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PRACTICAL MECHANICS

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Fair Comment

By The Editor

Power from the Air

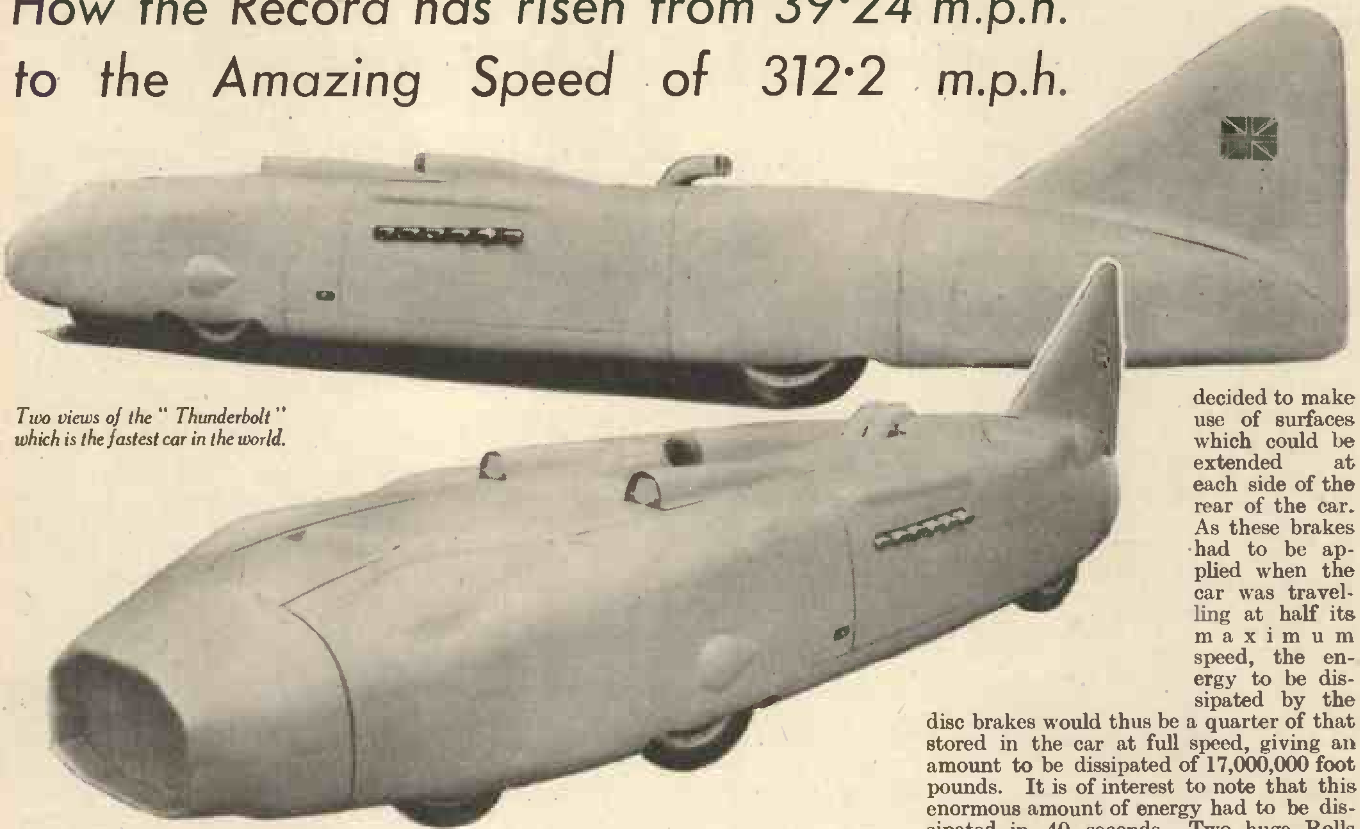
EVERY time we switch on a wireless set and tune in a station we are literally extracting from the air a minute proportion of the power radiated from the transmitting station in the form of electric waves or vibrations. It is true that they are not of audible frequency, but they have to be detected and amplified before we can hear the signals which are the audible counterpart of the minute spasms of power which we pick up with our receiving aerials. All the same, we are extracting power from the air, and this encourages the thought that within a few years we may be able to propel motor-cars, aeroplanes, locomotives, machinery, and in fact, all mechanisms from a sewing machine to a clock, from a toy to an ocean-going liner, by means of power radiated from some central transmitting station. That is not a fantasy, but a practical possibility, and I observe that in Germany some ingenious people have been able to illuminate their houses free of charge by extracting power from the air. They were residing, of course, close to a wireless transmitting station, and took advantage of the simple laws of induction. They thought that it was legal for them to do so, but the authorities thought otherwise and fined them for stealing electricity. The centralisation idea is developing. We do not nowadays have a variety of electric undertakings operating separately with an outlook governed by the needs of a small town or village. All such undertakings have been linked by the Grid System and those of us who use electricity from the mains are virtually drawing our supply from a central system. The telephone is a central system ; so is broadcasting, the latter tending to absorb all of the smaller entertaining interests ; when television has developed a little further broadcasting is likely to absorb the cinema and the theatre. One central station will supply us with our entertainment ; let us hope in greater variety than it does now ! The telephone is a centralised service. The mines shortly may be. The marketing of vegetables and meat has been centralised under the Marketing Board. Broadcasting has even invaded our schools and is usurping to some extent the functions of school teachers. Housing is controlled by the Ministry of Health, and I have even seen it suggested that we should all wear a national costume. Electricity has practically killed the spring and weight-driven clock industry. The idea of centralisation can be a double-edged sword. We have already seen that it has not redounded to the good fortunes of civil aviation. The railways are centralised, and are doing their utmost to kill or to suppress all rival means of transport. They have opposed and very successfully the development of road transport, canals, and civil aviation to such an extent that a Government enquiry is to be made into the problem as far as civil aviation is concerned. Individual incentive is responsible for all great developments, and there is no evidence that any Government of any country controlling a science or an industry has ever produced a great invention. The individual is left to do that, and if the Government does not control it or suppress it the inventor is entitled to trade with his idea for 16 years, when the idea becomes public property free for all to use. That is the problem which is facing the world of science, invention and mechanics. We are tending to become robots, whose movements are dictated by laws and restrictions, governing the particular field of science or mechanics in which we operate.

Broadcasting is controlled by the Government, and however brilliant an invention may be if it is not approved by the B.B.C. the idea is worthless. You cannot offer the idea to anyone else because there is no one else to whom you may offer it. So, it would seem that it is not really in the national interests for a Government to control a new science too early in its development.

The railways had a century's run before they became centralised. Aviation has less than twenty years ; broadcasting less than two. Thus, they have largely been throttled and developments stifled. It is good for the well-being of a well-ordered State that we should submit to reasonable laws and government. It is infinitely better, however, to guide and encourage as well as to control, and this cannot be done by hedging round a new science with unnecessary restriction. I mentioned just now the possibility of developing some system for radiating power through the ether. You would, however, not be permitted to experiment with such a system unless you are in possession of a transmitting licence. In order to obtain the latter certain technical qualifications are necessary, particularly concerning the rate of transmission of messages in the morse code. Should it not be possible in special circumstances which may be of national concern and interest for such rules and restrictions to be waived ? Reasonable freedom of action should be given to those who have the ability to create. Unfortunately, that state of affairs does not exist at the moment, for the whole history of invention consists of a series of stories of poverty and privation on the part of those who have with remarkable abnegation spent years perfecting an idea only to find manufacturers unresponsive or a Government uninterested. I think the Government should re-introduce a system of large cash prizes for inventors who produce the best idea or mechanism which attains a certain desired result. Governments have done this in the past ; when they required a very accurate timepiece they offered an enormous cash prize for the first chronometer to pass certain tests. The prize was won by Harrison.

THE HISTORY OF THE WORLD'S LAND SPEED RECORD

How the Record has risen from 39·24 m.p.h. to the Amazing Speed of 312·2 m.p.h.



Two views of the "Thunderbolt" which is the fastest car in the world.

AT his very first attempt, Capt. George Eyston has succeeded in securing the coveted title of "the fastest man on land." Although he made a number of unsuccessful runs before he achieved his desire, he at last managed to push the "Thunderbolt" over the measured mile at the amazing speed of 311·42 m.p.h., and over a kilometre at 312·20 m.p.h. His car, which has now been shipped back to this country, will be in the limelight for many weeks to come. Hundreds of thousands of people, whether motorists or not, will want to see it.

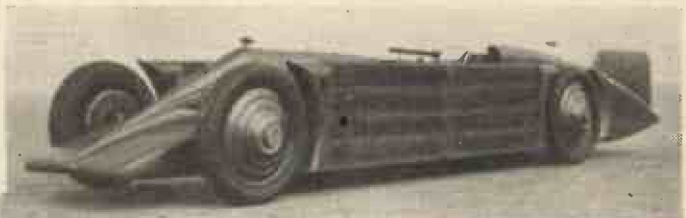
To ensure that the driver does not benefit from a favourable wind, it is essential that the record be based on an average of times taken in both directions over a measured distance. If the return run is not made within an hour of the first run the record does not stand. Eyston did the northward run at 305·59 m.p.h. for the kilometre, and 305·34 m.p.h. for the mile, and 319·11 m.p.h. and 317·74 m.p.h. for the kilometre and mile respectively on the southward run.

The "Thunderbolt"

When the designs for "Thunderbolt" were first discussed, it was laid down that it should be possible to raise the land speed record to 360 m.p.h. or 6 miles per minute. The weight of the car was kept as low as possible, but the final weight of the finished car was such that the stored energy to be dissipated at the end of each run proved to be 68,000,000 foot pounds. If this energy were converted into heat it would be sufficient to raise 1 cwt. of water from freezing to boiling point in 40 seconds; or regarded as stored energy it would be sufficient to lift a fully loaded London double-deck bus to a height of 3,000 ft. The greatest single force to overcome when travelling at high speeds is wind resistance, and in order to assist the friction brakes in the initial retardation of the car from 300 to 200 m.p.h. it was decided to make use of surfaces which could be extended at each side of the rear of the car. As these brakes had to be applied when the car was travelling at half its maximum speed, the energy to be dissipated by the disc brakes would thus be a quarter of that stored in the car at full speed, giving an amount to be dissipated of 17,000,000 foot pounds. It is of interest to note that this enormous amount of energy had to be dissipated in 40 seconds. Two huge Rolls Royce engines of about 6,000 h.p. supplied the motive power of the "Thunderbolt," and they simply ate up petrol at the rate of 8 gallons a minute.

The First Record Holder

It is amazing to look back and compare Eyston's speed with that of Count Chasseloup-Laubat, who drove a Jeantaud at a speed of 39·24 m.p.h. on December 18th, 1898. The Count was the first holder of the land speed record, and his achievement



(Above): Sir Henry Segrave's famous "Golden Arrow" which put the record to 231·44 m.p.h.
(Below): Parry Thomas with "Babs" breaks the record at 171·09 m.p.h. at Pendine.

was considered an amazing performance for that time. The course consisted of a straight stretch of road in the park of Acheres, France, and the record was timed with stop watches, as no electric timing apparatus was then available. The Jeantaud had a curious boat-shaped body, and was an electric car. The record set up by Count Chasseloup-Laubat, however, did not stand for long, for on January 17th, 1899, Jenatzy clocked 41·42 m.p.h., which in turn was again beaten by the Jeantaud with 43·69 m.p.h.

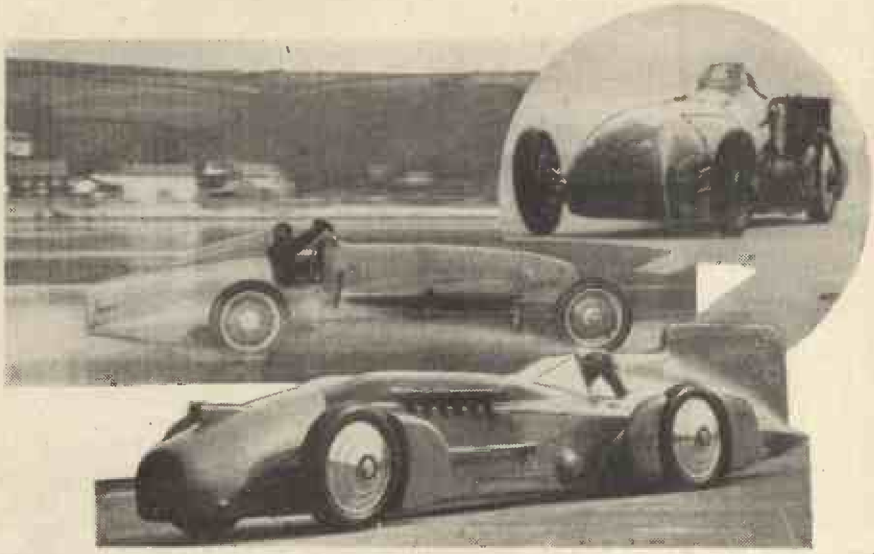
A Mile a Minute

Jenatzy again took up the challenge and by fitting more powerful motors to his car achieved 49·42 m.p.h. ten days later. The record was now slowly creeping up to the coveted mile a minute, and on March 4th Count Chasseloup-Laubat created a sensation by reaching a speed of 58·25 m.p.h. Jentazy's next attempt heralded the production of his famous car, the "Jamais Contente," which had a peculiar body shaped like a cigar, set high over four very small wheels. The car was steered by a tiller, and the driver sat more out of the car than in it. The car was said to be dangerous, and people said it would turn over, or if it didn't the speed would be such that the driver would not be able to breathe. Jenatzy was not deterred, however, and on April 29th he accomplished 65·82 m.p.h.

So the first milestone of a mile a minute was reached, and the thoughts of racing men now turned to the magical figure of 100 m.p.h. which was reached five years later. During that period the record slowly rose, and in 1902 Jenatzy's figure was beaten by Serpollet in one of his own cars. He clocked a speed of 75·06 m.p.h., which in turn was beaten by Vanderbilt on a Mors at 76·08 m.p.h., by Fournier on a Mors at 76·60 m.p.h., and by Augieres on a similar car at 77·13 m.p.h. In 1903 the record was pushed up by Duray who drove a Gobron-Brillie at 84·21 m.p.h.

America's Challenege

America now took up the challenge, and a young man named Henry Ford built a car of his own which he took to Daytona beach. He clocked 91·37 m.p.h. over the measured mile. The next milestone was thus approaching, but Ford, seeing that there was more money to be made in making cars for the general public, left record breaking to other drivers. Thus in 1904, Vanderbilt drove a German Mercedes at 92·3 m.p.h., which in turn was beaten by Rigolly on a Gobron-Brillie with 93·2 m.p.h. and de Caters on a Mercedes with 97·26 m.p.h. Rigolly made another attempt later on in the year and succeeded with 103·56 m.p.h.

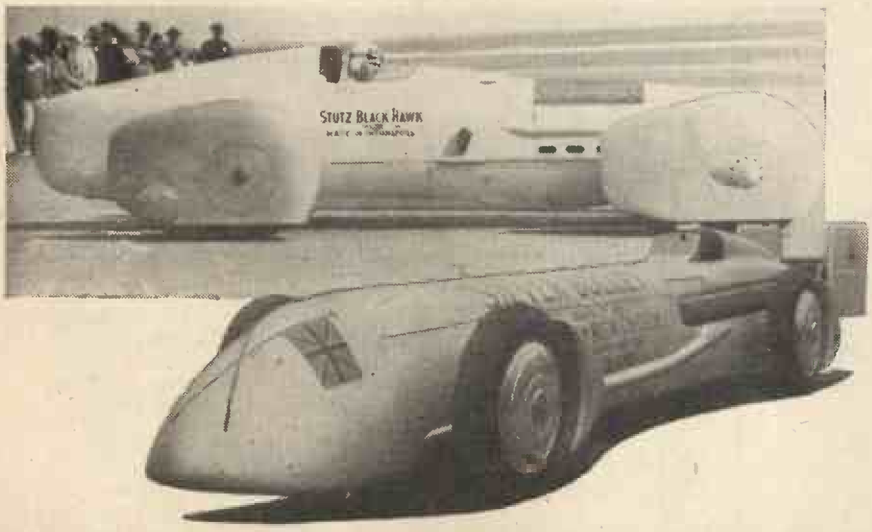


(Above left): Campbell's "Blue Bird" as it appeared at Pendine in 1926. (Above right): The "Blue Bird" at Daytona in 1928. (Below): The car in which Campbell took the record in 1933.

On crept the record via Barras and Hemery with Darracq cars, and Bowden who drove a Mercedes at 109·75 m.p.h., until we come to the Stanley steam car. In 1906 Marriot drove this steam car at the amazing speed of over two miles a minute —121·57 m.p.h. Three years passed before Hemery, on a Benz, reached 125·9 m.p.h. Americans who had previously had little to do with the record now began to assert themselves. Thus in 1910 "Barney" Oldfield clocked 131·72 m.p.h. with a Benz, then in 1911 Burman on a Benz did 141·73 m.p.h.

The Rules Revised

The Great War then caused world records to be forgotten, and it was not until 1919 that record breaking was resumed. In that year de Palma, an American, drove a Packard at 149·87 m.p.h. over the measured mile, which was raised to 156·04 m.p.h. in 1920 by another American, Milton, with a Duesenberg.



(Above): The Stutz "Black Hawk" in which Frank Lockhart was killed while making an attempt at Daytona. (Below): The "Silver Bullet" which was driven by Kaye Don in unsuccessful attempts on the record.

The rules for the record were now revised and two runs had to be made in opposite directions and the average of times taken to indicate the record, before it would be recognised by the international ruling body. Drivers were thus deprived of taking advantage of favourable winds. That they had been of great assistance was emphasised by the fact that Milton's record was not beaten until 1926.

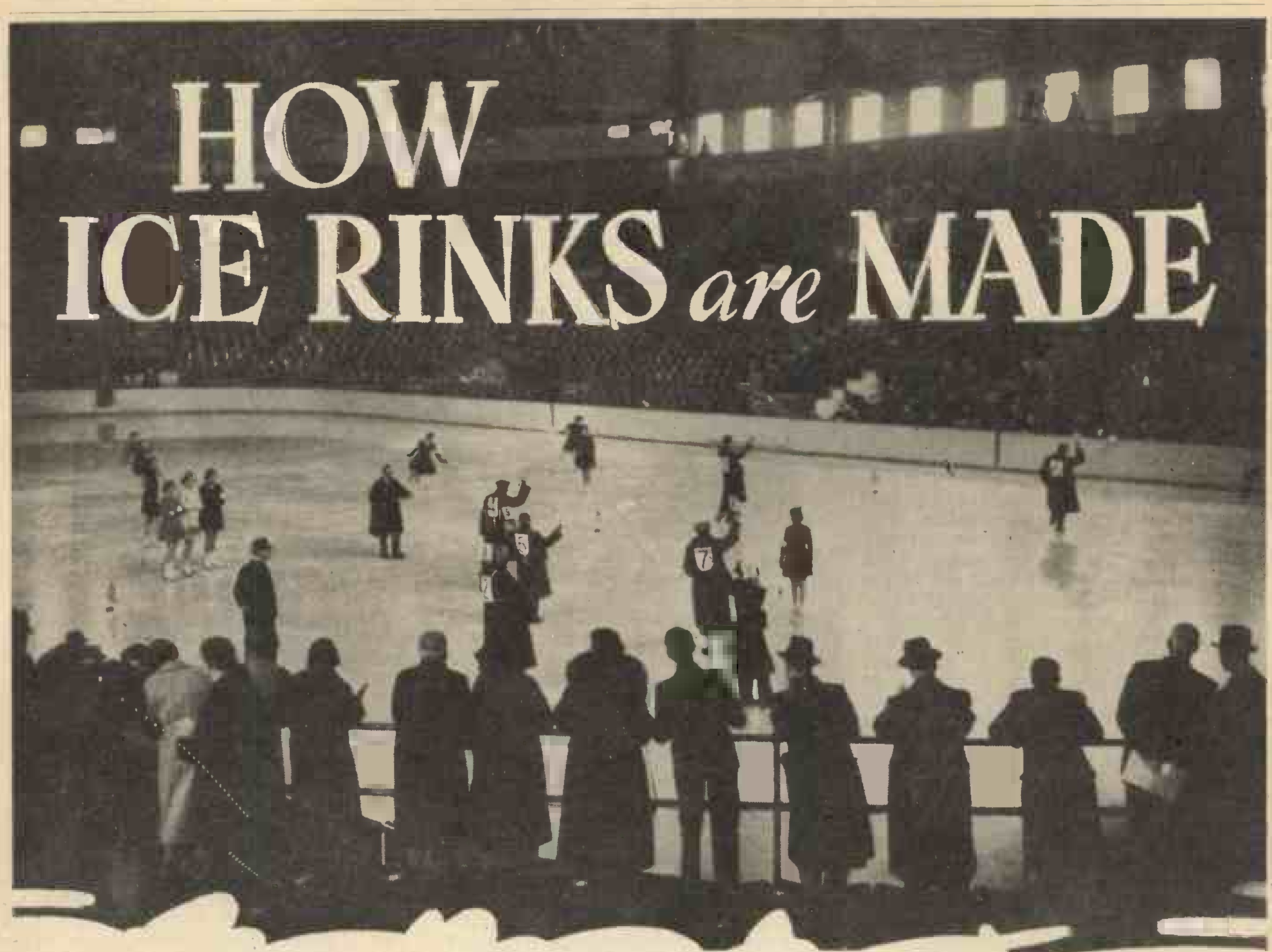
England began to take a hand in 1922, and from that time on the record has been almost exclusively ours. The record went to K. Lee Guinness, under the new rules, with 129·17 m.p.h. in his Sunbeam. Parry Thomas came next when he drove his famous Leyland Thomas over the mile at Pendine Sands at 129·73 in 1924. In the same year, however, the record passed through the hands of Rene Thomas who drove a Delage at 143·31 m.p.h. and E. A. D. Eldridge, the one-eyed driver, who drove a Fiat at 145·90 m.p.h. Campbell appeared on the scene in 1925 with a huge Sunbeam-engined machine which he called "Blue Bird." In this machine he reached a speed of 150·86 m.p.h. Another famous name was added to the list of record holders in 1926, when Henry Seagrave made his appearance. He just beat Campbell's record with 152·33 m.p.h. in another Sunbeam-engined car. The same year saw the return of J. G. Parry Thomas and, driving his Higham Special, he pushed the record first to 169·23 m.p.h. and then to 171·09 m.p.h. Campbell then deposed him of his title by driving the famous Napier-Campbell, powered by two Napier aero engines, at 174·88 m.p.h.

On Daytona Beach Once More

Daytona Beach was once again looked upon favourably for record breaking as Pendine was not large enough. The cars were becoming so powerful and achieving such amazing speeds, that they needed miles in which to get up speed, and more miles in which to pull up. It was at Daytona that Seagrave became the first man to travel at over 200 m.p.h. Driving his Sunbeam he reached the astounding figure of 203·79 m.p.h. People still said that record breaking was fraught with danger and that it would be impossible to beat Seagrave's record as drivers would not be able to breathe when travelling at still greater speeds. Drivers were not deterred, however, as in 1928 Campbell appeared at

(Continued on page 245)

HOW ICE RINKS *are* MADE



A scene on the Earl's Court ice rink during the world's figure-skating championship.

The Principles of their Construction and Operation Explained in Simple Language

HAVE you ever noticed how cold a damp rag becomes when held in a breeze or, better still, have you ever experienced the local feeling of intense cold when a few drops of ether or other very volatile liquid are poured on to the skin?

You may or you may not have observed the above effects, but, in any case, it is as well to draw attention to them, for they form the fundamental principle upon which the production of "artificial cold" is based.

A damp rag becomes cold when exposed to a draught or other form of air-current in consequence of the forced evaporation of its contained water. When any liquid evaporates, it requires some form of energy to do so. This necessary energy it obtains in the form of heat, abstracting heat from its surroundings and therefore causing them to be lowered in temperature.

In the instance of ether evaporating from the skin, the abstraction of heat is so intense that an almost painful degree of cold is experienced.

The Plant

In ice-making plant, as, for instance, that of the type responsible for the production of the degree of cold necessary to freeze a sheet of water for the formation of an ice skating rink, the well-known gas, ammonia, performs the role of the moisture in the rag or of the drops of ether mentioned above. Sometimes, and particularly in America, carbon dioxide gas ("Carbonic anhydride") is made to play the same part, but ammonia has certain advantages as a cold-producer or "refrigerant" and hence the majority of ice-making installations for commercial use rely upon this material.

The so-called "liquid ammonia" of household use, is really a very strong solution of ammonia in water. Ammonia, at ordinary temperatures, is a pungent-smelling, invisible gas, which, when subjected to powerful compression, condenses, like all other gases, to a liquid. This latter substance we will term "liquefied ammonia" in order to distinguish it from the "liquid ammonia" of the chemists' shops, which, as we have already seen, is merely a solution of ammonia gas in water and takes no part whatever in the working of the cold-producing apparatus which we are about to describe.

A glass of strong ammonia standing on a wooden block is frozen fast to the block after air has been blown through the ammonia solution for a few minutes, thus demonstrating the production of cold by the rapid evaporation of ammonia.

Under atmospheric pressure, liquefied ammonia boils at a temperature of -33 degrees Centigrade. During this boiling or evaporation, the ammonia abstracts heat from its surroundings.

Abstraction of Heat

Even in the case of the ordinary commercial "liquid ammonia" (the "ammonia solution" of the shops) this abstraction of heat can be demonstrated. Place a small amount of strong ammonia solution in a glass vessel standing in a small pool of water on a wooden block. By means of a bent glass tube, blow a current of air through the ammonia solution. After a few minutes, the glass vessel will be found frozen firmly to the wooden block.

Having grasped the import of these preliminary facts concerning ammonia, we shall now be in a position to realise exactly how this exceedingly useful gas is able to be harnessed commercially for the continuous production of cold in ice-making plant of all kinds, including, of course, that adapted for ice-rink formation and maintenance.

The diagram accompanying this article

depicts graphically not only the mode of utilising ammonia gas for the production of artificial cold, but also the manner of applying this cold-production in the construction and upkeep of ice skating rinks.

Let us begin our survey of the diagram of the ammonia compressor. This is a powerful compression pump, fitted with special alkali-proof glands and packings and by means of it the current of ammonia gas entering it is compressed to a pressure which may be as high as 180 lb. per sq. in. After compression, the ammonia gas escapes from the compressor through a discharge valve.

Compressing Gas

The effect of compressing a gas is to increase its temperature. Thus it is that the compressed ammonia gas has a very considerable heat content. This is removed by causing the compressed gas to circulate through a condenser consisting of a pipe coil immersed in a tank of running cold water. Here the heat of compression is removed from the ammonia, with the result that the compressed gas immediately liquifies.

From the condenser, the liquefied ammonia flows into a specially-designed receiver from which it passes, via a semi-automatic expansion valve, into an "evaporator" comprising a further pipe coil surrounded, this time, by strong brine.

After passing the expansion valve, the liquefied ammonia, owing to a sudden reduction of pressure, expands and gasifies (or vapourises). This process is carried out to completion in the brine-surrounded coils of the evaporator.

We have already seen how an evaporating liquid and, in particular, boiling liquefied ammonia, absorbs heat from its surroundings. Due, therefore, to this effect, heat is abstracted from the brine which surrounds the coils of the evaporator. The brine, in consequence, becomes cooler.

Having evaporated from its liquefied condition and returned to its normal gaseous state, the ammonia, when it reaches the upper coils of the evaporator is practically at atmospheric pressure. It now flows through a suction valve into the cylinder (or cylinders) of the compressor, there to be again compressed and made to follow out its previous cycle of operations.

It will thus be seen that the ammonia circulates continuously through the brine-refrigerating plant, its only possible means of escape from the circuit being through defective valves and compressor packings. Provided that the ammonia is entirely water-free, it may be used over and over again as a refrigerant in this manner. If, however, it contains more than a very small trace of water, alkaline-corrosion of the system results and trouble quickly ensues.

It is now easy for us to follow the actual manner of freezing a sheet of water so as to form an ice rink. From the evaporator of the ammonia plant, the strongly cooled brine is circulated by means of a force pump through a system of parallel pipes covered with a layer of water. In due course, owing to the cooling effect of the circulated brine, the water freezes and remains in its condition of ice as long as the circulation of the refrigerated brine continues through the underlying pipes.

Warm Atmosphere

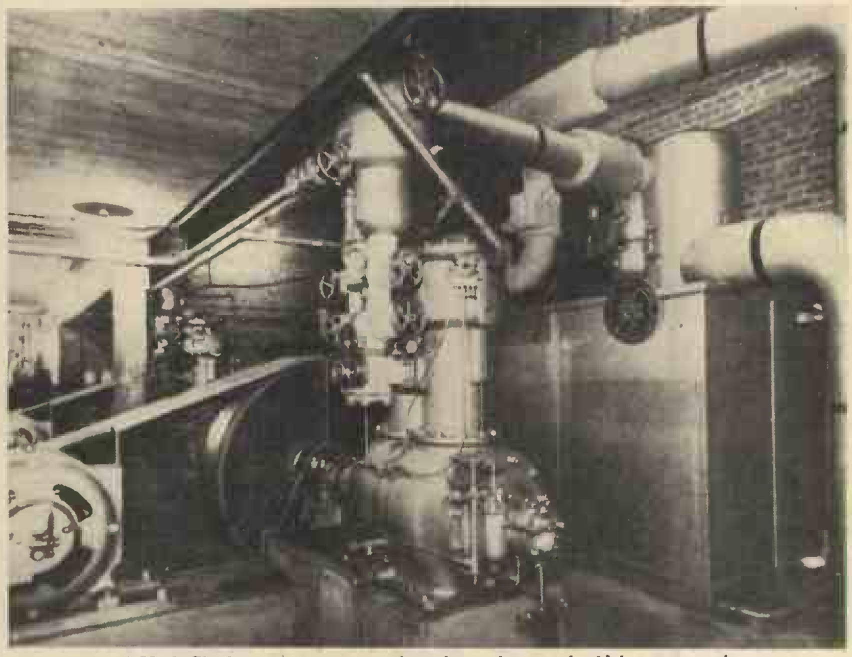
So strong is the refrigerating effect of the brine that the atmosphere of an ice rink may actually be heated, thus imparting a pleasant warmth to the skaters, without causing the ice surface to melt or even to become wet.

Usually, the "brine" which circulates rapidly through the refrigerating pipes underlying an ice rink is composed not of ordinary brine, which is a solution of common salt, but of a strong solution of calcium chloride. This has a very low freezing point and is not liable to freeze in the pipes under the strongest degree of refrigeration attainable by the ammonia plant.

The pipes used for ice-rink refrigeration are usually of one or one and a quarter inch diameter, are spaced from three to six inches apart, and laid across the arena. Sometimes they are secured to wooden sleepers fixed on the floor of the rink, but in some American rinks, the pipes are embedded in concrete.

"Starting-up" an ice rink is not as quick a process as the reader might imagine. Even with a powerful refrigerating plant, it takes from twelve to fifteen hours to freeze a large area of water to a satisfactory condition of ice.

Under normal conditions, the "refrigeration-power" expended in maintaining a constant hard ice sheet on the floor of an average-sized rink is equal to that



A York-Shipley compressor at work in the production of cold for an ice rink.

