching the other, they would make a line extending a thousand times round the earth.

A high-powered microscope can reveal particles which are only one-fifty thousandth of an inch across. Such particles, exceedingly minute as undoubtedly they are, form monstrous globes in comparison with the sizes of molecules, for they are some 5,000 times as big as the latter.

It would take approximately 40,000,000 molecules all touching one another in a row to make up a line an inch long, whilst if all the molecules in a cubic inch of any gas were similarly laid out in a row and all making contact with one another, they would form a line no less than 35,000,000 miles in length and one which would extend more than a thousand times around the earth at its equator.

Molecules, therefore, although they are much bigger than atoms, are nevertheless incredibly small bodies. Yet, as we shall now see, they are possessed of amazing properties.

Gases

Consider, now, a quantity of gas, say a cubic foot of hydrogen gas. If we wish to preserve this hydrogen gas we shall have to keep it in a four-walled container. On the other hand, if we wish to preserve a liquid, we need only place it in a three-walled vessel, such as a basin or a bottle, whilst, of course, a solid may usually be kept indefinitely without the necessity of having to be provided with containing walls.

Why, we may now ask, should this be? Why should gases refuse to "stay put" when placed into vessels? Why are most liquids so mobile that they run all over the place unless their movements are restricted by rigid walls? And why, finally, are solids so docile in properties that they can be left more or less to take care of themselves?

For an adequate explanation of the above three questions, we must return to our consideration of a volume of gas—say, hydrogen gas—confined in a suitable vessel.

In that volume of gas, the component molecules of which the gas is made up are all separated from one another by distances which are very large indeed, compared with the size of the molecules themselves. Furthermore, the individual molecules are by no means stationary and at rest. On the contrary, they are all rushing about with a velocity of approximately 1,500 feet or just over a quarter of a mile per second.

Although the molecules are separated from one another by relatively great distances, they manage in their rushing here and there to collide with one another with a very great frequency. It has, in fact, been mathematically worked out that an average molecule in a volume of gas at normal temperature and pressure undergoes some 5,000,000,000 separate collisions per second. Such collisions, however, do not harm the molecule. They merely change its direction of motion, just as the path of a moving billiard ball is changed by its collision with another one.

Gaseous Pressure

Naturally enough, the molecules contained in our volume of gas will all at one period or another, be colliding with the walls of the containing vessel. Thus it is evident that they will be exerting a thrust or a pressure on the walls of the vessel. This, indeed, is the fundamental cause of gaseous pressure.

If we force a further volume of gas into the container, what we actually do is to increase the number of gas molecules in the container, and, consequently, to increase the number of collisions which the molecules make with the walls of the vessel. Hence, in these conditions the gas pressure goes up, for the molecular bombardment of the walls of the containing vessel is increased.

Owing to the fact that in a gas the spaces between the component molecules are relatively large, it is not a very difficult matter to force the molecules nearer together. This is done, of course, by compressing the gas, and when the compressing force is removed, the gas molecules immediately fly apart from one another.

Gas molecules may be looked upon as unsociable beings. Their constant endeavour is to fly apart from one another as much as possible. That is why all gases must be stored in all-enclosed vessels in order to keep the molecules together.

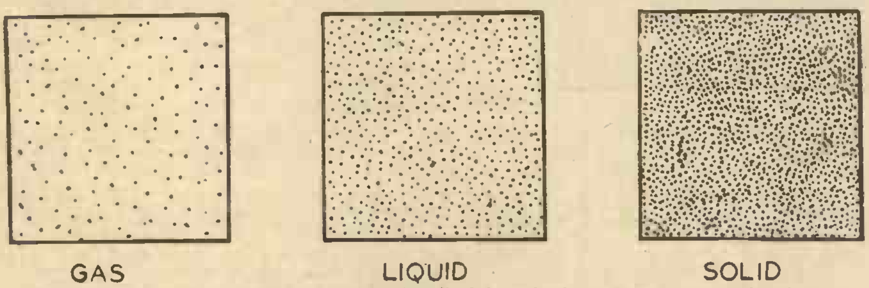
Conditions are rather different in the case of liquids. Here, the individual molecules are much nearer together, and, what is more, their individual speeds are very much slower than they are in the case of gases. It is for this fundamental reason that liquids do not dissipate themselves into space on the slightest provocation, in the manner which gases do and that they can, therefore, be contained in three-walled vessels.

Compression

In solid bodies, the constituent molecules are all closely jammed together, so much so that the molecules merely oscillate or vibrate to and fro rather than move about independently of one another. For this reason, it is almost impossible to compress a solid. Compression is practically impossible precisely because the individual molecules of the solid are already nearly touching one another, and, therefore, because there is little or no space for them to be compressed into.

Liquids, for similar reasons, are nearly as incompressible as solids. Thus, under a pressure of two atmospheres (30 lbs. per sq. in.) 1,000 volumes of water becomes only 999.95 volumes.

Liquids, like gases, exert a certain amount of pressure on the sides of their containing vessels, for, to some extent, the individual molecules of the liquid in the vessel bombard the inner walls of the vessel. In the case of solids, however, where there is hardly any free and independent movement of the molecules, no such pressure is set up.



This diagram shows the relative degree of "packing" of the molecules making up a gas, a liquid and a solid. It shows why gases are easily compressible and why liquids are almost incompressible.

This phenomenon of molecular pressure is a highly important one, since it is the steam molecules which press upon the upper surface of the piston in the steam engine and so give rise to mechanical power, whilst a similar effect takes place in the case of the internal combustion engine.

If we add heat to a gas, we increase the speed of its component molecules. The molecules move faster and faster, tending to fly apart from one another with an ever-increasing velocity. The result of this is that a volume of gas expands when it is heated, and, within wide limits, this degree of expansion is directly proportional to the amount of heat which the gas receives.

Expansion

If, however, the gas is unable to expand by reason of being confined in an all-enclosed vessel having rigid sides, the component molecules of the gas, on being speeded up by the added energy of heat, bombard the walls of the vessel with a greater frequency. Consequently, the pressure of the gas within the vessel goes up, and if sufficient heat energy is added to the gas molecules they will develop sufficient force to overcome the resistance of their restraining walls, the result being that the containing vessel will burst under the influence of the pent-up molecular energy within it.


In a volume of gas, the constituent molecules, speeding here and there with amazing velocity and frequently colliding with one another, set up a bombardment on the inner walls of the containing vessel. This mass bombardment of molecules is manifested as the pressure of gas.

Heat, therefore, when added to a gas always increases the speed and the energy of its constituent molecules.

The same, also, is true in the case of solids and liquids.

Take, for instance, a solid, such as ice. When this is warmed, energy is added to its molecules so that they tend to fly farther apart from one another. In consequence, the ice loses its compact, solid form and is converted in a liquid—water. If, now, heat is added to this water, the individual energies of its component molecules will be steadily increased until, eventually, a gaseous state will be reached, the water molecules behaving exactly as the molecules of a true gas and showing the same tendency to fly as far as possible apart from one another. At this stage the water will become changed into steam, the phenomenon being known as "boiling."

Steam to Ice

The converse of the above is also true. If we take heat away from steam, its individual molecules lose some of their energy of motion. Therefore, they are no longer able to fly apart from one another. Their speeds are lowered and they fall together, giving rise to the liquid form, known as water. Again, when heat is abstracted from water, the component molecules fall still closer together in consequence of the diminution of their energy of movement, the result being that a solid—ice—is formed.

It is now possible to grasp clearly the intrinsic differences between the three states or conditions of Matter—Solid, Liquid and Gaseous. We have realised, also, just how molecular pressure is set up under the influence of heat and we know, of course, the overwhelming importance of this effect of molecular pressure in view of the world-wide use of it, which is made in the steam and the internal-combustion engine.

There is still one thing, however, which we have not yet inquired into. And that is the fundamental or root cause of this astounding molecular motion.

Here, however, we come up against a blank wall, for we do not know what makes molecules move

Molecular Motion

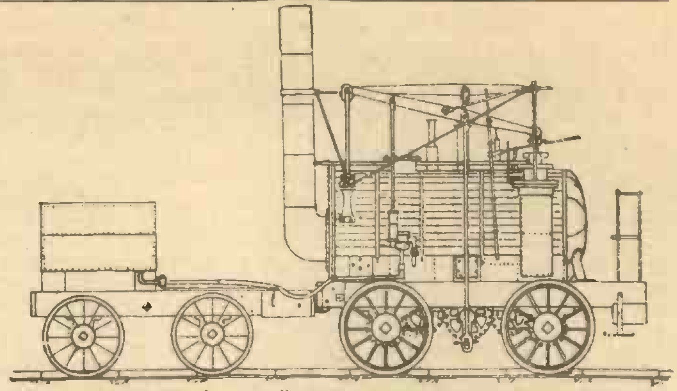
Seemingly, this molecular motion and the effect which we know as heat appear to be one and the same thing. Heat, therefore, is merely a form of molecular motion. If you speed up the molecules of a mass of gas or a quantity of liquid you make the gas or the liquid hotter, whilst, conversely, if you slow down the molecular motions in either of these materials, you make them colder.

At the temperature of Absolute Zero—which is—273° C., or 273 degrees below the freezing point of water on the Centigrade scale—no heat can exist. Hence, the molecules of a substance which has been cooled down to that point must all be motionless.

For heat is molecular motion and molecular motion is heat, and where the one is unable to exist, neither, also, can the other be present. The temperature of a substance, therefore, is merely an conventional and a convenient relative estimate of the average velocities of its component molecules. But what exactly makes molecules move and causes them to remain in motion is a question to which Science, at the present time, has still no satisfactory answer.

MASTERS OF MECHANICS

No. 42. A "Second Stephenson"



The famous "Puffing Billy." Although Hackworth's name is usually connected with this engine, for the greater part, this locomotive, was built by William Hedley, Hackworth merely putting the finishing touches to the design.

The Story of Timothy Hackworth, of Wylam, Englishman and Locomotive Engineer

WHEN the Bill concerning the cutting of the Liverpool and Manchester Railway was brought before the House of Commons in March, 1825, Sir Isaac Coffin, a noted M.P. of that time, said:

"This railway project is a most flagrant imposition. What is to be done with all those who have advanced money in making and repairing turnpike roads? What is to become of coachmakers and harness-makers, coachmasters and coachmen, innkeepers, horse breeders and horse dealers? Are the public aware of the smoke and the noise, the hiss and the whirl, which locomotive engines passing at the rate of 10 or 12 miles an hour would occasion? Neither the cattle ploughing in the fields nor grazing in the meadows would be able to behold them without dismay. Iron will be raised in price a hundred per cent. or, more probably, exhausted altogether. The railway engine will be the greatest nuisance, the most complete disturbance of quiet and comfort in all parts of the kingdom that the ingenuity of man can possibly invent!"

From these remarks it will be gathered that Sir Isaac did not relish the coming of the locomotive and of the railway in general. Neither, for that matter, did the remainder of the English public. Yet the locomotive and, with it, the railway, came into existence within the space of little more than a decade of years chiefly in consequence of the enthusiasm, activities and boundless faith of a bandful of pioneer engineers, best known of which is, of course, the renowned George Stephenson.

A "Second Stephenson"

But Stephenson was by no means the only founder of the railway, as some writers would have us believe. There was, at least, a "second Stephenson" whose aid in the making of railways and of locomotive engines in particular is apt, in these now distant days, to be overlooked. Yet to this individual, whose life was lived out in a far less turbulent manner than was that of his contemporary, George Stephenson, locomotive design owes many practical improvements such as, for instance, the use of a spring-operated safety-valve and the passing of the exhaust steam of a locomotive into its chimney flue in order to heighten the draught and so increase the heat of the fire.

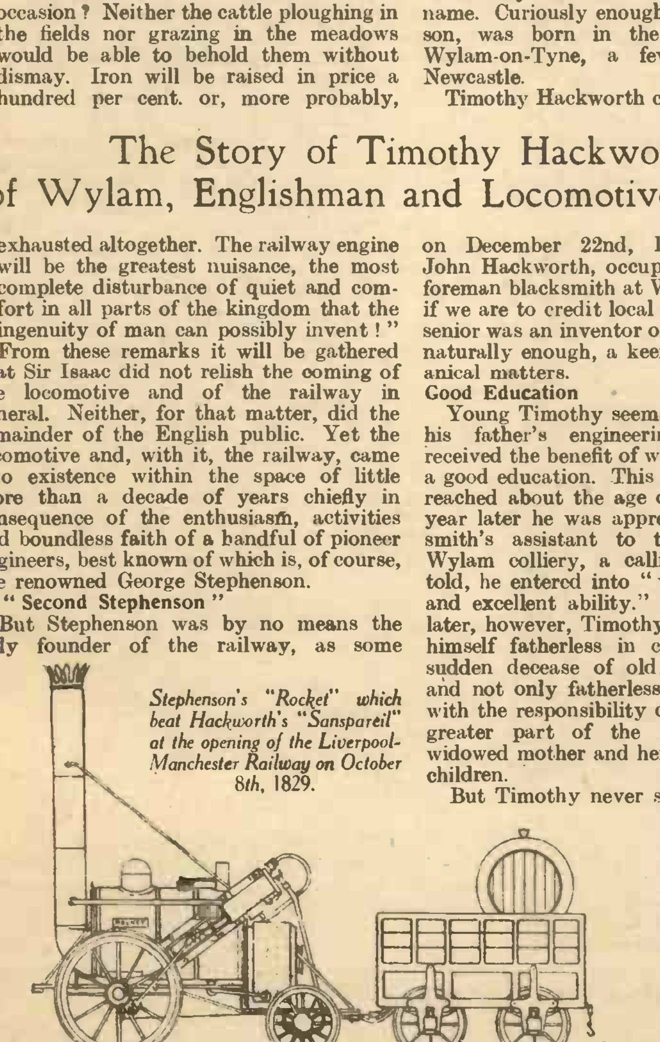
Timothy Hackworth was this engineer's name. Curiously enough, he, like Stephenson, was born in the small hamlet of Wylam-on-Tyne, a few miles west of Newcastle.

Timothy Hackworth came into the world on December 22nd, 1786. His father, John Hackworth, occupied the position of foreman blacksmith at Wylam colliery and, if we are to credit local legend, Hackworth senior was an inventor of some ability, and, naturally enough, a keen student of mechanical matters.

Good Education

Young Timothy seems to have inherited his father's engineering instincts. He received the benefit of what was then called a good education. This lasted until he had reached about the age of twelve years. A year later he was apprenticed as a blacksmith's assistant to the owner of the Wylam colliery, a calling which, we are told, he entered into "with cheerful heart and excellent ability." A couple of years later, however, Timothy Hackworth found himself fatherless in consequence of the sudden decease of old John Hackworth, and not only fatherless but saddled, also, with the responsibility of providing for the greater part of the maintenance of a widowed mother and her family of younger children.

But Timothy never seems to have been daunted by the prospect which was thus held out to him. He plodded along at his blacksmith's job, becoming, in time, engine-man to the colliery and, ultimately, supervisor of the entire colliery workings.



Stephenson's "Rocket" which beat Hackworth's "Sanspareil" at the opening of the Liverpool-Manchester Railway on October 8th, 1829.

History, indeed, might have had nothing to record about Timothy Hackworth had it not been for the fact that in 1818 he left the colliery in which he had been employed since his father's death and obtained another position as engineer to a neighbouring colliery.

Hackworth was, of course, more than an ordinary engineman. Most of his spare time was devoted to the study of engineering and mechanics, and for miles around he became known as the one individual who could invariably be relied upon to diagnose and rectify any mechanical trouble in connection with colliery engines and their boilers.

It was in 1824 that George Stephenson undertook to survey the proposed line for the Liverpool—Manchester railway and to prepare designs of locomotives which would be suitable for drawing passenger carriages on that railway.

Hackworth's Fame

Stephenson, of course, was well known in Newcastle. He had his own works there, and he knew, too, of the local fame which Timothy Hackworth had gathered to himself. Reliable engineers were scarce in those days. There was hardly a man in the whole of Newcastle of Hackworth's calibre. Realising this, Stephenson went over to see Hackworth at his Tyneside colliery. He made him an amazing offer which, in actual import, amounted to his entrusting Hackworth with the charge of his Newcastle works during his necessary absence on the Liverpool—Manchester railway project.

So well did Hackworth acquit himself as acting manager of Stephenson's Newcastle works that, ultimately, he was offered a partnership in one of Stephenson's other concerns, an offer which, for some reason now unknown, he rejected. He declined at this time, also, a proposal to accompany an exploring expedition to Venezuela, Trinidad and the West Indies in search of gold and precious minerals.

As a matter of fact, Hackworth had now determined to set up for himself as an engineer. Stephenson, however, prevailed upon him to accept the post of resident engineer on the Stockton and Darlington railway, a position which he took over in June, 1825, some three months previous to the opening of this line for traffic.

Method of Progress

At the beginning of this article the reader has been presented with a fair sample of the prejudice and intolerance with which the early railroads were surrounded.

To be perfectly truthful, however, the railway projectors were by no means agreed among themselves as to the best manner of hauling carriages along their lines. Some thought that the haulage should be done by horses harnessed to the carriages. Others considered that a stationary engine fixed at one end of the length of railway track would meet the case, such an engine rotating a drum upon which was wound a rope cable attached at its opposite end to the train of carriages. In this manner, the carriages would be "wound" along the railway track.

Stephenson, Hackworth and those of the more "advanced" school, considered the "travelling engine," the locomotive, as it came to be called, the only solution to the problem of hauling carriages and coaches along a fixed railway track; and, fortunately, Stephenson and his followers had, in the end, their final say in the matter.

To his duties as resident engineer of the Stockton—Darlington line, Timothy Hackworth now devoted all his energies. He had, in a sense, consecrated himself to the service of the locomotive, for the latter had entirely captivated his engineering instincts, whilst his ready imagination was quick to disclose to him the latent possibilities of the steam locomotive.

The "Royal George"

The original locomotive used on the Stockton—Darlington railway was not a great success. Indeed, at one time the directors of the railway seriously considered abandoning the locomotive system of hauling carriages and going over to horse-drawing of the coaches. Hackworth, it seems, prevailed upon them to postpone their final decision and to give him authority to construct a new type of locomotive which would prove superior to any previous engine which had been employed on the line. This authority was granted, but was subject to the proviso that Hackworth should use for the building of his new locomotive the boiler of an old and discarded engine.

Thus came into being Hackworth's first locomotive, the "Royal George," which was built at a total cost of £425.

In the "Royal George" Hackworth incorporated many then novel constructional features. He discarded as inefficient the single fire-tube used by George Stephenson and he employed a system of multi-tubes in order to increase the steam pressure available. Also, by turning the waste steam from the loco's two upright cylinders into a narrowed portion of the chimney flue, the force of the fire blast was greatly augmented and greater heat produced in the fire box.

The "Royal George" was equipped, also, with an adjustable spring device controlling its safety valve. This, which was Hackworth's own idea, completely replaced the old and cumbersome method of hanging weights on an arm of the safety valve. Six coupled wheels carried the engine on the rails, this construction giving the locomotive the rail-adhesion necessary for its heightened speed.

In 1827 Timothy Hackworth's new loco was completed. It proved an entire success and it formed the first of a long line of locomotive models which succeeded it.

"Puffing Billy"

Of Hackworth's part in the construction of the famous "Puffing Billy" locomotive, little need be written, for, although Hackworth's name is usually connected with this model, the loco was, for the greater part, designed by William Hedley, another Northumbrian engineer and locomotive builder, Hackworth merely putting the finishing touches, as it were, to the loco's design and improving it somewhat at a later date.

Perhaps the most interesting of Hackworth's locomotive creations was the one which was officially dubbed a failure. This was the famous "Sanspareil" (the name meaning "without equal"), one of the locomotive engines which, along with Stephenson's more celebrated "Rocket," competed for a prize of £500 at the opening of the Liverpool—Manchester railway on October 8th, 1829.

Four locomotives entered into the competition, the "Novelty," the "Rocket," "Perseverance" and "Sanspareil," the last-named, as we have just seen, being the product of Timothy Hackworth's workshops. Another competitor, a Mr. Brandreth, entered a "locomotive" worked by a horse, but owing to its excessive weight and the slow running speed of the vehicle, it was abandoned.

Hackworth's "Sanspareil" was a four-wheel loco having two vertical cylinders acting directly upon the rear driving wheels. Its tender and water tank were placed in front of the engine, but, apart from this detail, the loco was in many respects similar to Stephenson's more successful "Rocket."

A "Successful" Failure

At the Liverpool—Manchester railway competition of October, 1829, "Sanspareil" failed to win the day mainly because Hackworth had been unable, in consequence of other duties, to give to its construction the personal attention which was necessary. The loco, during the trial, travelled at an average speed of 14 m.p.h. Then, suddenly, something went wrong with the cold-water pump, bringing the engine to a standstill. Hackworth's system of diverting his waste steam into the main flue of his loco did not please the directors of the Liverpool—Manchester railway, for, although it gave speed to the engine, it resulted in increased fuel consumption owing to the sharpness of the blast through the fire box.

But although Hackworth's "Sanspareil" did not succeed in its trial run as a competitor on the Liverpool and Manchester railway, it attained success elsewhere, for it was ultimately purchased by the Bolton and Leigh railway and worked continually for passenger haulage on that system for many subsequent years.

The disappointment which resulted to Hackworth owing to his failure to obtain the prize at the opening of the Liverpool and Manchester railway, rather than discouraging him, led to his putting forth still greater efforts in order to improve his locomotives.

He returned to his position as engineer of the Stockton and Darlington line and spent the remainder of his life in continual trial and experiment in connection with locomotive efficiency and improvement.

A Home-loving Man

Hackworth was of a quiet disposition. He was a home-loving man, abstemious in his habits, non-controversial, and hating, above all things, the mental unrest and turmoil consequent upon disputes. Had, perhaps, he been of a less mild disposition, had he been disposed to journey more frequently to other parts of the kingdom instead of staying at home on his Stockton—Darlington railway, he might have made a far greater name for himself.

As it was, however, this locomotive pioneer, the "second Stephenson," as he has been called, contented himself to remain as engineer to the Stockton—Darlington railway for the remainder of his life. He acted, too, as an independent railway and locomotive consultant, a line of activity in which, especially in his ten latter years, he attained outstanding success, many railroad systems coming into being under his able advice and large numbers of locomotives being constructed to his designs.

In 1849, he died at the age of 63 years, outliving his old friend, former employer, and engineering rival, George Stephenson, by barely twelve months.

Timothy Hackworth is little thought of nowadays, even in engineering history. Nevertheless, he was a man of genius to whose designs the early locomotive owed much for its eventual success.

TRIBUTE TO A SCIENTIST

Awarded the Gold Medal of the International Faculty of Sciences

THE Gold Medal of the International Faculty of Sciences, which is awarded annually in recognition of outstanding contributions to scientific progress, has been awarded for 1938 to Mr. J. J. Denton, Secretary of the Television Society, and Vice-President of the Institution of Electronics. The award is in recognition of nearly 50 years continuous devotion to scientific and technical education.

Wireless

In addition to many contributions to scientific research in the fields of wireless transmission and reception, metallurgical and high temperature technique and the design of educational instruments, Mr. Denton has been closely associated with scientific education since 1889, when he was appointed honorary lecture demonstrator for "Old Vic" science lectures and also as chemistry and physics lecturer at Morley College. For over fifteen years, from 1894, he was assistant and lecture demonstrator in physics and chemistry at Bedford College (University of London), and during that period he acted in an honorary capacity as research and lecture assistant to many leading scientists.

In 1895 he was appointed teacher in Physics at Morley College, a post which he held for over 40 years, and for 23 years he was also teaching physics at Working Men's College, London, N.W. He founded the Faraday Society, Morley College, of which Professor Carey Foster, F.R.S., was president. Later, in 1927, he was Founder Honorary Secretary of the Television Society, a position which he still holds.

In 1931 Mr. Denton was appointed lecturer on Television at the Borough Polytechnic, the course being stated by the Board of Education Inspector to be the first of its kind to be recognised. During his career he has given a great number of lectures on television before scientific societies, institutions and public schools throughout the country.

Pioneer Work

Mr. Denton's pioneer research work included photographic images obtained by means of electrical oscillations; the first educational film; the melting of tungsten and the making of tungsten targets for X-ray tubes for the War Department; the isolation of uranium by a smelting process; the production of crucibles to withstand a temperature of 2,500 deg. C.; and the wireless control of aircraft.

He founded the London Branch of the British Radio Institution (later incorporated as The Institution of Electronics), was its first Chairman of the Council and is now a Vice-President of that institution.

NEW INVENTIONS

Easy Shaving

SHAVING is a necessary evil, and there have been many attempts on the part of inventors to assist the run of this perennial morning performance. The safety razor has proved to be the most popular, and the tiny guarded blade has reduced involuntary throat-cutting to a minimum.

One of the latest and most remarkable in this class is the electric dry shaver, which has emanated, it is claimed, from the brain of an American—Colonel Jacob Schick. To parody a jazz melody, the new system may be described as shaving Schick to Cheek

A safety razor, for which a patent in this country has recently been applied, is characterised by a flexible handle. The devisor states that he has aimed to produce a razor which will afford a closer and smoother shave than any at present in use. He declares that an appropriate degree of flexibility in the handle causes the blade to move over the face with the ideal action. According to his belief, it surpasses the customary unyielding scrape.

This accommodating razor has a tubular resilient handle enclosing a helical wire spring. There is a rigid stem with a sliding fit within the handle for adjusting the flexibility.

Equipped with this appliance, the shaver —if I may use that term in relation to an adult—can readily suit the razor to his liking. And he may quickly alter the adjustment from time to time, as different parts of the facial lawn are mowed.

Nature and Art

IDEALLY, artificial teeth should so closely resemble those with which Nature has fitted the human family that the deception is perfect. Obviously, when artificial are mixed with natural teeth, the colouring must be effected in such a manner that there is no suspicious contrast.

It is affirmed by the originator of an improvement in artificial teeth that the shade of colour of natural teeth, in artificial light, varies according to the nature of the illumination. He states that the colour of natural teeth is built up principally from red and yellow shades. Now, electric light contains many red rays in addition to yellow rays. These yellow rays are, for the greater part, absorbed by the natural teeth. The result is that, with artificial illumination, the red shade of the natural teeth is more emphasised.

Hitherto artificial teeth have been so coloured that, in daylight, they have the same shade as natural teeth. But, it is averred that the effect of electric light on the mixture of colours employed has imparted to the teeth a shade tending to greyness. Consequently, in these circumstances, the artificial teeth present a contrast to the natural ones. The inventor in question has conceived a method which he claims will produce the same colouring effect with artificial as with natural teeth. His plan is to add to the material from which the tooth is formed yellow and red colouring matter of a particular kind, the constituents of which he divulges. Teeth coloured in this way, present, in artificial light, the appearance of Nature's dentures, so that there is no betraying contrast. And, fitted with such a set, the fair *habituée* of the brilliantly illuminated palais de danse can safely reveal her teeth, without disclosing the fact that they are works of art.

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."

Nicotine Trap

NUMEROUS inventors have endeavoured to contrive a tobacco pipe which will filter the smoke of the fragrant weed and render it harmless to the votary at the end of the stem. Nicotine is described as a poisonous liquid from tobacco. The aim of the inventors has been to trap this toxic liquid so that the smoker can tranquilly puff away without fear of impregnating his throat and lungs with the noxious nicotine.

An idea has of late materialised, which promises not merely to attain this object but likewise to effect other useful purposes. It is maintained that, by means of the device, two evils are killed with one gadget. A spiral spring inserted in the stem of this new pipe arrests the enemy when *en route* to the internal economy of the smoker. The pipe has an enlarged bore partly in the stem and partly in the mouthpiece. This bore is adapted to receive a helically coiled wire. The pointed end of this coil serves as a pricker or scraper. And it can be turned by the other end without the fingers being soiled, because that end receives moisture from the mouth and not nicotine.

The helical wire can be readily withdrawn, rinsed with water, dried and replaced.

This hygienic tube and bowl will not only benefit the health of the smoker; being so easily cleaned, it will also be welcomed by his boon companions, who will be less likely to suffer annoyance from that abomination—a foul pipe.

Bags for Bathers

WHEN one bathes, owing to the fact that some folks do not obey the Eighth Commandment, it is not safe to leave valuables on the shore. To protect one against this weakness in human nature, a bag has been devised for attachment to the person when bathing. It is a receptacle of bellows-like design, having a rigid frame or ring round its mouth. This is fitted with a hinged cover provided with a lock or stud and eyelet fastening. The cover also has a sealing ring which is firmly pressed against the mouth ring to effect a watertight closure. The bellows may be enlarged or reduced by a girdle with a running noose. Upon this being placed round the waist of the wearer and tightened, the articles in the bag are pressed together.

The bather naturally will not desire to carry a heavy weight. He will not wish to be in the position of a shipwrecked miser who loses his life through being pulled down by the weight of the possessions he attempts to save. In any case, the bather will certainly have a load lifted from his mind.

Self-control for Trolleybuses

IT has been said that a groove is a grave. Certainly two grooves—the rails—have doomed the trams, which are being driven off the roads by trolleybuses. According to the returns of the Ministry of Transport on tramway and trolleybus undertakings exclusive of those of the London Transport Board, tramway passenger journeys decreased by 117,609,881, compared with the previous year, and trolleybus passenger journeys increased by 67,435,735.

But although the trolleybus is not restricted to the ruts, as is the tram, and can avoid obstacles, it has not the freedom of the petrol-propelled vehicle. In foggy weather it is difficult for the driver of the trolleybus to know whether he is steering a course directly beneath or parallel to the overhead conductors. It has been proposed to provide a warning lamp which becomes illuminated when the vehicle takes a wrong course. But it is pointed out that such an arrangement is not without disadvantage. For instance, a driver keeping a keen look-out ahead may fail to notice the warning lamp until it is too late to avoid an accident.

According to a recent invention, for which a patent has been applied, the trolley arm extends forwardly instead of rearwardly. And misalignment in relation to the overhead conductors is utilised through the movement of the forwardly extending arm to control automatically the steering of the vehicle. The automatic means can, at will, be put out of action and steering be effected by the drive in the usual way.

Muffled Typewriters

THE subject of noisome noise is occupying the minds of certain leaguers, whose purpose is to transmute the din of our daily life more or less into the quietude of a cathedral close. In life's orchestra undoubtedly the instrument which is perpetually played upon is the drum of the ear. If a prize were offered for the most deafening sound, the electric road drill would have a good chance of securing the award. But there are lesser noises which add their quota to the Dutch concert of modern times. In some offices the work is carried on amid many distracting sounds. While it is a gift to be able to concentrate where all around is tumult, any invention which will muffle the blatant blare is welcome to the outraged ear.

This is the overture to a description of an improved device for subduing the noise of a typewriter. In connection with this sound-deadening machine, it is contended that the impact of the type-bars upon the platen of a typewriter causes vibrations and resonance proportionate to the form and structure of the several essential parts of the machine. To choke the vibrations, especially of sheet-metal parts, we are told, is an effective way to deaden the sonorous sound of these parts.

In the past, in order to muffle the sound of a typewriter, sheet-metal parts have been lined internally with linoleum, felt, rubber, asbestos, cork and sometimes with internal layers of lead.

The invention I am reviewing provides for locking together two similar pieces of sheet-metal, but of plys of less than the usual thickness, surface upon surface, throughout by the use of spot-welding. It is stated that by this means vibrations in either piece are immediately choked by those in the other piece.

Damper for Stamps

THE postage-stamp moistener is a common object in post offices. One type consists of a rotatable glass roll which dips into water placed beneath it. The British Patent Office has received an application for an improved apparatus of this type. The new appliance, in shape, resembles its forerunner, but it is constructed in such a manner that the water container is comparatively large, easily accessible, removable and covered to protect from dust. From the hygienic point of view, this gum-moistening cylinder should commend itself to the public, who, for damping adhesive paper, so often employ the unruly member.

A Model Plank-

By

The Second and

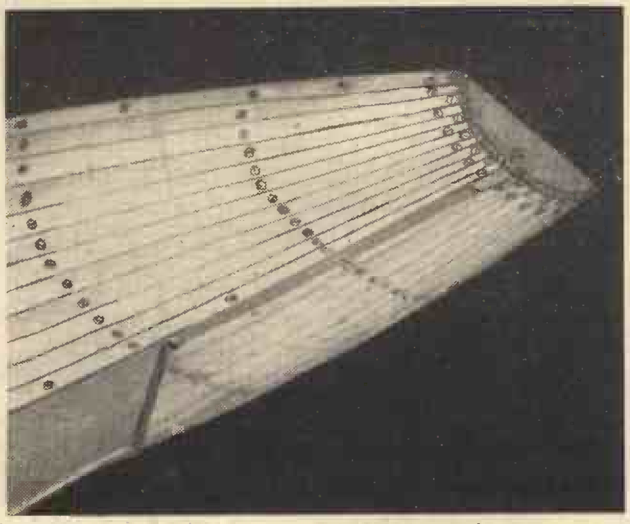


Fig. 13.—A close-up photograph of planking at the stern.

FIT the transom exactly on the centre line and screw it to the deck with two screws and to the keel with a No. 4 screw 1in. long driven in as shown in Fig. 11. Shellac the joint between keel and transom with thick varnish before screwing up finally. Put no shellac between transom and deck, though.

The Inwhale

The inwhale should now be fitted. This is a ¼-in. square strip of birch as used for making model aeroplanes and runs from end to end of the hull in one length at the corner between the deck and the walls of the hull (see Fig. 5). It should be steamed by holding it in the steam from a kettle for a few minutes and bent approximately to the required curve. Ease the ¼-in. square notches in the ribs and deck beams if necessary and fair off the bottom of the notches parallel to the edge of the deck to allow the inwhale to bed right down; this may be done best with a small square file, as it is rather difficult to reach with a chisel. When the inwhale beds down nicely so that its outer edge agrees with the pencilled line below the deck (allowing ⅛-in. for the planks), screw it to every rib with a ½-in. No. 3 screw driven in horizontally, also screw the front end to the bow reinforcement with two screws and the back-end to the transom with one screw. Countersink this last screw extra deeply to allow for fairing off the corner of the inwhale, which should project out slightly from the transom when first fitted. Glue with thick shellac at each rib, but don't allow the inwhale to stick to the deck.

The Framework

The deck may now be removed by unscrewing it from the deck beams, etc., thus leaving the deck beams, transom, and No. 9 section all attached to the skeleton, which will then appear as shown in the photo, Fig. 12. This framework should now feel a perfectly rigid structure. Paint over all the joints with thick shellac, working this into all crevices, and when dry varnish the whole with thin shellac.

With a sharp, paring chisel, fair off the ribs and the rebate round the keel to conform with the curvature of the hull and allow the planks when fitted to bear on the whole thickness of the ribs instead of only on one edge. On the ribs near the bow the front edge will require bevelling off, while at the stern the rear edge must be removed. Test all over the ribs and rebate with a flexible strip of wood long enough to touch several ribs at once. The rebate near the bow will require to be chamfered off quite a lot. Do not scamp this fairing-off operation, but get the framework as perfect as possible before starting planking. Give the newly-cut surfaces a coat of thin shellac and the framework is ready for planking.

The planks should be ⅛ in. thick and 5/16 in. wide, each being long enough to reach from stem to stern without a join. Either pine or mahogany may be used.

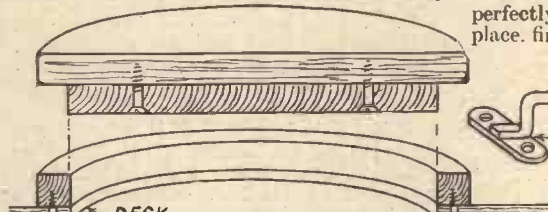


Fig. 14.—The hatch and cover.