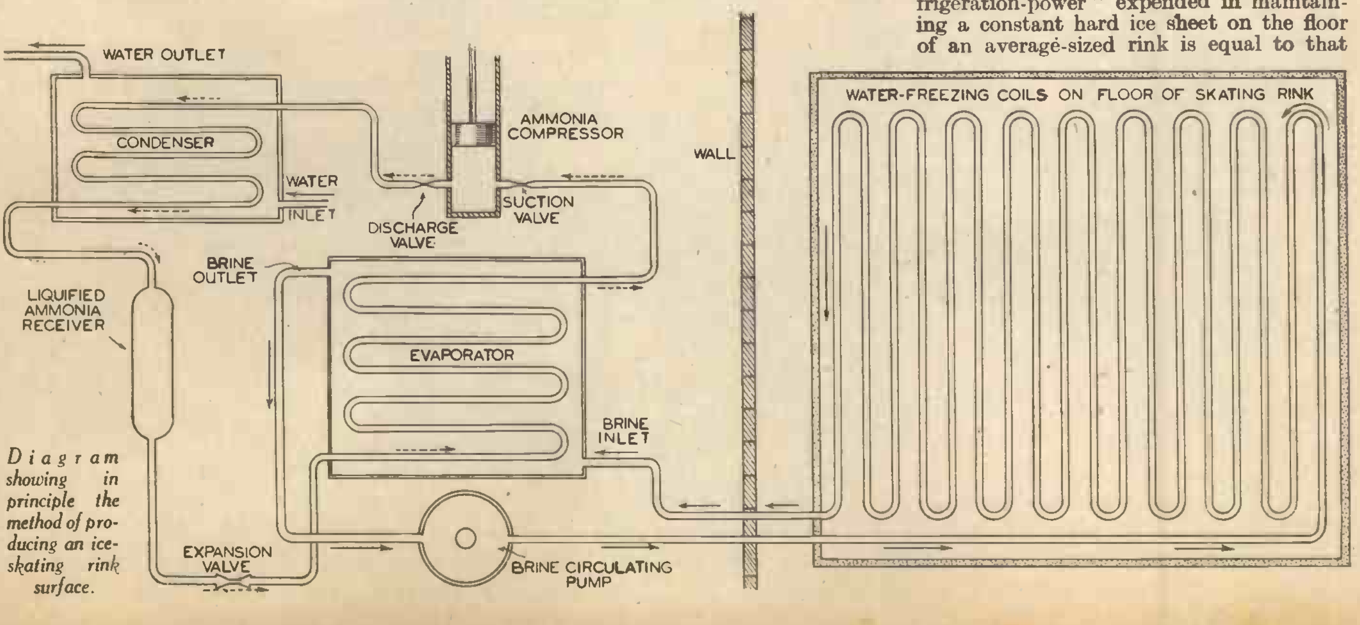


Diagram showing in principle the method of producing an ice-skating rink surface.

which would be consumed in manufacturing approximately eight tons of solid ice per day.

Usually, the ice-making plant of a rink has a reserve of power and, for a rink of average size, an ice-plant capable of turning out twelve tons of ice daily is employed. Many ice-rink concerns, of course, utilise this balance of power by undertaking ice-making for commercial uses and, also, in maintaining cold-storage apartments for various purposes.

Pipe-laying Systems

Needless to say, the working adjustment of ice-making equipment used in conjunction with ice rinks must be capable of being very minutely governed. Different systems of pipe laying under the ice of the rink have been found to influence very considerably the working " balance " of the refrigerating machinery. Hence, it is that an ice-making plant which proved successful for one ice rink might not be found to run economically in conjunction with another.

Many of the adjustments on an ice-making plant are semi-automatic in nature, as, for instance, the suction, discharge and expansion valves which operate the circulation of the ammonia refrigerant. In order to obtain strong cooling, powerful multi-cylinder compressors are used for dealing with the circulating ammonia, these compressors being usually driven by an electric motor or a gas or diesel engine.

Every portion of an ice-making plant and, also, of course, of its supplementary ice-rink refrigeration circuit requires to be very carefully designed and constructed in the strongest and most enduring of materials. Steel tubing is mostly employed in the refrigerant and brine circuits, the various pipe bends and couplings being made in extra heavy metal.

To a certain extent the working capacity or " ice-tonnage " of a compression refrigeration plant can be varied by making adjustments to its component parts. Economically speaking, however, an ice-making plant operates best when working very near to its full load or capacity. Hence it is that when powerful refrigeration plants are employed for ice rink formation and maintenance, some other commercial outlet is usually found for the refrigerating power which is not utilised by the rink itself.

A good ammonia-refrigerating plant will reduce the brine temperature to about 16–18° F., or from fourteen to sixteen degrees below freezing point. Allowing for a certain amount of heat loss (or, rather, " cold loss ") through the insulation of the pipes connecting the brine circuit to the rink piping proper, it will be seen that there is an ample reserve of cold in the circulating brine to freeze and to retain in a solid condition, the skating surface of the rink, despite the fact that the latter is continuously being warmed by the heated air of the arena.

NEW INVENTIONS

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

Flags that Don't Flag

TO a flag, as to a windmill, the breeze is the breath—I almost wrote staff—of life. In a dead calm, the bunting, however gaily designed, hangs listlessly, as though life were not worth living. But when the god of the winds bestirs himself, the flag expands its chest, so to speak, and makes the most of itself. And under the influence of a gale it even indulges in a flutter. To enable a flag at all times to appear at its best, an inventor has produced a device in which air is caused to flow towards the outermost edge of the flag. Under pressure from some such source as a fan or blower, air may be conveyed to the flag by a nozzle directed towards it or by way of side openings in a hollow pole.

It is stated that, as a rule, the flag will make a braver show, when intermittent puffs of air are directed towards it, than when it is the target of a constant blast.

Primarily, the inventor has had in mind a flag for advertising purposes. The enterprising tradesman, by means of this device, can certainly give his wares a good puff.

Patent Voices

TRILBY, the heroine of George du Maurier's novel, had a wonderful throat but no ear for music. Some people have a soul for music but no effective larynx with which to express it. I wonder how these good folk will be affected by an invention to which a patent has been recently granted in the United States. This consists of an artificial larynx. False teeth have been an unspeakable—or should it be " speakable " ?—boon to the human family. But what may one expect from an artificial larynx ? Is it possible to have constructed a replica of the throat of a Tetrazzini or a Bing Crosby and by means of this artificial larynx to produce the dulcet strains of the prima donna or the king of crooners ?

A Serial Match

THE repeatedly ignitible match, which is not unknown, has received further attention at the hands of an inventor. It is still lit by friction, extinguished by blowing and then re-lit by rubbing. The characteristic feature of the latest version of this more or less everlasting combustible stick consists in its constituents. It now embodies a new collection of inflammatory chemicals, some of which have names of many syllables. In view of the fact that the alleged lighter is at times temperamental, the devotees of the weed may be intrigued by this encore match.

Garment Drier

THOUGH not so old as the wooden horse of Troy, the clothes horse, whom one may call " Old Faithful," for generations, has been caparisoned with moist trappings. This primitive contrivance has now a rival which resembles a gigantic cage. But, in place of the parrot, there is a heating apparatus. The garments to be dried or aired drape the wires of the cage, above which is a hanger. The new device at least has the virtue of not screening the cheery blaze and genial heat of the fire from the inhabitants of the kitchen.

Muffled Ear Drums

THE idea of an ear plug to shut out or modify unpleasant sounds is not new. But a variant of this anti-noise stopper has been patented in the United States. The cumbersome but explicit title of the invention is " Device to be worn in the ear for eliminating or damping noise reaching the ear of the wearer." It comprises a loose core of fibrous material, and attached to it is a string for withdrawal. The core is coated with a non-adhesive substance, which, at normal temperature, is not plastic. However, it becomes plastic at body temperature. Consequently, when inserted in the ear, it naturally moulds itself to the shape of the aural channel. The imagination of the reader will conjure up the many useful purposes to which, in this age of nerve-wrecking noise, such an invention could be put. Henceforth the blatant electric drill need have no terrors.

Tooth and Gum Loofah

THE " Keep Fit " movement cannot neglect the teeth which play the overture to the opera of digestion, to which effective mastication has always been regarded as an indispensable preliminary. Hitherto the public have relied upon a brush to keep the teeth in a fit condition. But this method may be at least reinforced by a recently patented device. Equipped with a small tubular casing which resembles a finger stall, one's finger may conveniently be inserted in the mouth, and the teeth and gums can be massaged. Not only will a cleansing effect be the result, but the pearls of the mouth will be polished as by a lapidary. An Irishman might style this process a mouth manicure.

DYNAMO.

Thomas A. Edison.

MASTERS OF MECHANICS

No. 29.—A Prince Among Inventors. The Renowned Thomas A. Edison and His Many Creations

WOULD you call Edison a great scientist or merely an ingenious, commercially-minded mechanician and inventor ?

There are many would deny him even a shadow of the former status, yet few there are who would care to assert that he was not a great and, indeed, an extraordinarily fertile and gifted inventor.

Sound-recording, the incandescent electric lamp, the early cinematograph and the alkaline storage battery or accumulator constitute, perhaps, the best known and the most important of Edison's multitudinous scientific creations, and the ones which brought to him commercial success as well as universal renown. Yet there are many lesser known inventions of Edison. Indeed, at the time of the inventor's death in October, 1931, the total number of patents granted to Edison by the United States Government amounted to upwards of 1,400, of which some four hundred were master-patents which had actually been commercially worked. Edison's patents in countries other than America again ran into hundreds, most of them being derived from his American master-patents.

It is true that Edison had not the mind of a Faraday or other great scientific pioneers. Yet he showed throughout his amazingly active career a degree of inventive ingenuity which has hardly been equalled, let alone excelled in any other single individual.

Theory and Practice

Practice, according to Edison, is worth infinitely more than theory. He hated abstruse reasonings into the nature of things. Mathematics, too, he disliked, preferring, as he said, to create in actuality rather than in mere figures.

Perhaps this attitude of mind, together with Edison's great commercial instinct, was responsible for his " missing " of several great opportunities for fundamental scientific discovery. When, for example, he observed that the filaments of his carbon lamps " evaporated " slightly and caused a discolouration on a portion of the inner side of the lamp bulb, he merely noted the fact, but made little attempt to investigate its cause. Actually, of course, this " Edison effect," as it is now called, the result of the emission of negative electricity from the hot filament, contained within it the germ of the radio valve, but Edison himself never appreciated it. It was one of his few great " misses."

Thomas Alva Edison, the son of Samuel and Nancy Edison, was born at Milan, Ohio, on February 11th, 1847. His father was of Dutch descent and his mother of Scots extraction. During his early childhood, the Edison family suffered severe reverses of fortune, with the result that the young boy had at an early age to fend for himself.

But " Al," as his mother always called him, was a more than usually intelligent lad, and his first occupation he regarded more in the light of a great adventure than a serious business. This was his rôle of newsboy on the Canadian Grand Trunk Railway, which occupation he assumed at the age of twelve and plied his trade daily in the trains which ran between Michigan and Detroit.

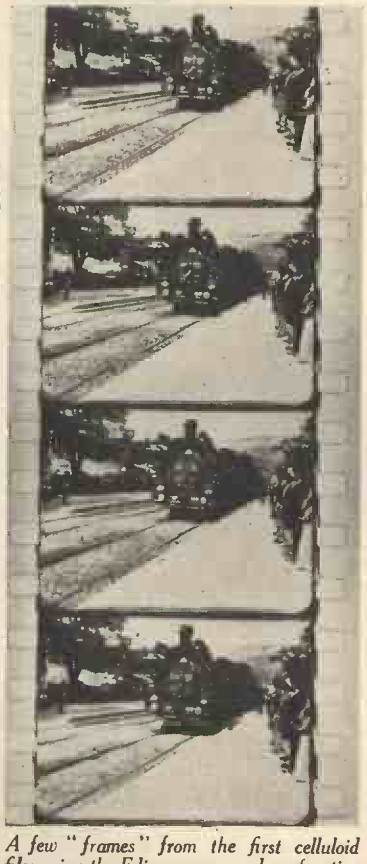
An early cinema camera, constructed in 1890.

Chemical Experiments

Even at this early stage of his existence, Edison's mind had given itself over to thoughts and aspirations of a scientific and mechanical nature. In a corner of the luggage compartment of the train, Edison maintained a little portable laboratory by means of which he conducted small chemical experiments during the " off " hours of his occupation. Such free hours, however, were not very numerous, for the lad, despite his tender years, actually set up a printing press on the train and, in a corner of the luggage compartment, printed a weekly news-sheet, which he called the *Grand Trunk Herald*.

The *Herald*, despite its frequent misspellings and amateurish composition, proved a success, and Edison, perhaps, might have made a name for himself as an author or a journalist had not an unfortunate incident happened during one of his train journeys. This was his setting fire to the luggage-van of the train as a result of one of his chemical experiments. The angry guard succeeded in extinguishing the fire before much harm had been done—and he was also promptly successful in flinging Edison himself out, printing press, chemical laboratory and all, on to the platform of the next station and in giving the lad a severe cuff on the ear as a memento of the occasion.

As a memento ! Alas, that box on the ear proved to Edison a very sad incident in his life, for it brought about a very severe degree of incurable deafness under which the renowned inventor laboured for the remainder of his life.



A few " frames " from the first celluloid film using the Edison gauge and perforation which has since become standard.

Telegraphy

Not long after his sudden dismissal from the Grand Trunk Railway, the young Edison managed to rescue a child from an oncoming train. The child happened to be a rural stationmaster's daughter, and, as a reward for his bravery, the station master offered to teach Edison all he knew about telegraphy, which was, at that time, one of the world's new wonders.

Edison jumped at the opportunity. Quickly, he became an expert telegraph operator and found employment successively at Memphis, Cincinnati, New Orleans and Louisville. There is a story that about this time he devised an electrical machine for killing cockroaches,

The first talking machine in the world. Edison's original phonograph. The reproducing diaphragm (cracked) is seen on the right of the photograph.

with which some of the American buildings swarmed. Whether this be true or not, it is certain that when he was a telegraph operator, Edison took out his first patent, which was for a vote-registering device intended for the use of the American State Legislature. Members had merely to press a knob and their vote was automatically recorded.

The vote-registering instrument proved a complete failure. It did one thing, however, Edison tells us. It taught the inventor to assure himself that there was an actual demand for a machine or device before he spent time and money on its making.

The cost of making and patenting the vote-registering instrument denuded Edison of all his savings. Moreover, he lost his employment and, for a short period, walked the streets of New York in an almost penniless or, rather, shall we say, " cent-less " condition. Opportunity, however, was never long away from Edison's door. Within a short time, it came again in a set of circumstances which caused him to invent a sort of telegraphic tape machine. He offered it to a certain concern for the price of 5,000 dollars and was much surprised when, after testing out the merits of the invention, he was awarded no less than 40,000 dollars for it.

A Flood of Inventions

Now, a self-made man, possessing reasonable financial security, Edison set up a laboratory and mechanical workshop at Newark, New Jersey and, employing a number of assistants, began to pour out upon the world the flood of inventions with which his name has so long been associated.

The first of these inventions was an electrical one. It comprised a system of duplex telegraphy, whereby two messages could be transmitted over the same circuit at the one time. This system Edison perfected in 1872. Two years later came his quadruplex system of telegraphy, or four-message working, and afterwards his six-message or sextoplex system of telegraphic operation. These inventions saved the American telegraph companies literally millions of dollars, and Edison flourished exceedingly in fame and in pocket as a result of them.

Then came, among a perfect welter of minor inventions, the single invention which made the name of Thomas A. Edison famous throughout the world. It was the phonograph.

There is no doubt whatever, say some what they will, that Edison was the father of the phonograph and the pioneer of practical sound-recording. Previous to Edison's time there had been many attempts at the making of mechanisms which would utter words and even coherent sentences. Not one of these earlier inventors, however, actually conceived the idea of storing up or recording sounds and then mechanically reproducing them. It is to Edison alone that the beginning of practical sound-recording is due.

The Phonograph

The story of the phonograph has often been told and can only be related very briefly here. Its inventor was engaged upon a machine intended to repeat Morse characters which were recorded on paper in a series of indentations. On passing the indented paper through his machine, Edison noted that it produced a musical, rhythmic sound, faintly resembling human speech. This observation led him to conceive the idea of providing a light diaphragm with a stylus and of registering its vibrations upon tinfoil or paraffined paper mounted upon a mandrel or cylinder which revolved at a steady rate. Edison quickly saw that his experiments were being made in the right direction. He devised better apparatus and, ultimately, succeeded in recording—and reproducing—human speech.

Edison's most popular phonograph. The Edison " Gem " model which, for many years, was a music maker in thousands of homes.

The first Edison phonograph, for which a patent application was filed on the Christmas Eve of 1877, comprised a hand-revolved cylinder covered with a layer of tinfoil. A stylus attached to a large diaphragm made light contact with the tinfoil. When " spoken at," the diaphram vibrated the stylus, which latter indented the revolving tinfoil, thus producing a crude form of record. The diaphragm-attached stylus was then made to re-traverse the tinfoil record, the indentations of which caused it to vibrate, thereby reproducing the original speech.

Edison's phonograph was not an instantaneous success. It was so crude and imperfect that for several years it remained little more than a laboratory curiosity. Ultimately, however, and egged on by the competition of other inventors, Edison took his phonograph seriously in hand, revolutionising it, devising methods of producing records commercially and " fathering " the instrument in every way.

It has always been said that the phonograph was Edison's favourite invention. No doubt this statement is a perfectly true one, for, in later years, wherever you came across Edison, there, also, you would be sure to find a phonograph or two.

The Carbon Lamp

The carbon lamp was one of Edison's next inventions, although it was closely followed by a similar lamp made by Swan, of Newcastle. Edison, for his incandescent lamp, employed thin slips of bamboo, suitably charred. Swan, on the other hand, used pieces of linen charred by sulphuric acid. In his search for suitable materials for lamp construction, Edison, now a rich man, sent explorers to the ends of the world. They brought him back fibres and other vegetable materials from various countries, all with a view of improving upon his original lamp.

In 1878, the Edison Electric Light Company was formed. It moved rapidly to complete success, all, of course, on the basis of the bamboo-fibre lamp. Finally, after many differences, Edison and Swan combined their lamp interests, thereby giving

Early cylindrical talking machine records made by Edison at Orange, New Jersey.

rise to the Edison-Swan incandescent lamp.

Towards the end of the '80's of the last century, George Eastman, the famous inventor of the Kodak, put celluloid film on the market. Edison immediately seized upon this product for the furtherance of an invention which he was then engaged upon. He called this new instrument a "Kinetoscope," and it comprised a crude cinematograph device for presenting pictures in motion. Edison's "Kinetoscope," which reached England in 1891, had a short vogue, mainly as a peep-show instrument. In it, a series of pictures recorded upon a celluloid film were moved downwards continuously behind a lens through which the observer peered. The effect of motion was thus produced.

The "Kinetophone"

Another interesting invention due to Edison was the "Kinetophone," a combination of the cinematograph and the phonograph or gramophone. This, which was introduced in practice about 1908, was the first talkie system which met with any practical success.

During the Great War, Edison worked energetically in a new direction—that of chemical engineering. He devised processes for producing synthetic chemicals and other materials. Then, in 1916, he was made a member of the United States Naval Consulting Board, to which organisation of scientific men he contributed no less than forty original inventions.

One of the earliest phonographs known. It was operated by a sewing-machine treadle.

At all times, Edison was a truly indefatigable worker. He could continue for sixty hours without sleep and with hardly any food. Yet, strangely enough, there were many of his inventions which he quickly lost interest in.

Much of Edison's inventive work lies buried in the archives of the great laboratory and engineering shops which he set up at Orange, New Jersey, and in the records of theAmerican Patent Office. One day, however, it will all be collated. Then and only then will mechanical, chemical and electrical science realise their respective degrees of indebtedness to Thomas A. Edison for the ceaseless and powerful practical aid which he gave towards the extension of their separate domains.

A BUTTERFLY VALVE IMPELLER PUMP

A Pump that was Judged the Most Interesting Invention of the Year

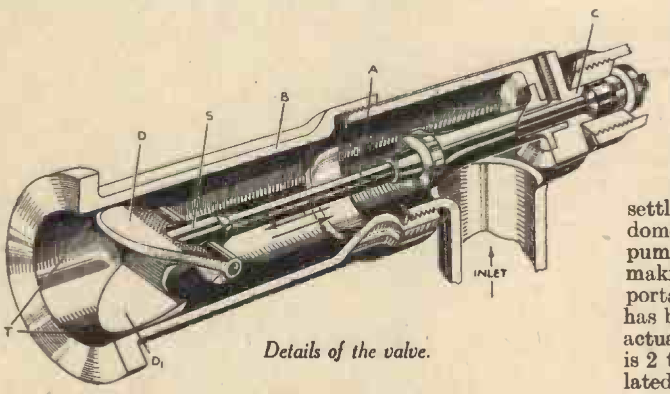
THIS development, like so many other excellent ideas, was the result of chance. The inventor was experimenting with an ordinary piston pump equipped with large hinged flap-valves fitted into the piston head. On one occasion the piston itself was taken out and the pump operated with the flaps alone. A notable increase of efficiency was at once observed, and the inventor was then enabled to solve his problem of dredging sand- or weed-infested channels in marshy districts. This discovery was pursued further and patents taken out covering the new advance in pumping technique.

On October 4th, 1937, the inventor, Captain Louis le Clezio, was awarded the "Grand Prix" at the Concours Lepine in Paris, where his pump was judged the most interesting invention of the year.

How it Works

The principles underlying the le Clezio pump are, like most good things, very simple. A piston rod *A* is caused to reciprocate at 500 to 1,000 strokes per minute coaxially with the pump barrel *B*, which in practice need not be machined. *C* is an ordinary stuffing box. Two flaps *DD'* are cut to such half ellipses that when they are at, say, 60° to each other they completely fill *B*.

The flaps are attached to the end of the piston rod with the aid of a single common hinge permitting them to move freely relative to one another. Two stops *SS* are provided, so that on the forward stroke the peripheries of DD^1 do not touch the bore of *B*. Once the pump is in operation it has been found that DD^1 never touch the sides, even if *SS* are removed. This is due to the fact that the moving column of liquid keeps flowing in the same direction even on the return stroke, and at the end of the forward stroke considerable hydrostatic pressure is built up in the annular space *T* between *B* and DD^1 which is balanced by opposing forces present in DD^1. Thus a practically frictionless hydrostatic seal is formed between the flaps and walls of the pump



Details of the valve.

without actual metallic contact taking place between them. This is one of the great advantages of this type of construction. It would be interesting to examine this phenomenon more closely in its scientific aspects using a glass pump-barrel and stroboscopic illumination.

Its Uses

The le Clezio pump is particularly useful for handling solids mixed with water, such as cement, gravel, sand, coal-dust, or slurry. A demonstration pump of 2-in. bore was seen to pass ½-in. stones. At present great difficulty is experienced in dealing with the above materials and mixtures. This new solution to these troubles should be valuable to the industries concerned. Mud can easily be pumped, a fact which will be valuable in connection with the reclamation of land. Sewage, paper-pulp, and other aqueous suspensions can easily be dealt with.

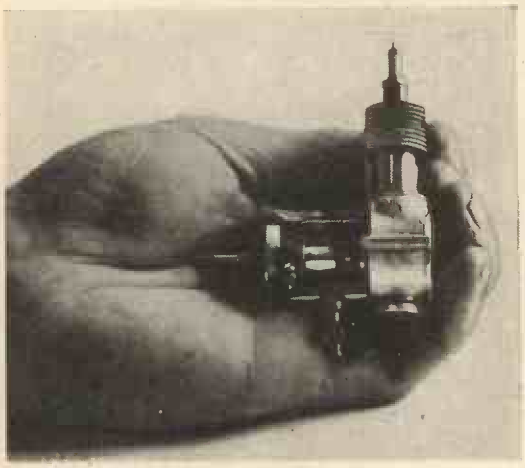
This new device is equally suitable for use with viscous liquids such as crude or refined oils, molten asphalte and sulphur, tar and molasses.

A hand-operated model will be useful, more particularly to gardeners for dealing with cesspools, settling tanks, and other domestic purposes. The pump is light in weight, making it valuable where portability is essential. It has been observed that the actual delivery of the pump is 2 to 2½ times its calculated capacity, taking into account the piston sweep and strokes per minute. This is explained by the fact that during the back stroke the column of liquid is moving at its normal equilibrium velocity. This enables a pump to be built to half the dimensions of what would ordinarily be required for any given output.

BUILDING A 1 C.C. ENGINE

By W. H. Deller

The First Article of a Short Series



The size of this midget engine can be gauged by comparison with the hand. In spite of its smallness, it will fly a model weighing 20 oz.

THOSE who have had experience in building small petrol engines will realise the precise nature of the work involved to produce efficient results. The engine about to be described, and the details for the construction of which will be given in a series of articles, is of considerably smaller capacity than others for which information has as yet been available. The actual capacity of this engine is closely approximate to 1 c.c., the bore and stroke being $\frac{7}{16}$ in. and $\frac{1}{2}$ in. respectively. In view of these rather abnormal dimensions, it will be readily appreciated that for the completed job to be successful, the parts will require making with precision, and on this account a fair degree of skill must be employed in its construction. This note is struck merely as a warning to deter those with little experience of accurate machining from lightly embarking on the construction of such an engine, as indifferent work will only entail subsequent disappointment.

Brief Details

In common with most small engines of this nature a 2-stroke cycle is employed. A notable feature, however, is the use of a mechanically operated valve for the gas intake. This is of a simple piston type operated by a face cam situated behind the propeller boss. The same cam plate serves to actuate the make and brake by means of a lobe cam formed round the outside.

No castings are used, the parts in the main being machined from bar material. Another feature, which undoubtedly saves weight, is the absence of bolts and nuts in the design of the engine. Two bolts and nuts only are used for holding the contact breaker blade, and fixed contact clips.

Those contemplating building this model would do well to study the text carefully and to carry out the work in the given order. By following the stage by stage operation exactly as set out, much unnecessary work will be avoided. Beyond this, the fact that clearances are cut very fine and the section of the metal in places is rather thin, it becomes essential for the surfaces machined at separate operations to be truly concentric with each other.

The Crank Case

The crank case, crank case end cap and drain plug are made from duralumin bar. About 3 in. of $1\frac{1}{2}$ in. dia. bar will make the crank case and end cap, and 3 in. of $\frac{1}{2}$ in. dia. bar is required for the drain plug. The latter piece is more than sufficient, but the remainder will be wanted for the connecting rod. These two pieces represent the total requirements of this metal.

First Operation of Crank Case

Cut off a piece of $1\frac{1}{2}$ in. dia. bar $1\frac{3}{4}$ in. in length. Chuck and lightly face one end, reverse in chuck and face opposite end to $1\frac{11}{16}$ in. overall length.

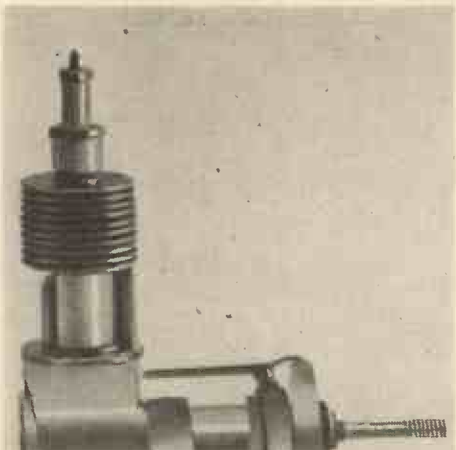
Second Operation

Hold by $\frac{3}{4}$ in. in chuck (running true), and turn to $\frac{9}{16}$ in. dia. for a length of $\frac{7}{8}$ in. to rough out main bearing boss.

> **Those Readers who wish to Complete the Construction of the Engine Before Publication of the Concluding Articles can Obtain a Set of Blueprints for 5s.**

Third Operation

Hold in chuck by boss with face of larger diameter as near to the jaws as possible. Reface front to a clean smooth finish. Centre drill, drill $\frac{9}{16}$ in. deep to point of drill and flat bottom drill $\frac{5}{8}$ in. diameter. Englarge hole by boring to exactly $\frac{13}{16}$ in. diameter face bottom of hole to $\frac{19}{32}$ in. deep, finishing to a square corner. Screw mouth of hole for a distance of $\frac{9}{32}$ in. from the front face, making certain that a full thread is cut. Counterbore the mouth of the hole to exactly $\frac{15}{16}$ in. diameter by $\frac{1}{16}$ in. deep; also counterbore out the first two threads to ensure the flange on the end cap will seat properly. It should be noted that this is necessary on account of the thread on the cap not being undercut. This part can now be removed from the chuck.



Another view of the 1 c.c. engine.

First Operation Crank Case End Cap

Chuck remainder of $1\frac{1}{2}$ in. diameter bar, leaving about $\frac{1}{2}$ in. projecting from jaws. Face and turn for a distance of $\frac{5}{16}$ in. to (·0015 to ·005 in.) under $\frac{15}{16}$ in. diameter, leaving a square corner. Turn front portion back for a $\frac{1}{4}$ in. to ·851 in. diameter. Turn $\frac{3}{16}$ in. diameter peg to leave ·851 in. diameter $\frac{3}{16}$ in. in length. Screw ·851 in. diameter 32 threads per in. with a narrow screw cutting tool, to get as close to the shoulder as possible, leaving not more than $\frac{1}{32}$ in. unscrewed. Use the thread in the crank case as a gauge for size, taking care not to seize the threads when fitting. After fitting, turn the first thread away to core diameter as shown. The part at this stage forms a screwed peg upon which to perform the next operation on the crank case.

Fourth Operation Crank Case

Put a little oil on the thread just cut and making sure that the thread and register in the crank case are clean, screw the crank case on to the peg up to the shoulder. Face end of bearing boss to $1\frac{5}{8}$ in. overall length. Centre boss, drill (correcting for truth by boring if necessary) and reamer $\frac{17}{64}$ in. diameter. Turn the boss the whole length to $\frac{15}{32}$ in. diameter. Face up back of crank case chamber to $\frac{3}{4}$ in. in length from front. Turn from front of the boss to $\frac{3}{8}$ in. in diameter for a distance of $\frac{3}{16}$ in. Leave a collar $\frac{1}{16}$ in width, and turn remainder of boss to the same diameter, finishing against the crank chamber with a small round nosed tool cutting into the back on the final cut to form a groove round the boss $\frac{1}{8}$ in. wide, and $\frac{31}{32}$ in. from the bottom of the groove to the end of the boss. This completes the case for this operation, when the end cap may be completed.