Fitting the Planks

Before fitting any planks, measure round the contour of each rib from the keel to the top of deck beam, and divide up the distance into as many equal parts as there are planks and mark each division with a pencil. There are twelve planks, each side of this model, so divide up into twelve spaces, except on rib 1, which should be divided into eleven only, for a reason which will appear later.

First fit the plank nearest the keel; on trying to do this with a straight plank it will be found to touch at the ends only, so shape it with a small thumb plane so that one edge fits the rebate of the keel along its whole length No. 1 section to the transom, and the other edge coincides with the first division on each rib. This first plank will be found to end just about No. 1 section, leaving only eleven planks to cross this rib. From this plank mark out another of exactly the same shape, except that they must be right- and left-handed; this new plank is for the other side of the hull. Give this plank a little final touching up if necessary to make it fit perfectly, and then screw them both into place, first painting the rebate and ribs with thick shellac immediately before fitting the plank. Use ¼-in. No. 0 brass screws (you will require about 4 gross) and put two through each plank at the larger sections and one screw only where the plank gets too narrow for two; also put two extra screws into the rebate between the ribs. Drill and countersink suitable holes in the plank, but do not drill the ribs, because these tiny screws will make a way for themselves. Wipe off any shellac that gets on to the outside of the plank to avoid unsightly stains. The first plank on the other side is fitted in the same manner.

It will be advisable to rest the framework upside down on a pad of wood about 1 in.

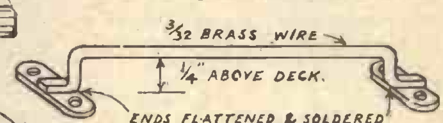


Fig. 15.—One of the hawsers.

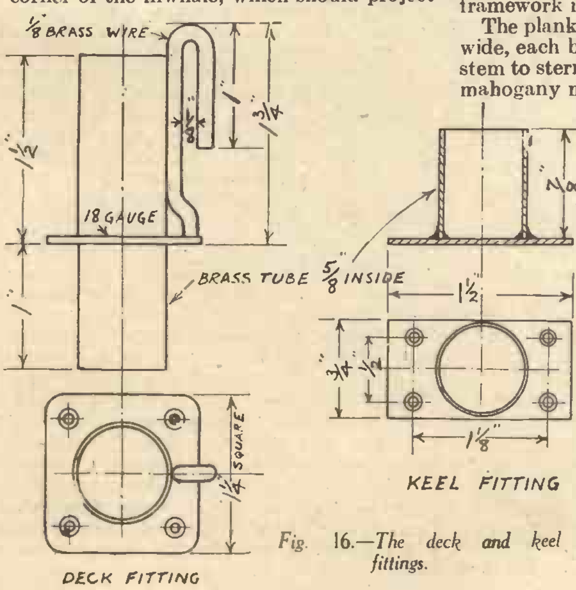


Fig. 16.—The deck and keel fittings.

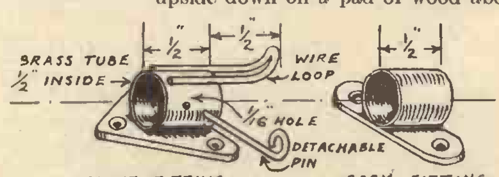


Fig. 17. Bowsprit fittings.

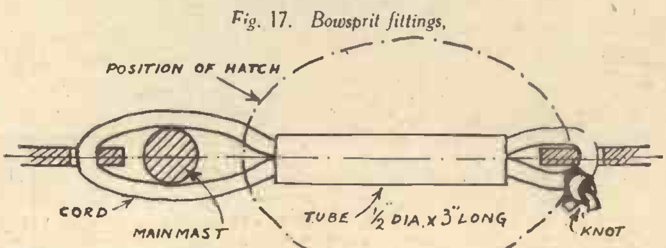


Fig. 18. The lifting handle.

Built Schooner Yacht

"Handyman"

Concluding Article

thick, to keep the bow and stern of the framework from rubbing on the bench.

The other planks are fitted in a precisely similar manner; paint all joints and the seams between planks with shellac before fitting. At the bow and transom each plank will only be about ⅛ in. wide, but this will give enough room for one screw. The screws at the transom should be arranged, one near the front edge and the next near the back edge, as shown in Fig. 13, which is from an actual photo.

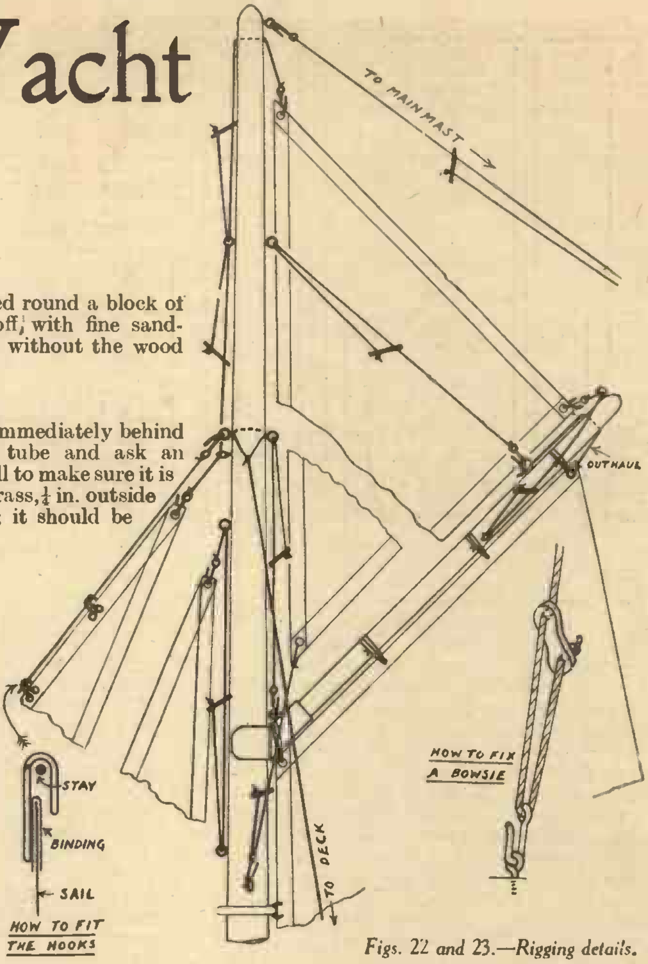
Planking

Do not hurry the planking; if you fit a pair of planks in an evening you will be doing well. Always fit the planks in pairs, one on each side of the hull, to avoid possibility of distortion. Do not force the planks together, or you may get distortion in the hull. Some of the planks about half-way between keel and deck will require to be twisted to make them bed down without forcing, and they should be steamed for this; it will not be necessary to steam them all. When the planking is finished give the inside of the hull a coat or two of thick shellac varnish, and wipe off any that oozes through to the outside. If any of the seams remain open after this treatment they may be caulked with a strip of thin card about

coarse sandpaper wrapped round a block of wood first, and finish off, with fine sandpaper folded into a pad without the wood block.

The Rudder Tube

Now drill a ¼-in. hole immediately behind the fin for the rudder tube and ask an assistant to watch the drill to make sure it is upright. The tube is of brass, ¼ in. outside and about $\frac{3}{16}$ in. inside; it should be long enough to protrude about $\frac{1}{32}$ in. below the keel and about ¼ in. above the deck. It should fit tightly in the hole, but not so tight as to risk splitting the keel. Before fitting the tube put the deck in place and hold it with a screw at each end; then paint the tube with shellac and push it through the hole until it touches the deck. Tap the tube with a hammer to mark its position on the deck, remove the deck and push the tube into its



Figs. 22 and 23.—Rigging details.

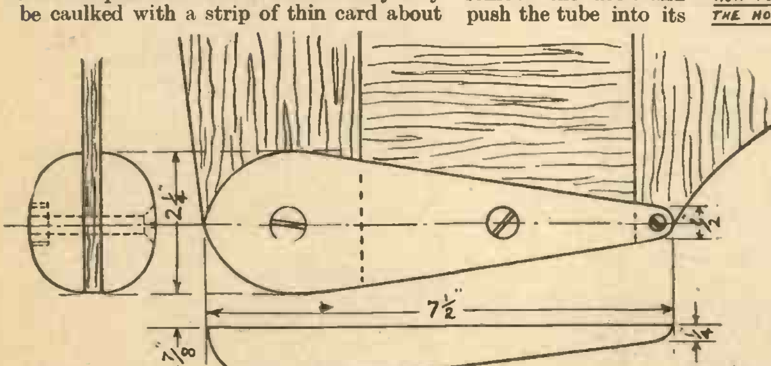
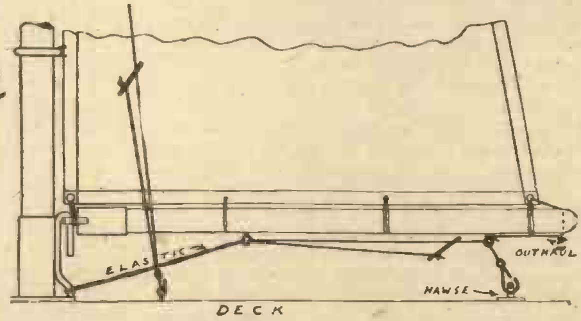


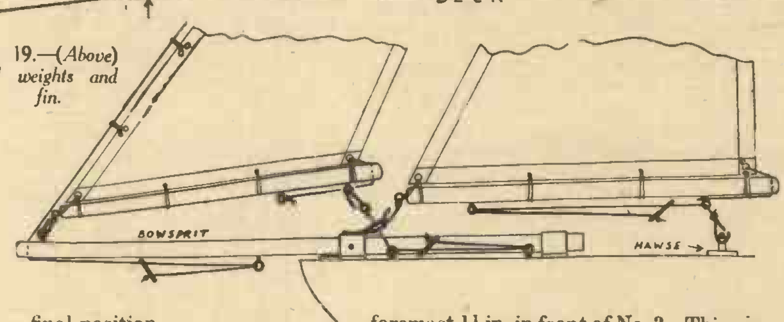
Fig. 19.—(Above) Lead weights and fin.



$\frac{3}{16}$ in. wide, soaked in shellac, allowing this to dry in position and trimming off when dry, but it is better to rely upon good fitting, instead of caulking.

The Hull

The outside surface of the hull should now be smoothed off with sandpaper until it forms a smooth curved surface instead of a series of flats, as formed by the planks. Use



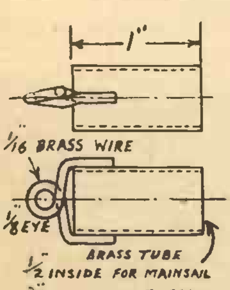


Fig. 20.—Boom fittings.

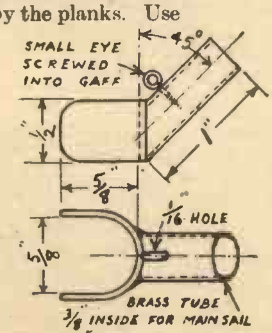


Fig. 21.—Gaff jaws.

final position.

The whole of the hull should now be given a coat of the best oil varnish obtainable. Shellac will not do for this. Special boat varnish is sold for the purpose, but the best quality pale varnish will do. Apply it thinly and allow it to dry for several days.

The deck may now receive further attention. Mark off the position of the masts on the under side. The mainmast is ⅜-in. behind No. 5 Section line and the foremast 1⅛ in. in front of No. 3. This gives a distance of 10 ins. between the mast centres. Drill three $\frac{1}{16}$-in. holes through the deck to mark the position of the two masts and the rudder tube, and strengthen the deck at these points by screwing a piece of wood about 1¾ in. square and ¼ in. thick on the underside; put the screws in from above and shellac the adjoining surfaces first. Make sure these pieces do not foul the deck beams when the deck is in place. A ¼-in. hole can now be drilled from the top for the rudder tube and two $\frac{11}{32}$-in. holes for the mast fittings.

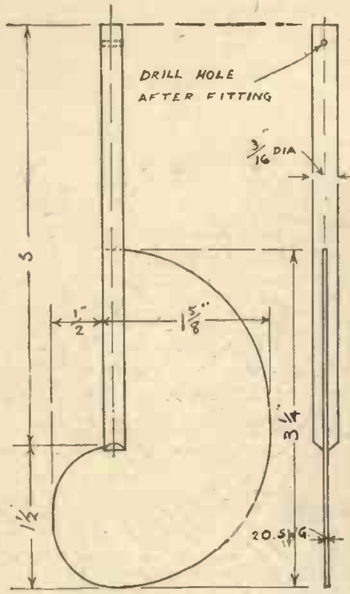


Fig. 24.—The rudder.

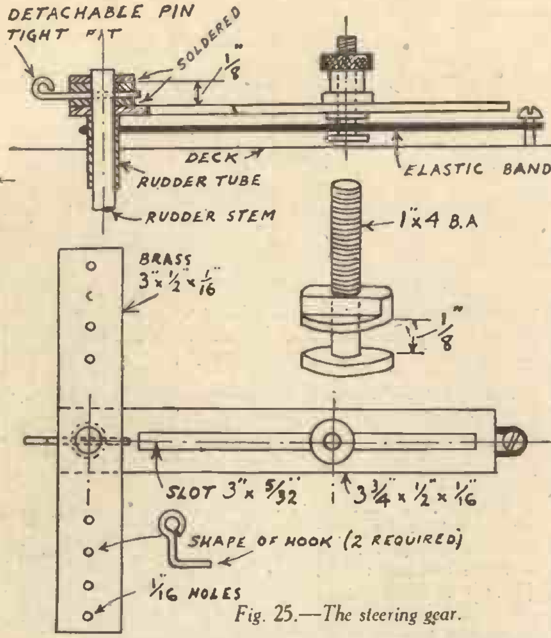


Fig. 25.—The steering gear.

The Fittings

These may be either bought or made as illustrated; bought fittings look very nice, but the home-made ones cost much less. The hatchway, if made at home, should be cut from ¼-in. mahogany to an elliptical shape, the hole being 4 in. x 3 in. and the outside 4½ in. x 3½ in. The piece from the middle of the rim should be screwed under the cover, as shown in Fig. 14, the grain of the two pieces being at right angles. The rim should be laid in position on the deck and marked round with pencil; drill sixteen holes for ¼-in. No. 0 screws from the top, but put in the screws from underneath, after painting the rim with shellac, and cut out the hole in the deck last. A screw eye should be fixed under the lid, carrying an elastic band secured at the other end inside the hull.

The construction of the other fittings will be obvious from the illustrations; all are made from brass and soldered together. Three hawsers like Fig. 15 are required, two of them 2 in. long and one 3½ in. long. The short ones should be fixed to the deck 1½ in. in front of each mast, the deck being strengthened (as already described) where they come. The long hawser is fixed near the stern, after the deck is screwed on, by screws which reach into the inwhale. The rear bowsprit fitting, Fig. 17, should be fitted 6 in. from the bow before the deck is screwed down, a strengthening piece being fixed under it. The other bowsprit fitting can be fixed later. Imitation planks, if required, may be ruled on the deck at this stage with a chisel-pointed H pencil. Varnish the deck on both sides with oil varnish and allow to dry for several days, then give it a second coat on the underneath side only.

Coming back to the hull, the mast steps (Fig. 16) should be screwed on to the keel in the positions already given and a handle for lifting the boat from the water arranged as illustrated in Fig. 18 which explains itself. The cord should be a piece of sash cord, and it is threaded through the ¼ in. holes shown in Fig. 4.

Screwing Down the Deck

The deck may (when the varnish has dried hard) be screwed down permanently by ½-in. screws, screwed into the inwhale about 2 in. apart, the joint between deck and hull being made watertight with white lead, a layer being smeared along the inwhale and top plank, so that it squeezes out all round when the screws are tightened up. Trim off the deck flush with the hull, and give the hull and the deck both a second coat of varnish.

When this is dry, cut away No. 6 deck beam where it crosses the hatch, putting in extra screws at each end first; then fix the mast tubes and the forward bowsprit fitting. All that is now required to complete the hull are the ballast weights.

Make a wood pattern for these to the dimensions and shape given in Fig. 19. Give the pattern a coat of varnish and fix a large screw into the flat side for ease of handling. When dry grease the pattern slightly with vaseline and make a mould of it in plaster of Paris. When the plaster sets pull out the pattern and bake the mould dry in a warm oven. Be careful to dry the mould well or it may cause the lead to splutter and possibly burn you severely. Make two castings in lead pouring 2¾ lbs. of molten metal for each. Allow them to cool down well before lifting them from the mould and they will come away easier. Smooth up the weights by scraping with a knife and finish with sandpaper; a file gets choked up too quickly for this job. Fix the weights to the fin as shown in Fig. 19 by two ¼ in. brass bolts and one ⅛-in. bolt. Countersink the heads, recess the nuts and file off any projections.

The temporary support on the fin may now be removed, the fin faired off to shape and the whole fin and weight given a coat of varnish. The hull in general should have at least three coats of varnish before being placed in water.

The masts, spars, and their fittings should now be attended to. For those who wish to make their own fittings details are given in Figs. 20 and 21.

The Masts and Spars

These are of the dimensions given in the following table.

	Length.	Max. Dia.	Min. Dia.
Mainmast	45in.	⅝in.	⅜in.
Foremast	38in.	⅝in.	⅜in.
Main Boom	21in.	½in.	7/16in.
Foresail Boom	9in.	⅜in.	⅜in.
Main Gaff	15in.	⅜in.	⅜in.
Foresail Gaff	10½in.	5/16in.	5/16in.
Bowsprit	13in.	½in.	7/16in.
Jib Boom	8in.	¼in.	¼in.
Staysail Boom	7in.	¼in.	¼in.

All should be made from carefully selected pine, quite straight in the grain. Plane down to square section first, then remove the corners to form an octagonal section, smooth off the corners again with a plane and finish off with sandpaper. The sizes given in the table are approximate, for some must fit tightly in their fittings, while the masts and bowsprit must fit freely so that they can be removed without force.

The varnish will make a considerable difference to the fit, so allow for this. The lengths are all on the ample side, but if the spars look too long after rigging is completed it will be a simple matter to reduce them. Do not make the tapered spars with a regular taper along the whole length; the large end should remain practically parallel for about half the length and should taper from there to the small end. Finish off all spars with a coat of oil varnish.

The Sails

The sails should be made to the dimensions shown in Fig. 2. Special cloth can be obtained from model dealers for yacht sails, though balloon cloth (obtainable from large drapery stores) will make a good substitute; it is cheaper but creases very easily. Whichever you use, cut the sails with their longest edge parallel with the selvedge of the cloth, and the foresail and mainsail should have the selvedge itself for the longest side. Pin the cloth out smoothly on a flat surface, but don't stretch it, and mark out the shape with a pencil, then cut along the lines with a razor blade. Make no allowance for

(*Continued on page 336*)

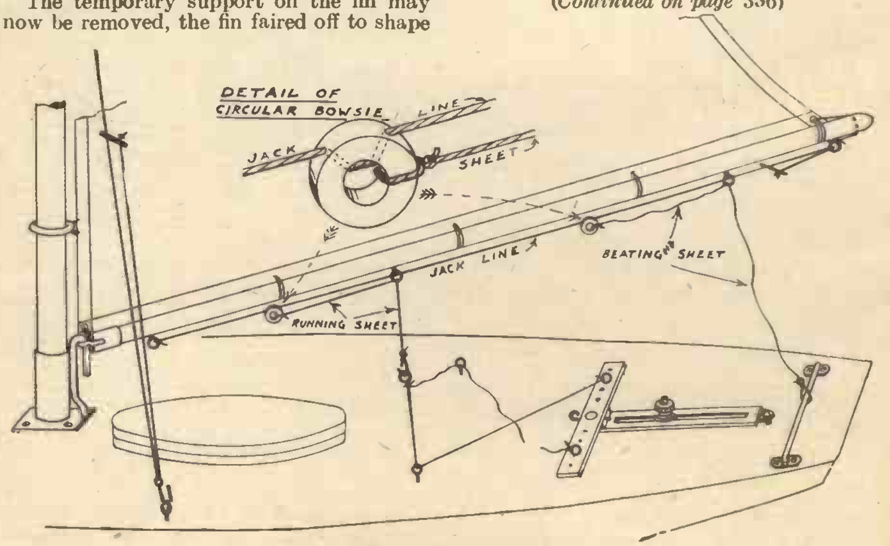


Fig. 26.—Rigging of steering gear and main boom.

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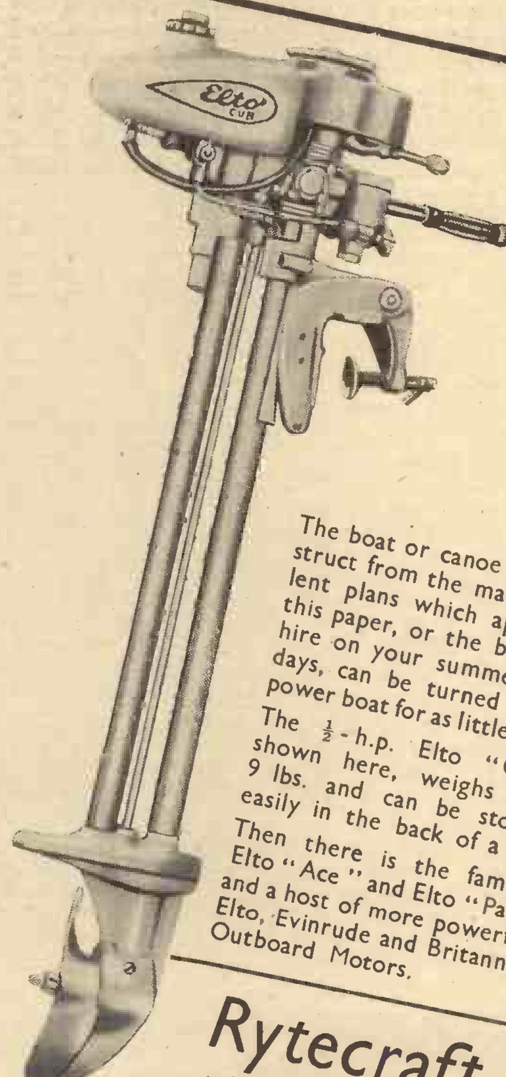

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MAGIC MESSAGES

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

Fig. 3.—Producing a message between two marked slates. The message is, at the outset, on the outside of the slates, and is concealed by the ribbon.

Fig. 1.—A slate with loose flap. The corner of the flap being cut off permits the slate to be marked and the message appear on the marked side.

Secrets of the Slate Trick in its Various Forms and other Technicalities of Conjuring Up Mystic Writings

SUCH a large number of conjuring tricks have for their effect the revelation of a chosen name or the showing of some kind of information, that means of producing these mystic messages are considerable. One of the most popular ways of getting an effect of this kind is by means of a slate.

In its simplest form the slate trick consists of showing a slate on both sides, laying it down and picking it up later on to reveal a message written on one side of it. The secret consists in a false flap, made of black cardboard, which fits loosely but neatly into the frame and so covers one side of the slate. The message is written on the slate, the flap placed in position and the slate shown to be apparently blank on both sides. The slate is then laid, flap side downwards, on a newspaper and when it is afterwards picked up the flap remains behind, its reverse side being covered with newspaper to camouflage its presence.

An Improvement

The first improvement on this trick consists of cutting off one corner of the flap. The edge of the diagonal cut has a chalk line drawn along it and another line in a similar position is made on each side of the slate. The message is written on the slate and covered with the flap as before, but now the conjurer can mark both sides of the slate by writing in the bracketed off corners, the initials of some member of the audience, or making any other mark they choose. As these marks are made on the slate itself they remain visible when the message is produced as shown in Fig. 1, thus considerably heightening the effect by making it seemingly impossible that a flap could have been used.

At this stage I should explain that nearly all slates used for conjuring tricks are made, not of slate but of stout cardboard painted dead black on both sides. This not only saves weight and reduces risk of damage but also makes it easy to match the colour of the slate with the flap. There are, however, one or two very ingenious trick slates on the market in which genuine slate is used both for the slate proper and the flap. These slates are used in pairs and the flap is locked into position by a spring device concealed in the frame. These slates are usually employed in pairs and when placed together with the flap side innermost, the flap may be automatically transferred from one slate to the other where it is again locked into position, revealing either one message on the previously hidden side of the slate, or two messages, one on the slate proper and the other on the reverse side of the flap, which, when the flap is transferred to the other slate, now becomes visible.

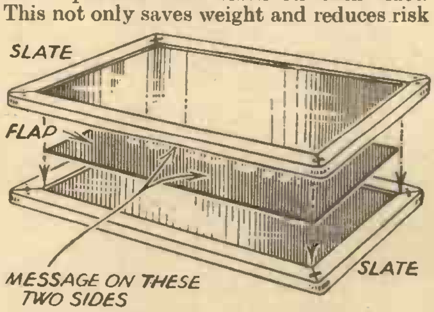


Fig. 2.—How two messages are produced.

These locking slates when well made may be examined by the audience and the effect produced while the slates are in the hands of a spectator. They are, however, somewhat heavy to carry about and their cost is necessarily high owing to the careful workmanship necessary in fitting the self-locking slates.

Two Messages

The production of two messages by using two slates can be achieved by identically the same method shown in Fig. 1. In this case one message is written on the reverse of the flap which is of course black, the same as its visible side. The flap is retained in position by pressure of the fingers and if neatly cut it cannot be distinguished at close quarters. The slates, having been marked (which, by the way, cannot be done with the expensive self-locking slates) via the cut off corner of the flap, are tied together and in due course the messages are revealed by separating the slates and getting the fit on to the other slate. Fig. 2 explains the procedure quite clearly.

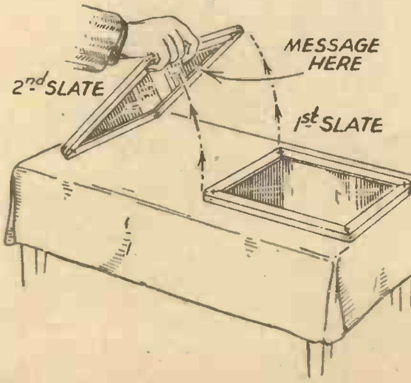


Fig. 4.—The two slates are placed together with the message in between.

If you want to produce a message on a slate while the audience themselves are holding it you can do so by the method shown in Fig. 1. Show the slate and mark it. Lay it down on a piece of newspaper while you borrow a handkerchief. Wrap the slate in the handkerchief and give it to a spectator to hold. As you have left the flap on the paper the message will be revealed on the slate when it is uncovered and, of course, the slate, having no preparation whatever about it, can be examined closely.

Fig. 3 shows a very crafty way of getting a short message on to one of a pair of marked slates without the need for disposing of any flaps or extraneous mechanism. Moreover slates and ribbon can be held by a spectator and thoroughly examined.

Preparing the Trick

To prepare the trick take two slates, both

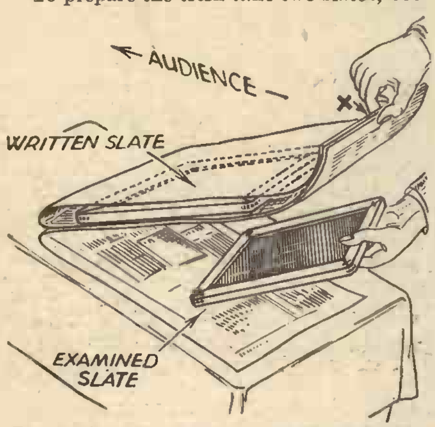


Fig. 6.—How the exchange for the written slate is carried out.

the same size, and a length of wide ribbon. Write your message across the centre of one slate, taking care to keep the lettering rather smaller than the width of the ribbon. It is as well to paint the words on the slate rather than use chalk, which may rub off.

Place the slates together with the message outside and tie the ribbon round them lengthwise as shown in Fig. 3. You can now show the two slates on both sides as the ribbon hides the lettering. Pick up a piece of chalk and ask someone to suggest a figure or a letter to place on each side of the slates. Mark the slates accordingly, then place them on the table with the lettering undermost. Untie the ribbon and lift off the top slate with a hinging movement so that its under side is revealed. Have a letter called out and mark this. Now comes the important part of the trick. Place the slate you have just marked, on the table and pick up the other one. Tilt it towards the audience so that they can see the top, which is the side previously inside when the slates were together. Mark this and lay the slate on top of the first one (Fig. 4). This brings the lettering between the slates, yet the audience have seen you mark all four sides of the slates. You naturally tell them nothing of what you are going to do but the impression firmly fixed in their minds at this stage of the trick is that they have seen two slates quite blank on both sides, marked with letters or figures of their own choosing.

Changing the Slate

You now hold the slates together and ask someone to tie them together with the ribbon and hold them. At the end of the trick the person holding the slates can untie them himself, verify the markings and find your message mysteriously written between the slates.

Another good way of producing a message

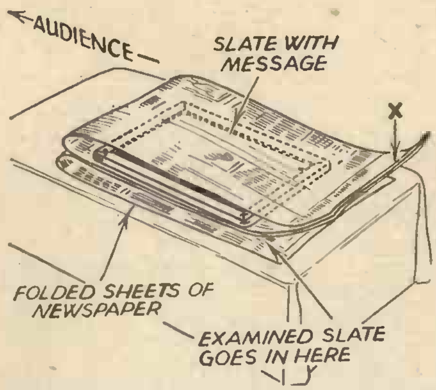


Fig. 5.—Producing a message by exchanging slates.

on a slate is by a secret exchange of the plain slate for one bearing the writing. Reference to Fig. 5 will show the preparation for this. The written slate is laid between the leaves of a folded sheet of newspaper. A similar folded sheet is placed on the table immediately underneath the one containing the slate. The folded edges of the papers are towards the audience.

A duplicate slate is shown and cleaned on both sides. It is then apparently placed between the sheets of a folded newspaper page and given to someone to hold. The exchange for the written slate is executed as shown in Fig. 6. The right hand holds the plain slate. The left hand apparently lifts the top sheet of paper but actually lifts the two leaves of the top sheet with the written slate between and the top leaf of the sheet below (X in Fig. 5). The blank slate is placed from behind, under the lifted sheets. The sheets are laid down and the written slate between the leaves of the top folded sheet is then slid off the table to the front.

The whole exchange is as easy as possible to do and there is not the slightest chance of the exchange being detected. For easy working the edges of the three sheets of paper marked at X, Fig. 5, should be folded up about an inch so that they can be grasped conveniently.

Producing Drawings

In this last method it is not, of course,

Fig. 8.—A velvet banner made to produce a message by dropping a length of ribbon or trimming on to it. The ribbon then becomes attached to the banner in the form of the desired words.

possible to mark the slates, but to offset this disadvantage, you can produce a whole chapter of magic writing covering both sides of the slates right to their edges. Or again you can produce drawings instead of messages on the slates.

If you really want to mark the slate when using this method you can do it if you are content with a message that occupies only the centre of the slate. In this case, having made the exchange of slates you carry the written slate forward in its newspaper jacket, then, as if by an afterthought, suggest that someone might like to mark the slate. Turn back the edge of the paper to reveal one corner of the slate and have it marked. Do the same if you wish with the other side. The writing will not be revealed during this marking and the slate can forthwith be left with the person who marked it, for the message to be discovered at the end of the trick.

There are two other ways of getting a short message on to a marked and examined slate. Both are ingenious but may prove a little difficult to operate. In each case the "slate" should be made of stout plywood painted black as someone has to sit on it.

"Looking-Glass Writing"

The first method consists of writing heavily in chalk on a piece of newspaper

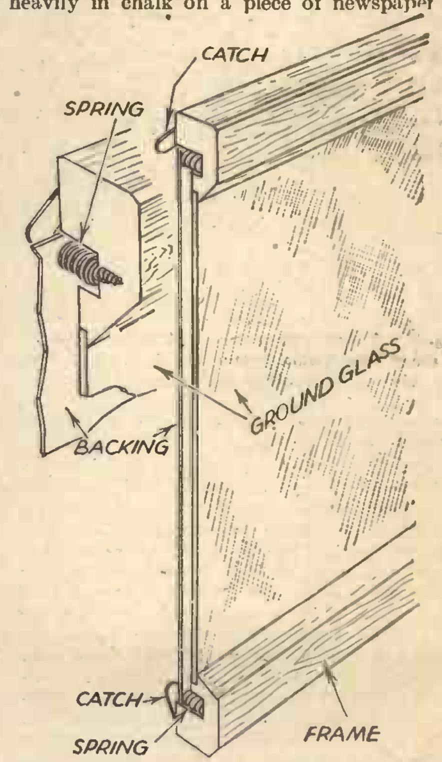


Fig. 7.—Small springs inserted at the corners to keep the picture away from the glass.

the word to be produced. The writing is done backwards, that is "looking-glass writing." The slate having been shown, is cleaned all over with a wet cloth, marked and wrapped up while still damp and someone is asked to sit on it. Care is taken that they sit on the side where the word is written on the paper and the weight of the sitter transfers the word to the slate where it appears right way round.

The second method consists of cutting out the required word from thick white paper and covering the back of the word with gum which is then allowed to dry. The word is placed loose in a sheet of paper which is then spread on the table just before the trick. Again the slate is washed and wrapped up while wet. Again someone sits on the parcel and by his weight causes the paper cut-out word to stick to the surface of the slate.

Another Trick

Still another slate-writing trick makes use of a ground glass drawing slate. The writing or picture to be produced is painted very boldly on white paper and put with two plain white sheets, into the frame, a plain sheet coming against the glass. The frame is taken to pieces and the sheets shown as two sheets, the printed one being held against a plain sheet and the two shown as one. In replacing the sheets into the frame the printed surface is brought next the glass. There must be a certain amount of play between the glass and the backboard and as long as the printed surface is kept separated slightly from the ground glass the slate will appear blank. By pressing the backboard against the glass and so bringing the printed surface against

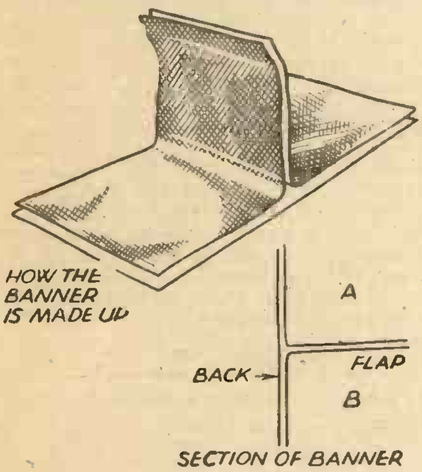


Fig. 9.—A black velvet banner made from two pieces of velvet, sewn together to form a flap, which covers upper or lower part of the banner as desired.

the glass, the writing or picture becomes clearly visible through the ground glass.

The trick would be very effective for producing a more or less gradual appearance of a picture and if the frame were specially made and fairly thick, small weak springs could be inserted at the corners as shown in Fig. 7 to keep the picture away from the glass until it was to appear, when gentle pressure with the fingers would produce the image.

Leaving the subject of slates, we find in Fig. 8 another means of producing a message. This consists of a black velvet banner made as shown in Fig. 9, from two pieces of velvet sewn together to form a flap which covers the upper or lower half of the banner as desired. The back may be covered with a third piece of velvet or with some quite different material.

The message is made by sewing a length of cord, tape or diamanté trimming onto side B of the banner to form the required words. The banner is held with the flap hanging down so that side A is visible and it appears blank. A length of similar tape or cord is shown and dropped onto the banner which is folded into a sort of bag with the tape inside. The corners of the flap are held against the top corners of the banner and the whole given a shake. The bottom corners of the banner alone are dropped and side B comes into view displaying the message apparently written with the cord just openly dropped in.