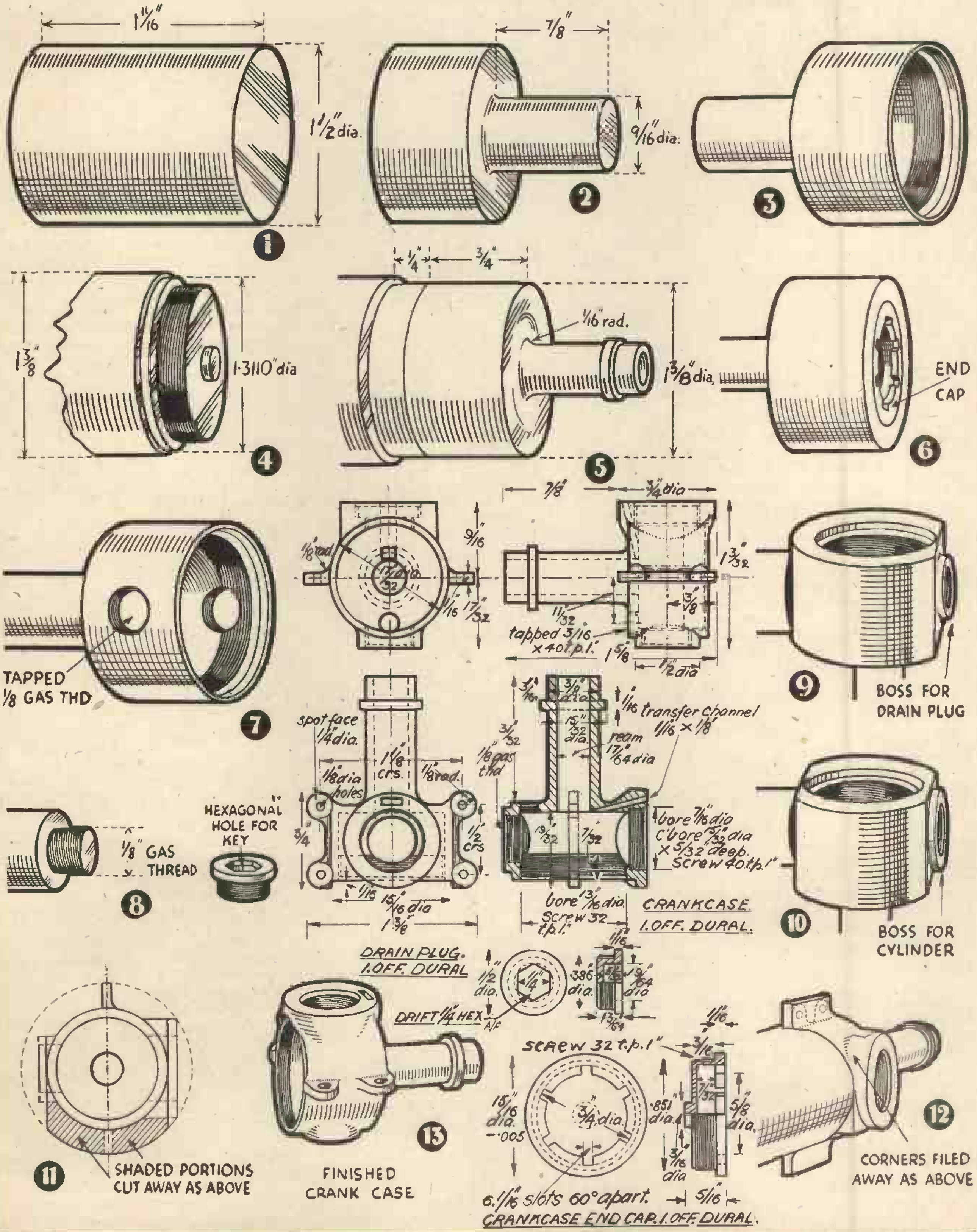
Cyc-auto Engines

GEORGE GROSE, of Ludgate Circus, London, E.C.4, have a limited number of brand new 98-c.c. Cyc-auto Engines, complete with magnetos, plug, exhaust box and drive, etc. All have been bench and brake tested by the makers.

Originally listed at £9, George Grose are able to offer these engines at 55s. each. They are suitable for driving machinery, lawn mowers, air compressors, dynamos, etc.

THE 1 c.c. TWO STROKE PETROL ENGINE

Stage-by-Stage Constructional Details



Televising an outdoor motor-racing scene.

THE MONTH IN SCIENCE AND

Hot Water in Iceland

THE latest news from Iceland is that hot water is now laid on from a natural hot spring to the town of Reykjavik. Iceland is noted for its hot springs. There is so much hot water in subterranean reservoirs that snow and ice do not lie nearly so thickly as would be expected in this northern land. With water from these sources laid on in the houses winter will be a little more bearable. Engineers have simply laid down a pumping station and put in a system of lagged trunk and distributing mains. Every house will be provided with radiators and with a supply of hot water on tap. The water is at 160° F., which is rather hotter than the human touch can bear. Imagine how pleased we would be in England if we got hot water just as we get cold at a turn of the tap.

Waste from Power Stations

HOT water could be made available in this manner in properly built towns if engineers were given a free hand. The towns would be laid out round their power stations and the hot water which is rejected to the tune of many million gallons daily from power-station condensers would be piped round the town. The water is heated, of course, in cooling the exhaust steam from the turbines of the turbo generators. About 50 per cent. of the heat in the coal burnt under a power-station boiler goes in this way, 25 per cent. goes up the stack in the hot chimney gases. Only the remaining 30 per cent. is usefully employed to generate electricity.

A Heated Swimming Bath

IN Great Britain there have been one or two isolated attempts to use the waste hot water from a power station. The municipal baths of the city of Edinburgh at Portobello get warm water from the condensers of a nearby power station. In this way the water in the bath can be kept at 70° to 80° F. all the year round practically free of charge.

Wave-making Machine

THE Portobello baths are also unique in possessing a wave-making machine. It consists of a reciprocating quadrant made in four sections extending practically along the whole of the deep-end wall. Two 160-h.p. motors actuate these quadrants at any set rate and create a surge which travels along to the shallow end. Here the waves break in a rolling surge just like natural waves rolling up a beach.

Fruit Research Laboratory

COVENT Garden under a Government research department is going into the question of the safe transit of fruit from distant parts of the empire. A fruit research laboratory has been established for the purpose in the market. Merchants thus have a laboratory on the spot where they can take faulty consignments for diagnosis of their ills. Fruit, in going bad, forms acids and alcohol. Chemists can measure these substances by developed methods. They also research into such questions as the effect of neon light and carbon-dioxide in fruit preservation. An atmosphere of carbon-dioxide, it is found, helps to keep fruit in good condition.

Smithfield Too

LONDON'S big meat market at Smithfield is also kept under Government inspection, and regular tests are made on the soundness of meat. The quickest test for freshness is to measure the electrical resistance of the fat and lean. Stale meat becomes acid. As acid readily conducts an electric current, a drop in resistance soon shows up a bad carcase. Eggs are tested too. The test here is to measure the head of water required to break a yolk. Fresh yokes break far less easily than stale ones. In fact a fresh egg is also a tough one.

The Gnathydynamometer

IN America the problem of eating has been tackled by scientists as well. An enterprising dental college set itself the problem of measuring the strength of the human bite. The instrument is quite simple. It consists of a spring gag which is bitten. A calibrated pointer measures the strength of the bite. This instrument is called a gnathydynamometer. Literally this means a bite-pressure-measurer. An average man's bite is about 171 pounds to the square inch. The record so far measured is no less than 270 pounds.

The Phagodynamometer

STILL better, however, is the phagodynamometer. This instrument measures the jaw power required to masticate different foods. Jaw power for a tough steak is about 80 lb. to the square inch. With the average bite standing at 171 lb. it seems that mankind has an adequate factor of safety in his masticatory machinery.

A New Toy

TOYS get more ingenious every year. But this one deserves special mention. It is a streamlined motor-car which goes or stops when you whistle to it. The trick is that the car roof has an open grid under which is a balanced plate. If you whistle directly above this the blast of breath tips the plate and releases the clock-work.

Photomicrographs

THE world is getting short of library space. The British Museum alone possesses 5,000,000 books and countless files of newspapers, magazines and periodicals. The tremendous volume of scientific literature which is poured out yearly accumulates in like manner. Business houses and government departments find the task of filing their records getting greater and greater with every year that goes by. A way has been suggested of squeezing up all this record keeping into one hundredth of the space. Documents and books can be photomicrographed on to cinematograph film.

The Kodak Company in America started the idea. Wartime newspapers were printed on ordinary wood-pulp paper. Even the library copies meant for preservation were so printed. It is the custom to use rag paper for library copies as it lasts better. As expected, within fifteen years

THE WORLD OF INVENTION

the cheap wood-pulp paper started to yellow and decompose. It was decided to photograph them. It was done and it proves so compact and cheap that the whole issue of a big newspaper can be photographed on two feet of film at the cost of a 1*s.* and at the rate of 30 pages a minute. The method is finding all sorts of applications. Films of rare books are being interchanged between the great libraries of Britain and America. Business house files are telescoped up on film reels. In twenty years' time if you wish to consult this issue of PRACTICAL MECHANICS at the British Museum it is as like as not that you will have it in film form projected on a ground glass screen.

A Leviathan of the Road

A MOTOR coach which has accomplished 87 m.p.h. on German motor roads made its appearance at the Commercial Motor Show at Earl's Court. The 330-h.p. oil-driven engine has twelve cylinders horizontally opposed in two banks of six. There are six wheels, four of which are power-driven, and the gear box has five gears with overdrive. This leviathan of the road is for use in mountainous country where railways do not exist and to provide fast transport on the motor roads.

Two Miles into the Earth

BY drilling to a depth of 9,500 ft., nearly two miles—in search of a gold reef—Dr. H. S. Harger, geologist and discoverer of some famous mines, has set up a world record for a diamond drill.

£8,000,000 Harbour

LARGE ships plying on the Great Lakes and ocean-going liners have hitherto found Toronto an inaccessible port. This handicap has now been removed by the completion of a new harbour at a cost of £8,000,000, which enables it to cope with shipping on a much larger scale. Work was first commenced on the harbour over nineteen years ago.

World's Largest Aeroplane Propeller

THE de Havilland Aircraft Co. have designed what they claim to be the biggest aeroplane propeller in the world. It is 14 ft. 6 in. in diameter. Made of aluminium alloy of high tensile strength, it has three blades each capable of converting 500 h.p. into actual propulsive thrust. It is also rendered immune from corrosion through the action of salt waste by means of a special treatment.

Underwater Broadcast

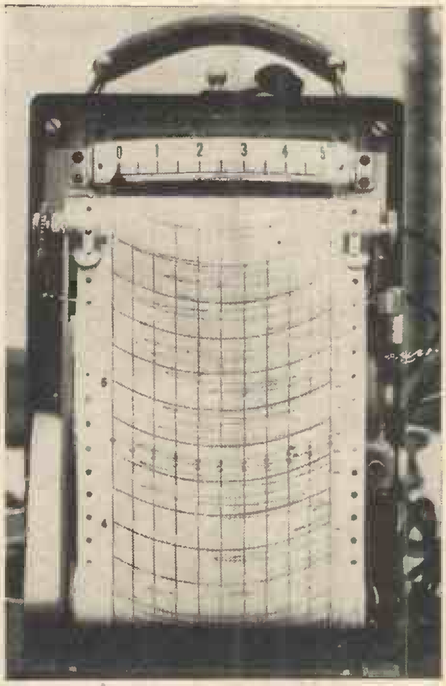
FOUR radio engineers of New London (Connecticut) have succeeded in broadcasting voice signals from a submerged submarine for the first time. The submarine was submerged off Bartlett Reef Light, and the signals were picked up ten miles away at the New London submarine base. Broadcasts over a waterproof telephone to a short-wave transmitter on the surface have previously been made from undersea craft.

A Boon to Telephone Subscribers

A NEW switchboard system has been devised by Gustav Tauschek. By dialling a number a card is automatically punched with holes by the switchboard, which then feeds the card into an electric device which rings the number. When the number answers, the card is passed into a box and is collected in due course and passed to a machine which makes out the telephone bill automatically. The cards also record the length of each call. When the number does not answer the card is rejected by the machine to another part of the mechanism which then returns it at intervals until the number does answer.

The New German Zeppelin

THE sister ship of the ill-fated Hindenburg, LZ130, will make her first trial flights in April. A delay of six months has been caused by certain changes in the construction, which have become necessary to make the ship suitable for carrying helium. The LZ130 will make her first flight to the United States after her trial flights have proved successful. It is intended to use the ship on the North Atlantic service, because the distance is only 6,000 kilometres, whilst the Graf Zeppelin flew over the South American route, which is a distance of 10,000 kilometres. Only 40 tons of fuel will be necessary for the route to North America, whilst the Graf Zeppelin carried 60 tons of fuel for the trip to South America. This saving of weight enables the use of helium, which is about one-third heavier than hydrogen. The four diesel engines which will be fitted to the new dirigible have already been dispatched to Friedrichshafen.



(Left) A suspect being questioned by means of a "lie-detecting" machine. (Above) A close-up of the "lie-test" recording device.

World's Records

A NEW altitude record for a light hydroplane, of 11,869 metres (nearly 40,000 ft.) is claimed by Captain Jerebchenko of the Red Army. Another world record, this time for speed, is claimed by Maurice Arnoux and Mlle Laleis, who covered 1,000 kilometres at

The "flying tricycle," said to be the safest aeroplane in the world.

an average speed of 184½ m.p.h. in their two-seater 6½-litre plane. The record holds only for this type of plane.

Thought Transference

IN our September issue we had an article on " Is Thought Transference Possible ? " We now learn that the Duke University, North Carolina, America, has produced a special pack of cards which they claim holds the key to remarkable researches into the mystery of mental telepathy, or projected thought. The pack consists of twenty-five cards, split into five each of the following symbols : Three wavy lines, circle, a star, square and a plus sign. The cards are used by two persons, one being the " sender " and the other the " receiver." The sender then sits with his back to the receiver, and when they are both in the right mood for concentrating, the sender shuffles and cuts the cards. The sender then concentrates on the chosen card and raps on the table with a pencil. The receiver then endeavours to name the card, mentioning the first one he thinks of, or the one of which he gets the clearest image. This game is quite simple, but there are more difficult ones for those with considerable powers of concentration. The cards are reputed to be the first step in applying scientific methods to the tracing of the Sixth Sense.

A New Aeroplane Engine

A SPECIAL American all-metal aeroplane has been imported into this country by British aeroplane engineers for testing out a new British aeroplane engine which is claimed to be the most powerful in the world. The reason given is that our own engineers are busily engaged on overdue R.A.F. contracts and have had no time to design a special machine.

The American plane is constructed of specially strengthened and thickened metal to withstand the great strains of flying behind the new engine. The wings have also been specially shaped to keep the plane stable.

A " Flying Tricycle "

ABOVE, is an illustration of the U.S. two-seater " flying tricycle " which is reputed to be the world's safest aeroplane. It can be taken off without touching the controls and landed with no danger of nose-tilting. It will be used by Royal Dutch Air Line pilots for practice as the new 30-seater Douglas air-liners they will use will be " tricycles." Two British firms—De Havilland and General Aircraft—have built experimental types.

A " Riverdrome "

MR. R. A. C. BRIE, flying manager for the Cierva Autogiro Co., has designed and patented a " riverdrome " for windmill aeroplanes. The " riverdrome " consists of a platform 50 yd. long by 15 yd. wide. Its purpose is to enable the " windmill " aeroplane to take-off and land with ease. In order that it may swing into the wind one side is hinged, which also enables it to be anchored alongside the river bank out of the way of shipping. The advantage of the " riverdrome " is that it can be anchored in a busy waterway, such as the Thames, thus enabling a direct-take-off autogiro to carry passengers and mail between the West End and Croydon and Heston.

An Air-conditioned Train

INDIA'S first air-conditioned train recently made a trial run from Delhi to Agra and back. The five coaches attached to the train have a constant temperature of 75 degrees. The air changes every four minutes.

Armed Mine Sweepers

FIRST of a pair of 1,500 h.p. armed mine sweepers, the new Thames-built mine-sweeping motor boat, M.M.S.I., which recently made its appearance on the Thames, may supersede fishing trawlers.

A new Baldwin high-speed locomotive, 90 ft. in length, which is reputed to have reached a speed of 100 m.p.h. during a test run in Philadelphia. The engine is the first of six to be constructed and will be used to haul the " Super Chief," the crack Los Angeles train.

The boat draws very little water, thus enabling it to pass over submerged mines where a larger vessel might meet with disaster. It can attain a speed of 12 m.p.h. when towing heavy sweeping gear. A special winch operated by a 50 h.p. engine capable of exerting a pull of seven tons, is carried by the boat for handling mines. The M.M.S.I. is to be stationed at Portsmouth, where trials will be carried out with a new type of propeller. Spirals take the place of the more usual blades, so that the propeller will not be damaged or fouled by anything it may strike.

Into the Stratosphere

LT.-COL. PEZZI, who on May 7th attained the high altitude of 47,000 ft., in a statement to an *Evening Standard* reporter advised that the super-fast stratosphere plane of the future must be of the bi-plane type used for his record attempt.

Control of rudders, he explained, must be very rigid for stratosphere planes because cables, such as are now used, are liable to show undesirable variations in length at high altitudes. Special attention must be paid to engine lubrication. Oils must be as indifferent to low temperatures as possible. The Italian Stratosphere Flying School, Lt.-Col. Pezzi revealed, has gathered important data on the physical reactions of the pilots at high altitudes. Over 42,000 ft., "stratosphere suits" with electric heating, or completely isolated cabins, are necessary if the pilot is to be insured against death.

A Rigid Chain

THE rack chain, or rigid chain, invented by M. Michel Le Roy, has a number of useful purposes. It was while watching an Indian fakir do the rope trick that Michel le Roy first thought of creating his rack chain.

Among the hundred and one uses to which this ingenious device can be put are wireless aerials, railway-station signals, etc.

At the present moment the Naval Ministry are using the rack chain on board submarines, in time of peace, as masts and aerials. In cases of accident it is run up the side of a sinking vessel, and stands out straight at a height of 75 metres, giving distress signals. The equipment can be used for supplying food and air to a submarine crew, as it is possible to slide a tube through the centre of the chain.

Not the Indian rope trick but a "rack chain" that can be made to stand rigidly to a height of 75 metres.

The rack chain is also a boon to fishermen, who can carry a rack chain wound round a reel (spool or bobbin) small enough to put in the pocket.

Rapid Measuring Instruments

TWO new instruments have been devised for measuring the thickness of tin coating on tinplate. Previous methods of estimation were chemical and suffered from the disadvantage that a considerable time was required, and as the coating had to be removed the tinplate was spoilt. One of the new instruments is magnetic and the other electro-magnetic. They are both capable of giving results rapidly without detriment to the tin coating.

The method of Chalmers and Hoare employs a cobalt-chrome-steel permanent magnet and measures the force necessary to pull it off the sheet using a syphon-operated water balance for this purpose. The second instrument, devised by Tait, uses a small transformer which is placed upon the sheet so that the magnetic circuit is the core of the exploring head, the gaps formed by the non-magnetic coating and the basis material. The former is particularly useful for plotting the contour of the surface and the latter is primarily a workshop instrument for measuring the average thickness and large-scale variations. Differences of thickness in the coating of 5 millionths of an inch can be measured by the magnetic method.

Millions of Pounds Lost

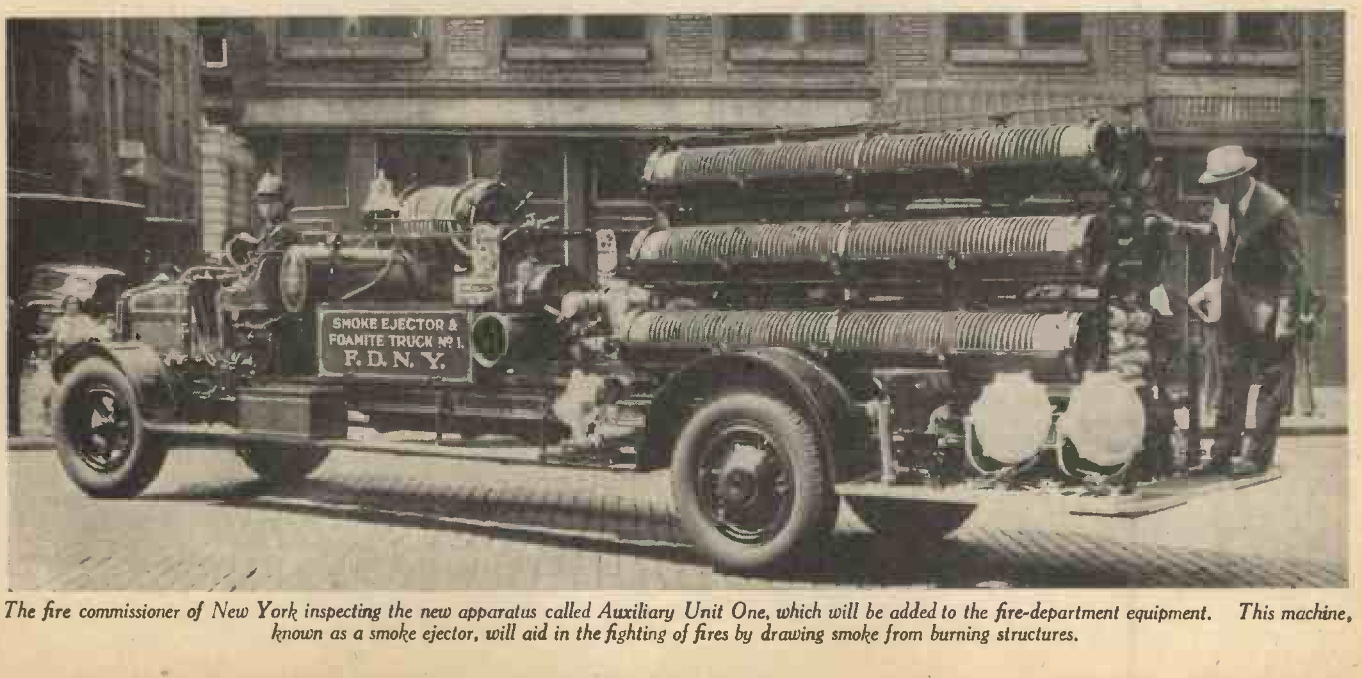
THE Decimal Association, which numbers amongst its members our most prominent industrialists and leading figures in every section of the community, has recently been carrying out surveys in different branches of British industry to determine the savings which could be effected by a decimal coinage and a metric system of weights and measures in Great Britain.

It is estimated that many millions of pounds are lost annually by our adhesion to £. s. d., avoirdupois, etc., and a scheme for a complete revision of our present system has already been drawn up.

Award to American Professor

THE award of the medal of the American Section of the Society of Chemical Industry to Professor E. J. Crane, of Ohio State University, took place on November 5th at the Chemists' Club in New York.

The prize went to Professor Crane in recognition of his work in abstracts of technical and scientific papers in all fields of the chemical industry. More than 60,000 abstracts are prepared and published annually by a staff under Professor Crane's direction. Data contained in nearly 3,000 scientific and technical trade periodicals published in thirty-one languages is thus made available to science and industry.



The fire commissioner of New York inspecting the new apparatus called Auxiliary Unit One, which will be added to the fire-department equipment. This machine, known as a smoke ejector, will aid in the fighting of fires by drawing smoke from burning structures.

MODEL AERO TOPICS

CURRENT NEWS FROM THE WORLD OF MODEL AVIATION

BY F. J. C.

Farewell Supper to Capt. Bowden

A PLEASANT little function took place at Ye Olde Cheshire Cheese, Fleet Street, on December 1st, when a farewell supper was given to Capt. and Mrs. Bowden. Capt. and Mrs. Bowden will be leaving for Gibraltar early in the New Year, and the supper was arranged by the S.M.A.E. to set on record their appreciation of Capt. Bowden's work, and to wish him a speedy return. It seems that he will be away for at least two years, and thus aero modellers all over the country will be denied the pleasure of watching his models fly, and the wise counsel he was always pleased to give to aeromodellers on this important subject of petrol-driven model aircraft. He has done more than any other man in the world to advance the science of petrol model aeronautics, and it is he who has created the new hobby of petrol model aeroplaning. He has built an immense number of petrol models, and published the results of his experiments—chiefly in this journal, for the guidance of others. He has been responsible not only for producing the planes, but for encouraging the use and design of even smaller engines, which have gradually come down in size from 30 c.c. to 1 c.c. The world of model aeronautics owes him a debt of gratitude for his work, and he will go down to history as the pioneer of petrol models, with D. Stanger, who created the first petrol-model record with a flight of 51 secs. before the War.

The many guests included Mr. R. York, Mr. E. Cosh, Mr. H. H. Dray, Mr. M. R. Knight, Mr. Rippon, Mr. F. J. Camm (PRACTICAL MECHANICS), Mr. Brook, Mr. D. A. Russell, Mr. J. C. Smith, and Mr. L. J. Hawkins.

Many tributes were paid by various speakers to the work of Capt. Bowden, who responded. He said that he was taking a case of models to Gibraltar with him so we may expect to hear further results of his experiments. I should like to add my personal good wishes to Capt. Bowden, and to repeat the hope I expressed in my speech that he would soon return to this country.

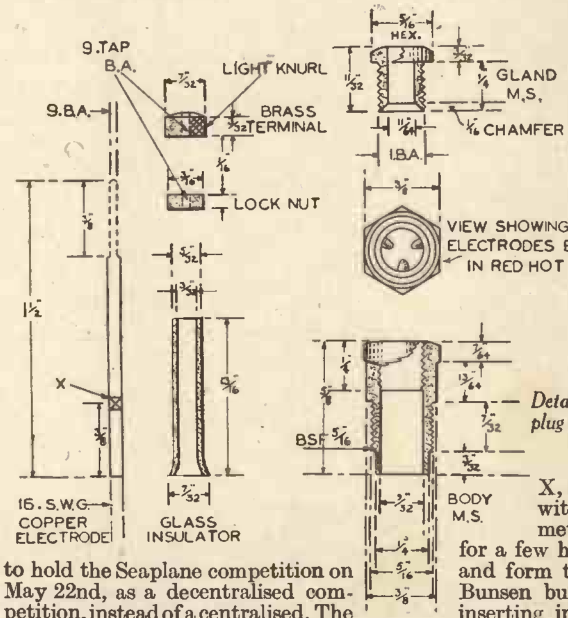
I am sure all my readers will reciprocate those sentiments.

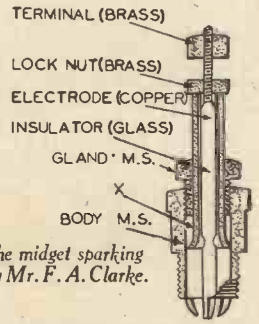
The Insurance of Petrol Models

WITH reference to the risk of damage to persons and property, to which the flying of petrol models give rise, and which I have dealt with previously, I am told that the S.M.A.E. have now introduced some new rules governing the flying of such models by members of clubs affiliated to it. Here is a summary of the rules: "No power-driven model propelled by steam, petrol or compressed air, etc., shall be flown over public open spaces at any time unless special permission is obtained from the S.M.A.E. No person under 18 shall be allowed to fly a petrol or power model unless under the control of an adult. The model shall carry a mechanical timing device fitted to the ignition system limiting the engine run to 2 minutes. Every person flying a petrol model shall be in possession of a current insurance policy covering third-party risk. No attempts on duration records shall be made without notifying the S.M.A.E., who shall decide if the conditions are suitable. Machines must be set to fly on a circular course." I understand that Mr. Dudley Ship, of 44 Holdenhurst Road, Bournemouth, issues a suitable policy against such risks as those I have mentioned. I congratulate the S.M.A.E. on the wisdom of making these rules, for whilst we have been free from accidents in this country, it is wise to take precautions in case such should occur.

S.M.A.E. Notes and News

THE Council granted permission to the Brighton and District Club for the Portslade flying ground to be used, provided that they conformed to the power-driven rules. The Competition programme for 1938, as previously announced in this journal, was approved. It was decided to hold the Seaplane competition on May 22nd, as a decentralised competition, instead of a centralised. The use of tanks for this competition is permitted. The Women's Cup competition which is for models conforming to the fuselage formula, and rubber driven will also be a decentralised competition, the entrance fee being 1*s*. Men must not in any way help to prepare the machines for the competitors. The London Branch of this competition will be held during the Northern Heights Gala Day at Fairey's Aerodrome. The White Cup for flying boats will be held as a centralised Competition at Danson Park on June 26th—the same day as the Lady Shelley Seaplane Competition. The Wakefield Trials will be held at Fairey's Aerodrome on July 3rd, and not on the 17th as previously suggested. The Aerodynamic Efficiency Competition will be held at Fairey's Aerodrome on July 10th. The Bowden International Trophy will be held on July 24th at Fairey's Aerodrome. The Council decided that Captain Plugg's cup will be awarded to the club with the highest number of points gained in Decentralised competitions throughout the 1938 season. A Photographic Competition will be run next season. It is proposed to produce an S.M.A.E. booklet and competition programme for 1938. This will contain full particulars of all competitions, F.A.I. rules, record-claim form, Wakefield entry form, etc., and it will be sold for a few pence.





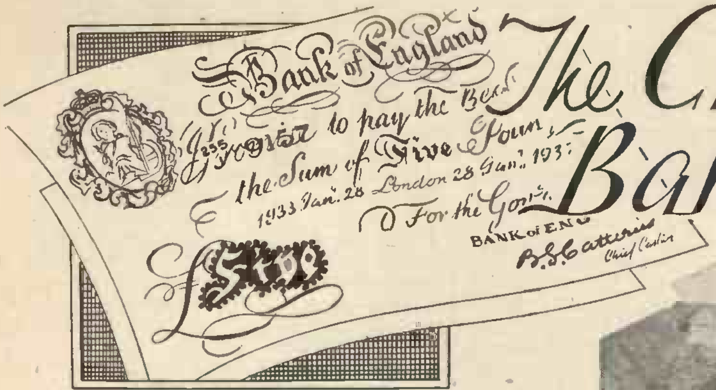
Details of the midget sparking plug made by Mr. F. A. Clarke.

The Sheffield Model Aero Society

I AM asked to say that the Joint Secretaries of the above are Mr. R. J. Hemingway, 8 Charles Ashmore Road, and Mr. Webber, 11 Robert Road—both of Meadowhead, Sheffield, 8. Indoor meetings are held fortnightly at Carver Street Schools, on Mondays from 7.30 p.m. to 10 p.m. Weather permitting, meetings take place every Saturday and Sunday afternoon at Coldaston Aerodrome. Any interested reader is invited to the meeting. The subscription is 4*s*. per annum for seniors and 2*s*. 6*d*. per annum for juniors, payable in cash or by instalments.

A Miniature Sparking Plug

MR. F. A. CLARKE, of Luton, Beds, sends me the particulars of his midget sparking plug, and I have had the appended illustration prepared of it. A few important points must be observed in the assembly. After preparing the central electrode file four flats at X, and bind lightly at this point with thread covered with Hermeticole jointing, and bake slowly for a few hours. Next take the glass tube and form the mouthpiece by holding in a Bunsen burner or gas ring until red, and inserting in that end an object such as a scriber which has also been made red hot. The mouthpiece and binding afford the means of locking the unit. Mr. Clarke says that any washer or collar made of metal would cause a short at this point. The outer electrodes are shaped by means of a file, leaving three equally spaced prongs $\frac{1}{16}$ in. wide; the points are set at ·015 in. Further Hermeticole jointing is packed round at the points shown, alternating with small rings of asbestos string which should be carefully forced down one ring at a time by means of the gland until the central unit is firmly fixed. Take care to keep the clearance below the bottom of the unit free from any of this packing as this will cause a short when damp with oil. When assembling the centre electrode into the glass tube further Hermeticole and asbestos string should be packed into the tube also. This is rather difficult as there is such little clearance, but it can be done with thin wire. When fully assembled bake the whole plug in a slow oven for two hours or so. This will cause the jointing to ooze and set. Hermeticole can be purchased from the Patent Motor Products Co., of London.



The Craft of the Banknote Maker

Bere Mill, Whitchurch, Hants, where the first water-marked bank note was made.

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

EVER since the first paper money was introduced, a fierce battle of wits has continued between the Bank Note *maker*, and the Bank Note *forger*. There has been, of course, a somewhat similar contest between the Royal Mint and the counterfeiters, but the coiner has never been so serious a menace to honest folk as the forger; firstly, because the individual amounts at stake are so much smaller—the usual "dud" coins being florins and half-crowns; and secondly, because bad money is usually much more easily detected by the ordinary public. It is usually sufficient for a tradesman to ring it on his counter in order to detect a bad half-crown, and in case of further doubt the matter can be settled by bending it in a suitable slot or holder.

Forged notes are much more difficult to detect. Since the invention of the photogravure process, every detail in the printing of the genuine note *must* be faithfully reproduced by the forger, even if it is so well hidden that he is unaware of it.

Our Bank of England Notes are printed in dead black upon plain white paper, and so are by far the easiest of all currency papers to copy by photographic reproduction. The modern Treasury notes, and the currency papers of many foreign states are printed in various colours, or shaded, which considerably increases the technical difficulties of making an exact copy, but even so form no real problem to a highly skilled photo engraver. Needless to say no gang of forgers would be complete without having one or more skilled engravers among their ranks.

Picking Out Forgeries

In spite of the ease with which the printing can be copied, it is yet a fact that no gang of forgers has ever yet succeeded in producing Bank of England notes that could not at once be detected as forgeries by the bank experts. The skill of these officials is amazing, and I once saw a remarkable instance of it.

Shortly after leaving the army in 1919 I advertised a motor-car for sale. Cars were very scarce, but even so I was surprised to receive a registered letter from a total stranger, containing the purchase price in full. This was over two hundred pounds in Bank of England notes, and I was naturally a little anxious about taking so large a sum in notes from a total stranger, and parting with the car. So I went to Laverstoke—where the note factory is situated—and called upon one of the head paper makers, whom I knew.

"Would you be good enough to tell me if these notes are genuine?" He took them in his right hand, shuffled them quickly through to his left hand, and returned them to me without even glancing at them.

"These are all right."

"But," I gasped, "You haven't even *looked* at them."

"Oh that is quite unnecessary, I can tell a good note by the *feel*."

How Bank Experts Can Detect a Forged Bank Note simply by the Sense of Touch.

An Interesting Story

This is quite true, and a former expert—now deceased—told me a remarkable story about this. He could take a bundle of notes—some of which were genuine, and others forgeries which had passed the ordinary bank cashiers—and *when blindfolded* could pick out all the duds. Further, if he were permitted to examine them closely he could state the date on which each note was made, and the name of the man who made it!

On one occasion a bank official challenged his decision. Holding up a note he said, "How can you say this note is false, I can see the water-mark"?

"Oh *that*," replied my friend coolly, "It's no water-mark."

He took a wet sponge, and passed it over the back of the note. In an instant the "water-mark" had disappeared, it was merely a surface imprint by some greasy substance.

This wonderful water-mark then, is the secret of the Bank of England note. Its history is a remarkable one. Up till the year 1724, Bank of England notes were printed on plain paper, and forgeries were very common. A young Frenchman, named Henri de Portal, was working at a small paper mill near Laverstoke, called Bere Mill, and here he invented the first water-mark. This was brought to the notice of the Bank Directors, and on November 17th, 1924, they entrusted young Portal with the privilege of making Bank of England notes, a connection which has been continued from father to son until the present day, when a direct descendant of Henri (Lord Portal) is the proprietor of one of the greatest bank note factories in the world, which manufactures security papers for this country and for many foreign governments. It is of special interest to add that Henri de Portal came to England for conscience sake, having barely escaped from a massacre of the Huguenots, in which his parents were murdered, and he himself, and his young brothers and sisters, were only saved after spending two nights and a day in a disused oven. We are proud to remember that this brave young man found prosperity as well as religious liberty in this England, which then, and now is the home of civil and religious liberty.

Watermarks

The Bank of England note relies upon two things to defeat the forger, and both are *in the paper, not the printing*. The first is a very special quality paper, which is of varying thicknesses in different parts of the note. Other paper is made from rags, or wood-pulp but this is made from—well never mind *what*, but you would never guess. Then the water-mark is actually a part of the fabric of the paper. As every paper maker knows, water-marks are produced by means of the grids or trays upon which the wet paper is dried off. The Bank of England note is produced by a method—never mind what—which is not only different in an important particular from the usual plan, but also demands craftsmanship of such a delicate and intricate nature that it is believed that there are very few men in the world who could produce it, even if they knew how.

The paper makers, too, are highly skilled and years of training are required before they can produce bank note paper.

We have shown then that the bank note maker, by means of special materials, skilled craftsmen, and wonderful machines, can produce paper which no forger—even though himself a craftsman—can hope successfully to imitate.

There have, however, been several remarkable coups by criminals who got the idea of letting the bank make their dud notes for them! The first, and perhaps the most sensational happening of this kind occurred about forty years ago, when a clever engraver named Griffiths carried through a scheme like an Edgar Wallace novel.

He had made many attempts to produce bank note paper, but without success, so he induced an ex-convict named Burnett, and a female crook known as "Flash Emma" to go to Whitchurch and steal paper from Laverstoke Mill. The couple duly took up their residence at Whitchurch. They were fashionably dressed, appeared to have plenty of money, and were said to be a wealthy artist and his ward. The latter, who was known as Ruby Tremayne, proceeded to "vamp" a workman at the mills named Brown, to such effect that they were soon engaged. Then she pressed him, "just to prove his love," to obtain some bank note paper for her. The poor dupe obtained some sheets, but was caught by a foreman named Brewer, who, instead of denouncing the thief to his employers, went into partnership with him, and in the course of a few weeks the precious pair smuggled out nearly twelve thousand sheets of paper, to the Tremaynes. Then the "artist" and "Ruby" disappeared. Soon after, beautifully printed bank notes, on genuine paper, began pouring into the bank, and the authorities were horrified to discover that these notes were identical in all respects with the genuine, save for certain technical details which proved that the notes had been *printed* by an outsider. Detectives came to Whitchurch, and soon knew all about the artist, his daughter and her "fiancé." The unfortunate Brown (who was obviously more fool than knave), speedily told all he knew, and both he and Brewer were arrested. Soon after, by very smart detective work, the rest of the gang were captured. Griffiths was actually arrested in his workshop, where ample evidence of his guilt was found. The three principals received long terms of penal servitude, while the two mill workmen got six months each.

The mill installed a clever device which made such crimes impossible in future. An automatic counting machine is attached to all the paper making vats, and keeps an exact record of the number of notes made each day, and all have to be accounted for to the mill manager before any of the staff can leave each day.

There can be no question that the best way to forge notes, is to employ the official printer to make them for you. In 1925 a clever trickster named Marang actually forged a million pounds worth of Portuguese notes, and actually got away scot free. The fraud involved the innocent printers in a huge loss, after a sensational lawsuit. It was held that they had made the fraud possible by contributory negligence.

Waterlow & Co. Spoofed

Briefly, Marang—or Mr. K. Marang van Ysselvere—by means of forged introductions, succeeded in spoofing the printers that he was a confidential agent of the Bank of Portugal, and as such was empowered to order a vast issue of escudo notes for use in the colony of Angora, but he said the matter was a close secret. When the notes were printed, the gang obtained permission to open a bank in Lisbon, and this was used by them to circulate the forged notes. There is reason to think there was much behind this amazing case, which has not been made public, but it is certainly the most successful forgery coup on record.

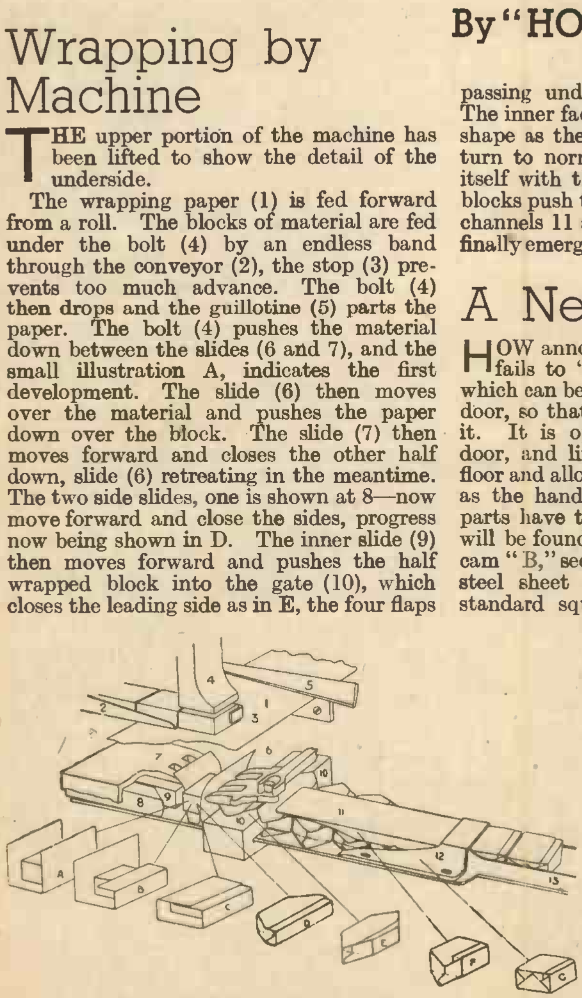
A CORNER FOR THE HANDYMAN

By "HOME MECHANIC"

Wrapping by Machine

THE upper portion of the machine has been lifted to show the detail of the underside.

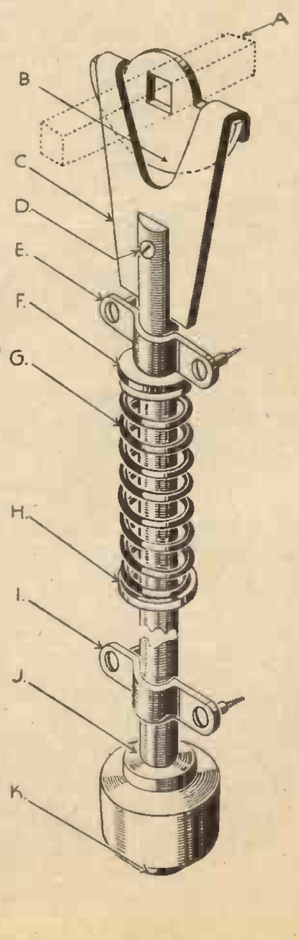
The wrapping paper (1) is fed forward from a roll. The blocks of material are fed under the bolt (4) by an endless band through the conveyor (2), the stop (3) prevents too much advance. The bolt (4) then drops and the guillotine (5) parts the paper. The bolt (4) pushes the material down between the slides (6 and 7), and the small illustration A, indicates the first development. The slide (6) then moves over the material and pushes the paper down over the block. The slide (7) then moves forward and closes the other half down, slide (6) retreating in the meantime. The two side slides, one is shown at 8—now move forward and close the sides, progress now being shown in D. The inner slide (9) then moves forward and pushes the half wrapped block into the gate (10), which closes the leading side as in E, the four flaps passing under and over the gate blocks. The inner faces of these blocks are the same shape as the slides (8). All slides now return to normal and the operation repeats itself with the next block. The following blocks push the previous blocks through the channels 11 and 12, and fold the four flaps, finally emerging into the conveyor chute (13).



A parcel wrapping machine.

A New Door-stop

HOW annoying it is to have a door which fails to "stop put." Here is a device which can be fitted to practically any type of door, so that it stops just where you leave it. It is operated by the handle of the door, and lifts a rubber stop clear of the floor and allows it to drop back again as soon as the handle is released. Several of the parts have to be made but most of them will be found in the average junk box. The cam "B," see diagram, is made of $\frac{3}{32}$-in. mild steel sheet and is a sliding fit over the standard square door spindle. The plate "C" hangs on the cam and it will be seen that by rotating the door spindle "A" the plate will be raised, no matter which way the spindle is turned. The rod "D" is secured to the plate with a screw and is held in position down the door by the saddles "E" and "I." The fitting "J" can be turned from a piece of $\frac{1}{2}$-in. diameter brass rod, and a piece of soft rubber, "K," pressed up into a hole drilled in "J." The rod can be tapped or soldered into the foot. The rod is normally pressed down on to the floor by the spiral spring "G" which pushes against the pin "H," inserted into a hole drilled through the rod. A washer "F" should be placed between the saddle "E" and the spring. The device can be fitted on either side of the door, and for appearance should be sunk below the surface of the wood. The upper part of the mechanism including the cam and the spring can be covered by the door or finger plate. The rod and the foot can be sunk into a groove in the wood, which can also be covered over with thin ply wood and so hide totally every part of the device.



A new type of door-stop.

EXPERIMENTS WITH INFLUENCE MACHINES

By V. E. Johnson, M.A.

Simple and Amusing Experiments that can be carried out with the Minimum of Apparatus

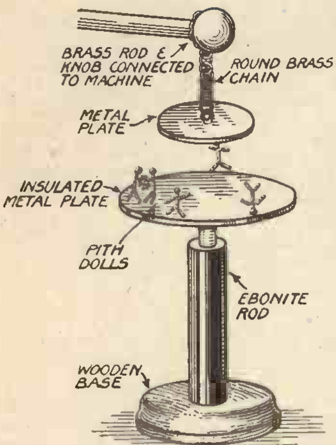


Fig. 1.—The acrobatic dolls.

ANYONE possessing quite a small influence machine, provided the plates (two only are needed) are glass, ebonite or mica, can easily perform the experiments which form the subject of this article.

The Acrobatic Dolls

This experiment, which is one of the oldest, is almost unknown to the present generation. The small figures which constitute the dolls, should be cut from elder pith, and the arms and legs should be jointed by means of a needle and thread. When placed between two metal plates as shown in Fig. 1, the dolls will perform amusing antics, which are extremely lifelike.

The Jumping Snake

This is a modification of the previous experiment, but with only one metal plate —largish sponge tin, placed on a warm and dry glass jam jar, the plate being connected to one terminal of the machine. The snake is made of a number of pieces of elderberry pith, gradually decreasing in size. About eight pieces make a snake from 3 to 5 in. long. Pinch the ends of the pieces to round them and join them together as in the previous experiment. Place the snake in the tin, with the snake partly overhanging the sides. Work the machine *very gently at first*. The snake will first of all rear its head, and finally jump right out of the plate.

The Rotating Top

The duration of the electric discharge from the Leyden jars of these machines lasts only about the $\frac{1}{300000}$ part of a second. Thus a fast-spinning top, disc or wheel appears stationary when viewed by the light from the spark.

The Electric Turbine

Obtain a small metal cap, such as a compass bearing, and solder it to some half-dozen equal-sized *fine* metal wires a few inches long, as shown in Fig. 3. Then turn all the ends at right angles, so that they all point in the same direction. The device should balance horizontally on the metal cap. Place the cap on an upright metal pin on which it can turn freely (this pin must be insulated) and connect it to one terminal of the machine. On working the machine, the turbine will commence to revolve in the opposite direction to that of the points.

The Electrified Water

Obtain a small cocoa or similar tin, and fill it with water to see if it is watertight. If not, solder up any leaks. Drill or punch two small holes, near the top, opposite one another, pass a piece of wire through these and bend in the shape of an arch so as to form a handle. Next make a *very* small hole in the middle of the base, so that when the tin is two-thirds full of water, the water will issue in the form of drops only. Insulate the tin by hanging it on some form of insulating support, connect the tin to the electrical machine and operate it. The water will not only flow more quickly, but the drops, being similarly electrified, will repel one another and then spread out fan-wise in the form of a cone.

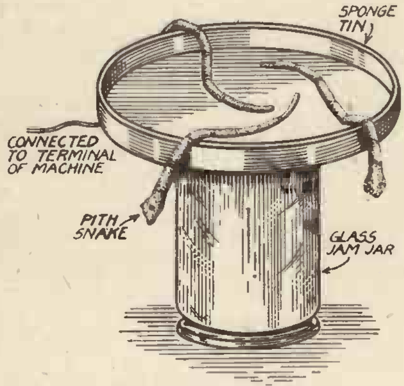


Fig. 2.—The jumping snakes.

If performed in the dark the stream of water will be faintly luminous. Try a similar experiment with sand using a fairly large funnel with a hole about $\frac{1}{8}$-in. at the base.

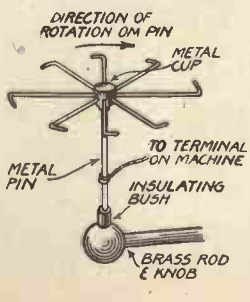


Fig. 3. — An electric turbine.

The Illuminated Lemon

Take two discharge wires fitted with small metal knobs, thrust the ends through a lemon till the ends are about $\frac{1}{4}$-in. apart, and operate the machine. Try the same with a *large* crystal of alum, blue vitriol or ferro-prussiate of potash, etc. The whole crystal will be illuminated with brilliant scintillating electric sparks. (Fig. 5).

Secret Writing

Dissolve some sulphate of quinine in water and draw a design or write a message (using a new pen) on a piece of white paper or cardboard, and allow it to dry. The wording will be quite invisible, but if it be illuminated by the light from a geissler tube connected with the influence machine, it will become visible as if written in blue ink. The experiments which can be performed with geissler vacuum tubes are extremely fascinating. They are tubes fitted with metallic electrodes sealed in an airtight glass. The tubes can be exhausted and other gases pumped in. They should be shown against a background of black velvet in a darkened room.

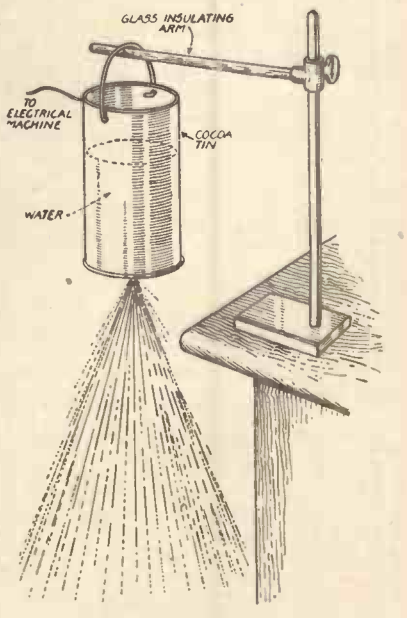


Fig. 4.—Luminous water.

Cohesion Figures

For these experiments we only require a

little plate or disc of mica or glass and a somewhat larger metal plate painted dead black. A little oil, water and a few saline solution are also needed, because different substances produce different figures. These figures can also be varied by interchanging the discharging rods and by using either a mica or glass plate. Place the disc of glass or mica in the centre of the metal plate; the end of one electrode is connected to the plate and the other, which must be a thin wire, is placed in the centre of the glass disc with a drop or two of the liquid placed around it.

As soon as the machine is worked, small irregularities form on the surface of the drop, which gradually spread out and form branches from which other branches grow, until the whole plate is covered with a most beautiful arborescent growth.

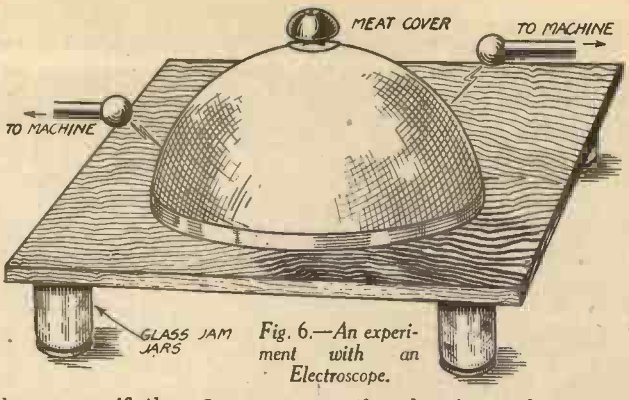


Fig. 6.—An experiment with an Electroscope.

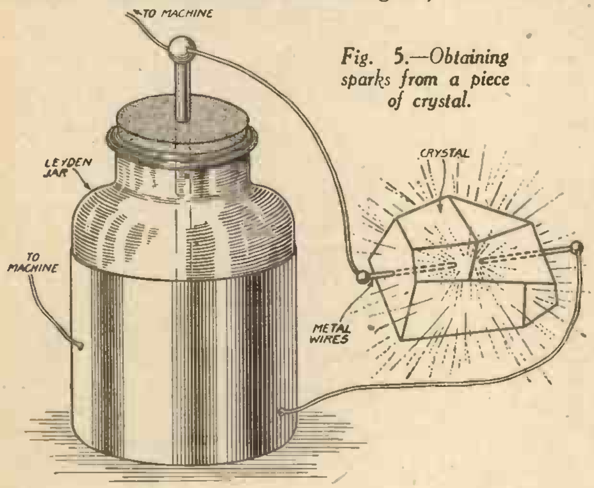


Fig. 5.—Obtaining sparks from a piece of crystal.

Photography Without Lens or Camera

Extremely curious or interesting figures can be obtained by the action of electric discharges on photographic plates. If small dry plates 2½ in. by 3 in. be placed first in a red envelope and then in a slightly larger black one, or if the plate be wrapped up in two thicknesses of good black opaque paper and placed between the discharging knobs of the machine (leyden jars disconnected), discharge figures will be obtained which will vary according to which pole of the machine the film is turned. Repeat the experiment with the Leyden jars connected.

Ignition Experiments

Place a piece of phosphorus (which must be kept under water) on a large piece of glass or earthenware. Dry it with a piece of paper—on no account touch it with the fingers—cause the electric spark to pass through it and it will ignite. Do the same with a small tuft of green cotton—it will be ignited instantly and disappear with a faint report.

Light a candle and allow it to burn for a few seconds, blow it out and as soon as it has ceased to smoke ignite the still hot wick in the same way.

An Electroscope Experiment

Place an electroscope under a wire gauze cover such as an ordinary dome-shaped metal meat cover. Place the whole on a board standing on four dry and warm jam jars. Connect up the meat cover to the machine—one pole on one side and the other pole on the other—and the discharge of sparks all over the outside of the cover, will not have the slightest effect on the electroscope.

AN AUTOMATIC TIME INDICATOR

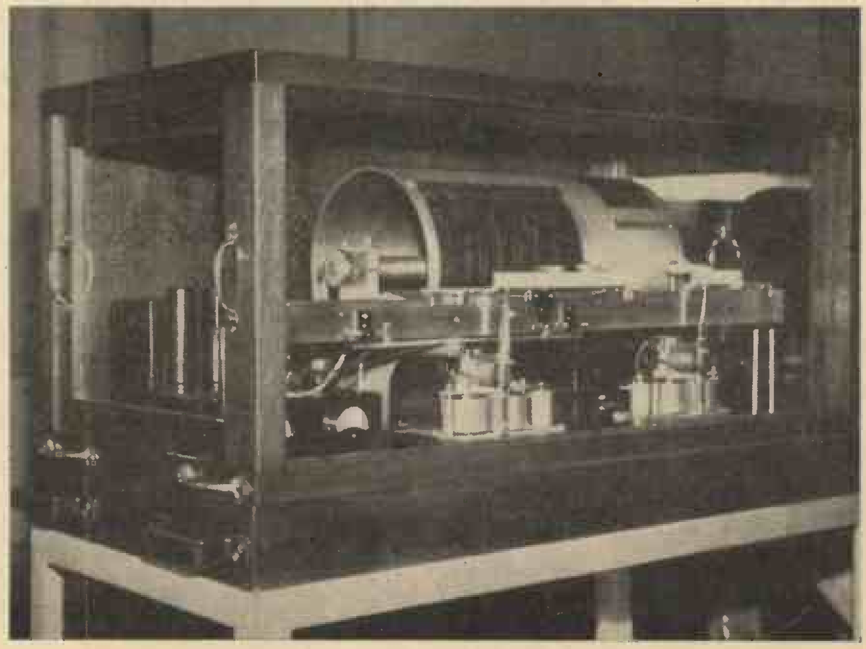
ON this page is shown the automatic time indicator as used in the establishment of telephone services at Rotterdam. By turnng two figures on the 'phone dial you are instantly given the exact time automatically at any moment during the day or night.

This is done as shown by the illustration (an invention of a young Rotterdam *techniker*, Mr. Leeuwrik). It consists chiefly of a cylinder over which are tightly spun ribbons of celluloid; namely, the sound-track of sub-standard film.

This wavy track produces in a photo-cell very slight electric currents which are sufficiently amplified to enable the time to be heard quite easily over the telephone.

THE LEIPZIG FAIR

MORE than twenty countries with more than 9,000 exhibitors will be represented at the Leipzig Spring Fair, 1938, which will be open from the 6th to the 14th March, to a purchasing public from all over the world. Twenty-three magnificent palaces in the interior of the town house displays of general trade samples; the engineering and building trades section is included in nineteen independent halls. During the 700 years of its existence the Leipzig Fair has given more than ample proof of its importance to commerce. Particularly in recent years has the Fair overcome many of the obstacles confronting trading between countries. Since 1933 the number of exhibitors has increased by 40 per cent., the number of foreign exhibitors by 50 per cent. In the same period the number of buyers has been trebled. At the last Spring Fair there were more than 32,000 foreign buyers, as compared with 15,500 in 1933. Many improvements are in course of progress for 1938, and new exhibition halls are being added to the engineering section. There is every indication that the Spring Fair of 1938 will produce good business both for the exhibitor and buyer.



The automatic time indicator installed in Rotterdam.

LIQUID LEGERDEMAIN

Some of the Ingenious Ways in which Magicians Conjure with Everyday Materials Such as Water

Fig. 1.—The china bowl here being shown has the rim ground flat and the mica disc illustrated fits on this ground rim, forming a lid which, when the bowl is filled with water, is kept in place by atmospheric pressure.

Fig. 5. (Right).—Under cover of laying a sheet of paper over this glass of water, a mica disc is put on the glass first with the result that . . . (See Fig. 6).

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

A CONJURING trick with any sort of liquid always appears to be very difficult. It seems all too easy to "spill the beans" in a very literal sense. There is obviously no possibility of the conjurer getting a quantity of water up his sleeve or from any of the places from which conjurers are popularly supposed to obtain and dispose of the things they use.

Actually, however, a trick with water is no more difficult than a trick with a handful of coins or a block of wood. The general secret underlying nearly all such tricks lies in the means used to keep the liquid under control.

First of all here is a very popular trick, which probably had its origin in China. The fact that two china basins are used, by the way, is not supposed to make that last remark a pun.

Rice in the Basin

The two basins are shown and one is filled with rice. The other basin is placed over it, and, in due course, when the upper basin is lifted, the rice is seen to have doubled in quantity, being heaped up in the lower basin and pouring out all over the tray on which the trick is performed. The performer then levels the rice and again places the empty bowl over the lower one. The next time the bowls are separated the rest of the rice has vanished and water has taken its place.

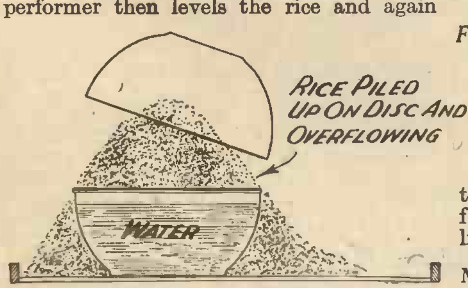


Fig. 3.—Giving the impression that there is twice the quantity of rice as first shown.

This trick is a peculiar instance of the method used for producing one part of the effect automatically making the other part possible. To begin with one of the basins has the rim ground flat. This is best done by holding the bowl against the side of a grindstone. A fake is then made from two pieces of thick mica or celluloid. One piece is cut to a fraction larger than the outside diameter of the bowl while the other is cut very slightly smaller than the inside diameter. The two discs are then cemented together and the result is a circular fake which forms a sort of loose flat lid for either bowl (see Fig. 1).

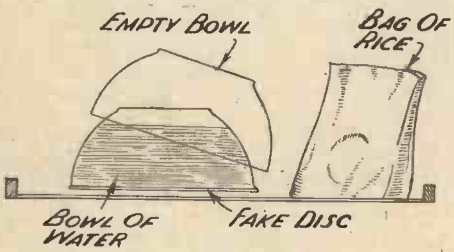


Fig. 2.—In presenting the trick the bowls are brought forward as shown.

Mysterious Water

The bowl with the ground edge is almost filled with water and the ground edge is moistened. The mica fake is then placed on this bowl so that the smaller disc fits inside the rim. The bowl may now be held upside down in perfect safety, as the well-known principle of atmospheric pressure causes the disc to adhere closely to the mouth of the bowl and so retain the water. The purpose of the smaller disc is to prevent the fake from sliding sideways off the bowl.

In presenting the trick the bowls are brought forward on a tray as shown in Fig. 2, the loaded bowl being undermost. It is a wise precaution to place a broken match under the bowl to prevent the mica disc from sticking to the tray when the loaded bowl is lifted. The two bowls are lifted, one in each hand quite casually and the empty one is held so that everyone may see that it is empty. No comment is made about the emptiness of the bowls because this might cause the audience to wonder if both bowls really were empty. Holding them upside down and allowing one to be seen empty is quite sufficient.

The empty bowl is now stood mouth upwards and filled level with rice from a bag. The loaded bowl is placed on top. The bowls now have to be turned over so that the loaded bowl of water is at the bottom. This is usually done by picking up both bowls, waving them in the air and turning them over as they are placed down. If the top bowl is now lifted, the rice, resting on the mica fake, piles up and gives the impression that there is twice as much of it as at first. Here you see the first effect is produced by the very means used to control the water for the second effect (see Fig. 3).

The Fake

The rice is now levelled, the surplus being

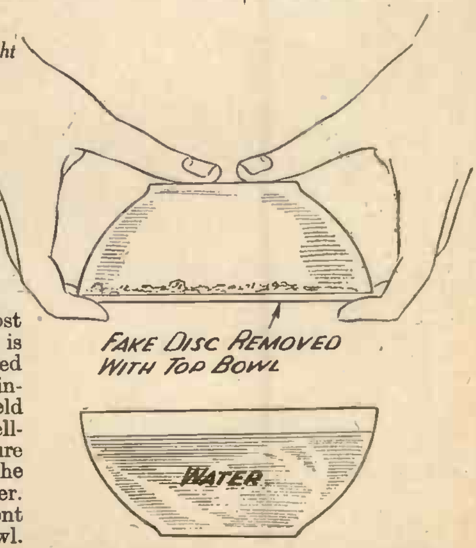


Fig. 4.—Lifting the false disc covered with rice.

Fig. 6.—The water remains magically in the glass although the glass is held upside down. The presence of the mica disc seen in Fig. 5 accounts for this.

swept off on to the tray, leaving the fake just thinly covered. The empty bowl is replaced and, when it is lifted off again the finger-nails are inserted under the mica disc which is thus lifted off with it as shown in Fig. 4. This bowl is placed on the tray while the hands are dipped into the bowl of water to show that it is water. The empty bowl is then lifted, some of the loose rice on the tray being flicked over the disc to hide it, and the water is then poured from bowl to bowl.

Exactly the same principle is also used for a trick in which a tumbler filled with water is seemingly hypntoised so that the water does not fall out when it is turned upside down. The trick commences as the old experiment of partly filling a glass with water, placing a piece of paper over it and turning the lot upside down. Of course the water remains in the glass. The conjurer then makes a pass and slowly peels away the paper. To the surprise of the audience the water does not gush out but remains in the glass until commanded to fall, then it rushes out into a bowl placed to receive it.

In this case the tumbler has a disc of mica to fit it exactly as shown in the rice bowls trick. This fake is under the paper used for covering the glass and is fitted to the mouth of the glass in the act of placing the paper over it (Fig. 5). When the paper is removed of course the mica disc holds the water in place (Fig. 6). It is, by the way, necessary to have the paper well damped beforehand to make it adhere to the disc.

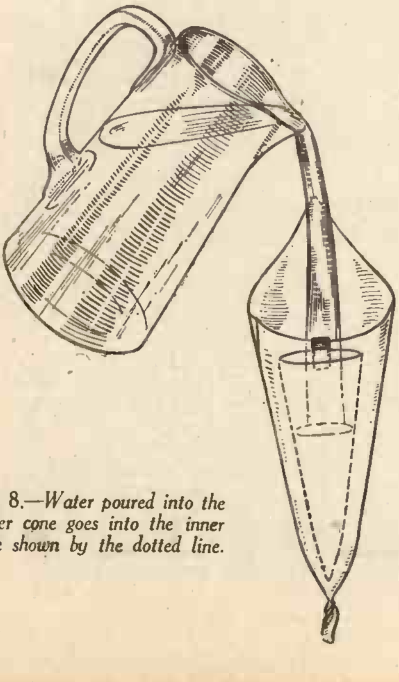


Fig. 8.—Water poured into the paper cone goes into the inner fake shown by the dotted line.