A Changing Bag

Another magic message can be produced in a rather striking fashion by using a changing bag or a hat with a moveable partition as described in a previous article of this series. In effect some big cut-out letters are dropped into the bag or hat, followed by a length of tape. The ends of the tape are held by members of the audience and when they are asked to pull the tape it emerges with the letters attached to it, forming the words required.

Fig. 10 makes clear the working. There are two lengths of tape and two lots of letters. The pre-determined words are made by sewing the letters to one length of tape. This tape is then packed into one side of the bag or hat and the ends of the tape left conveniently on top, knots being tied to facilitate finding them when wanted. The partition is then moved over so that the hat or the bag may be shown to be empty.

Duplicate Tape

The duplicate tape and loose letters are shown and dropped openly into the bag, the partition is moved over and it is the ends of the concealed tape which are given to the two spectators to hold. It will now be evident that when they pull on the tape a message will be drawn out and the bag can again be shown apparently empty.

It is a good idea in a trick of this kind to have a few loose letters in the same side of the bag as the strung message so that these may fall out at the end of the trick and be regarded as left-overs not required for the message. The use of the exact number of letters that were dropped in

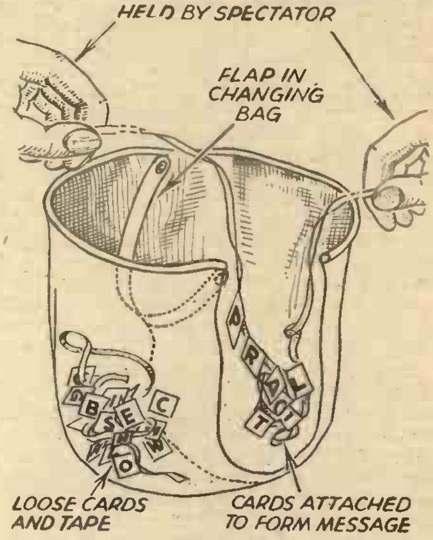


Fig. 10—How messages are drawn out of a bag.

might seem rather too much of a coincidence to be true.

It will, of course, be appreciated by my readers that the mere production of a message does not as a general rule make a complete trick. Sometimes it does, as for instance, making a strip of diamanté trimming form the words Good Night on the velvet banner is complete in itself. As a rule, however, the message is used to reveal the name of a card previously chosen, or the name of some celebrity, or perhaps the total of a sum. The required name or number has been previously forced by one of the methods previously described in these pages.

A good combination trick using a magic message can be built up by having the name of a country chosen by the audience. The name then appears written on a slate, a previously empty frame contains a photograph of the ruler of the country and a large flag of the same country is produced from a box or canister.

A NATURAL STORAGE BATTERY.

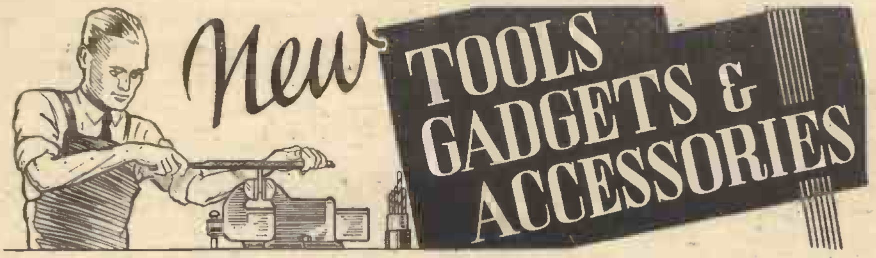
An Eel with a Kick in its Tail

THE Exide people seem to be prepared to go to any amount of trouble to further the interests of their batteries. Their technicians have even gone so far as to obtain an electric eel from South America. "Exide," as the eel is called, is a comparative youngster, he is only about 18 inches long at present, but will grow to a length of from four to six feet.

The batteries of the electric eel are hundreds of thousands of minute muscles separated by an electrolytic fluid. Human muscular activity is a conversion of energy in two stages : first from chemical to electrical; second, from electrical to mechanical muscular contractions. Because the eel's tissue is a modified form of muscle it is believed that the chemical processes by which human muscular energy is released are also utilised in the tissues of the eel, but that the process is reversed. The eel's electric organs produce voltages 1,000 times greater than are developed by human muscular activity.

Recently a Cathode Ray Oscilloscope was used to register the strength of "Exide's" electrical discharges. This showed that the eel at first gives off a small discharge, which is followed by a series of six successive muscular contractions producing discharges of identical intensity. Fortunately, perhaps, for his river companions, the eel's electricity is generated only when angry or hungry.

"Exide" the electric eel, in his tank.



A Review of Some of the Many New and Ingenious Tools which will be on View for the First Time at the Leipzig Engineering and Building Fair which Opens on March 5th until March 13th

Welding With a Gun

IT is often necessary for certain components to be welded again during the course of production on the assembly-line system used nowadays for the manufacture of motor vehicles, and a special spot welding device in the form of a gun has been produced for this class of work. It is intended that this tool should be hung up in a handy position over the assembly line so that it may easily be taken to any position where it is wanted.

Its usefulness has been well tested in one of the largest motor-car factories in Germany and it will become available on the market for the first time at the Leipzig Spring Fair. By the aid of this special tool it becomes an easy matter to weld places which are awkward to get at, as well as to carry out isolated spot welding on work that has to be done subsequently. It seems likely that this is a device which will very quickly be taken up in other branches of industry.

Rim-welding Machines

NOT only are numerous possibilities afforded for using welding machines in all branches of industry, but a large number of special designs have been found necessary for the requirements of the motor vehicle industry, so that work necessarily included in assembly-line production methods may be turned out rapidly and easily.

A very interesting and comprehensive assortment of equipment of this description will be found exhibited on the stand of one of the firms. Not only will machines be shown for rapidly attaching the wings to a car, but a machine which is certain to attract more than ordinary attention is a rim-welding machine which can weld 420 motor-car wheel rims per hour, which means that, in a few hours, it can turn out the entire daily requirements for a large output on the assembly-line system.

Unbreakable Steel Chisels

CHISELS are used for a great many kinds of work. As a rule they soon break, either at the cutting edge or at the top. If the former happens, the edge has to be forged anew and some attempt must be made to temper it if the tool is to be of any further use. Usually, however, the repair is not carried out very well, with the result that the tool is very soon thrown on the scrap-heap as worn out or useless.

A firm that specialises in tool-making is to introduce a new type of chisel to the market. This chisel does not possess the usual drawbacks, for it is ribbed on both sides for strength, and is made of chrome-nickel vanadium steel. The ribs strengthen the cutting end, and thus prevent the edges from chipping off, as so often happens. The practical shape of the new tool allows a saving of 50 per cent. to be made on the metal used for its construction, and results in a corresponding decrease in weight. At the same time, being evenly tempered all through, this chisel is considerably stronger and lasts much longer than others. The head, too, will give far harder and longer service than is usually the case. When the cutting edge becomes blunt, it can be sharpened again quite easily and it is not necessary to temper the new edge. Thus the chisel can be used until it is practically worn out. Both flat and cross-cutting models of the new invention are to be had, and we are sure that they will prove an economy both as regards time and material.

New Tools for Motor Mechanics

A PARTICULARLY large number of tools are used in motor-repair shops, for a single repair may necessitate the removal of innumerable screws and bolts of every shape and size. The mechanic requires not only a variety of spanners, but also hammers for all kinds of materials, and pliers of every description, and very few of his tools can be utilised for more than one purpose.

These difficulties will be removed to a considerable extent by a number of exhibits which will be on view. For instance, one firm specialising in these goods will display there a locksmith's hammer that can be adapted for use as a wood, rubber, copper, or brass hammer by attaching extra parts which are held in position by spring washers. The same firm is also showing a pair of angle-jawed pliers with slanting pincer tips, made of chrome vanadium steel. Although slenderly built and light in weight, these pliers can grasp and loosen any screw or nut up to 1 in. in diameter. Another pair of pliers is specially designed to deal with split pins; these too have obliquely cut pincer tips, which can grip a split pin in any position, and—thanks to their saw-tooth edges—can hold it securely. Being also equipped for cutting wire, the same pliers can be used to remove at once any projecting ends. Both pairs of pliers described are very strongly made, and can therefore safely be used even on very stiff fittings, etc., without any danger of their being damaged. All three types will render superfluous many of the implements hitherto used for specific purposes, and will be welcomed as very useful tools in many workshops.

Measuring Instruments

THE manufacture of measuring instruments and gauges was, in former days, a specialised branch of industry followed by a few who were master craftsmen in precision engineering, but nowadays the great demand made by industry for measuring instruments of dead accuracy has led to the production of a machine for making them. This machine will, for the first time, be introduced by its makers at the Leipzig Fair.

Actually, this machine is a form-grinder of such accuracy that it can work to a limit of ± .00008 in. and can produce limit gauges ("go" and "not go" gauges), stamping dies, open or split matrices, relieved tools of special form, round patterns with radial and axial profiles, and special cams for automatics. The work is machined by a grinding wheel 5 in. in diameter running at a peripheral speed of 50 to 100 ft. per second. The machine is controlled from a special overseer's platform from which each working operation can be seen projected on to a screen and enlarged 50 times, every movement, both of the work and of the grinding wheel, being able to be accurately followed on this screen and correctly adjusted as well by two control wheels, so that, although the machine's accuracy is guaranteed to ± .002 in., it is an easy matter to bring this down to ± .00008 in. In the interior of the machine a vibrationless dust extractor is fitted. The electrical switchgear and controlling instruments for operating all the motors are arranged on the control platform, as well as the lighting device, and there is also photographic equipment provided, so that once any type of gauge has been made, it can be recorded in photographic form. The weight of this machine is 1 ton 10 cwt. 2 lb.

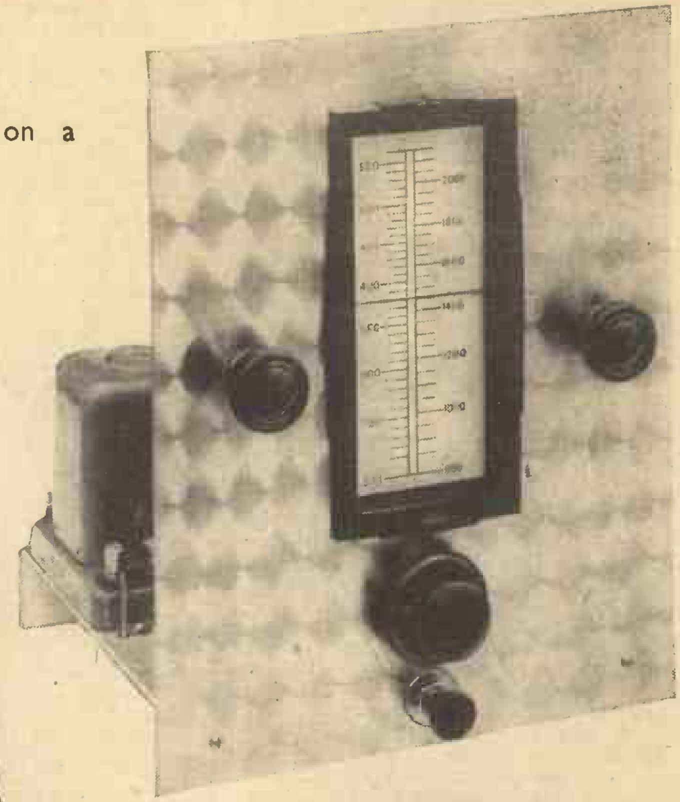
A New Filing Machine

IN numerous instances nowadays machine filing, with its greater accuracy and saving of time, has largely superseded hand filing. A firm in Central Germany which specialises in such machines will show a new type, this machine having not only two filing discs or rings for surface filing, but also being equipped with devices fitted to a flexible shaft for grinding, pivot grinding, drilling, etc. The machine will deal with all ferrous and non-ferrous metals and must be regarded as absolutely indispensable for working on materials of a softer nature, such as aluminium, lead, copper, bronze, etc., which are difficult to grind on account of the grinding wheels getting clogged. Four speeds are provided, so as to adapt the rotary files and the flexible shaft to the particular degree of hardness of the material to be worked, all clogging of the teeth being obviated by the special undercut teeth of semi-circular form on the rotary files and rings, as well as ensuring good clearance of the cuttings. This machine has been designed specially for service on constructional work (i.e., bridges, etc.); it takes only $\frac{3}{4}$ h.p. to drive it, is of very substantial construction and weighs only 441 lb.

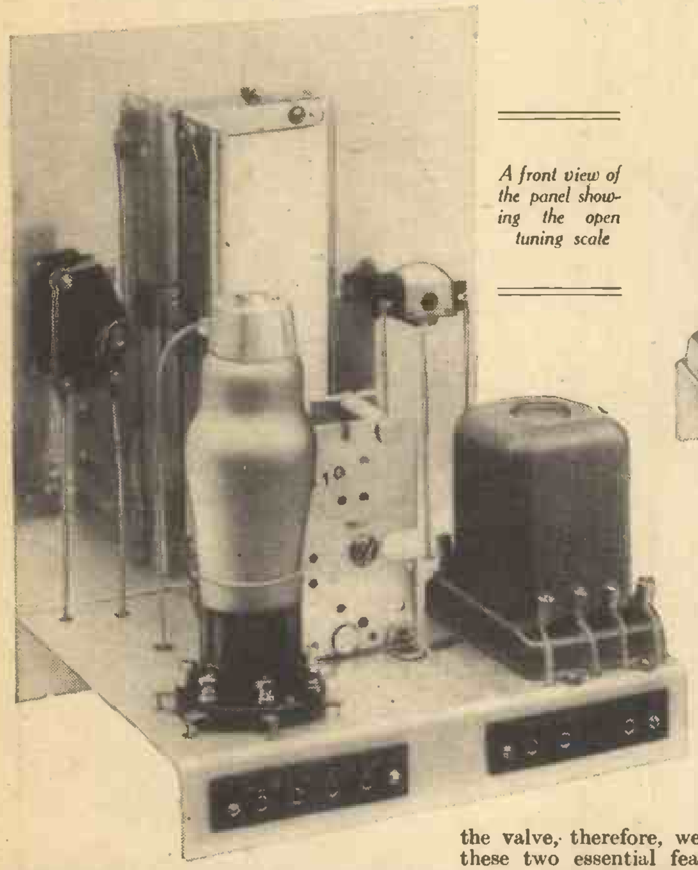
"PRACTICAL MECHANICS" WIRELESS EXPERIMENTER

THE P.M. 1939 ONE-VALVE RECEIVER

Constructional Details and Operating Notes on a Simple and Efficient Single Valve Set



A front view of the panel showing the open tuning scale



This three-quarter rear view of the "P.M." One-valver shows the business-like layout which is adopted

ONE of the most useful receivers for a beginner or anyone requiring individual reception is that employing a single valve in conjunction with an efficient circuit.

To provide a design of this type we have produced the P.M. 1939 One-Valve Receiver, and, as with all our designs, we have spared no trouble to produce a simple piece of apparatus combined with the highest degree of efficiency, and so arranged that the veriest beginner will experience no trouble with the constructional work.

From the appearance point of view, the panel, which is formed from machine-finished aluminium, and which supports the three controls, makes the receiver distinctive and quite professional.

As it is of vertical oblong shape we selected the Polar vertical dial, the scale being marked in wave lengths which are clearly visible from all angles.

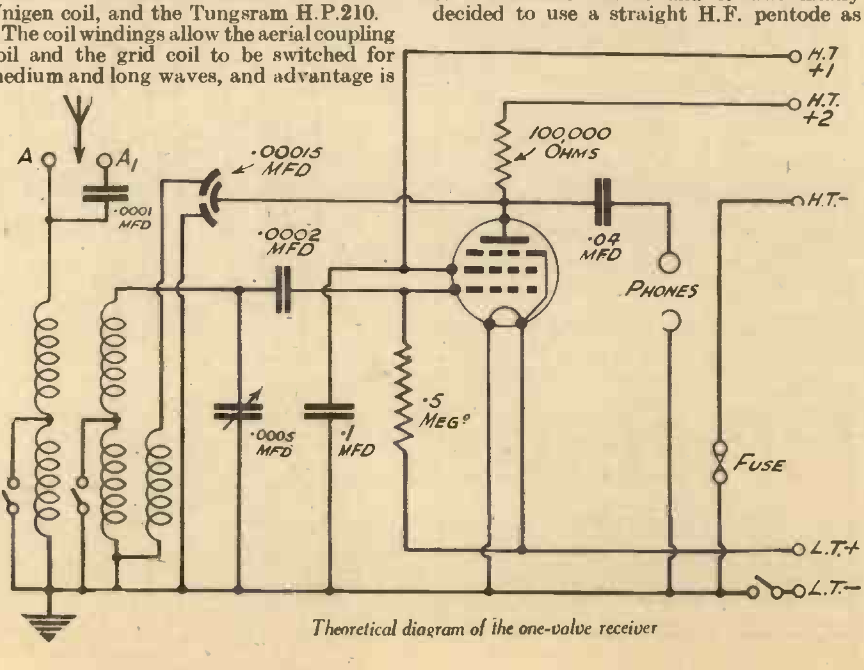
To the left of the dial is situated the wave change switch, to the right is the reaction control, while directly underneath the tuning knob is a small push-pull switch which is used to switch the receiver on and off.

One might say that the efficiency of a receiver of this type is governed by the coil and the valve, therefore, we have selected for these two essential features the Wearite Unigen coil, and the Tungsram H.P.210.

The coil windings allow the aerial coupling coil and the grid coil to be switched for medium and long waves, and advantage is taken of this to secure the maximum selectivity. In this direction alternative aerial connections are also provided so whatever type of aerial is used, it should be possible to secure the most satisfactory operating conditions.

The tuning and reaction are controlled by polar variable condensers, which allow a very smooth action to be obtained.

The advantages and disadvantages of triode versus pentode valves were explored to the fullest extent and it was finally decided to use a straight H.F. pentode as



Theoretical diagram of the one-valve receiver a leaky grid detector, as the gain obtainable more than repaid for the slight addition of cost and wiring.