The Effect

The final effect of making the water gush out on command is managed by having a small hole drilled in the bottom of the glass. A small piece of wax is placed over the hole to seal it. With the glass full of water upside down and the water held in by the mica disc it is only necessary to scrape the wax off with the finger-nail when the air enters through the hole and the disc is dislodged, being disguised in its fall into the basin by the volume of water that drops with it. For this trick it is not necessary to grind the rim of the glass, as with careful handling the mica disc will hold quite well enough on the polished rim, whereas this would not be safe in the rice bowls trick where the loaded bowl has to be handled rather more carelessly.

Fig. 7.—Scooping a transparent cone into the paper cone from behind the jug makes it possible to pour water into the paper cone and then make it vanish by burning the cone.

Now, here is a trick which I devised for my part in a Chinese magical act at Maskelyne's a year or two ago and which caused quite a small sensation. In effect a sheet of paper was made into a cone and filled with water from a glass jug. The top of the paper cone was lighted and gradually the paper burned right down, the ashes being blown away. All trace of the water had vanished.

The Secret

Fig 7 pretty well explains the secret, although it does not make clear the small but important details of presentation. A cone-shaped fake of mica or celluloid is made watertight, and fitted with a hook of the same material. This fake hangs on the back of the jug. I had the jug of water brought on by an assistant, the handle pointing towards me as I stood with it on my right, the fake of course being at the back. Having made the paper cone I held it in my right hand and picked up the jug with my left, scooping the fake into the cone as shown in the photograph. The hook on the fake then engaged on the edge of the paper cone. The water was then poured from a fair height into the cone and of course went into the fake (Fig. 8). As I finished pouring I brought the jug down in front of and below the paper cone, then with an up-and-down movement of each hand I hooked the fake on the jug again. The jug was then carried off behind me with the fake still at the back while I proceeded to burn the empty paper cone.

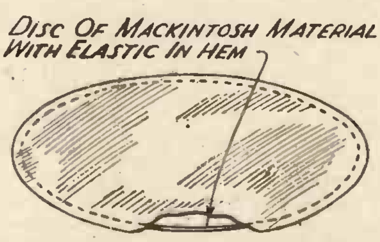


Fig. 9.—Disc of mackintosh with elastic in the hem. The elastic ring must be smaller than the diameter of the bowl so as to tightly fit over it. It is shown the same size here to make clear the construction of the cover.

One important detail which added considerably to the effect was to have a few drops of water leak out of the bottom of the paper cone while it was burning. This was managed by splashing about a teaspoonful of water into the paper cone as it was being poured into the fake. In fact I did this accidentally at one performance, found the spilt water leaked through and so improved the effect and therefore continued to do it on future occasions. Improvements in the presentation of conjuring tricks are often arrived at by accident in this way.

Producing Bowls of Water

Producing bowls full of water from a cloth is another trick which is always well received and, although in some ways a little more difficult than other tricks, it is by no means impossible to the beginner.

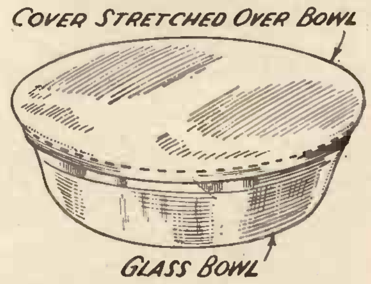


Fig. 10.—The cover fitted over the bowl.

The bowls are of glass, very flat and shallow, being in fact almost glass saucers. Ordinary glass ice-cream plates answer the purpose very well. Having been filled with water, the bowl is sealed by drawing over it a rubber cover which effectually keeps the water in. Proper rubber covers for the purpose are sold by conjuring shops, or a very practical cover can be made from the thin rubber covers sold for use on motor lamps in foggy weather. Or again a piece of mackintosh sheeting may be made into a sort of shallow mob cap with strong elastic run through the hem. As long as the elastic is a tight fit over the bowl there is no fear of accidents. The diagrams in Figs. 9 and 10 will make clear the method of making and using such a cover.

The photograph in Fig. 11 shows the method used for producing the bowl. To begin with the bowl, duly filled and covered, is placed under the coat on the left side. The rubber cover is against the body and the lower edge of the bowl rests on the hip. The bowl in this position can be easily and safely held in position with very slight pressure of the left elbow against the side.

To produce the bowl, pick up a large cloth, about a yard square is a good size. Hold it by two corners and so display it four square to the audience. Now turn slightly to the right and bring the right hand round in front of the left to show the reverside side of the cloth. Your right hand will now be just by your left elbow. You drape the edge of the cloth along your left arm, then, letting go with your right hand you slide that hand down, under the coat and draw the bowl out as shown in the photograph. The movement is a continuous one and need not be hurried. As you bring the bowl forward under the cloth you draw the cloth right away from the body and leave it hanging over the bowl, the shape of which can now be seen through the cloth. To produce the bowl, grip the cloth where it drapes over the front edge of the bowl, nipping the edge of the rubber cover through the material, and draw it off upwards and backwards. This will remove the cover, which remains concealed in the folds of the cloth.

Probably some of the water will be spilt as the bowl is produced, but far from being a drawback, this adds if anything to the effectiveness of the trick.

Where several bowls are produced each has its own cover, one may be concealed as described and others disposed in the opening of the dress waistcoat on either side, the lower edge of the waistcoat being fitted with an elastic band to retain the bowls. Other bowls may be carried in special pockets in the tails of the dress coat. Such bowls are usually of small size, measuring about 6 ins. in diameter, but a bowl produced from under the coat as described above can be as much as 8 or even 10 in. across.

Sometimes bowls are produced from the back of an assistant. In this case the bowl, duly covered, is hung on the assistant's back by means of a hook sewn to his coat and a ring fastened to the bowl cover. The assistant enters in the centre of the stage, at the back and walks straight forward, carrying a folded cloth. The performer opens it and they take a corner each. It is then an easy matter for the performer, with the hand nearest to his assistant, to unhook the bowl and bring it forward under the cloth, when it is produced as already described.

Fig. 12 shows this method of production. The assistant takes away the cloth with the cover in it after the trick and, if further bowls are to be produced, assistant enters as described, each time, carrying a new cloth and with a bowl on his back. With three assistants, two to appear in turn and a third back stage to hook the bowls on, any number of

Fig. 11.—Producing a bowl of water from a cloth. The bowl is fitted with a rubber cover (omitted here for the sake of clearness) to keep the water in. Here you see the bowl being secretly introduced into the cloth from under the performer's coat.

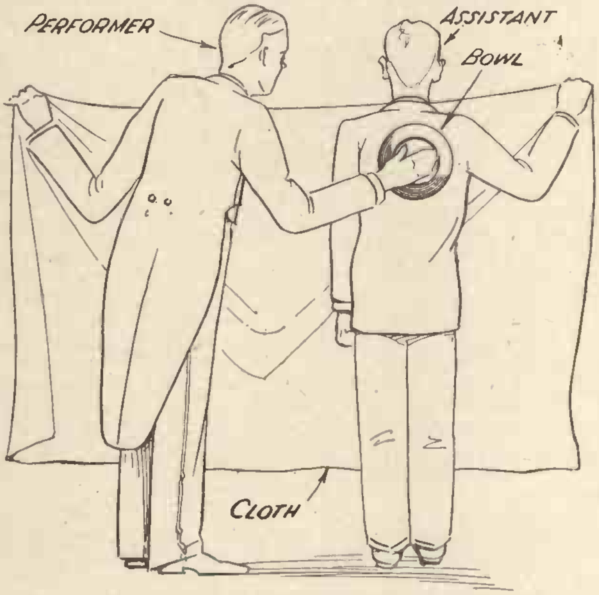


Fig. 12.—Producing a bowl by obtaining it from the assistant's back.

bowls may be produced by this method and large fairly deep bowls may be used.

To produce a monster bowl of water a special trick table is employed. The construction of a simple form of table for this trick is shown in Figs. 13 and 14. An ordinary folding card table may be used as the basis and four flaps are hinged to the four sides. These flaps must be the same height as the bowl to be used, say 4 in., and they are covered on both sides with black velvet, the top of the table being similarly covered. Fringe is fixed round the edges of the table proper and also to the free end of the flaps.

The bowl, which may be an ordinary glass salad bowl, is filled with water and perhaps a few floating flowers are added, or even a life goldfish if you like. It is placed in the centre of the table and the four flaps are folded up, forming a kind of shallow box around the bowl. The flaps are kept in position by a square of black velvet with small metal corner pieces sewn in the extreme corners, as shown in Fig. 14. The square of velvet is the same size as the table top.

The table with the bowl concealed, as shown in Fig. 13, is ready for the production. Under cover of a large shawl, the velvet square is pulled off, the flaps fall and the bowl is revealed as shown in Fig. 14.

Of course to produce the bowl by flinging a shawl over the table and dragging it off again would be almost as good as telling the audience that the bowl was hidden inside the table. A more subtle method is therefore employed. The shawl has sewn into it a ring, the same size as the mouth of the bowl, made of thin wire or cane. A catching movement is then made in the air and the sides of the ring grasped, the shawl draping round it and giving a perfect illusion of a bowl under the cloth. The conjurer then looks round for somewhere to put the bowl, goes to the table, puts the shawl flat on the velvet square and instantly drags away shawl and velvet, revealing the bowl of water.

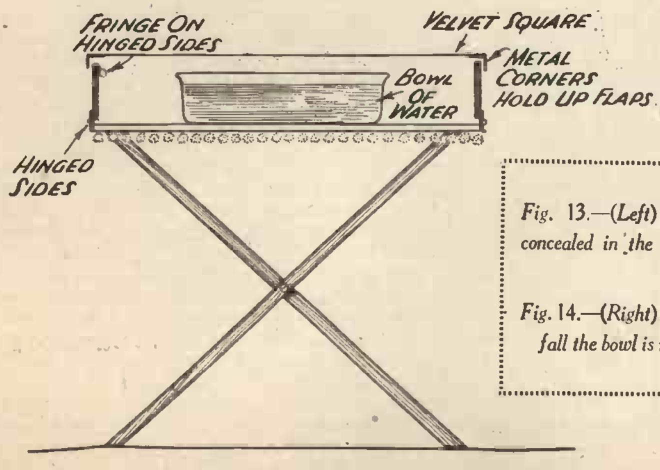
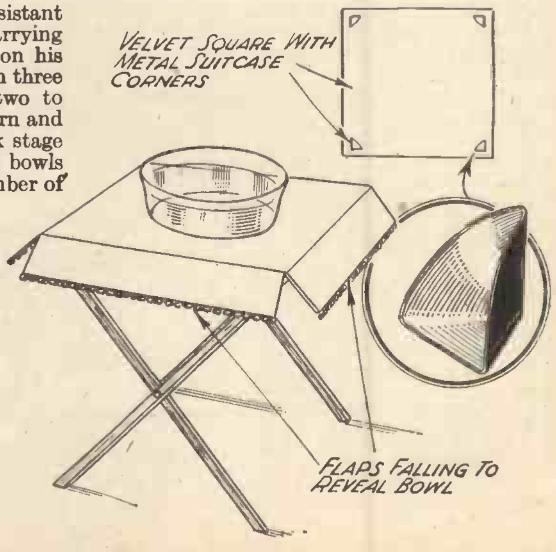


Fig. 13.—(Left) The bowl concealed in the trick table.

Fig. 14.—(Right) As the flaps fall the bowl is revealed.



STARGAZING FOR AMATEURS

A NEW SERIES

By N. de Nully

A GUIDE FOR JANUARY

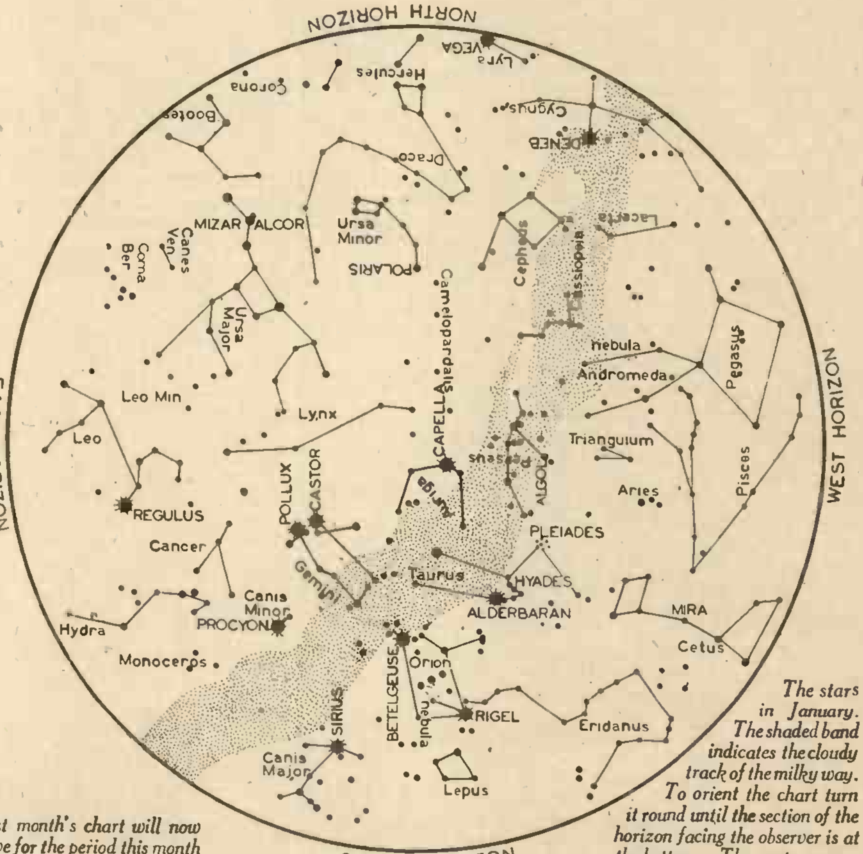
THE Earth will be at its nearest to the Sun on the 3rd. It will then be over three million miles closer than it was six months ago in mid-summer. But for this, our winters would be colder than they are. There will be four eclipses in 1938, two of the Sun and two of the Moon. Of the former the one on May 29th will be total; but the central line will lie wholly in the Southern Ocean. The other will occur on November 21st to 22nd, and will be partial. This will be seen solely from a region in the North Pacific. Both the lunar eclipses will be total. That in the evening of November 7th will be visible from this country: but views of the other on May 14th will be obtainable only from the Atlantic Ocean, America and the Pacific.

The Moon

There will be two "new" moons in January, one on the 1st and the other on the 31st. Astronomers are continually on the look out for the slightest signs of definite change on the stereotyped face of our weird satellite. The gradual darkening, instead of brightening, of the interiors of several of the great walled-plains and lesser mountain-rings, as the Sun ascends vertically over them, is very remarkable. Attention has lately been drawn to curious alterations in the dusky tints of the floors of both Grimaldi and Billy. Another notable example of this class of formation is Plato, termed the "Great Black Lake" by the ancients. It is situated on the northern "shores" of the Mare Imbrium and is well portrayed in the photograph here reproduced. Grimaldi and Billy may be most conveniently examined an evening or two before "full"; and Plato at about the same interval after "first quarter." A map of the Moon will render identifications easy. No explanation is as yet forthcoming of these inverted effects. Professor Pickering of Jamaica (who specialises in Moon photography) suggests rapidly growing vegetation springing up under the warming influence of the rising Sun. At the abrupt termination of the long scorching day this growth is probably cut down by the swiftly oncoming frigid lunar night; to recurrently revive a fortnight later. It may be recalled that this idea was used by Mr. H. G. Wells in his book *The First Men in the Moon*, written over thirty years ago. These instances of darkening and colour variation are mostly to be found adjacent to each side of the Moon's equator, in regions corresponding with our tropical and sub-tropical zones. Plato, though a notable exception to the general rule, lies on the lunar equivalent of the temperate terrestrial latitude of London.

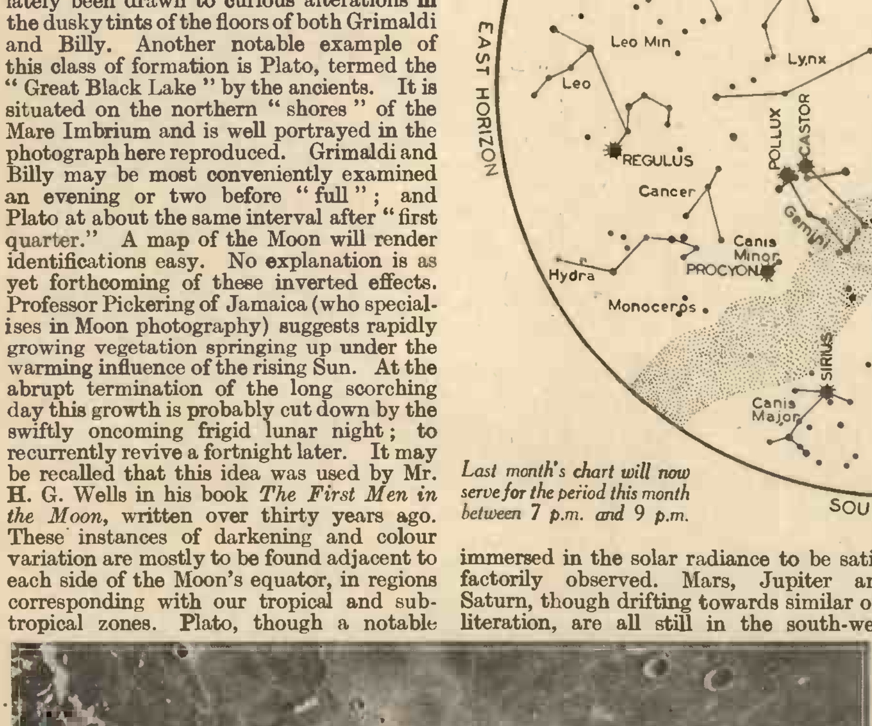
Planets

Mercury and Venus are in apparent proximity to each other, but are too deeply immersed in the solar radiance to be satisfactorily observed. Mars, Jupiter and Saturn, though drifting towards similar obliteration, are all still in the south-west evening sky. Mars sets soon after 9 o'clock throughout January, and Jupiter not long after the Sun. Saturn lingers until 11.0 p.m. at the beginning, and 9.30 p.m. at the end of the month. The interesting planetoid Eros is expected to approach to within about 20 million miles of the Earth in a fortnight's time. It will then be the nearest celestial object to us except the Moon. Eros should be looked for next week before moonlight becomes too strong. It will probably be a little above the well-known Pleiades star cluster. At the time of writing its approximate position is not available farther ahead than December 21st, for which date it was given as R.A. 4 hrs. 4 min., N. Dec., 25 degrees, 50 min. and it is moving southwards. If the sky is clear Eros might be picked up by means of a binocular and when found will be easily seen through a small telescope shining with a dull non-stellar light. This unique member of the large family of Minor Planets—also called the Asteroids—is believed to be nothing more than a huge elongated mass of irregularly shaped rock 22 miles long and 7 miles wide. Changes in its brightness point to a somewhat dumb-bell form with a narrow "waist" and a shifting angle of rotation. A departure from the usual planetary spheroid might perhaps be expected if these seemingly derelict bodies are really the fragments of a shattered world as many suppose. If Eros serves no other useful purpose, its regular visits every two years and four months at least enable astronomers to check up their calculations of the exact distance of the Sun.



Last month's chart will now serve for the period this month between 7 p.m. and 9 p.m.

The stars in January. The shaded band indicates the cloudy track of the milky way. To orient the chart turn it round until the section of the horizon facing the observer is at the bottom. The centre represents the zenith.



The lunar walled-plain Plato under afternoon illumination. Note the darkened interior, notwithstanding the high angle of sunlight.

(*Continued on page* 246.)

The machine ready for flight.

Building the "LUTON MINOR" the Light Aeroplane

PART IV

Fuselage Assembly

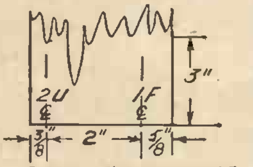
THE fuselage of the " Luton Minor " is a plywood box structure of great robustness. It is of spruce girder construction, the spruce members being so triangulated that the plywood covering is not essential for load carrying, but acts as an additional safety factor, besides providing a very serviceable covering (Fig. 1).

Scarfing the Plywood

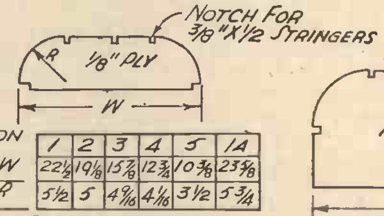
Construction is commenced by scarfing up the plywood for the two sides. It will be found that four sheets of $\frac{1}{16}$-in. ply are required for the full length, and these may be scarfed as complete sheets, or each sheet may be cut approximately in half before splicing in order to shorten the length of each scarf. The plywood is placed with the grain (outer) horizontal, but with the nose piece grain vertical. Fig. 3 (*a*) and (*b*), shows alternative ways of arranging the two sides from four sheets, depending on the size of the initial plywood boards, and, as already mentioned, the severance of the two sides may be made before or after scarfing.

(Don't forget to place strips of paper on both sides of the plywood during scarfing to prevent sticking to the holding-down strips while the glue dries under pressure.)

After the glue is properly set, the splices should be cleaned up and carefully examined to ensure that no unglued gaps are left. If necessary, such faults should be made good.

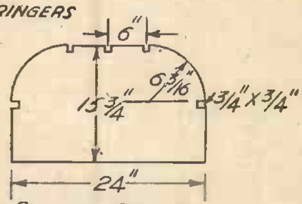


DETAIL AT 2U. AND 1.F.



STATION	1	2	3	4	5	1A
W	22½	19⅛	15⅞	12¾	10⅜	23⅝
R	5½	5	4 9/16	4 1/16	3½	5¾

DECKING SUPPORTS



DECKING SUPPORT BEHIND PILOT'S SEAT

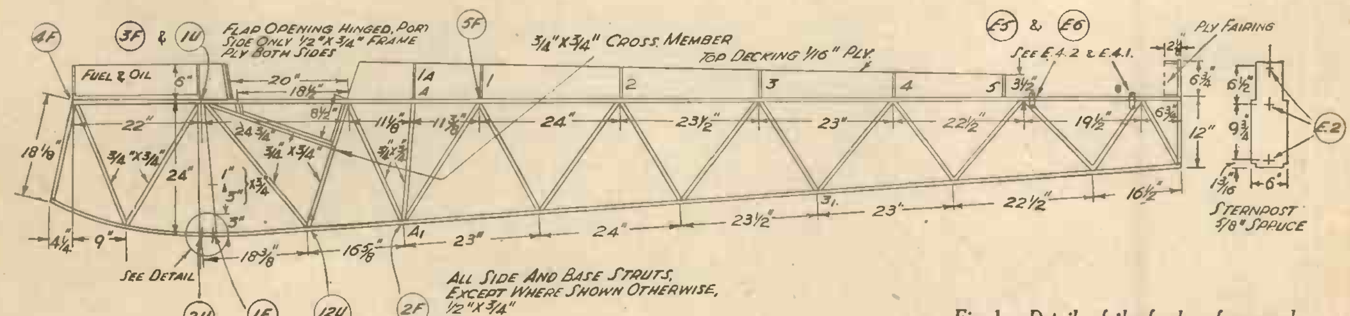
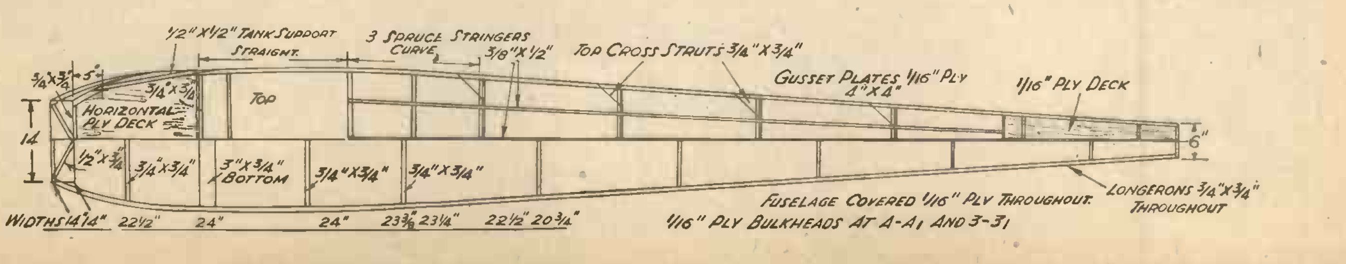


Fig. 1.—Details of the fuselage framework.



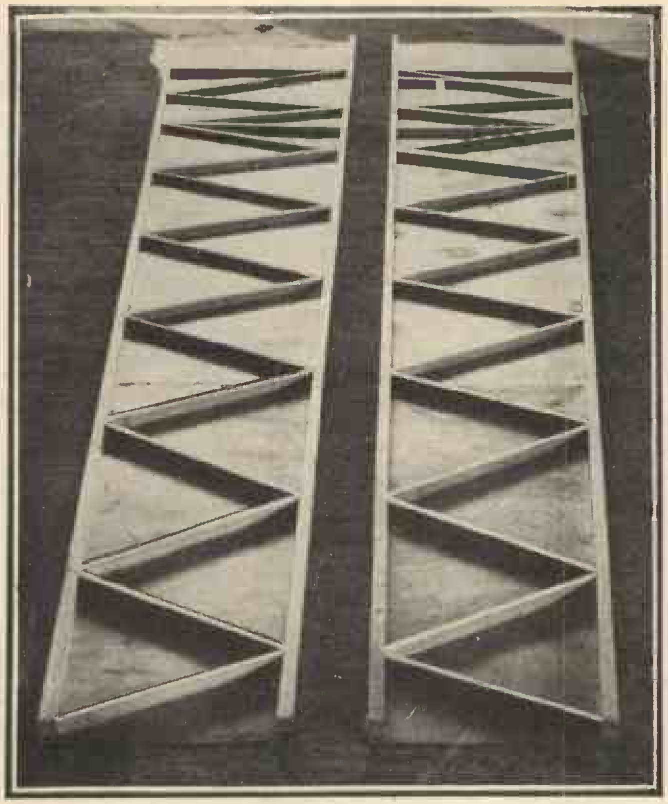


Fig. 2.—Photograph of the fuselage sides.

Making the Fuselage Sides

The next step is to carefully draw out the fuselage sides on the plywood, but leaving roughly 1 in. of ply beyond the outline at all edges. Before fixing the four main longerons they should be longitudinally sliced over the length forward of the heavy, 3-in. side members (Fig. 1). The two top longerons are sliced with a vertical cut so as to divide the section in two (see Fig. 5), whilst the bottom longerons are divided into four equal parts. The reason of this slicing, which is best done on a fine circular saw if available (or will be done by Messrs. Luton Aircraft Ltd., upon request) is to assist in bending the longerons over the curved nose. Tie them temporarily with string to avoid damage.

The longerons may now be glued on to the plywood in the positions marked and temporarily tacked, or clamped, to avoid relative movement whilst the ply sides are turned over so as to rest on the longerons. Brass gimp pins, $\frac{5}{8}$ in. by 20 gauge, may now be driven in, at 1-in. to $1\frac{1}{2}$-in. spacings, all along the length of the longerons, the heads being driven well home in the ply in order to produce sufficient pressure whilst the glue is setting. Note that no gluing should be done at the stage forward of the heavy undercarriage member, the longerons being left free over this length until the final boxing up of the nose portion.

The diagonal members are next cut carefully to length, inserted in position and glued and pinned as before. If pencil lines are drawn on the outside of the plywood, running the length of the centre lines of all diagonals, the pinning will be facilitated. As before fix no members forward of the heavy side strut.

When the glue is set, the surplus plywood at top and bottom edges may be removed and the edges made good by means of glass-paper. The two slab sides are now ready for boxing up (Fig. 2).

Boxing-up the Fuselage

First scarf up a length of plywood to cover the bottom of the fuselage from point A to the sternpost. The plan form may then be drawn on the ply, the width being 6 in. at the stern, increasing to $23\frac{3}{4}$ in. at point A^1. The plan shape is perfectly straight from A^1 to the tail.

Now stand the two sides on their bottom edges, with the straight part (rear) close to the floor, the sides being 6 in. apart (outside) at the stern and increasing towards the front as shown in Fig. 1. The sides should be set parallel and perpendicular to the floor, or bench, on which they rest, checking being made by means of a large set square.

The sternpost may be cut to shape (Fig. 1) and clamped in position, but not yet fixed.

Cut the cross struts for the fuselage bottom and place them in position on the floor and fix by means of plywood gussets, glued and pinned. The gussets are fixed on the inside of the struts and longerons. The method of gusseting is illustrated in Fig. 4. The arrangement at (*b*) provides a better job than (*a*) but takes a little longer. In both cases there is a cutaway for the side struts.

Bulkheads

Now cut the cross struts for the fuselage top at points A, and 3, together with the plywood bulkheads A,A^1 and 3,3^1. These latter should be carefully cut square, i.e. each corner making an angle of 90°, as they determine the fuselage sectional shape. The corners must be cut away for the longeron and it is better to cut out rather more

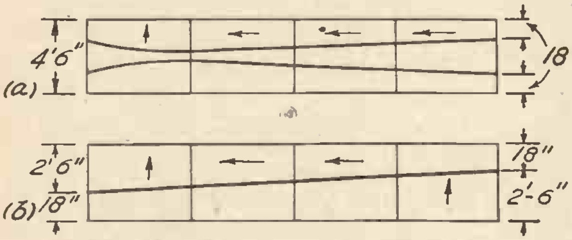


Fig. 3.—Scarfing of plywood for fuselage sides.

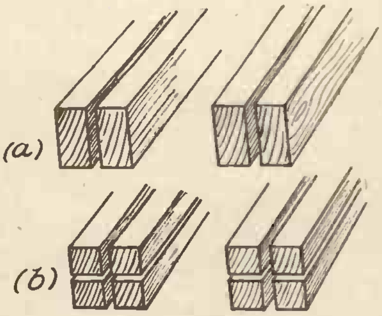


Fig. 5.—Slicing of longerons (a) top and (b) bottom.

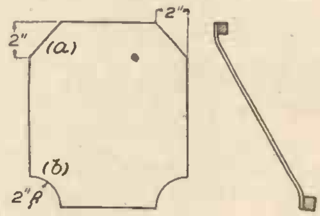


Fig. 6.—Fuselage bulkhead.

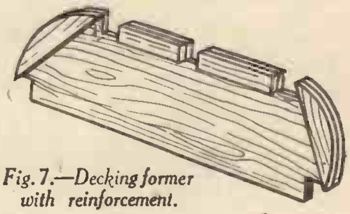


Fig. 7.—Decking former with reinforcement.

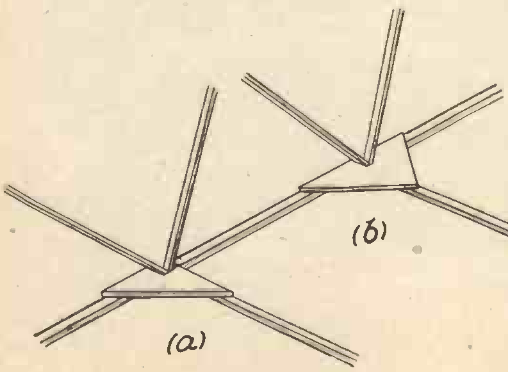


Fig. 4.—Gusseting of fuselage joints.

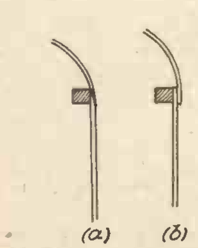


Fig. 8.—Fuselage decking attachment.