With correct screen voltage, this type of valve forms one of the most efficient detectors, and as the headphones are connected to the anode circuit of the valve via a resistance capacity coupling, the maximum output is secured with the minimum of distortion.

This arrangement also serves another purpose. In many cases, it will be desired to use a battery eliminator which, if of the D.C. type, is in direct contact with the mains supply, and this might raise some doubts regarding the advisability of using headphones. The resistance capacity output, however, removes any fears that one might have in this direction as the headphones are isolated from any direct current voltage.

Again, it may be necessary at some future date to add an L.F. amplifier to the receiver. Through embodying the output circuit mentioned above, such additions will be rendered quite simple.

To simplify the wiring a small metal chassis has been used, and it also allows the panel to be securely fastened by two bolts.

There is very little constructional work in a simple set of this type, and as we have used a baseboard type valveholder the amount of metal cutting on the chassis has been reduced to a minimum. Clearance holes for the connecting wires are the main details, with clearance holes or slots for the terminal strips on the rear runner. For these you can drill either single holes for each socket, or a slot to accommodate all of the sockets on each strip. The condenser will have to be mounted on small feet in order that the dial may be placed sufficiently high to enable the control knob to clear the push-pull switch below it. The first job, therefore, is to cut the panel and then to place the dial in position with the condenser behind it. The spindle should, of course, be placed in the socket on the dial. This will give the height of the condenser above the chassis and the size of the feet may, therefore, be measured. The three panel controls may then be placed on, and the panel bolted to the chassis. Mount the tuning coil, noting carefully that the terminals are in the correct position, which may be judged from the wiring diagram given on this page.

LIST OF COMPONENTS FOR THE "PYRAMID" ONE-VALVE RECEIVER

One vertical C.K. dial (Polar).
One No. 5 tuning condenser, No. 5 .0005 (Polar).
One reaction condenser—Compax differential .00015 (Polar).
One Unigen coil (Wearite).
One valveholder—V.H.22 (Bulgin).
One grid condenser—type 451, .0002 mfd. (T.C.C.).
One anode condenser—type 451, .0003 mfd. (T.C.C.).
One coupling condenser—type 451, .04 mfd. (T.C.C.).
One series condenser—type 451, .0001 mfd. (T.C.C.).
One screen condenser—type 341, .1 mfd. (T.C.C.).
One grid leak—.5, ½ watt (Erie).
One anode resistance—.1 meg., 1 watt (Erie).
One switch—S.114 (Bulgin).
One switch—S.22 (Bulgin).
Two terminal strips—1.3 sockets—A., A.1, and E., 1.2 sockets, L.S. (Clix).
One panel—9¼ in. x 7½ in.—Alu. (Peto Scott).
One chassis—7½ in. x 6in. x 1½ in.—Alu. (Peto Scott).
Fuse—100 mA. (Microfuses).
Fuseholder (Microfuse).
One H.P.210 metallised valve (Tungsram).
One pair earphones (Ericsson).
One 120 volt H.T. battery (Exide).
One 2 volt 40 A.H. accumulator (Exide).
One Stentorian loudspeaker (W.B.).

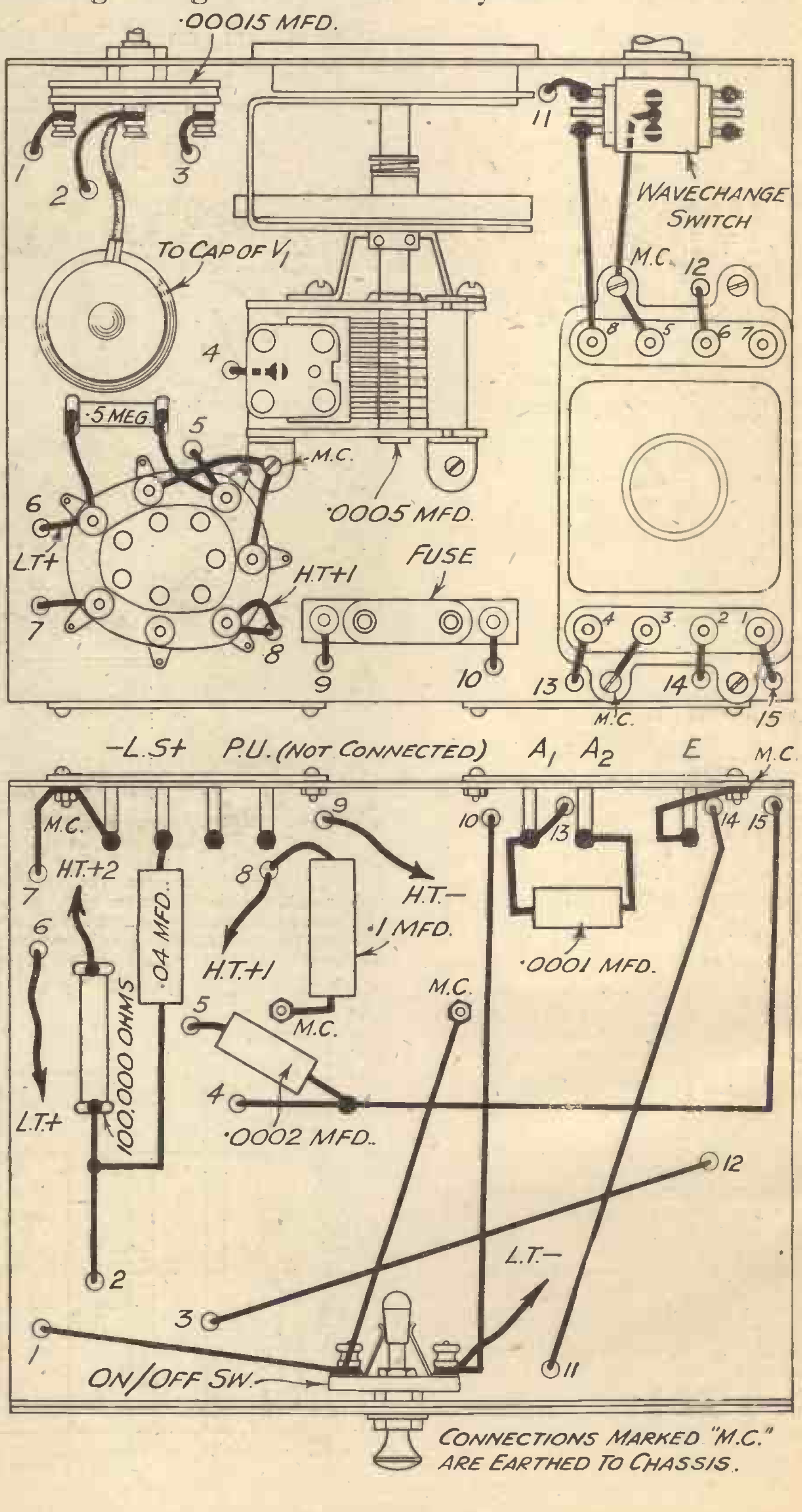
Wiring

Wiring should be carried out with heavy insulated wire, clearing off the insulated covering where the wire is joined to terminals. Soldering will have to be adopted in certain places such as on the switch, as terminals are not provided on this particular component. In the interests of reliability it is also advised that the leads to the valveholder be soldered, tags already being provided on the base for this purpose. A word of warning may be offered here not to use pliers to tighten up the terminals on the coil unit, as if undue force is used there is a possibility that the terminal may be loosened and poor contact may develop.

When wiring is completed it should be carefully checked, preferably following the theoretical circuit as a cross check. Con-

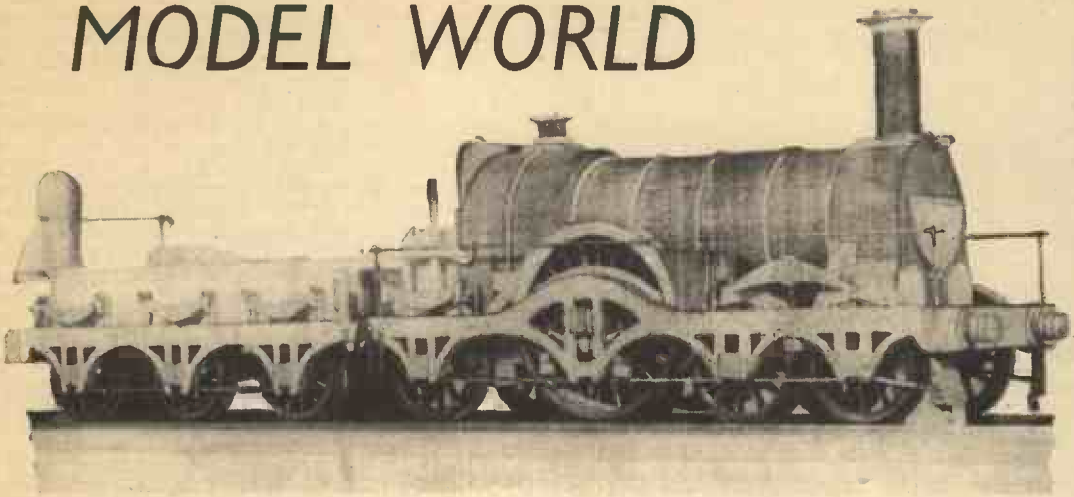
(*Continued on page* 342)

Wiring Diagram of the "Pyramid" One-valver



"MOTILUS" PEEPS INTO THE MODEL WORLD

"Motilus" Our Model Fan Tells you More of his Adventures (with a Camera!) in the Model World!



A 3-m.m. scale model of the broad gauge locomotive "Lord of the Isles"

IT has long been a fascinating hobby to make your own ship model miniatures, but the more difficult hobby of making non-working models of locomotives to a small scale is equally fascinating, if you have just that little more patience and adaptability in achieving your object. A friend of mine has been interested in the articles on the progress of steam transport, which W. J. Bassett-Lowke, M.I.Loco E., has been writing for "Practical Mechanics," and has just completed a 3½-m.m. scale model of the famous broad gauge locomotive of 1851, Gooch's "Lord of the Isles" (a drawing appeared in the March, 1938, issue). Other details he obtained from the article on the large model written and illustrated by Mr. E. W. Twining for this paper in the August 1934 issue. You will see from the photograph of the unpainted model, that the boiler barrel is of hard wood, the side frames of Bristol board, and the wheels (he tells me) were obtained from a gauge "OO" suppliers. The other small details are of metal and the model is now ready for painting. The length is 6½ inches over buffers, and the height from rail level to top of chimney is 2 inches. What an attractive and unique ornament this will make for the study of a lover of the old broad gauge of the last century. It took my friend 102 hours to make the model and he will probably need another 30 or 40 hours to do the painting. This will give you some idea of the amount of time involved in making a small, accurate scale model by hand.

A Model Railway "Crash"

I know one model railway owner—no other than Mr. Cecil J. Allen, the well-known railway writer—whose outdoor gauge "O" railway is the rendezvous of all keen model railwayites for miles around. The railway is laid out-of-doors with a central building, which forms an indoor station for the railway. Mr. Allen's railway is most realistic, even to the staging of model railway "crashes" on special occasions to entertain his visitors. Here is one. The main line express appears to have cut through the middle of a goods train, which is setting back on a siding.

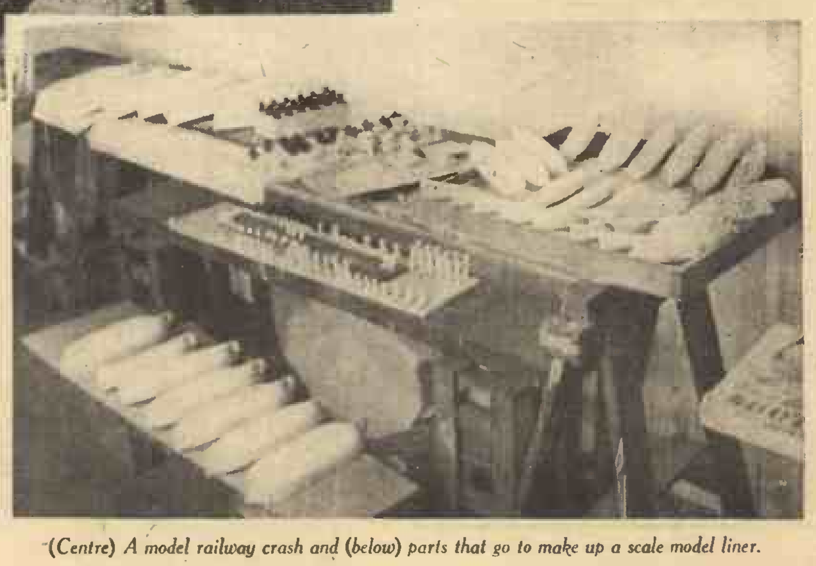
Was it the signalman's or the driver's error?

Model Liners

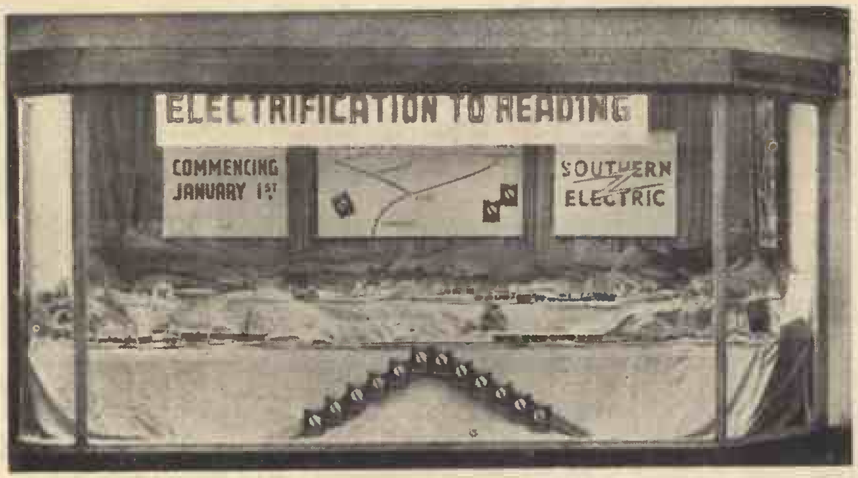
The details that go to make up a scale model liner are more numerous than the "waves on the ocean," and when they are made, whether in metal or wood, they must be hand-painted. Here is a group of lifeboats, capstans, ventilators, bollards, and other parts of a liner like the *Mauretania* or *Strathmore*, going through the paint shop of a modern model shipyard.

"OO" Gauge Layouts

I have seen some smart gauge "OO" layouts recently. The Southern Railway hit on an attractive idea with their display to bring to public notice the extension of their electrified system to Reading. They wished to convey the impression of the railway run from Waterloo to Reading, and the background included several high spots of the journey, as for instance, Ascot race course, rowing sports on the Thames, Windsor Castle, and wooded Virginia Water. Reading, itself, as a thriving manufacturing town, was featured, as also was the other terminus—Waterloo, and the impression of "distance" between the two was achieved by laying out the display on two different levels—two double road oval tracks, which faded into the background scenery. The operator had four electric trains running, practically without a stop between 10.30 a.m. and 7.30 p.m., and the two goods trains demonstrated the fact that the Southern Railway do not only run electrified passenger traffic but goods traffic also.



(Centre) A model railway crash and (below) parts that go to make up a scale model liner.



The Southern Railway hit on this attractive idea to bring to public notice the extension of their electrified system to Reading.

From America

(Although "Motilus" has not yet had the opportunity of visiting America, he has friends near and far, and one from this progressive land across the Western Ocean, shows himself a real enthusiast about British Railways.)

Lieutenant W. C. Johnson of Newport, Rhode Island, has sent me details of his G.W.R. 2-6-0 Mixed Traffic locomotive. He says: "This engine has pulled trains consisting of six and seven standard American Pullman cars at a sixty and seventy m.p.h. speed . . . has operated on several lines in the United States, and has elicited praise all over the country as I have taken her to duty with me as I have been assigned by the U.S. Navy Department. After consulting a retired G.W. engineer who lives in Vancouver B.C., Canada, I have added cab detail, and have also turned her flanges off to conform to National Model Railroaders' Association standards of this country.

"I have built rolling stock for this engine and patterned it after the older Great Western designs for their rolling stock. Incidentally, after meeting several model railroaders who hold to British prototype, I feel the trend among the dealers of this country is towards models of older English equipment, such as six-wheel carriages, four-wheel carriages, older engines such as the Great Western standard gauge 'singles' and the Caledonian's of race fame, the Stirling engines of the G.N.R. and Webb's 'Hardwicke' and 'Charles Dickens' of the old 'Nor'west'."

American dealers carry as stock items representative pieces of early American rolling stock such as "Balloon Stack" wood burning engine prototypes and "open-platform" cars.

Building up the casings for a new Gauge "O" locomotive, the 5 x P class "Victory" No. 5712

Building Model Locomotives

So much for America. Here is a photograph taken in the heart of England, where I found myself on the zealously guarded ground of a well-known model factory, making anything from scale model rails to intricate gears. The gear machine flooded with oil, cutting grooves silently and neatly on the mild steel blanks merited more examination than I was able to give, and I was fascinated by the ingenious methods of assembling the bogie frames of various locomotives, large and small. This picture shows the building up of the casings for a new gauge "O" locomotive, the 5XP class "Victory" No. 5712. This is a later edition of No. 5701, "Conqueror," and both these L.M.S. locomotives are strongly reminiscent of G.W.R. practice, with their coned boilers and curiously-shaped cab roofs. In the power classification "5XP," "P" indicates Passenger, and "5X" a power half-way between classes 5 and 6.

Delving into the Past

Reminiscences of the past! One of the first large-scale models ever placed upon the market was the old Midland Compound No. 2632, which was ⅜-inch scale and 3¼

One of the first large-scale models ever placed upon the market—the Midland Compound 2632.

gauge, and was built entirely of brass castings. It was unique in its time and, in a way, marked the beginning of the making of scale model locomotives by semi-skilled amateurs. I happened to be looking through a pile of old model catalogues the other day and came across one issued in 1903 by Bassett-Lowke and Co., before this model firm became a limited company, and found this model, and here is a short description of it. The prices, too, are interesting compared with the present day. The locomotive was built entirely from castings, the footplate side frames and every little sundry being supplied; in fact, there were over 130 castings in the set. The boiler was fitted with a downcomer and circulating tubes. The complete set of castings and working drawings were £5; the finished boiler, £3 19s. 6d.; and the complete locomotive, tested to 120 lbs. pressure, fitted with spirit and water tank, hand force pump, steam gauge, water gauge, cylinder drain cocks, etc., was priced at £25. Mr. Douglas Picknell of Birmingham has sent me photographs of his No. 2632 model, which he first saw as a schoolboy at Bexhill. He has just rebuilt the locomotive, adding a new boiler, and hopes to see her running on the Birmingham Societies continuous track, which is 100 yards in circumference and will accommodate locomotives up to 5-inch gauge (No. "O," 2½, 3¼, 3½, and 5-inch). His locomotive is 3½-inch gauge.

(*Continued on page 342*)

Items From Manufacturers

CATALOGUES AND NOVELTIES

Fixing Devices

WE have recently received from The Rawlplug Co., Ltd., a copy of their "Fixing Devices" brochure which is now in its tenth edition. The brochure gives details of a number of new gadgets which have been introduced in recent months.

A newcomer is Rawlplastic, which is for filling and plugging irregular holes. It is an asbestos plugging compound and it is necessary to immerse this product in water and ram home the material into which it is placed, to make a really sound fixing. Also, there is a Plastic Plug which is in the form of a cigarette plug and is made of similar material to that of Rawlplastic. Here again, it is immersed in water and rammed into the hole to effect fixing.

Screw anchors have been produced as a result of some users demanding a plug that incorporates a flange and which could be used for bottomless holes, that is in hollow bricks, partitions, etc., but would also, as a result of having been made of lead alloy, be suitable for external fixings.

Other devices include the Rawldrive, which is a screw that can be driven home with a hammer, Rawlbolt pipe hangers, electric hammers and drills and tubular boring tools.

Cold-Water Glue

HANDYMEN will no doubt be interested in a new type of glue which is now on the market. It is known as "Casco" and is sold in the form of a dry powder, which, when mixed in cold water, forms a liquid glue of great strength. It sets by chemical action and becomes highly resistant to moisture and heat.

"Casco" will bind firmly and permanently almost everything. It will not bind together non-absorbent materials such as metal, rubber, etc., as one of the materials to be glued must be sufficiently absorbent to let the moisture in the liquid glue disperse. 1 lb. of glue powder makes 1½ to 2 quarts of liquid glue.

Motorised Cycles

GEORGE GROSE, LTD., Ludgate Circus, E.C.4, have recently issued a catalogue in which is listed all makes of motorised bicycles. This firm keep a comprehensive stock of all motorised cycle spares, and are sole City of London agents for Villiers engine spares. Any part, from a screw to a frame, can be obtained from their normal stocks. All the machines listed are priced in the neighbourhood of 18 guineas. Road tax on these machines costs 12s. per annum, or 3s. 4d. per quarter or part thereof. Renewals are effected by obtaining the necessary forms from any post office, completing and sending to your local county council with the necessary remittance, log book and insurance certificate. It is, of course, necessary to have a driving licence and this can be obtained by applying at your local post office. Cost: Provisional licence, 7s. 6d. (for a learner); renewals, 5s. Holders of provisional licences are required to carry "L" plates, and these are obtainable from the above firm at 3d., 6d. or 1s. each. The catalogue is obtainable from the above address, priced 3d.

Loose-Leaf Catalogue

WE have just received a copy of the new loose-leaf catalogue issued by Dennis & Smith, 83, Goswell Road, E.C.1.

A nominal charge of 1s. is made for this list, but this amount is redeemable on the first orders of, or to the value of, 10s. This charge also includes all further sections, issued in loose-leaf form, for clients' insertion into the loose-leaf cover, and all price lists which will be issued in the same form.

The catalogue, as now issued, contains 18 leaves on which are listed all types of tools, including vices, drills, bellows, treadle grinders, saws, lathe accessories of all types, pliers, wire gauges, etc.

In the drills section is listed a sturdy motor-in-hand electric tool adaptable for use for grinding, routing, drilling, polishing etc., on almost any kind of materials. It has a speed of about 25,000 r.p.m., and weighs only six ounces.

A Model Plank-Built Schooner Yacht

(*Continued from page* 322)

hemming, but finish the edges with ½-in. "Paris Binding." This is a special kind of tape that will not stretch. Fold the binding all along the middle, lay the edge of the sail on the fold, and stitch the whole length with a double row of machine stitching. Be careful not to pull the edges before the binding is fixed or you will spoil the smooth set of the sail. Don't attempt to bend the binding round the corners, but cut a separate length for each side of the sail and let the binding cross at the corners. A small triangular piece of the sail cloth, about an inch wide at each corner, to make a double thickness and strengthen the corner, is an advantage. Our yacht will carry the sails illustrated in a moderate breeze, but for strong winds a suit of smaller sails is required.

Fix a small brass eyelet at each corner through the double thickness of tape as indicated in Figs. 22 and 23. No battens are needed for these sails, as the sides are all straight. Fix four ¾-in. curtain rings to the mast side of the mainsail and three on the foresail; brass rings will do, but white ivorine ones look very neat.

Bending the Sail to the Spars

The method of "bending" (*i.e.*, fixing) the sail to the spars is illustrated in Figs. 22 and 23, but a word of explanation is necessary. First tie the sail to the mast end with two or three turns of fine twine through the eyelet. Then tie a length of string in the eye at the outer corner and pull the sail outward along the spar, by threading the string through a hole in the spar and tying the other end to the shank of a screw eye. This forms an "outhaul." The sail can then be bound lightly to the spar at intervals through small holes as shown. Fig. 22 shows the foresail gaff, etc., but the main gaff and its topsail are rigged in the same way. All other rigging details can be gathered from the illustrations. Fig. 22 looks a bit complicated at first, but if it is studied carefully it will be found quite explicit. Special twine from a model dealer should be obtained for the rigging; don't waste your time with string.

The Sail Rings

The rings of the sails should be threaded on to the masts before the latter are "stepped" into their fittings. The shrouds are simply looped over the masts, the loops being prevented from slipping down by two screw eyes, and the lower ends of the shrouds are hooked into eyes screwed through the deck into the inwhale. About two dozen bowsies will be required; these should be bought, as they are quite cheap, but troublesome to make. Also get two circular bowsies for the main boom (see Fig. 26). The rubber band below the foresail boom is to keep the boom down, thus preventing the gaff from swinging out too far. The mainsail, being wider, does not need one. The bowsprit should project forward 6ins.; fix it in this position by drilling a $\frac{1}{16}$-in. hole in it for the pin shown in Fig. 17.

The Rudder

The rudder is shown in Fig. 24. It is made of brass, the rod being split with a hacksaw, the flat part inserted in the split and soldered.

The steering gear is of the author's special design; it follows the principle of the usual Braine steering gear, but is easier to make and to operate. The construction is fairly obvious from Fig. 25. The sliding bolt is an ordinary cheese-headed 4BA screw, with the head filed down thin; the ⅛-in. groove is formed by screwing on a nut to the required position, soldering it in place and filing it to the shape shown. The upward projecting part fits into the slot to prevent the bolt from turning when the knurled nut is turned. The elastic band is slipped over the rudder tube and on to a screw *close up* to the end of the slotted tiller arm, and the sliding bolt goes between the two lengths of rubber. The rubber needs no adjustment once a suitable band has been fitted. By sliding the bolt along the slot the leverage between the elastic and the tiller is altered, and this, of course, controls the movement of the rudder itself. There must, of course, be no tendency to binding in the rubber tube. Fig. 26 shows how to rig the rudder gear and the main boom.

When "beating," *i.e.*, sailing as nearly as possible against the wind, the "beating sheet," fixed to the hawser, is used, the sail being pulled in close; the rudder is then inoperative and centralised by the elastic. But when "running," *i.e.* sailing with the wind, the mainsail will be well out over the side and will tend to turn the boat round. The beating sheet is then unhooked and the running sheet brought into use, thus operating the rudder to correct the tendency to turn.

IT'S A SMALL WORLD

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

Fig. 1.—High-speed vertical engine and boiler with oscillating cylinder and steam valve.

Fig. 3.—This locomotive is only 2 in. long.

As the power of men grows, so do their productions grow. The *Queen Mary* was greater than the *Mauretania*—soon the *Queen Elizabeth* will be greater still. The 4-6-0 Pacifics were greater than the Atlantics, now the huge *Duchess of Buccleugh* is more powerful than either the *Royal Scot* or *Princess Royal*.

So in this world of growing powers, it is unique to find the exquisite workmanship which makes a perfect thing of microscopic proportions. Tiny *working* models of engines which can be encased by a silver thimble. Models which need but a puff of compressed air to set them in motion. These are the rare models which fascinate more than anything. They are to scale and they work, perfect replicas of their huge prototypes.

The three models illustrated of this "magnitude"—or should we say smallness—are the work of George Cresswell, of Tottenham, queried by their creator as the smallest working models in the world, and indeed I should say that here they have a strong claim.

Vertical Engine and Boiler

The high-speed vertical engine and boiler shown in Fig. 1 was made over thirty years ago, and took over two years of Mr. Cresswell's spare time. He was inspired to make the model to work under a thimble after seeing one, styled the "smallest in the world," about two inches high, at the Science Museum, South Kensington. His own model, shown in Fig. 1, is only ·7 of an inch high, and is complete with oscillating cylinder and steam valve. Every part of this tiny model was made from the solid, and altogether he experimented with four types of engine before he had the satisfaction of seeing one work. It was designed to work by steam, but this necessitated so much cleaning of the delicate parts that compressed air was found the more satisfactory motive power. This is led through the bottom of the boiler, through the steam pipe to the cylinder. The bore is ·06 of 1 in., and the stroke ·085, and the model revs. to 5,000 per minute and works quite comfortably under the casing of a thimble!

Mr. Cresswell tells me that he did all the turning for this model on a 6-in. treadle lathe, even to the steam and exhaust pipes, which are only ·03-in. in diameter, with a bore of about .012 in.! These microscopic holes were drilled with a small flat drill held between finger and thumb.

The Second Model

In the second model—the double-acting slide-valve vertical engine and boiler, with feed pump—his greatest difficulty was the making of the cylinder. This is in gunmetal, and he had to drill the steam and exhaust ports and the steam ways to cylinder ends by home-made flat drills held between finger and thumb. Screwed glands were fitted to the cylinder for the piston and valve rods, and the steam chest cover was fastened by screws. The crank-shaft bearings, of phosphor bronze, were fitted with lubricators, and all the fittings, steam valve, safety valve, fire door, pump, etc., will work. The dimensions of this intricate model are as follows: Bore, .08 of 1 in.; stroke, ·095 of 1 in.; height, ·7 of 1 in.

Fig. 4.—The two vertical engines compared with a thimble. The uncovered one is the one with double-acting slide-valve cylinder.

Third on the list comes Mr. Cresswell's locomotive. Until quite recently his knowledge of locomotives was practically nil. However, with the help of a few photographs, data, and pencil sketches, he made a start on this task. The frames were constructed first, and the cylinders, as with his previous models, were a source of trouble. He made them from hard bronze, bored by means of drills and D bits. The ports and steam ways he had to drill by hand, and he fitted screwed glands for both the piston and valve rods. As he intended to use screws for the working parts, and the smallest screws available were .025 in., actually the scale of the locomotive was determined by the size of the screws. All the working parts, such as links, screws, studs, etc., were hardened and tapped after hardening. The motion work, coupling rods, return cranks, connecting rods, smokebox door hinges, and boiler fittings were made from German silver, hammered out for toughness.

Fig. 2.—High-speed double-acting slide-valve vertical engine and boiler with pump.

The Walschaerts valve gear, as might be anticipated, proved a stiff problem, but Mr. Cresswell's patience overcame all obstacles eventually and the model was finished. That, however, did not mean that it would *work*, and it took much time and adjustment before the model was ready to show at the Model Engineer Exhibition, where, with its comrades, it gained for its industrious maker a "Highly Commended" diploma.

The dimensions of the locomotive are as follows: Length to buffer, 2 in.; bore, ·085 of 1 in.; stroke, ·1 of 1 in.; height, ·73 of 1 in.; piston rod diameter, ·03 of 1 in.; slide valve rod diameter, ·025 of 1 in.; axles diameter, ·04 of 1 in.

It would interest me very much indeed to find smaller working models than these.

The Piano—A New Method of Learning to Play It

By MAURICE REEVE

THE PRESENT ARTICLE ON TEACHING THE PIANO DEALS WITH DEVELOPMENTS ON THE SUBJECTS PREVIOUSLY DEALT WITH.

LET us bring our studies of the subject that has occupied us in the preceding articles to a conclusion with a résumé of them, in the form of an examination, and then a little talk on what we can build from the foundation which we have laid.

Making the Fingers Respond

Our original desire was to be able to sit at a piano and to play music that we put up on the desk in front of us. It was realised that, in addition to every note we wanted to play being on that score and the score having to be referred to before we could play anything at all, that every effect we wanted to produce was there also. Every degree of loud and soft, quick and slow, the whole rhythm of the piece—everything was represented on the copy in various ways and by various signs, and that before we could produce any sound from our instrument that was worthy of a better title than "banging," "strumming" or "vamping," we had, first of all, to thoroughly understand how to "read a score." The next great point after gaining all this knowledge was to make the fingers respond to what the eye had previously read. It was obvious that some special work had to be given to them to make them adequately perform the multitude of "tasks" which the score ordered them to do, and that a system for distributing the fingers over the notes in the most convenient groups and shapes for playing the notes with as little fuss and bother as possible would enormously help us in achieving our object.

Sound and Time

Thirdly, we had yet to understand the twin elements of a musical composition—sound and time—to understand the inseparable nature of their association,

Above and on the facing page are given studies in single notes beyond the compass of five notes, employing the thumb as pivot the ascetic needs of both in relation to the whole and the elements going to the make-up of each. A manual of scales is provided together with a chapter on their construction very largely with the object of helping you to understand what "key" is, and the relation of one key with another, in addition to their being indispensable exercises for your fingers. The ability to "hear" the key the piece is in is such an enormous help when reading.

We will postulate some questions, and if you can satisfy yourself that the answers are all "yes," then you should be ready to proceed with the next stage in the study of playing the piano. Imagine you are playing a piece—any piece—and that the questions are being asked you as you come up against the problems during the course of the piece :—

Problems

(1) Can your fingers play these semi-quavers, just coming, within the specified time measure? Or will you have to "slow up" in order to get all the notes in?

(2) Can your fingers hold on to these minims and crotchets, giving each one their full value in tone? Or will you hurry through them?

(3) Take these two dotted notes in the next bar. Can you apportion the value of the beat correctly between the dot and the following note?

(4) Do you know how to execute these slurs, or binds *between* these next notes and this one *over* these other notes?

(5) In what pitch, or compass, are you going to play the piece "Boite de Musique"? Do you understand the directional sign for this at the commencement?

(6) How are you going to count, according to the time signature, in the piece "Hide and Seek"?

(7) Is there any difference in the keys of the two pieces, "Boite de Musique" and "Le Coucou," and, if so, what is it?

You can ask yourself similar questions, always remembering that you must, first of all, understand *what* it is you have to play; how you play it comes afterwards.

"Trustworthy" Fingers

So far the tasks allotted to the fingers have been almost entirely of a mechanical nature. In these first stages the necessity for getting everything right is so paramount that there is little room left for other things. But in the next stages the fingers will be called upon to do very much more; they will have to "interpret" the music and to paint the picture according to the title and character of each piece. No credit whatever will be given for having things right—only censure if they are wrong! That is why it is so important to get the mechanical side done with as soon as possible. Make the fingers "trustworthy," so that a crotchet will always be a crotchet and B Flat B Flat, etc., because the real interest and pleasure in studying the piano only begins to unfold itself when we can forget crotchets and quavers, and lines and spaces—knowing that the fingers will always "add up the bill" correctly—and give ourselves up to the pieces, their keys, modulation, rhythms, harmonies, etc., etc., and enjoy the scenes and pictures which the composer has painted for us. This should be your reward on commencing the next stage of your studies.

(x) DO NOT HOLD ONE HAND OVER THE OTHER

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 344, 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.

DRIVING A LATHE

"I HAVE recently purchased a Myford 3½ in. lathe, and intend to drive it by means of a ½ h.p. electric motor. Can you advise me on a suitable motor?" J. W. (Kingsbury, N.W.9).

YOU require a split-phase 240 volt 50 cycles motor of ½ h.p. This machine will be for single phase and can be run from a 5 amp. point and requires no special starting gear. The consumption is between 300 and 400 watts, depending on load, and the speed 1,425 revs per min.

COLOURED LANTERN SLIDES

"I WISH to produce hand-drawn lantern slides and if possible to colour them. Can you suggest a suitable method and are there any books on this subject?" A. B. (Leeds).

A GOOD way of obtaining coloured diagrams on lantern slides is to use the finest ground glass obtainable and to draw upon this the diagrams in ordinary Indian ink or water colours. If by any chance the grain of the glass shows on the screen it can be eliminated simply by flooding the slide with a layer of varnish made by dissolving gum dammar in benzene, or by means of celluloid varnish.

If suitable ground glass is not obtainable, ordinary clear glass can be treated with a matt varnish, which may be purchased ready prepared or may be made up according to the following formula: Gum mastic, 25 grains; gum sandarac, 25 grains; methylated ether, 2½ ounces; benzene, ½ ounce.

This varnish, when flowed over the glass plate and allowed to set, gives a matt surface very similar to that of finely ground glass. The surface will "take" ink, colour or pencil and subsequently, if necessary, the grain can be eliminated by varnishing the surface over with the gum dammar varnish mentioned above.