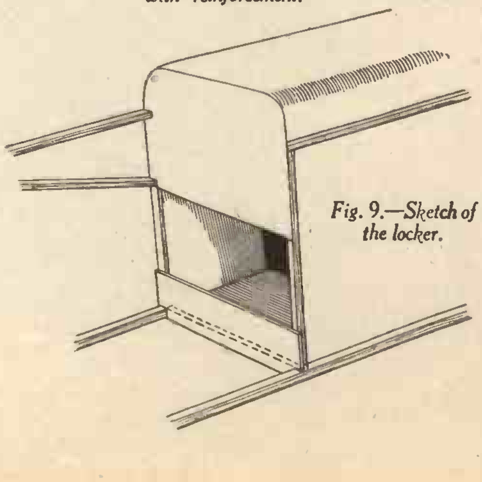
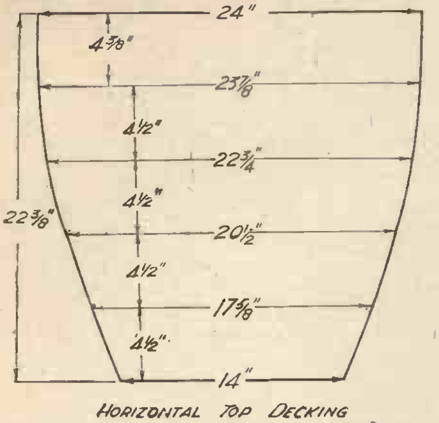


Fig. 9.—Sketch of the locker.



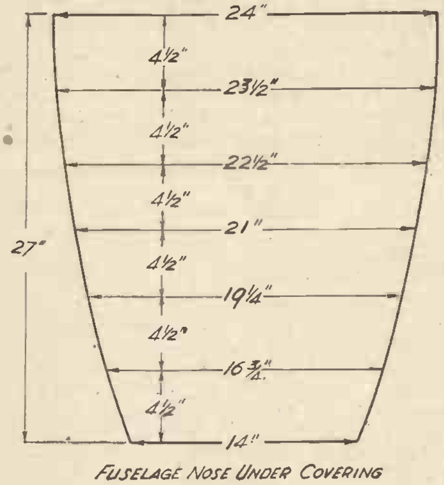


Fig. 10.—*(Above) Horizontal top decking. (Right) Fuselage nose under covering.*

than is essential, say by cutting each corner with a circular arc of 2-in. radius (*b*) of Fig. 6, or by cutting a triangular piece 2 in. by 2 in., as at (*a*), which is equally good. See that the cuts are clean and not liable to start splitting of the bulkhead. Fix these two struts and bulkheads, gluing the latter to the bottom, side and top struts, the plywood being slightly curved at the top and bottom to lie vertically along the faces of the struts, as shown in Fig. 6.

Now turn the fuselage over so that it stands on the top edges, and check again for squareness, having first removed the stern-post member. Cut and fit the remainder of the top cross struts, to the rear of the pilot's seat position, fixing as before with gussets (Fig. 4). This is followed by the fixing of the plywood bottom, from the stern to the 3-in. undercarriage-support member.

Fuselage Decking

After cleaning off the bottom ply, turn the fuselage over again and fix the stern-post in position. Mark out the decking formers on ⅛-in. plywood, and cut them out, cutting also the notches to take the three longitudinal stringers and the longerons. Glue and pin the formers to the cross struts.

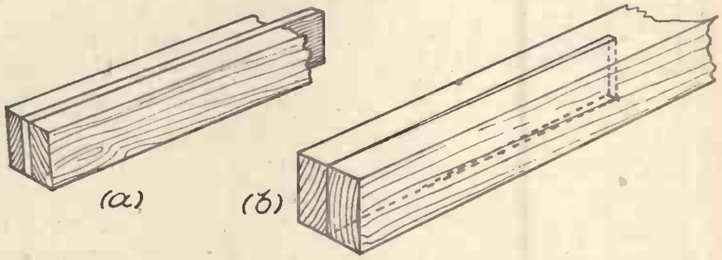


Fig. 11.—*Gluing up the longerons.*

The edges of the formers are reinforced with strips of spruce, say ¼ in. by ½ in., or any other convenient size available. ⅛-in. ply will do for these stiffening pieces (Fig. 7), pin and glue the stringers (⅜ in. by ½ in.) in position, taking care that the top faces are in proper alignment, or difficulty will be experienced in getting the decking ply to fit properly.

We now come to the fixing of the plywood decking to the rear of the cockpit. This may, if desired, be scarfed up into one piece before fitting, but a better job is likely to be obtained if it is fitted in two lengths of about 4 ft. as dictated by the positioning of the formers, since each scarf must coincide with a frame if the splicing is done "on the job." The decking ply should extend 1 in. down the fuselage side, and the joint may be either scarfed, (*a*) of Fig. 8, or lapped as at (*b*). If the former the fuselage side ply is planed to shape before the decking is laid on. The lapped joint is considerably easier and quicker for an amateur, and gives a very smart appearance if the edge is nicely cleaned off before painting. If the lapped joint is to be employed the ply formers should be left $\frac{1}{16}$ in. wider at each side.

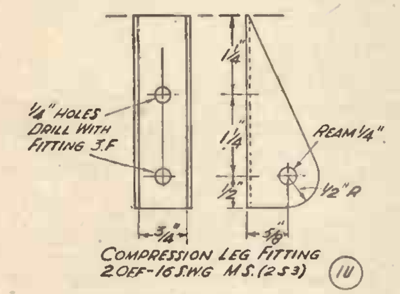
Due to the double curvature of the decking between the cockpit back and point 1 the decking here must be scarfed on in two separate strips.

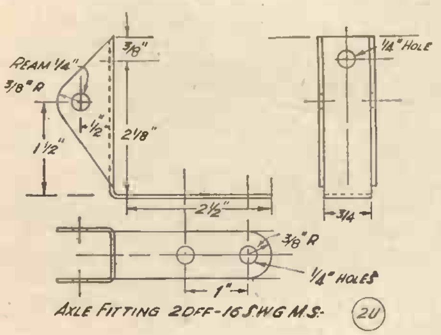
Fittings 2F and 5F should be attached at this stage.

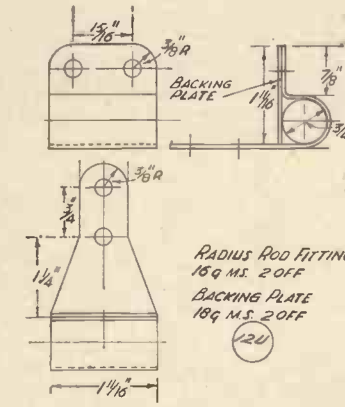
The Locker

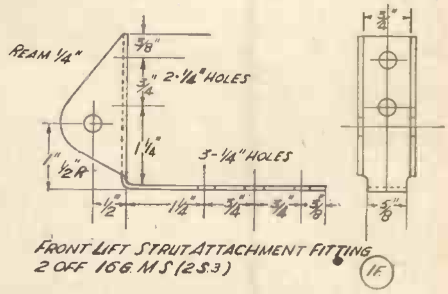
The bulkhead A,A[1] forms also the back of the locker. The floor consists of ⅛-in. plywood, but should be stiffened up by an additional ½-in. by ¾-in. strut across the middle of the floor, this being inserted, of course, before the plywood is fixed in position. The two sides of the locker are lined with $\frac{1}{16}$-in. ply, and a 6-in. strip of ⅛-in. plywood is fitted across the front at the base (see Fig. 9).

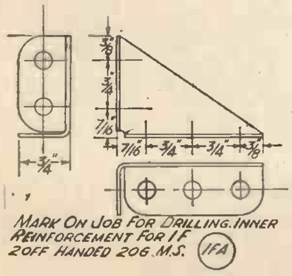
The decking former at this point forms also the rear lining of the pilot's cockpit and extends down 8½ in. to the extra ¾ in. by ¾

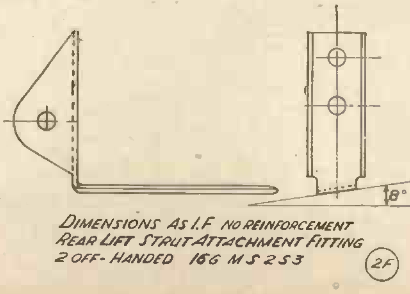


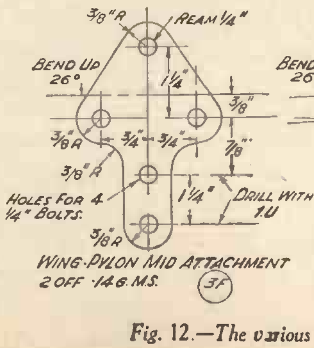












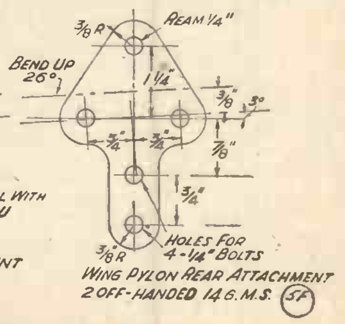
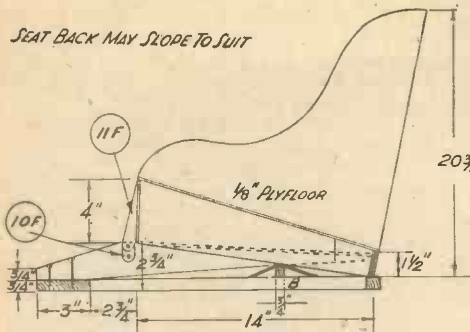
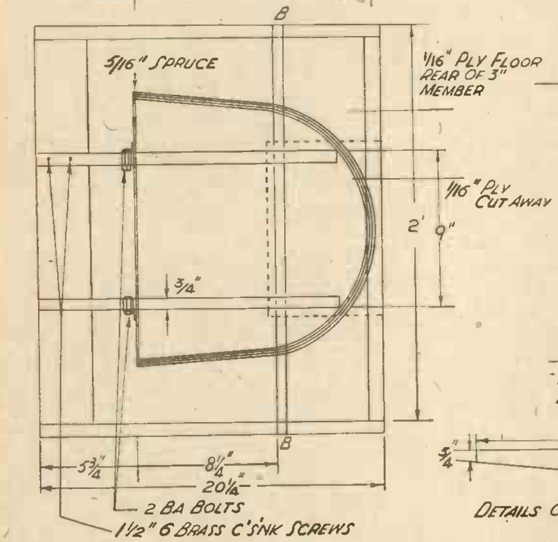


Fig. 12.—*The various fuselage fittings.*





in. strut at the base level of the pilot's entrance flap.

Building up the Nose

First cut the horizontal ply decking to fit on the top longerons. This should be cut to the ordinates given in Fig. 10. The top longerons may now be pulled into shape, fit a strip of plywood, ¾ in. wide, along each saw-cut, and glue up the longerons with the ply strips in position (Fig. 11). Tack the top ply decking in position temporarily, but do not glue yet. Cut and fix the engine bulkhead, of ⅛-in. ply, the bottom longerons being also pulled into position as before. *Note.*—Two plywood insertions will be required for the double cut and one of these will have to be halved to fit on either side of the other. If it is considered too laborious to fit these plywood insertions throughout the length of the saw-cuts, they may be omitted, but at least a short length of plywood, with the thickness tapered or feathered (Fig. 11 (*b*)) should be inserted when gluing up.

The remainder of the side and bottom struts may now be fitted and the plywood covering finished off. When all is set remove the top horizontal decking for insertion of the cockpit flooring and controls. Cut also the horizontal decking ($\frac{1}{16}$-in. plywood) at the tail-plane housing, but do not glue.

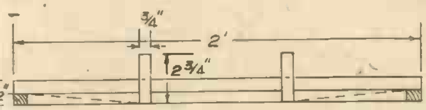
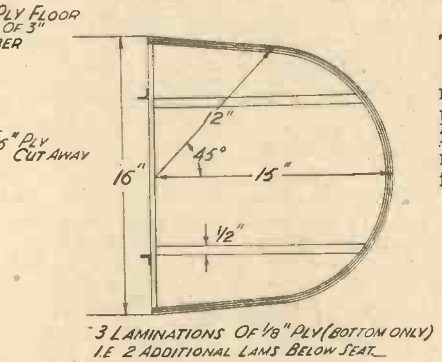
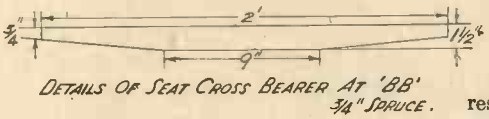
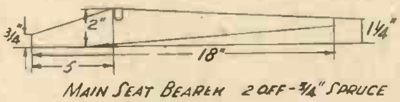


Fig. 13.—The seat and seat bearers.





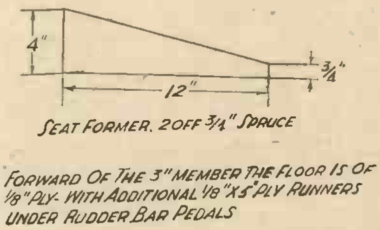


PRICE LIST OF "MINOR" FUSELAGE COMPONENTS	
Complete set of materials, spruce, plywood, steel tube and sheet.	£8
Extra for making up the two sides	£3
Extra for making up complete fuselage	£24
Fuselage, complete with fittings and controls, and painted to customer's colours . .	£36
Set of fittings, made-up, controls, pulleys, etc. (33 fittings)	£4

The fuselage fittings may next be attached and all bolts locked. These consist of fittings 3F, 1U, 2U, 1F, 12U, E2, E5 and E6. Set the tail plane in position whilst fittings E5 and E6 are being attached, to ensure correct positioning, and fix fittings E3 and E4 at the same time (see Fig. 12). The bolt heads should be on the outside, and in no case should a bolt head, or a nut, come in contact with the timber, a large "penny" washer being inserted between the nut and wood. Where two or more bolts are close together the washers should be trimmed to prevent overlapping. (This applies throughout the whole of the construction.)

The Cockpit

The flooring forward of the 3-in. spruce member to the rudder bar is cut from ⅛-in. plywood, notches also being cut to allow for all side struts and bolts. Additional runners of ⅛-in. ply, 7 in. wide, will be glued from the rudder bar support to act as heel rests. They should be screwed also at the cross members.



Make up the seat and seat bearers (Fig. 13), screw the latter in position and attach the seat by means of the hinge fittings 10F and 11F (Fig. 15). The flooring round the seat may then be finished with $\frac{1}{16}$-in. ply, this being cut away at the middle where not required.

Cockpit Former

The purpose of this circular former is to strengthen the fuselage against torsion where it has been weakened by the presence of the cockpit opening. It acts also as an arm rest.

Obtain three strips of spruce, or preferably ash, $\frac{3}{16}$ in. by ¾ in., place together and bend into a hoop so that it just fits into the cockpit opening, the rear of the hoop bearagainst the ¾ in. by ¾ in. central cross member behind the seat (already referred to), and the front coming just below the cross member between the top longerons forward of the cockpit (Fig. 14). Cut pieces of $\frac{1}{16}$-in. plywood to fit above and below the former. At the rear the lower ply will glue under the cross strut and at the front the top ply will glue also to the cross strut there. Remove the door by cutting through the ply with a sharp blade or chisel and clean up the ply edges.

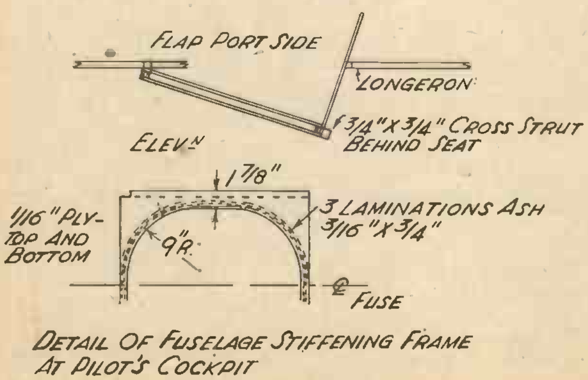
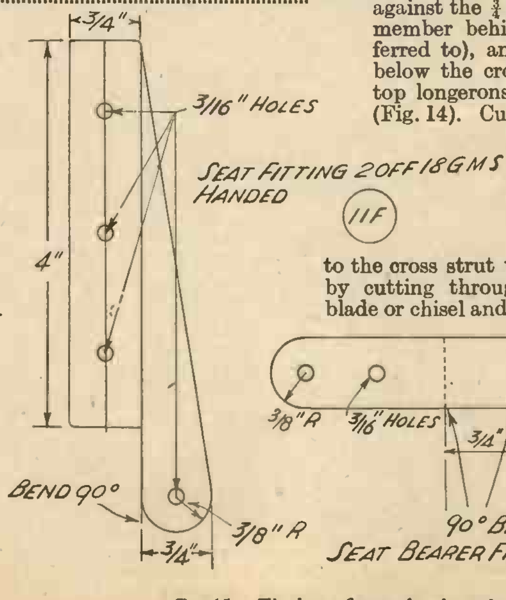


Fig. 14.—Fuselage stiffening frame at pilot's cockpit.



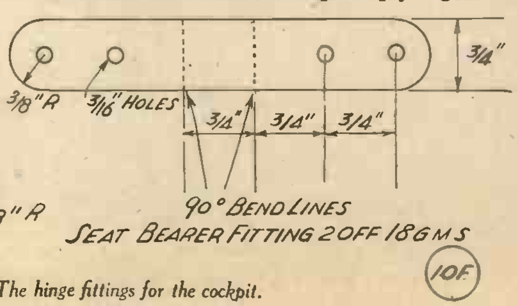
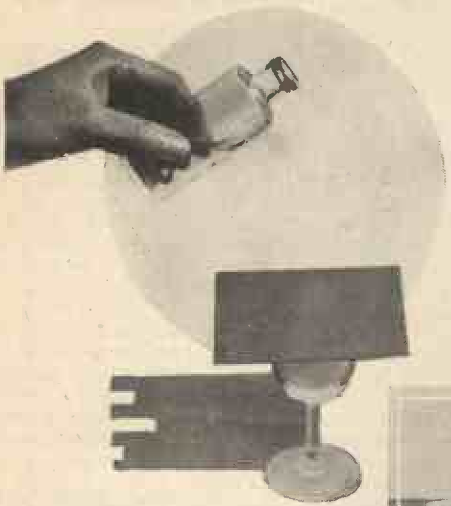


Fig. 15.—The hinge fittings for the cockpit.

GLASS SILVERING FOR THE AMATEUR

Straightforward Practical Details for the Working of a Very Useful Process



Varnishing the back of the mirror. After its final drying, the mirror is laid face downwards upon some support and a little celluloid or other varnish is poured over its upturned back.

The actual silvering is being deposited upon the sheet of glass in the solution. Note the formation of sludge on the sides of the dish.

IT is very often the case that the amateur mechanic, woodworker or other hobbyist finds himself in need of a piece of mirror glass of special dimensions for the job which he has in hand. At other times, also, it may be desired to provide old mirrors with a new coating of silver in order to remedy their defects and to bring them up to their pristine condition, whilst, occasionally, the experimental worker may wish to silver glass articles of unusual shape, as, for instance, the interior of a glass sphere or the inner sides of a glass vessel of irregular design.

All such requirements can be fulfilled satisfactorily by following the practical glass-silvering instructions which are given in this article. It is true, of course, that mirror glass of all qualities and thickness is commercially obtainable, but there is an interest and a fascination in the home-production of an article, and particularly to the chemical-minded worker will the technique of amateur glass-silvering make its appeal.

By following the directions given in this article, almost any type of glass can be silvered satisfactorily. The few chemicals required are not expensive and they are obtainable from any local druggist.

Two Important Points

Two factors alone are necessary for the success of home glass-silvering. The first lies in the careful making up of the silvering solutions, whilst the second is absolute cleanliness of all vessels, solution and glassware throughout the process. The slightest contamination of the silvering solution with dirt or foreign matter will bring about unsatisfactory results. Hence, from beginning to end of the silvering operations, the vital necessity of scrupulous cleanliness of everything concerned in the silvering must be well borne in mind.

If possible, it is best to make up the silvering solutions with distilled water and, also, to use distilled water for the final rinsing and washing of the glassware under treatment. Ordinary tap-water or rain-water will, of course, suffice for the process, but the use of distilled water is in all instances to be recommended.

It is not difficult to obtain an adequate supply of distilled water. Merely boil a kettle of water on a gas-stove and allow the steam from the kettle spout to impinge upon a metal vessel filled with cold water. The steam will condense and the water can be collected in a dish or vessel placed under the suspended can, as illustrated in the photograph on this page. Needless to say, the sides of the condensing vessel, as well as the receiver of the condensed water, must be scrupulously clean if the distilled water is to be free from contamination.

Removing Old Silvering

If the glass to be silvered has already a deposit of silver on it, as, for example, an old mirror, the old silver deposit must first of all be removed. This can be effected readily by immersing the glass in a 5 per cent. solution of nitric acid in water, the glass being subsequently well washed under a stream of hot water.

The glass for silvering, whether it be perfectly clean and new or whether it constitutes an old mirror glass which has had its silver removed in the nitric acid bath, must first of all be subjected to a chemical cleaning treatment. No matter how clean the glass may appear, this chemical treatment is an absolute necessity, and any attempt to silver the glass without the preliminary treatment will end in failure.

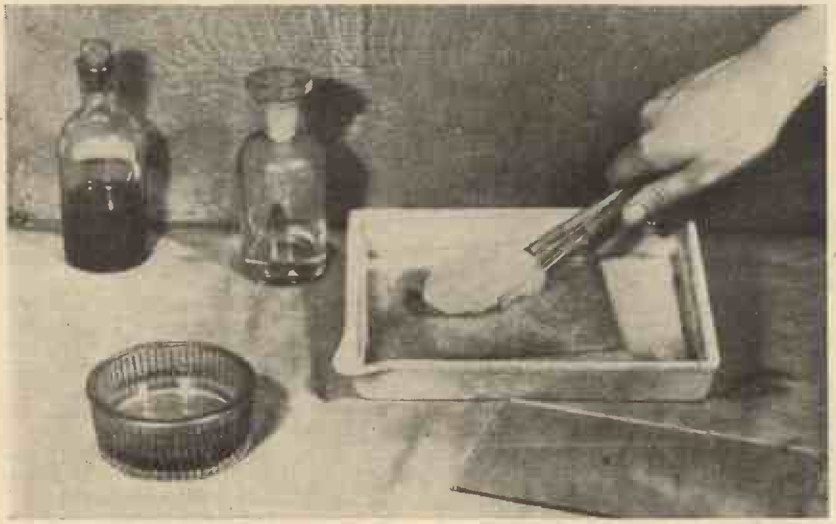
First of all, then, the glass to be silvered is washed in warm water, using a clean, soft rag and a liberal amount of soap. After rinsing, the glass sheet should be transferred immediately to a moderately strong solution of bichromate of potash to which about 1 per cent. of sulphuric acid has been added and allowed to soak therein for about an hour, or, alternatively, to a bath of strong nitric acid.

As the glass sheet lies under either of

A simple method of obtaining distilled water for silvering operations. The steam from a kettle spout is directed against the outer sides of a suitably suspended vessel containing cold water, the condensed steam being collected in a vessel beneath.

the above liquids it should be gently "scrubbed" with a wad of cotton-wool which is pushed over its surface by means of a glass rod.

Finally, the glass sheet is rinsed in plenty of clean water and then immediately transferred to the "silvering dish," which should consist of a perfectly clean shallow dish just sufficiently large enough to accommodate it. A photographic developing dish, preferably one of the porcelain variety, makes an excellent vessel for this purpose. As it lies in the "silvering dish" the chemically-cleaned glass sheet is covered with a layer of water and allowed to remain undisturbed while the silvering solutions are being made up.



Before the glass sheets are silvered they must be chemically cleaned. Here is a glass sheet being "scrubbed" with nitric acid, a wad of cotton wool held between two glass rods being used for this purpose.

Silvering Solutions

Two silvering solutions are necessary. They may, of course, be made up separately beforehand and, stored in brown or amber-coloured bottles, they will keep in good condition for a considerable time. They must not, however, be mixed until immediately before their use.

Solution A

Silver Nitrate .	4·5 grains	or	0·5 gram.
Rochelle salt .	4·25 ,,		0·7 ,,
Water . .	5 oz.		250 ccs.

Solution B

Silver Nitrate .	39 grains	or	2·5 grams.
Water . .	$\frac{3}{4}$ oz.		25 ccs.

Solution A should be boiled for four or five minutes and then filtered and bottled for use.

Solution B, however, needs special treatment to bring it into a "sensitive" condition. Add to this solution, strong ammonia *drop by drop*. A white precipitate will first form and will rapidly turn brown. The ammonia must be added until this precipitate *just dissolves*, leaving a clear solution. Hence, it is necessary after each addition of ammonia to shake the vessel containing the solution in order to give the precipitate a good chance to dissolve. After the solution has thus cleared, add to it, also, drop by drop, a weak solution of silver nitrate (strength immaterial) until the solution *just perceptibly* becomes cloudy and darkens. Then dilute the solution with 250 ccs. ($8\frac{1}{2}$ oz.) of water and bottle it for use.

Having prepared the two silvering solutions in the manner described and chemically cleaned the glass surface to be silvered, we are now ready to undertake the silvering operation proper.

Pour off the water from the chemically-cleaned glass sheet and pour on to the latter a strong solution of stannous chloride. Allow the latter solution to remain in the dish for about half a minute, then pour it off and finally rinse the glass with several changes of water.

Silvering the Glass

This stannous chloride treatment is not essential to the silvering, but it forms one of the secrets of glass-silvering which are adopted by the trade. Its advantage is that it gives a very adherent layer of silver on the glass.

The glass sheet, after having been finally rinsed with water, is allowed to lie, side-to-be-silvered upwards, in the silvering dish. Equal parts of silvering solutions A and B are mixed in a clean glass vessel and *immediately* poured into the silvering dish. The silvering of the glass will commence instantly. The dish should be rocked gently for five or six minutes in order to prevent particles of the sludge which will form in the mixed solutions from settling upon the silvered surface.

Finally, after the above-stated time, the silvering solution is poured away (it is of no further use) and a little clean water is poured into the dish. The silvered glass is given three or four of these rinsing treatments and then removed from the dish and allowed to stand on edge to dry.

A perfectly silvered surface will now be present upon the glass. In order to prevent injury to it, the surface, when dry, should have poured over it a little celluloid or shellac varnish and, when hard, this varnish layer may be further protected by a thin coat of paint. Thus completely protected from atmospheric action, the layer of chemically-deposited silver will remain bright for many years and will form a perfect reflecting surface, the quality of which can only be marred by any possible surface irregularities in the glass.

Naturally enough, the silvering method must be modified when dealing with glass spheres and the insides of glass vessels. When these have to be interiorly silvered, the chemical cleaning solution, the stannous chloride solution and the silvering solution are all poured in turn into the vessel and swirled about therein so that the interior sides of the vessel are brought completely into contact with the liquid. Otherwise, of course, the procedure for the interior silvering of a vessel is exactly the same as that for an ordinary sheet of glass.

Cleanliness Necessary

The scrupulous cleanliness necessary for the success of glass silvering must extend to the hands, or, at least, to the fingers of the operator. It is best to handle the glass to be silvered as little as possible, but when it does become necessary to handle it by its edges, the fingers should previously have been well scrubbed with soap and water in order to remove all perspiration and grease from them. Dust, of course, must be guarded against at all stages of the silvering operation.

Do not allow the glass sheet to remain in the silvering bath for more than five or six minutes, otherwise it will tarnish. If a heavier deposit of silver is required, this can be built up by pouring a further quantity of the freshly-mixed silvering solutions upon the silvered glass, allowing it to act for another five or six minutes and then applying, if necessary, a still further quantity of the mixed solutions. Usually, however, if the mirror is carefully varnished after its final drying, one silvering will be found ample.

If, after the final drying of the silvered glass, any silver is found deposited upon the front side of the glass, this can easily be removed by gentle rubbing with a rag, or, in more obstinate cases, by wiping with a cloth moistened with dilute nitric acid. This final treatment, however, should be deferred until the silvered side of the mirror has been protected by varnish.

A ROMAN KILN

BETWEEN 1,600 and 2,000 years ago on a site near which the village of Compton, Berkshire, now stands, the manufacture of pottery was carried on. After the pottery had been shaped by hand out of the crude clay, it was burned or fired in a kiln to harden it. The kiln, crudely constructed of clay in a hollow of the chalk subsoil, has recently been unearthed in the middle of a ploughed field where it had lain hidden for centuries.

The discovery of the kiln was due to the acquisition of a motor tractor plough by the farmer which rendered deeper ploughing possible. The farmer noticed a patch of soil which was darker than the rest of the field and casual examination disclosed pieces of broken pottery. Closer examination suggested the presence of the kiln and careful excavation revealed the entire kiln in a perfect state of preservation. Constructed of hardened clay, the kiln consists of a lower chamber in which the fire burned beneath a "floor" which supported the pottery. The floor is perforated by a number of holes which allowed the heat to reach the pottery, and, when in use, the kiln would have been covered over by a temporary covering to maintain the temperature.

The discovery of this kiln is of considerable interest, since it is the only perfect example known. This fact caused the authorities of the Science Museum to undertake its excavation and removal to London. Encased in a complete cradle of reinforced concrete and weighing $4\frac{3}{4}$ tons, it was transported intact to London, where it is now on exhibition in the Science Museum and where it will be preserved for future generations.

WHEELS FOR MODELS

By "Handyman"

The Second Article of a Short Series Dealing with the Construction of Wheels Suitable for every Type of Model.

AFTER dividing and saw-cutting, drop a hub, which will be bored to fit, over the pin in its respective jig, and a tyre into the ring of pins, or the recess formed by the small blocks, around the circle. Now pin a piece of 8-sheet Bristol board down on a drawing board and draw accurately all the spokes to the shape shown at C, Fig. 5. Unpin from the board and carefully cut all the spokes out with a pointed and keen-edged knife, preferably cutting on a piece of glass.

Building up a Wheel

Having cut all the spokes, a wheel can now be assembled. Touch each end of a spoke with a little tube glue, such as Seccotine, and slide it down into one pair of slots in the hub and tyre, then a second spoke diametrically opposite the first. Another two spokes may next be put in at right angles to the first; then continue until the wheel is complete. Fig. 6 shows the wheel in its jig with three spokes in place. Lay the whole on one side until the glue is dry, and, if the first is a bogie wheel, take the driving-wheel jig and proceed to build one of the large wheels. When the bogie wheel is quite dry it can be removed and another built on the same jig.

Balance Weights

In Fig. 3 is shown a coupled wheel with its balance weight and crank. Now, the position of the balance relative to the crank is correctly given for a coupled wheel, i.e. directly opposite to the crank, since it has only to balance the crank and coupling od, but on the driving or centre wheel (on a six-coupled engine) the weight will not be opposite the crank, and the reader must refer, for its correct angular position, to an illustration, either photograph, postcard, or picture in a railway paper, of the engine

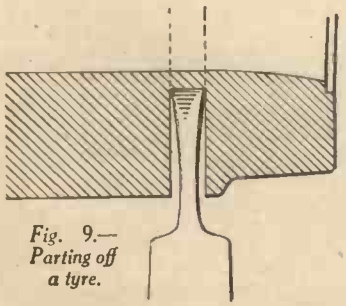


Fig. 9.—Parting off a tyre.

he is modelling, since the position is different on engines of differing types and railways. It is sufficient to describe how the balances and cranks shall be made.

The wheel is built up, with its spokes glued and inserted in slots, in the same way as a bogie or other unbalanced wheel, except that, if thought desirable, the spokes can be cut straight on the front edge, where the balance comes, instead of curved. Cut, in fact, as drawn in Fig. 7, where the spoke is marked "straight." Then three plates of Bristol board are cut, crescent-shaped, as in Fig. 3, to fit the curvature of the wheel. One crescent is glued at the back and two, to make a double thickness, on the face.

Cranks

The crank is dealt with in much the same way, except for the fact that the piece of Bristol board on the outside face of the wheel is to be cut pear-shaped, so as to cover the circular face of the boss. The crankpins to take the coupling rod, and, in the case of the driving wheel, if it be an outside-cylinder engine, the connecting rod as well, must be inserted after the wheels are finished, because steel pins are to be used—the kind which are used by cabinet-makers

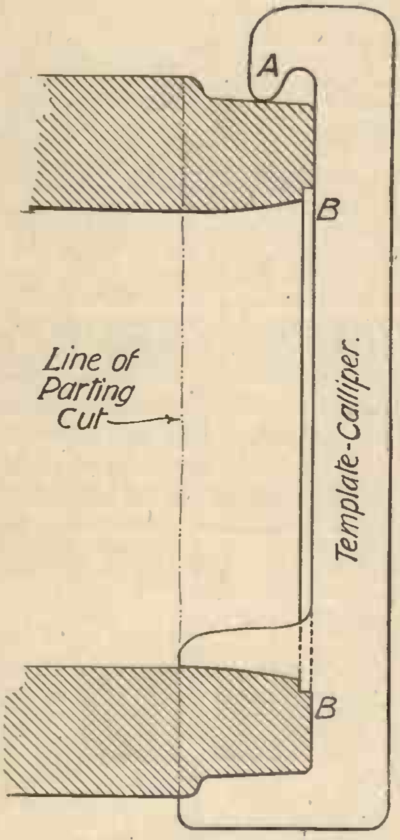


Fig. 10.—A tyre-profile gauge.

and fretworkers for fine woodwork. The heads on these will otherwise prevent the rods from being put on, so fine holes will have to be made for them in the crank. These holes can be made with one of the pins themselves. Insert one in each crank at the correct distance from the centres of the wheels and, for the present, leave it there.

We now have to fill in the spaces between the Bristol-board facings and between the spokes, both at the cranks and balance weights.

With a small brush paint the insides of the apertures to be filled with glue, and when this is dry, mix up a little fine plaster of Paris; not too wet, but just stiff enough to work nicely. Fill all the spaces with this, and smooth off neatly between the spokes with the point of the penknife.

As ordinary plaster sets somewhat quickly, it can be made more workable by using, instead of plain water, a thinned

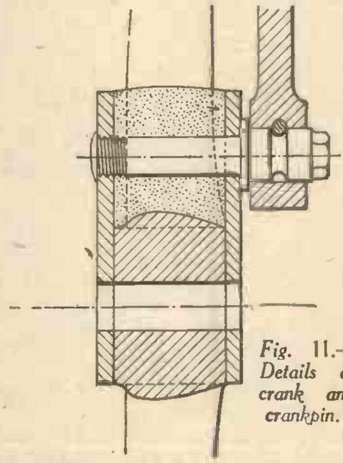


Fig. 11.—Details of crank and crankpin.

solution of the tube glue, say, equal parts of glue and water.

When the plaster has set, draw out the pins in the cranks, thus leaving holes right through cardboard and plaster in which other pins can be fixed in Seccotine, when the engine is assembled and the coupling rods and connecting rods are put on.

The method of building up wheels for locomotive models, in wood and cardboard, leads us by a course of simple reasoning to ask: Why not adopt the same procedure for wheels in metal, using solder instead of glue? Such a natural evolution of an idea would be excellent—is excellent, in fact; for it enables one to produce, for perfect little working scale models of from 0 gauge up to ½ in. to 1 ft. scale, wheels which are far cleaner and sharper in form and outline than those which are made from castings.

Faults of Cast Wheels

Every model locomotive enthusiast who adopts rail gauges below 2½ in. knows how difficult—if not impossible—it is to obtain really neat scale replicas of wheels for his engines. The spokes, particularly, are clumsy and rough, and frequently have too much taper from front to back, so that if the model builder wishes to improve them he has to carefully and laboriously go over every spoke with fine files, to say nothing of the difficulty of getting down into the sharp angle close to the hub, especially if the original foundry pattern was designed to have the correct number of spokes.

Either brass or gunmetal, or both, will be the best metals to use. One cannot have cast-iron tyres, because the spokes have to be soldered. Steel can be used if a piece of tube of the correct diameter and just the right thickness can be found. This would, of course, make the best and most correct job, but brass does equally well if the wheel or wheels are nickel plated, or, better, chromium plated, so as to have a more natural-coloured metal for the bright treads of the tyres.

Turning the Tyres

If suitable steel tube can be found from which the tyres can be turned, a mandrel will have to be turned in the lathe for it to fit over somewhat tightly. Each tyre is turned to its correct profile—and this profiling should, of course, be done to a metal template—and then parted off. The next tyre is turned and parted, and so on until the number required is made.

Failing the tube, however, a pattern in wood must be made, which pattern can have prints at each end for coring out the bore. From this pattern a casting is obtained in either gunmetal or brass, shaped as in Fig. 8; that is to say, cylindrical and with four lugs at one end through which bolts will pass to secure the casting to the lathe faceplate.

The casting should first be bored out to the exact inside diameter of the tyre, then the end is faced and the first tyre is formed to a profile gauge; which gauge may include the flange, the face, and the inside of the tyre. By cutting it to the outline shown in Fig. 10, with the little lug marked A, it may also be made to serve as a calliper for diameter. The long, straight edge, B, is needed so that the line of the faces of the tyre serve as a guide in determining the angle of the profile on the rim.

After turning to the gauge the tyre is parted off, as shown in Fig. 11, using a parting tool in the slide rest.

The bosses of the wheels, or hubs, can be turned and parted from brass rod of the correct diameter.

A drill of somewhat smaller diameter than the axles are to be should be run up the centre of the rod whilst it is in the lathe before parting off. Hubs should be given an outline as shown in Fig. 12.

The spokes may be cut from sheet brass, or hard-rolled strip brass can be used. Many full-size wheels have spokes of rectangular cross-section, but most modern cast-steel wheels have oval spokes. To reproduce the latter form the brass strips will have to be a little thicker in gauge, and the corners will have to be rounded off.

For assembling the wheels and soldering the tyres, spokes, and hubs together, jigs will be required of the same kind as those shown in the previous article for cardboard and wooden wheels. If the metal wheels which are now being dealt with are quite small—say for a 0-gauge engine—wooden jigs will do quite well, because the work can be done with a soldering iron, but if wheels as large as ½-in. scale are being made, then it would be advisable to do such soldering with a blow-pipe, in which case it will be necessary to use iron jigs. These can be exactly like the wooden ones as regards shape, with the parts screwed or riveted together.

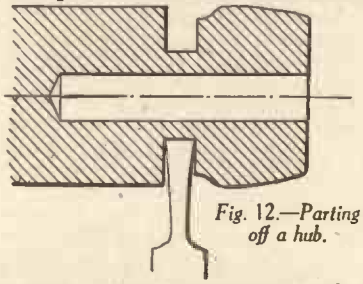


Fig. 12.—Parting off a hub.

Saw cuts will, of course, be made in both tyre and hub, into which cuts the spokes will fit.

Now solder all the parts together, every spoke at both tyre and hub, using just sufficient solder to make a nicely rounded-off curve at the junctions of the metals.

Tin the faces of the hub at back and front and sweat on, one side at a time, whilst in the jig, the crank cheeks. When cold, remove from the jig and fill in the spaces between the spokes and between the cheeks with solder, using for this purpose a soldering bit. Deal with the balance weights in the same way, having prepared the plates by first tinning their inside faces. The crank pins are fitted as shown in Fig. 12, that is to say, the crank, composed of solder and brass, is drilled and the back brass plate is tapped. The pin is screwed in and riveted over on the back of the wheel. It is quite possible that the drilling of the hole through the crank will cut through one or more of the spokes, but that will not matter if the soldering is well done.

Although the point is not a part of the subject of this article, it may be mentioned that the drawing, Fig. 11, shows not only the shape of the crank pin, but the method of securing the coupling rod upon it, namely, by a round pin passing through the rod and making an easy fit in a groove turned in the pin.

After all the wheels are finished and off the jigs, they should be truly chucked in the lathe and the holes through the hubs carefully bored out to make a driving fit on the axles. When knocking them on to the axle ends see that the cranks make exactly 90 degrees one with the other. After mounting, run each pair of wheels in the lathe, taking a very light skimming cut, if necessary, to true them. Polish and clean them all over and they are ready for plating.

SPEEDING UP TRUNK CALLS

NEWLY DESIGNED APPARATUS THAT WILL SPEED UP THE HANDLING OF TRUNK CALLS.

THE Post Office have recently carried out successful tests with newly designed apparatus which will speed up considerably the handling of trunk calls. This new system will be inaugurated about 1940 and will enable a trunk operator to dial direct to a subscriber in a distant town in the same way that a subscriber now makes a local call. Despite the fact that during the last twelve months the Post Office have installed approximately 250,000 telephones, a record never previously achieved, the demand for telephone service continues to grow. To meet the need for greater facilities, more than 2,000 additional public call offices were provided last year. The number of telephone calls have reached the extraordinary figure of 2,000 millions, and inland trunk calls alone amount to 99 millions, an increase of 11 millions over the total for the preceding year. The cheap shilling night call continues to increase both in popularity and numbers. Between 7 p.m. and 10 p.m. the number of such calls now dealt with exceeds 30,000 each evening as compared with 26,000 each evening a year ago. This great growth of traffic necessitates the continuous preparation and carrying out of cable-laying programmes. Although the Post Office maintain more than 12 million miles of telephone wires (of which approximately 11 million miles are laid underground), new twelve-channel carrier cables are to be laid between England and Scotland, and about 1,000 new telephone channels to Scotland via Carlisle and Newcastle will become available in the course of the next few years.

A Radio Newspaper

The average newspaper reader fails to realise what a vast and extremely expensive machine is working day and night to let him know what is happening in every part of the world and how much human endeavour and ingenuity is represented in the printed sheets for which he pays a copper or two. It is only a century ago that news was transmitted by pigeon post between Paris and Boulogne, and then sent on by special steamer to Dover, and thence by specially chartered train to London. To-day news is transmitted to and from all parts of the world by telephone and telegraph in a matter of seconds. Picture transmission has made great strides and many newspapers now use portable transmitters which enabled a picture to be sent from practically any part of the United Kingdom where a telephone exchange is available. Facsimile telegraphy has already been tried out in this country for the sending of news, but at present the process is still too slow and is more expensive than the present methods. In America, however, a company has recently applied for permission to start radio-newspapers in the homes of its subscribers. Independent broadcasting stations proposed to provide several hundred owners of ordinary wireless receiving sets with the necessary apparatus, which includes a roll of chemically treated paper about 6 in. wide and which emerges from the instrument at the rate of 1 in. a minute. Pages of news and pictures measuring 8 in. by 6 in. are transmitted, but it would be possible to increase the width of the roll to the size of an ordinary newspaper page. Further experiments will undoubtedly lead to an increase of speed in the reproduction of these radio newspapers. With the progress already achieved in the realms of television, one can imagine that in the household of the future a room will contain a television set illustrating, with commentary, important events taking place in different parts of the world.

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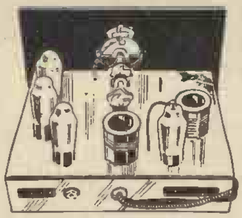

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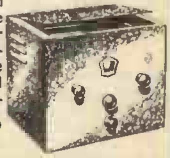

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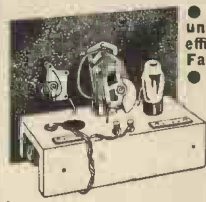
I-VALVE ALL-WAVE BATTERY RECEIVER



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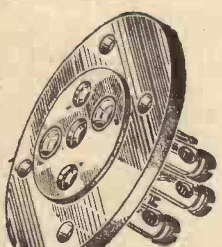
The higher the frequencies, the more important it becomes to use low-loss contacts, or in other words "CLIX," the contact components which, because of their proved high efficiency, are used by the leading set designers, experimenters and home constructors.



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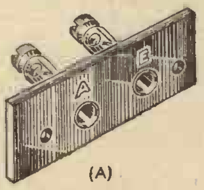

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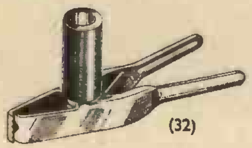

(32)

CLIX ARE SPECIFIED FOR THE "P.M" 1938 SHORT-WAVE THREE

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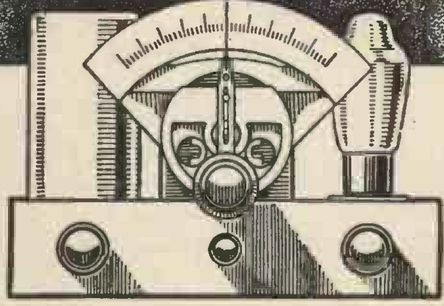


THE P.M. 1938 S.W. THREE

An Easy-to-build Three Valve Short-wave Set which will give Remarkable Results in the Hands of the Beginner and the Expert

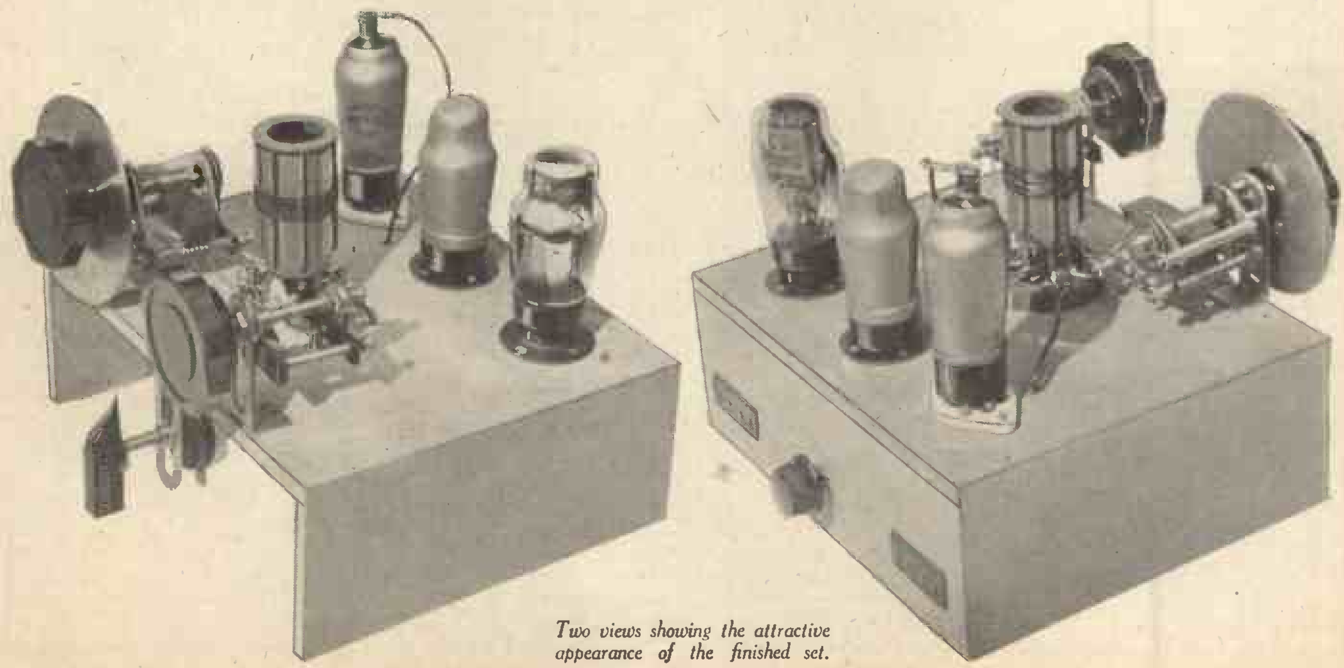
THE thrills of short-wave listening have now been explained and are well-known to every listener, but many have hesitated to take advantage of short-wave reception in the belief that specialised apparatus is necessary for the purpose. It is true that multi-valve superhets will ensure results when conditions are poor, but, even with the most elaborate apparatus yet designed, climatic conditions may be such that good signals over long distances are not possible. The beginner does not want to build a multi-valve set which will be tricky to adjust, and a properly-designed detector stage (single-valver) has been known to produce signals from every continent. Obviously, such an arrangement must be handled properly, and if the signals from it are amplified by standard L.F. stages it is possible to obtain many signals on the loudspeaker, and to make audible in headphones other signals which would normally be too weak to follow on the single valve set. Bearing all these points in mind, we have designed the receiver illustrated on this page which utilises three valves, a detector stage followed by two L.F. stages, the method of coupling being "mixed" to provide high quality from those stations which are sufficiently loud, and at the same time to ensure stable working.

The Circuit

A detector valve, for long-range reception, must be used with a very efficient reaction circuit—unless of course, the super-regenerative principle is adopted, and in the circuit used in this receiver, an L.F. pentode is employed in place of the more usual triode, and a very effective scheme of reaction control is employed. The reaction condenser usual to such circuits is fitted *at the back of the chassis*, and is adjusted when the receiver is first set up, after which the control of raction is carried out by varying the voltage on the screen of the valve—a standard potentiometer being used for the purpose. It will be found that this will enable the valve to be put into oscillation much smoother than when the ordinary reaction condenser control alone is used, and thus a signal may be built up much more surely, and if the tuned circuits are correctly designed it will be found that such an arrangement will often enable stations to be heard which would otherwise be unobtainable. To simplify tuning, which is always critical on the short-waves, the system known as band-spread tuning is adopted—a normal short-wave tuning condenser being used in conjunction with another very small condenser wired in parallel. The method of using this will be explained under the section dealing with operating conditions. The arrangement of the remainder of the circuit is quite standard, but to enable every listener to employ the receiver in the most effective manner for his own individual requirements the construction has been carried out in a rather unusual manner.

The Layout

It will be noted that the two tuning condensers are mounted on the top of the chassis on standard component-mounting brackets, and the reaction-controlling potentiometer is situated in the centre below them. In the photographic illustrations two special Eddystone controls are fitted to the main condensers, but if desired, a special slow-motion condenser may be fitted to the left-hand condenser, and a pointer and numbered dial (from the same suppliers) may be fitted to the right-hand condenser. If this is adopted, it will be possible to draw up calibrated tuning logs for the various coils which are employed in the receiver. The chassis may be obtained ready drilled, or you may carry out this part of the construction yourself. 1-in. diameter holes are needed for the two right-hand



Two views showing the attractive appearance of the finished set.

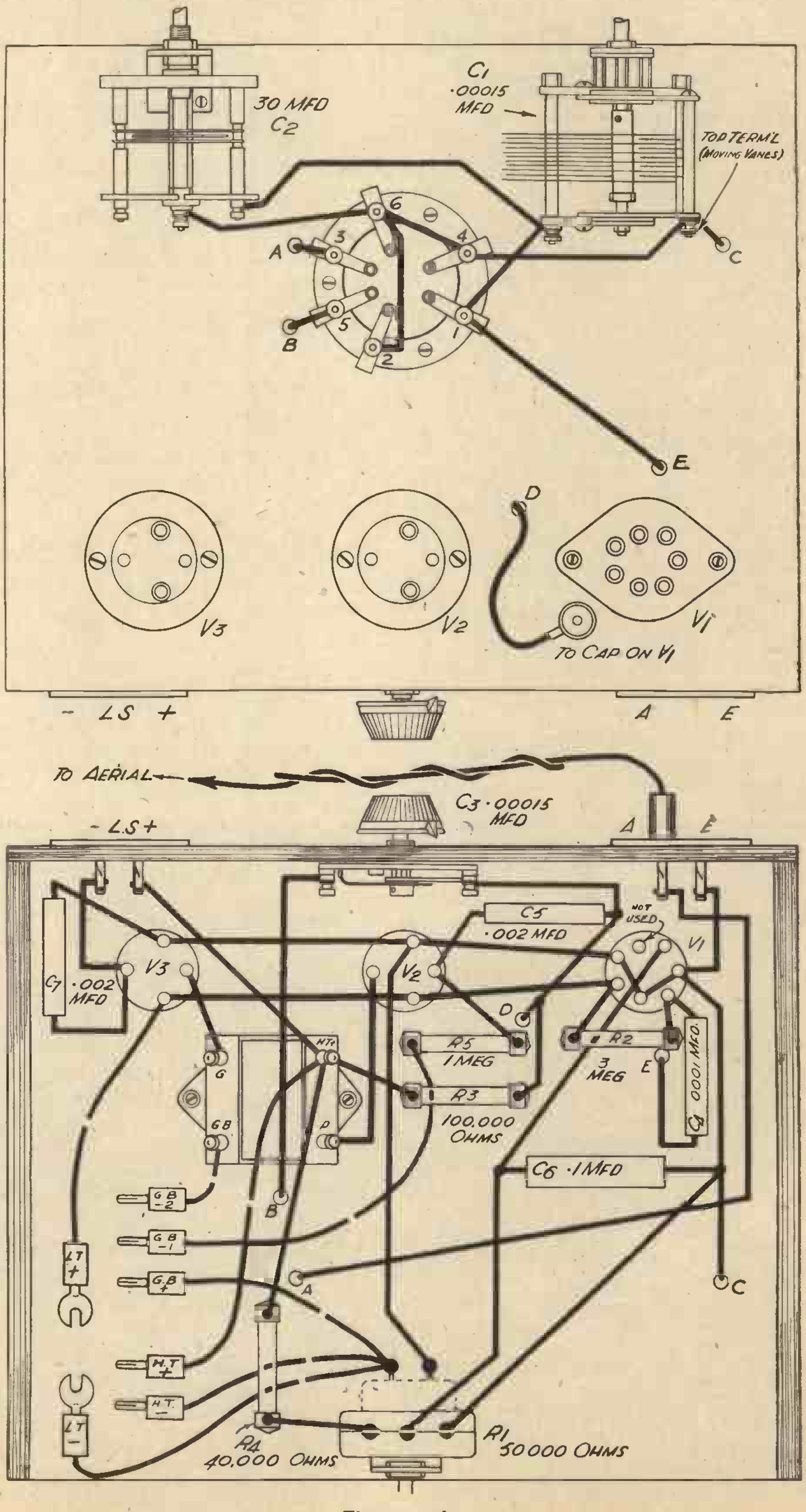
valves, and the detector, which is of the 7-pin type, must have a 1¼-in. hole drilled. On the rear runner of the chassis, a ⅜-in. hole is drilled in the centre, and the metallising for a space of about 1 in. round it must be carefully scraped away. If this is not done the H.T. will be short-circuited. To make quite certain, an insulating washer may be placed beneath the locknut before the condenser is locked into position. The small holes in the chassis through which inter-connecting leads pass should be drilled with a ⅛-in. drill, and for the terminal socket strips either slots, or two ⅜-in. holes for each strip may be drilled. When all holes are made, the valve-holders should be attached, and care should be taken to guard against the metal sockets or the tops of them coming into contact with the metallised surface of the chassis. Now turn the chassis upside down, and screw into position the L.F. transformer, and make the connections which are indicated on the Wiring Diagram. The filaments are wired with a single length of wire, passed through the holes in the valve sockets. By carrying out the majority of wiring in this way, you will find that the chassis is much easier to control, as it rests flat in both positions. Whilst working on the underside, attach the bracket in the centre of the chassis, mount the potentiometer control and the reaction condenser.

No Soldering

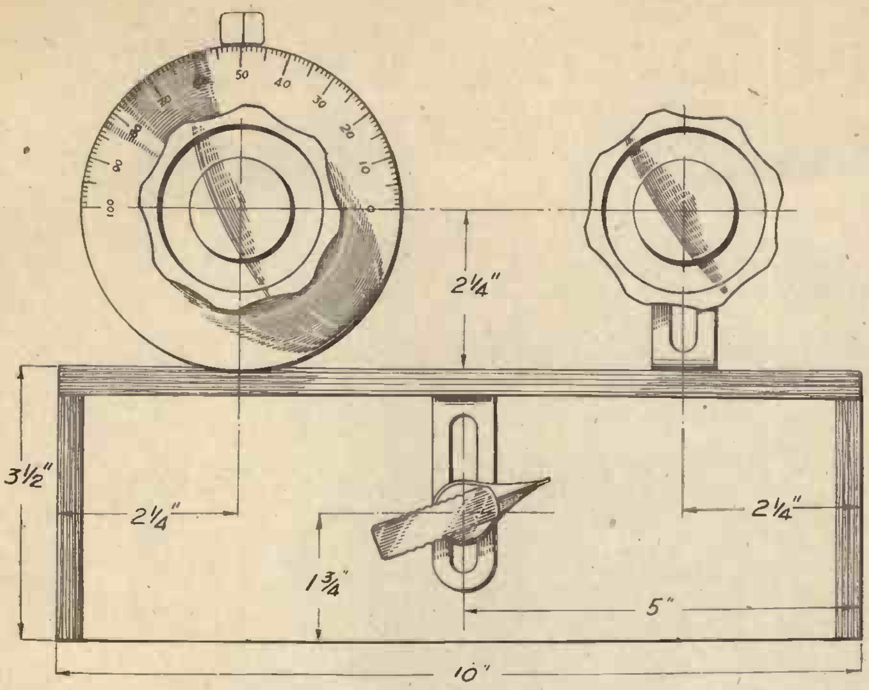
It will be noted that the major part of the wiring in this receiver, with the components specified, may be carried out without the need of soldering, and there are only a few points where connections must be soldered. Make quite certain that these connections are sound, as good contact is essential on short-waves, and any poor contact will not only result in signal loss, but will also give rise to all kinds of background noises. When as much of the wiring

One S.W. Condenser, Type 2043	J.B.
One Midget U.S.W. condenser, Type 2141	J.B.
One L.F. Transformer—Niclet	Varly
One 50,000 ohm. potentiometer	Bulgin
Two 4-pin Chassis Type Valve-holder (Type VI)	Clix
One 7-pin Chassis Type Valve-holder (Type V6)	Clix
One 6-pin Coil Base	B.T.S.
Two ·002 mfd. Tubular Fixed Condensers	T.C.C.
One ·0001 mfd. Tubular Fixed Condensers	T.C.C.
One ·1 mfd. Tubular Fixed Condensers	T.C.C.
One Reaction Condenser, ·00015 mfd.	B.T.S.
One 1 megohm Grid Leak	Dubilier
One 3 megohm Grid Leak	Dubilier
One 40,000 ohm. 1 watt Resistor	Dubilier
One 100,000 ohm. 1 watt Resistor	Dubilier
One A.E. Socket Strip	Clix
One L.S. Socket Strip	Clix
One 4-way Battery Cord	Belling Lee
One 6-pin Low Loss Coil (Type to suit wave-length, or a set may be obtained)	Eddystone
One H.P. 215 7-pin valve	Hivac
One 4-pin P.220 Valve	Hivac
One 4-pin L210 Valve	Hivac
One Metallised Chassis 10 in. by 8 in. by 3 in.	Peto Scott
One Metal Panel 10 in. by 8 in.	Peto Scott
One Pair Ericsson 'phones	
One Clix L.S. Panel	
One 120-volt H.T. Battery	Exide
One 2-volt L.T. Accumulator	Exide
One 9-volt G.B. Battery	Exide

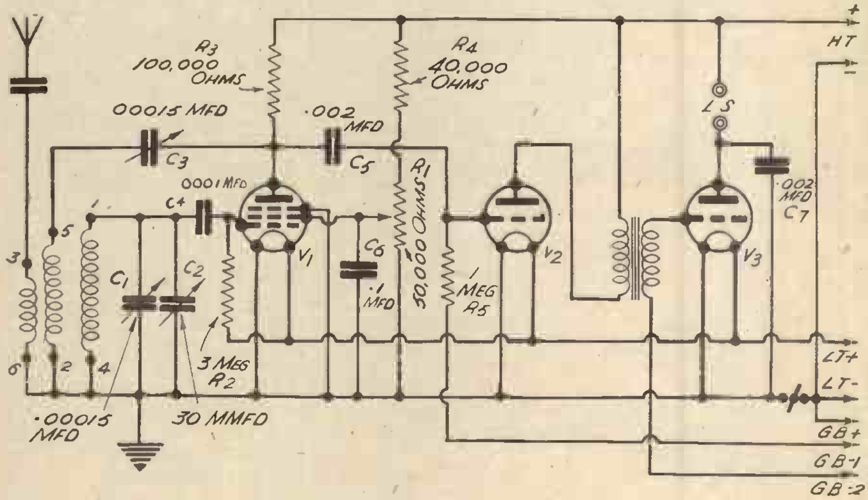
A TOP AND UNDERNEATH VIEW OF THE CHASSIS SHOWING THE WIRING



The wiring plan.



The panel layout of the P.M. 1938 Short Wave Three.



The Circuit.

as possible has been carried out on the underside, turn the chassis over and attach the coil-holder and the two condenser brackets, and mount the condensers in the positions shown. The remainder of the wiring may then be carried out. With regard to the battery on/off switch this may be accommodated in several ways. The simplest is to obtain one of the potentiometers which has a switch mounted upon it, and this is shown in dotted lines on the Wiring Diagram. This will avoid another control, but has the disadvantage that when the reaction control has been adjusted for any particular station it must be lost when the set is switched off, and found again when the receiver is next used. To avoid this, an ordinary type of on/off switch may be mounted on the rear of the chassis, or on the side of the cabinet in which the receiver is housed, and the connections to it will be exactly the same as indicated on the Wiring Diagram with the dual component. Make quite certain that all earth connections are sound, and use a good earth with the receiver in order to get the very best out of the set.

Using the Receiver

The most suitable waveband upon which to start listening is the 40-metre band, and for this you should plug an Eddystone 6Y coil in the coil holder. With the condenser specified for this receiver the set will then tune from just over 26 metres to just over 52 metres, and the 40-metre amateur band will be found about three-quarters of the way round the dial. This band, which is quite near a number of American and other long-distance broadcast stations, will give best results after dark, but the 16-metre American and other stations, with wavelengths between 15 and 29 metres, which may be heard by using a 6LB coil, will prove most effective shortly after sunset. It is important to remember these times of listening as the wavelength is critical on short-waves and is affected by sun and darkness. Other coils are available from Messrs. Stratton (the Eddystone people) with which the receiver may be used to tune right up to 100 metres or more, and thus it is possible to hear not only amateurs, but various commercial stations, ships, trawlers and many other interesting broadcasts. The aerial to be used with this type of receiver should be short and well insulated, suspended well clear of walls, trees and other earthed bodies, and a total length of 15 ft. will probably be found as effective as a 30 ft. aerial. To obtain good reaction control and absence of "dead spots," the aerial lead should not be plugged into the aerial socket on the receiver, but a 6 or 7 in. length of ordinary rubber-covered flex should be inserted into the aerial terminal, and the end of the leading-in wire should then be twisted round this, the amount of twist being found by experiment to give smooth reaction over all wavebands. In most cases about three inches of the wire will have to be twisted, and the ends should not, of course, be permitted to come into contact.

"Aero and Auto Engine Facts and Data" by H. R. Langman. Technical Press Ltd. 2s. 6d. net. Crown octavo. 85 pp.