Special inks or colours for lantern slide work can be made by colouring ordinary shellac varnish with spirit-soluble aniline dyes. These colours dry rapidly and, once dry, will not run.

You can obtain all materials, including dyes, for lantern slide work from Messrs. Flatters & Garnet, Ltd., Oxford Road, Manchester.

Two books which would be of service to you in this connection are: T. C. Hepworth, "The Book of the Lantern"; Lewis Wright, "Optical Projection."

These are now out of print, but second-hand copies may be obtainable from Messrs. W. & G. Foyle, Ltd., Charing Cross Road, London, W.C.2.

SILK SIZING

"WILL you kindly inform me if the following ideas are worth patenting? One is an instrument for obtaining uniform tension in silk sizing and the other is a switch for completing a bell circuit in case of fire." W. W. (Coppull).

PROVIDED the device for use in obtaining uniform tension in silk sizing is novel, it forms fit subject matter for protection by patent. We think the invention is novel, but it would be advisable to make a preliminary search amongst prior patent specifications dealing with the subject matter. If the invention is successful in practice and is novel and more useful than existing devices for the same object it should have commercial value and be worth protecting by patent.

It may be that you are conversant with the textile industry and know the known methods of tensioning silk during sizing, in which case it would probably not be necessary to make a preliminary search, but to file an application for patent with a provisional specification which would give protection for about 12 months, during which time you should be able to ascertain the possibility of getting the invention taken up at the least expense for protection.

The electric fire alarm is not thought to be broadly novel. There have been many devices patented which rely for their functioning on the melting of a low temperature-melting alloy, so that any patent which could be obtained for the device would be restricted more or less to the exact combination of parts. In other words, any protection obtainable would be so limited as not to have any great commercial value.

A NOVEL DOOR CATCH

"I HAVE thought of an idea for a door catch, and wondered if it is fit matter for protection by patent. I would like your opinion of the device (particulars enclosed) and whether you think it novel." A. P. (Cheshire).

THE improved door catch, if novel, is fit subject matter for protection by letters patent. You are probably aware that the broad idea of a spring-pressed ball engaging a recess for use as a catch is old and unpatentable. The novelty of the device appears to reside in the means employed for locking the ball in its recess when desired, and such means is novel as far as we know.

If you are in a position to market the catch yourself, it might be worth while obtaining protection from an advertising point of view, but if you have to interest the trade in marketing it, it is not thought to have sufficient commercial possibilities to make it worth while incurring the expense of patenting.

UNDER-WATER PRESSURE

"WHAT is the under-water pressure at depths of 200 and 300 fathoms and could an inflated rubber tube 3 in. in diameter and 4 ft. long withstand the pressure?

"Also, what would be the sustaining or buoyancy power of such a tube?" D. C. (Aberdeen).

THE mean pressure at a depth of 200 fathoms is approximately 550 lbs. per sq. in. At a depth of 300 fathoms, the mean pressure is about 680 lbs. per sq. in.

No tube such as you mention could withstand these tremendous pressures. All rubber tubes are porous and if inflated with air at these pressures, the air would probably escape through the pores into the surrounding water or, alternatively, the water would enter into the tube. For your purpose, you would require a specially-madetube of the strongest and toughest steel.

THE PROFESSOR..A "WITHERING" SHAME

Subjected to such pressures, the tube would have no real sustaining or buoyancy power since the external pressure would be continually tending to crush it.

AN IMPROVED MATCHBOX

"I WOULD like your opinion on a method I have devised on improving a matchbox (details enclosed).

"Also, where can I purchase a reliable instruction book on the manufacture of matches, including box making, label printing, etc?" A. O. (Co. Sligo).

IT is not thought to be a commercial proposition to manufacture matches on a small scale. The plant is costly and special regulations are in force for factories making matches. We are not aware of any "instruction book" dealing exclusively with match manufacture, which is a specialised trade. Most technical recipe books will give formulæ for the compositions.

With regard to the improved matchbox, this is thought to be novel as far as we know, and it may be possible to obtain a patent for the invention, but it is questionable if it has any commercial value. The additional cost of manufacture would preclude it from being generally adopted, even if the want for such a box exists, which is doubted. The only people likely to be interested are match manufacturers, for instance: The Anglia Match Co., Ltd., of Letchworth, Herts; Bryant & May Ltd., Bow, E.3; J. John Masters & Co., Ltd., Abbey Match Works, Barking.

LUMINOUS PHOTOGRAPHS

"BEING interested in your article 'Luminous Photographs,' which appeared in a recent issue of 'Practical Mechanics,' I would be obliged if you could give me the address of the people from whom I could purchase the radium and zinc sulphide luminous paint and also the cost, giving the approximate quantity to use. Also, any information as to how to apply this paint. Can it be used on the top of ordinary paint or does it require a special under-coating?" M. V. (Glasgow).

RADIUM-ACTIVATED luminous zinc sulphide and similar preparations can be obtained from Messrs. Johnson, Matthey and Co., Ltd., 73/83, Hatton Garden, London, E.C.1, or from Messrs. Philip Harris & Co., Ltd., Birmingham. The paint is extremely expensive, since it contains a small percentage of radium bromide or of radium barium bromide, its price being, of course, based mainly on its radium content. We believe, however, that you will be able to obtain about a gram of the material for approximately 12s. 6d.

Although radium-activated zinc sulphide is permanently luminous and does not require periodic re-exposure to bright light for a continuance of its luminescence, we would advise you, particularly in the beginning, to employ ordinary luminous zinc sulphide, costing about 2s. per ounce. This can be obtained from Messrs. Harrington Brothers, Ltd., Oliver's Yard, City Road, London, E.

These luminous paints *can* be used on top of other paints, but, in many instances, if so employed, their luminescence is likely to be curtailed, since the paints are capable of being "poisoned" by the metallic ingredients in the underlying coat of paint. It is best, therefore, to apply the luminous paint to clean, fresh surfaces which need not have received any special preparation.

ORTHO-PHOSPHORIC ACID

(1) "WHAT is the effect of ortho-phosphoric acid (commercial 89 per cent. solution) on stainless steel?

(2) Has it a greater corrosive or other effect as a more dilute solution? If so, what solution has the greatest effect?

(3) What acid or oxide has the effect of permanently marking stainless steel black?" H. L. (Wolverhampton).

(1) COMMERCIAL "syrupy" ortho-phosphoric acid slowly dissolves stainless steel, especially when warm, with the evolution of hydrogen.

(2) A dilute solution of the acid has a similar effect, but the action is much slower and is sometimes hardly appreciable in the cold. The maximum effect is obtained with the hot "syrupy" acid to which some three per cent. of water has been added.

(3) A hot strong solution of ferric chloride, made acid by the addition of hydrochloric or phosphoric acid, will permanently stain stainless steel a dark grey colour. Such areas when rubbed over with an oily rag will appear grey-black. To obtain a jet black, platinum chloride solution must be used, but this is far too costly and we think you will obtain satisfaction with the ferric chloride method.

ELECTROLYSING BRINE

"I WISH to make several electrolytic cells for the purpose of producing hydrogen and oxygen from brine, using "carbon" plates, 24 in. by 18 in., passing a current not exceeding 20 volts. How can I make the plates? Would you describe the production of a suitable paste for this purpose, and also how to obtain the carbon from carbon dioxide (not by introducing burning magnesium). If a burning jet of hydrogen is introduced into an atmosphere of carbon dioxide, will it continue to burn? If so, what is the product?" J. G. (Glasgow).

IF you attempt to electrolyse brine you will obtain chlorine and sodium hydroxide, the chlorine being liberated at the anode and the metal, sodium, liberated at the cathode, combining with the water of the brine to form sodium hydroxide (caustic soda).

The best way to obtain hydrogen and oxygen electrolytically is by the electrolysis of pure water slightly acidified with sulphuric acid. Hydrogen of high purity will be evolved at the cathode, oxygen being liberated at the anode. Owing, however, to the great tendency for the oxygen to become absorbed and/or to oxidise the material of the anode, the yield of oxygen will usually be considerably less than the theoretical.

Carbon plates can be used and a current of 12 volts D.C. is ample, but much of the liberated oxygen will be absorbed by the carbon. Strips of rare metals such as platinum foil, tantalum or tungsten form by far the best electrodes for this purpose.

Carbon dioxide, CO_2, is a very stable gas and is only decomposed with some difficulty. If, however, you pass a slow stream of dry carbon dioxide over heated sodium, potassium or calcium, a vigorous reaction will take place whereby the metal will abstract the oxygen from the carbon dioxide, leaving the carbon. Actually, the black soot which will be formed will contain a proportion of the metal carbonate.

A jet of burning hydrogen introduced into a vessel full of carbon dioxide gas would immediately be extinguished.

THE P.M. 1939 ONE-VALVE RECEIVER

(*Continued from page* 332)

nect the H.T. battery with 120 to 150 volts at H.T.2 and 60 to 80 volts at H.T.1. The latter voltage should be adjusted when the receiver is put into operation so that smooth reaction is obtainable over the entire waveband. Connect the phones, aerial and earth and tune in. For preliminary tests it may be desirable to use terminal A, the remaining aerial terminal bringing into circuit the pre-set condenser, which will give sharper tuning. This should be used when it is desired to cut out a station working on a nearby wavelength, although it should be appreciated that with a simple set of this type a very high degree of selectivity cannot be obtained. For all normal purposes, however, selectivity is adequate, the primary winding on the coil, which is switched for medium-waves, sharpening up tuning without loss of signal strength.

Reaction

For the local station reaction should not be needed, and therefore the right-hand control should be turned to its maximum position in an anti-clockwise direction. Next the main tuning control should be slowly turned until the rising pointer gives an approximate indication on the scale of the wavelength of your local. It may not be exact when first put into use, but will give a guide as to the approximate position of the station. When accurately tuned in, note whether the reading is incorrect, and if so, the screws holding the scale to the condenser may be loosened and the drive moved until the pointer shows the correct wavelength, taking care not to turn the condenser in doing this.

Distant Stations

When locating a distant station the right-hand control should be slowly turned until a breathing sound is heard in the phones. This gradually turns to a rushing noise and is followed by a "plop" as the receiver goes into oscillation. If this occurs, turn the condenser back, and it should plop again at the same point as the receiver comes out of oscillation. The voltage applied to H.T.1 will control the degree of overlap experienced and an attempt should be made to obtain a setting where the set goes into oscillation and comes out of it at exactly the same position.

"MOTILUS" PEEPS INTO THE MODEL WORLD

(*Continued from page* 333)

Painting Locomotives

The L.M.S. Pacific "Princess Elizabeth" bids fair to be the most popular locomotive of gauge "OO" railways. The painting and lining of these Bassett-Lowke scale models for this gauge is a highly skilled job. The castings, after special chemical treatment, are sprayed with L.M.S. lake, matched in colour from the actual paint used on the L.M.S. Railway. The black parts of the locomotive are then picked out, and when thoroughly dry there follows the lining and lettering. Quite a number of colours are used, yellow for most of the lining, the name-plate for instance, scarlet for the buffer beam, gold for the lettering, and white for the headlamp bulls and the numbering on the smoke box door. I watched a lady at work, and, as you can imagine, her job is very painstaking and requires to be done with great care and skill.

FREE SERVICE FOR READERS

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

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Advertiser	Page No.	Information Required

Attach sheet of paper, with particulars, and your name and address (written in BLOCK letters) with date, to this announcement.

TRADE NOTES

Coupon Saving Scheme

THE City Sale & Exchange (1929), Ltd., have introduced a coupon saving scheme for the benefit of those people who are adverse to easy payments. With this scheme you are not tied down to any amount—2s., 3s., 5s., 10s., or any higher amount can be sent when you feel disposed to send it. In return you are supplied with coupons to the exact cash value of your subscription. Simply save these up until you have coupons totalling the purchase price of the apparatus you require and the goods will be sent in return for them. Coupons may, if desired, be used as deposit payment on their easy payment plan, and customers bringing apparatus in part exchange may, if they wish, be credited in the form of these coupons.

For those who prefer the more orthodox deferred payments City Sale can make arrangements for payments to be spread over periods from nine months to two years according to the cash price of the apparatus purchased. Further particulars of these two schemes can be obtained from the City Sale & Exchange (1929), Ltd., 59, Cheapside, E.C.2.

How To Become A Pianist

MR. H. BECKER, of 69, Fleet Street, London, E.C., has taught very many adult pupils to play the piano during the past 34 years. He teaches by correspondence and claims to teach you quickly to read and play at sight any standard musical composition. Interested readers should write to the above address for the free booklet *Mind, Muscle and Keyboard*, and also the form for free advice. When writing state if advanced, moderate, elementary or beginner.

A Bomb-Proof College

YOU have noticed that the Bennett College of Sheffield has been very active in teaching police, firemen, air wardens, decontamination squads, etc., A.R.P. work free of charge. Many thousands have taken advantage of this splendid offer which, at the time of the crisis last September, was extended to include every hotel proprietor and manager in Britain, who would thus be able to take the utmost precautions to protect the children and adults staying at their hotels.

It is obvious that a College offering such a splendid free service to the community at large would not neglect its own personnel; and, therefore, the Bennett College has acquired a large house standing in an acre of grounds, which adjoins the College. This house is on a hillside and has extensive cellarage. Working to architects' special plans, this hillside is now being tunnelled so that a bomb-and-gas-proof chamber nearly fifty feet underground will be available for the staff of almost 200, together with several hundreds more, if necessary. Mr. Bennett is to be congratulated not only on his generous national effort, but on the initiative which has caused this remarkable local shelter to be built.

BUY, EXCHANGE OR SELL

TOOLS

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: 1/8"; 5/32"; 3/16"; 7/32"; 1/4"; 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. —Below.

Small Taps in all above sizes. Taper; Second or Plugs, 1/8" to 1/4", 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 1/4" Adjustable, all steel, 9d. each.

Three tons ground bright Tool Steel Pieces, 1/4" to 3/4" 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, 5/8" to 1½", 10 lbs., 4/-; 28 lbs., 10/-. Also larger sizes 1¼" to 3" diam., in blanks and short pieces, not bright, 28 lbs., 6/6; 1 cwt. assorted, 1/4" 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. 1/8" thick. 3/4" hole, 2/6 each; ditto, approx. 6" diam. 1/9 each.—Below.

1" Die-Stocks, all steel, 1/9 each. Special thin Grinding Wheels, as used for cutting brass tubes, etc., 6" diam, 3/4" 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 1/4", 5/16", 3/8", 7/16", 1/2". Usual price, 7/6 set; outstanding value, 2/9 set. Also 5/8", 3/4", 7/8", 1", in same threads, 4/- set of four Any four sets 1/4" to 1", 24/-, for thirty-six die-nuts.—Below.

700 Large Split Dies, best quality. Dies 1 5/16" diam., 7/16" thick, cutting 1/4", 5/16", 3/8", 7/16", 1/2", Whit. and B.S.F., 1/4" Gas, 7/16" by 24 threads, 1/3 each. Also 1½" diam. Dies. 1/2" Whit. only, 2/- each. Also 2" diam. Dies, 1/2", 5/8", 3/4", 7/8" Whit., 3/4" B.S.F., 1/4" Gas, 1" by 26, 7/8" by 20, 31/32" by 30 threads, 2/9 each, Worth double. Also 2¼" diam. Dies, 5/8", 3/4", 7/8" 1¼" Whit., 5/8", 3/4", 7/8" B.S.F., 3/4", 1¼" Electric Conduit, 1/2", 3/4" Gas, 3/6 each.—Below.

1,200 Best Quality Taps, Tapers, 2nds, Plugs. 5/8", 9d.; 3/4", 1/-; 7/8", 1/3; 1", 1/6, Whit., B.S.F. Also in gas thread, 1/8", 6d.; 1/4", 9d.; 3/8", 10d.; 1/2", 1/-; 5/8", 1/3; 3/4", 1/6; 7/8", 1/9; 1", 2/-.—Below.

12 Only Ball-bearing Double-ended Grinding Heads, to take 3/4" 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. Stand 10/- each, if purchased with grinder.

2/9 any lot. Eight lots £1.—Below.

3/8" Toolholder with four H.S. Tools.

3/8" Adj. Boring Tool with H.S. Tool.

1/2" Drill Chuck, taper or straight shank.

1/16" to 5/16" Silver Steel, 13 pieces.

3/8" to 3/4" Silver Steel, 4 lb., 2" to 4" long.

500 Ass. Brass and Steel Screws, etc.

100 Steel Hex. Bolts and Nuts, 1/8" to 1/4".

16 H.S. Drills, 1/32" to 5/32".

12 Drills, 1/16" to 3/8". Carbon.

Set 1" Dies, 1/4", 5/16", 3/8", 7/16", 1/2", Whit.

Ditto, B.S.F. 26 threads or S.A.E.

Set 1/4" to 1/2" Taps, same as Dies. T.S. or P.

Slitting Saws, five 1/32" to 1/8" thick, 1" hole.

Two dozen Fine and Odd Thread Taps to 3/8".

Three dozen Tungsten Hack-saws to 12".

18 Grinding Wheels, 1/4" 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 1/2" by 3/4" hole.

200 Springs to approx. 6" long.

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, 8" by 1¼" by 1" hole, 3/9 each. Good pair for general tool use.

J. BURKE, 30 TRIPPET LANE, SHEFFIELD, 1

TOOLS—*Continued*

High-Speed End Mills, 1/2", 2/9; Straight Shank, 3/8" carbon ditto, 1/9.

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

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

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.

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

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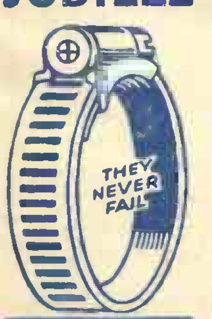

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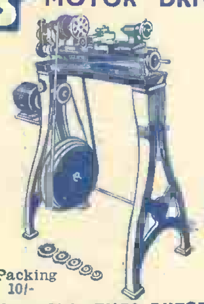

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