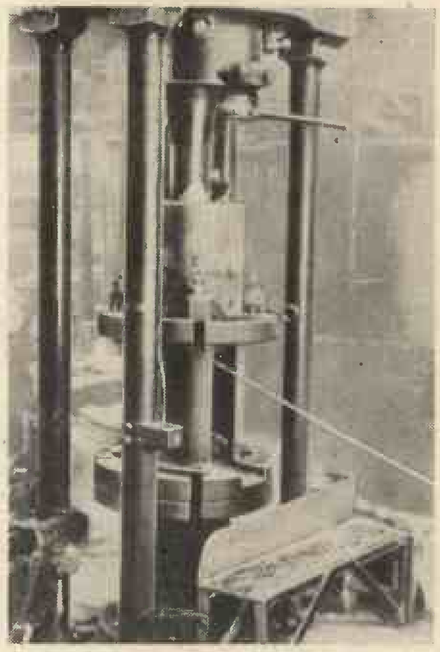
THIS book consists of a miscellany of formula, and a number of well-known facts. It is difficult to ascertain the purpose of the book, which is by no means complete, although it claims to answer "the usual run of questions." The book is not indexed, and the work appears to have been hastily prepared, for it is impossible within the compass of 85 pp. to thoroughly discuss the subjects given in the wide scope indicated by the title of the book.

"The Railway Age," by Cyril Bruyn Andrews. Published by Country Life Ltd., 12s. 6d. net. 145 pp. Colour frontispiece. Quarto size.

THIS is a handsome and well produced volume, and deals with the immense influence on the life of the last century and the effect on Society created by the railways. Railway construction has inspired a wealth of literature and illustration that hitherto has not been recognised because it was too near to our own time to be valued or collected. In this book Mr. Cyril Andrews (Editor of the famous *Torrington Diary*) has recaptured through contemporary pamphlets, papers, books and prints, the very spirit of the railway age. The 100 or more illustrations from private and public collections are such as have never before been brought together. The book is well indexed, and deals with the first railways, the birth of the locomotive, the effect on the population, Royalty, the Government and the speculators, engineering feats, the London Termini and Railway Hotel, stations in the provincial towns and in the country, art and decoration, comforts and discomforts, social activities, the London Railways, and the Railway Age. This is a book which should be in the hands of everyone interested in railways—full size or model.

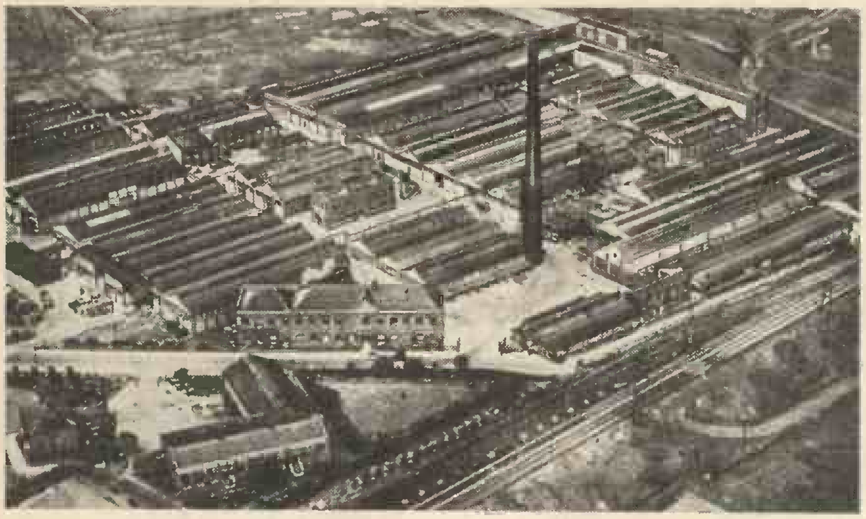
The Home of the Battery

By Our Special Correspondent



(Above)—Vertical press for extruding lead rods.

I RECENTLY paid a visit to the works of the Chloride Electrical Storage Co., Ltd., situated at Clifton Junction, Manchester, which is one of the largest plants manufacturing storage batteries in the British Empire. Unlike many factories producing large quantities of articles of outward similarity which would appear to be born of a universal type of plant, the processes and machinery used at the Clifton Junction works have been devised and manufactured in their own works. It could be aptly described as a works within a works.



An aerial view of the Exide works.

Very few people realise to what full extent batteries play a part in domestic, social, and business life. To name a few industries in which batteries have their uses, the following come to mind: motor-cars and motor-cycles, radio, train lighting, railway signalling and switch operation, submarines, electric tractors, country-house lighting, emergency lighting, aeroplanes, numerous other services from the coal mines to liners at sea. Extremes in the range of batteries are indicated by the small police-lamp batteries weighing but a few ounces to the large cells for central electricity stations weighing as much as 3 tons. Between these two limits cells of several hundred different types are produced.

Locomotive and Railway Equipment

The first authentic record of the lighting of a railway carriage by electricity appears to date back to about 1881 when a battery of 12 lead-acid pasted plate cells was used. After the cells were discharged, they had to be removed for recharging. It was quickly realised that this method was not satisfactory for general purposes, and eventually after several methods had been tried the most satisfactory proved to be the fitting of a complete equipment comprising a generator, control gear, and battery, each complete equipment being independent of any outside source for keeping the cells fully charged. The generator was suspended from the under-frame of the carriage and driven by a belt off a pulley fixed to the axle of the carriage. This method still predominates to-day, the different systems in use varying only in the method of control and in the use of either a single or double battery. Voltage has now been standardised on all train-lighting systems at 24, thus fixing the number of cells required at 12 for a single battery and 24 for a double battery system.

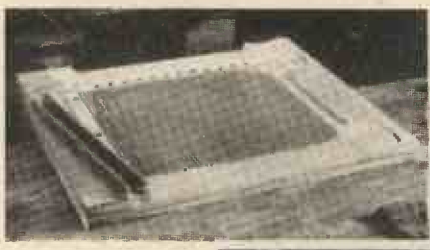
Aircraft

The safe operation of aircraft, whether on military services, civil air-transport, or in private flying, demands the use of battéries for navigation lights, radio, cabin and intrument lighting, and in some cases for the electrical starting of engines.

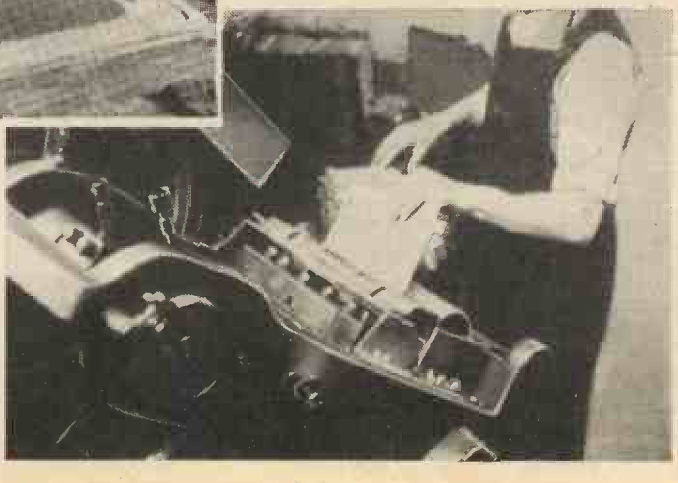
More and more aircraft are using the airways of the world during the hours of darkness, requiring navigation and landing lights and needing electrically illuminated instrument boards for safe navigation. The safety of pilots, passengers, and aircraft in such circumstances depends, to an even greater extent than formerly, on the battery supplying the current for such electrical demands, and since the unusual requirements of aviation call for batteries of special design, a great deal of study of the problems involved has been undertaken by the Chloride Electrical Storage Co., Ltd.

It is of interest to note that the Exide aircraft battery service station operated at Heston Airport by Messrs. Airwork, Ltd., was the first purely aircraft battery service station to be operated in this country.

The Exide indicator removes any fear that the battery will run down without warning to the operator. This device is essentially a hydrometer, consisting of an indicator needle fitted with a balance weight, and shows at a glance when the battery wants recharging.

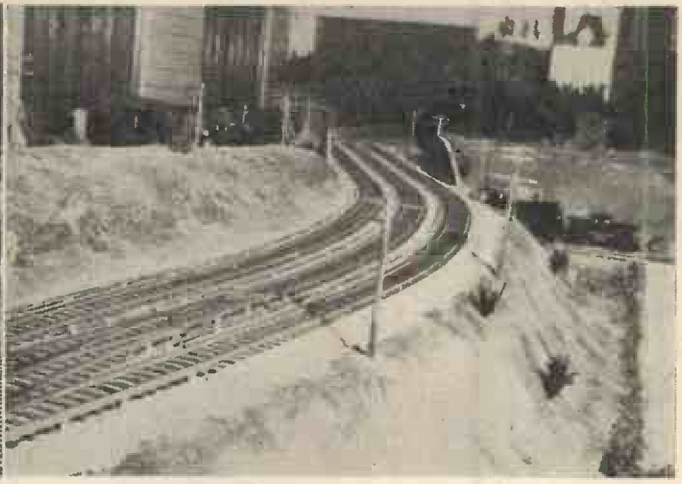


(Above)—One half of a mould for casting Chloride-Plante positive plates.



(Right)—Machine for shearing the gate metal which has to be removed from plate castings.

(Left) *Cut-off track near the locomotive depot.*

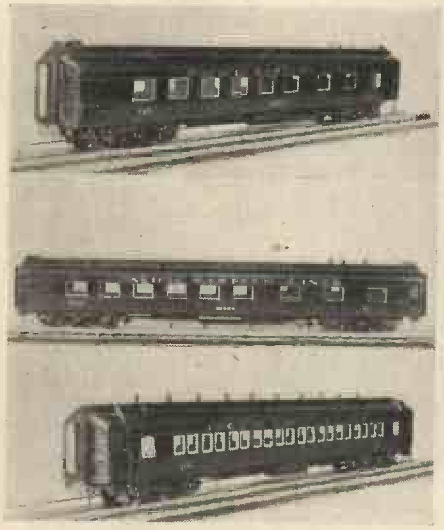


(Right) *The three-track main line at Grand Avenue.*

SOME NOTABLE MINIATURE RAILWAYS

The Layout of the Milwaukee U.S.A.

IT is not widely known in this country that the railway modelling craft has within recent years become enormously popular in the United States, where its following has grown until it is almost three times as large as our own. The actual progress of the hobby has been commensurate with its numerical increase in devotees, so that, although the designs and methods are necessarily very different in that country, the Americans have much to teach us along the lines of improvements and realism. The literature of the subject has also taken great strides towards perfection across the Atlantic, and it is largely to the editor of the leading organ of the craft, Mr. A. C. Kalmbach, that the writer is indebted for much of the information that has gone to form the basis of this article.



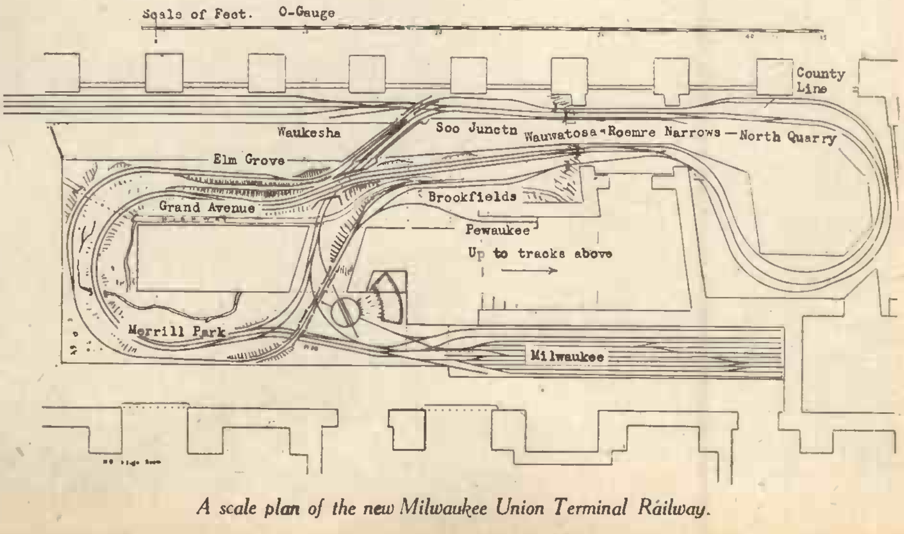
Passenger cars made by Mr. Walthers.

Perhaps one of the most significant factors in this advance is that of the formation of clubs which are exclusively given up to miniature railway work, and of these the Milwaukee Club is one of the most outstanding. There are fully forty members, including the editor and many of the staff of a model railway journal which has its publishing offices in that city, along with Mr. William K. Walthers, one of America's leading manufacturers of scale model products. As may be imagined, meticulous organisation is an important feature of this and similar societies, a notable example being that when the layout about to be described was constructed, a record was kept of the hours of work put in by each member and this record was used in determining the seniority of "officials" of the club layout, which has for its title the Milwaukee Union Terminal Railroad.

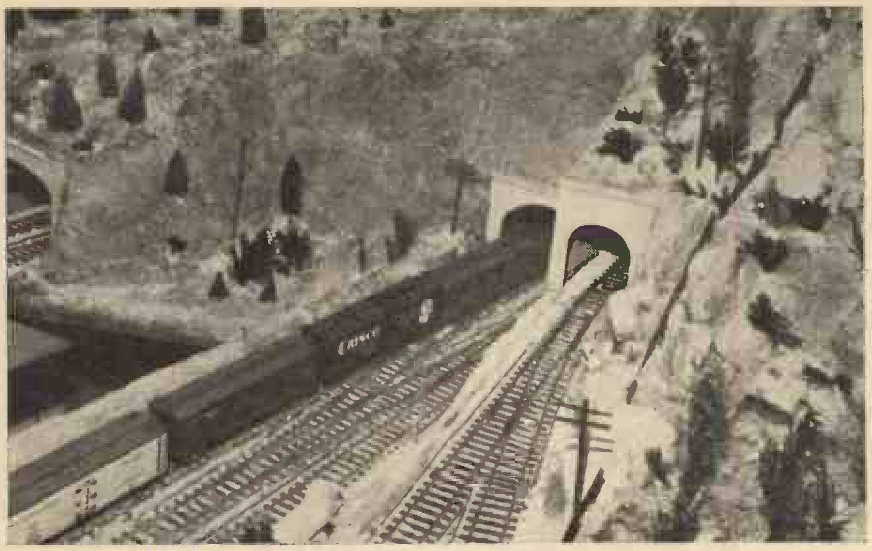
The Layout

The layout plan was actually designed in Mr. Kalmbach's office, and the design itself was patterned after an actual line to as great an extent as possible. It is a point to point system running in imagination from the city of Milwaukee to Waukesha, some nineteen miles away. The method of design was that of marking off a railroad route on the topographical maps of the countryside involved, computing the gradients, working out the positions of the points and track sidings for handling the imaginary traffic, and then completing the scale finish of the system. The plan was then as it were "wound around" to fit in the available space, which consists of the passenger building forming part of the old National Avenue station of the C. M. & St. P. Railroad. This building was fortunately secured almost rent free—only one instance of the interest, support and generous encouragement shown by the American railway companies to those interested in the craft. In the task of choosing the final design, the competitive element was introduced, the best work of the members being voted upon and selected, and the final drawings made as already described.

The layout, which is 0-gauge, comprises 1,000 ft. of three-rail track, with some 22,000 sleepers, 88,000 spikes and 3,760



A scale plan of the new Milwaukee Union Terminal Railway.



The main line near Roemre Narrows.

third rail supports. In the structure there are no less than 3,500 ft. of timber and 2,000 ft. of wire, as well as about 1,200 lbs. of plaster and 5 gallons of paint.

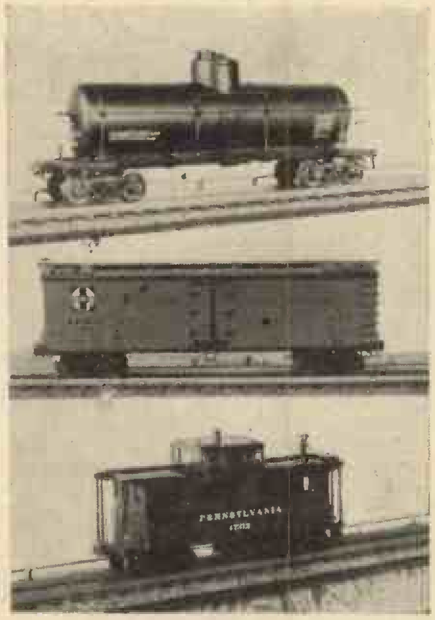
Varied Operating Procedure

The layout design is shown in the diagram, and it will be observed that this has been so arranged as to allow for the concentration of the bulk of the traffic around Milwaukee, as would literally be the case were the system a real one. Within the immediate area of this centre also the main lines are three-track or double-track, while on running out towards Waukesha it becomes single-road with the usual and necessary passing sidings. Very varied operating procedure is thus secured. The ballasting of the track was carried out in roofing paper of the colour of white crushed rock; all curves are super-elevated and geometrically formed. The scenic formation of embankments and cuttings and hills is carried out in plaster on wire screening. This was painted, and, while still moist, spread over with tinted or dyed sawdust and other similarly suitable material. The necessary highways were made of painted boards, with sand for the secondary roads.

There are no fewer than 67 pairs of points and five crossovers, as well as six bridges and a trestle viaduct. The locomotive depot takes the form of a main divisional centre from which both ends of the system can be adequately served over a kind of cut-off track, this same cut-off also serving to provide for continuous running, so that satisfactory exhibition runs can be staged if desired. The two back tracks of the Milwaukee section are the passenger station roads, being devoted exclusively to arrival and departure of trains, which are marshalled entirely on the car sidings in the front. It will be seen that these sidings are served by crossovers which facilitate the make-up of trains as well as their reversing. Inward and outward freight tracks are also included at this point, which are provided with means of releasing arrival and departing engines. There is also provision for cabooses (or brake vans), yard engines and so forth.

A "Wye" Track

Adjoining the engine terminal there will be seen a triangle or "wye" track. This, in keeping with a common procedure on American roads, is used for turning locomotives, and thereby serves the same purpose as a turntable. A turntable is



Freight cars.

also installed in front of the round-house, but this is normally used for purposes of ingress and exit only. At the entrance to the Milwaukee yards the track is of a triple nature and thus affords great flexibility for the handling of engine traffic.

Trains can be run round the entire layout without necessarily interfering with each other. It is interesting to note that there are six driving controls, so that six "engineers" can operate at once. Each control is equipped with an electric "throttle" and a speed controller, a clip for train order sheets, a pilot light, toggle switches for dead-alive sidings, together with an ingenius three-colour light signal which indicates an occupied track ahead and shows if an engineer is correctly following his train. The power supply is A.C. and is fed by 100-watt transformers, one for each control board. Each of these is fitted with a circuit-breaker. Mention must also be made of the correct telephone system, each comprising a train wire for reporting trains and transmission of train orders, and a message wire for use of the traffic department in keeping track of cars, loadings, supply of empties, and so forth. One instrument, switched into either wire by a key, serves both wires.

Gradients

There are necessarily a number of gradients on the system, the heavy up grades being countered by down grades, and they vary up to 1 in 100, some being rather steeper. It is intended to interlock the signalling at the two terminals, the one terminal with the other. It is proposed to cover the entire field of operating in a systematic manner. Thus, one night per week will be devoted to operating according to standard code rules, another night to simple running, another to shunting experiment and practice.

A number of photos of the layout are shown by courtesy of *The Model Railroader*, these being the work of Mr. Willard V. Anderson. One shows the main lines near Roemre Narrows indicated in the plan, with a freight train leaving the tunnel. Another depicts the three-track high-level main line near Grand Avenue, passing over part of the Waukesha Cut-off to the engine terminals. Another shows the cut-off tracks near the engine depot passing under the main line between Grand Avenue and Wauwatosa. Another gives the same view from above. The photo with the bridge at Grand Avenue.

The other pictures show some typical American rolling stock work executed by Mr. Walthers, one of the Milwaukee Club members.

A bridge near Grand Avenue.

Making a Hydraulic Press

How to Construct a Small yet Powerful Press for Workroom Use.

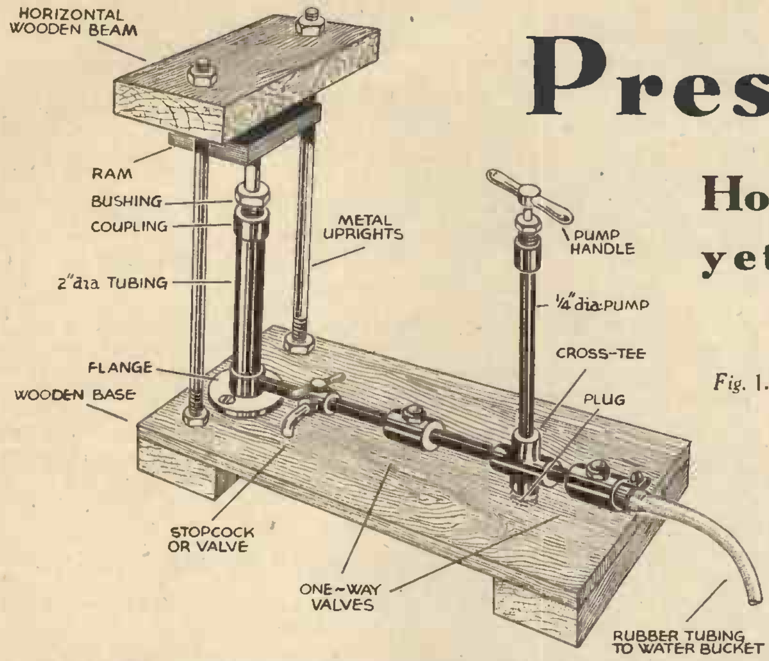


Fig. 1.—The finished press.

WATER is extremely incompressible. If, for instance, 1,000 volumes of water are subjected to double the normal pressure of the atmosphere (that is to say, to a pressure of about 30 lb. per square inch) they become 999·954 volumes. In other words, a gallon of water subjected to double atmospheric pressure diminishes its volume by about the space occupied by a single drop of the liquid.

Upon this well-known property of water, the truly prodigious power of the hydraulic press is fundamentally based. Owing to water being practically non-compressible, a hydraulic press is able to act as a power-converter, a given degree of pressure on a small area of water surface being productive of the same pressure per square inch upon a much larger surface of the liquid.

The Principle Explained

The principle of the hydraulic press is illustrated in Fig. 2. Here we have two cylinders containing water, the cylinders being interconnected by means of a lower pipe or channel. In the cylinder *A* a piston or plunger operates in a downward direction. Let us imagine that the piston in cylinder *A* has an area of 1 sq. in., whilst the piston or upward-moving "ram" in cylinder *B* possesses an area of 5 sq. in.

If, now, the space between the two pistons is completely filled with water, a downwards pressure of 1 lb. on piston *A* will give rise to an upwards pressure of 1 lb. per square inch of surface on piston *B* Hence the total upwards pressure exerted by piston *B* will be $1 \times 5 = 5$ lb., since the area of piston *B* is five times larger than that of piston *A*.

It is by making the upwards moving piston of a hydraulic press many times the area of the downwards moving piston that the enormous pressure generated in a press of this nature is obtained.

A hydraulic press of the kind shown in Fig. 2 would, however, be completely useless from a practical point of view, since in order to obtain an upward lift of piston *B* through a space of 5 in. a downward movement of some 10 ft. would be required on the part of piston *A*. In order to get over this difficulty, hydraulic presses are made with valves which permit the one-way flow of water only. Thus, by working the operating piston up and down, water is forced into the ram barrel at each stroke, the ultimate result being the same as if the operating piston had an extremely long stroke.

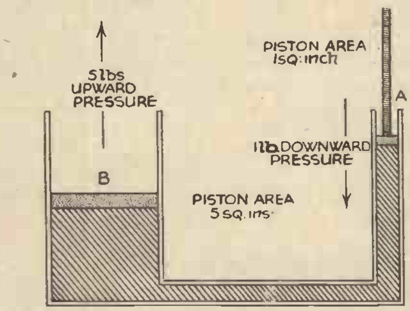


Fig. 2—Illustrating the principle of the hydraulic press.

A Home-made Press

The hydraulic press described in this article can be made by any amateur who possesses the necessary equipment for cutting and threading gas or water piping. It can be made at a very reasonable cost and, if carefully constructed so that no leakages occur at the various joints, it will generate a pressure of 3,000 lb. with fair ease.

The design of the press will become apparent by a study of the diagrams, Figs. 1 and 3. A substantial wooden baseboard is required, the exact dimensions of which are immaterial. In order to raise this baseboard above the bench level, it should have a couple of stout wooden cross-pieces firmly screwed to its underside.

The construction of the press is best begun by screwing a metal flange to one end of the baseboard. Into this flange is screwed a short length of iron gas or water pipe of about 2 in. diameter, the flange, of course, being of sufficient diameter to permit this size of tubing to be screwed into it. The exact length of the tubing is immaterial. Six or 7 in., however, is ample.

On the upper end of the upright tube a coupling union is screwed, and into this is screwed a stout metal bushing from which the internal thread has been removed.

Through the bushing and into the upright tube is inserted an iron or brass rod, making as close a sliding fit within the tube as possible. The rod may advantageously have a heavy metal plate secured to its upper end, but this detail is, of course, not essential.

Hemp fibre or some other suitable material must be rammed down into the space around the rod within the coupling. This packing may be compressed from time to time by screwing down the bushing.

A Wooden Cross-beam

Over the top of the now completed ram or upward-moving piston is erected a heavy wooden cross-beam, suitably supported by means of stout iron rods, as shown in Fig. 1.

Into the bottom of the ram thus (*Continued on page 245*)

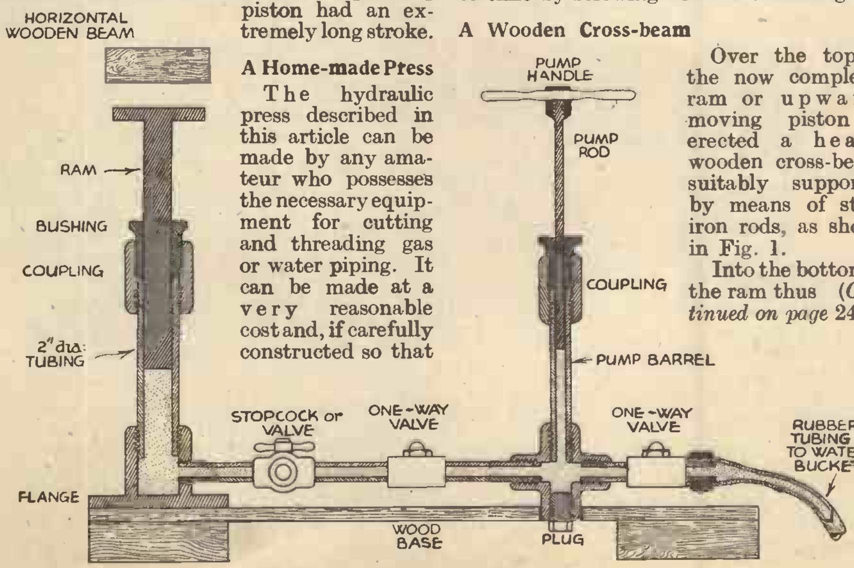


Fig. 3—A sectional view of the press.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 247, 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.

A GLASS SUBSTITUTE

"CAN you suggest a possible substitute for glass with none of the disadvantages of the latter. I have used the product with a wire gauze but find the wire mesh unsightly and not rust-proof. It is required to plate the roof of a laboratory, in which natural sunlight, its powers, etc., can be examined without any loss or bending of its complete visible and invisible spectrum; at the same time providing a sufficient barrier against weather conditions." (R. C., St. Annes-on-Sea.)

IT is impossible to bring about the conditions which you prescribe, since all forms of glass absorb a certain amount of ultra-violet light and all glass sheets bring about a small amount of light reflection, refraction and diffraction, even when they have been optically worked. Even, indeed, if such a glass could be produced for your purpose, you would find that it would be too soft and corrodible to withstand the inclemencies of the weather.

We can only suggest that you apply to Messrs. Pilkington Bros., Ltd., of St. Helens, Lancs., and ask them to quote you for sheets of their ultra-violet transparent glass. This glass, which is fairly transparent to ultra-violet rays, is made in different forms. It is, of course, expensive, but it seems to be the only form of material which is at all likely to suit your needs. Messrs. W. E. Chance & Co., Ltd., Oldbury, near Birmingham, produce similar glasses.

NON-EXPLOSIVE GAS

"CAN you tell me the name and boiling temperature of any liquids that will change, when reaching a temperature of 100 and 150° F., to a (preferably) dry and non-explosive gas of much greater volume than the liquid and if possible state the liquid to gas volume ratio." (A. B., Middlesex.)

THE following non-inflammable liquids all of which boil at temperatures between 100 and 150° F., will probably suit your purpose. The liquid to gas volume ratio cannot be stated, because it depends upon the pressure to which the vapour is subjected. In all cases, however, apart from conditions of much pressure, it is many hundreds to one.

	Boiling Point.
Chloroform . . .	143° F.
Dichlorethylene . .	123° F. (approx.)
Methylene dichloride .	107° F.
Methyl Iodide . .	108° F.
Ethyl bromide . .	101° F.

All the above substances can be produced from any firm of manufacturing chemists or laboratory suppliers. You should note that, although chloroform is non-inflammable when cold, it becomes somewhat inflammable when heated.

SPECIMEN OF METAL

"CAN you tell me the name and properties of the specimen of metal enclosed. You may submit the metal to any tests you may wish to make but I should be grateful if you could return same intact." (R. G., Kent.)

IN desiring us to keep the specimen of metal intact, you have restricted us very greatly in answering your query, for it is not always possible to ascertain the nature of a metal merely from its superficial appearance. We think, however, that the metal sample you submit is *bismuth* and from the few tests which we have been able to apply our opinion is confirmed. The metal is probably a very pure sample of bismuth, but, of course, there is a possibility of its containing other ingredients which could only be determined by chemical analysis.

Bismuth is a silvery metal with a very decided yellowish cast. It melts at 268° C., has a specific gravity of 9·823, is very brittle and crystalline and is a poor conductor of electricity. The metal is soluble in nitric acid and in hot sulphuric acid, but is only slightly attacked by hydrochloric acid. It tarnishes in moist air, becoming coated with a layer of oxide. Perhaps the greatest use to which metallic bismuth is put is the preparation of the various fusible alloys, such as Wood's metal.

ROCKET MAKING

"HAVING read your reply to F. M. (Hants.) in a recent issue, on the subject of fireworks, I wonder if you could supply me with the following information:

(1) Is the following a good recipe for making a rocket.

3 pts. iron filings.
4 pts. powdered charcoal.
8 pts. sulphur.
16 pts. nitre.
64 pts. meal powder.

(2) If so, what exactly is meant by "meal powder"?

(3) Since I am experimenting on a rocket $1\frac{1}{2}$ ft. in length, how thick should the shell be?

(4) Can anything be done to increase the propelling power?

(5) Is there any law preventing such a rocket from being fired in a built up area? (We have a 100 ft. stretch of garden.) (N. P., Yorks).

(1) THE rocket-powder recipe which you supply is quite an average one, but you can well leave out the iron filings, and, with advantage, at least halve the quantity of "meal powder" which is only present to make the powder porous and quick-burning. The speed of the powder's burning can be increased by incorporating a small quantity of potassium chlorate with the mixture, but this must be very carefully done, since potassium chlorate and sulphur often explode when rubbed together.

(2) "Meal powder" is really sawdust, a very fine grade of sawdust be denoted. It is not necessary to the success of a rocket powder.

(3) By the thickness of the "shell" of the rocket, do you mean the diameter of the rocket case or the actual thickness of its walls? The diameter of the case is, of course, dependent upon the wishes of the maker who must, naturally, bear in mind that a short thick rocket will not travel so well as a long thin one. The walls of the case should be of about $\frac{1}{4}$ in. thick cardboard or a trifle less for the type of rocket you describe.

(4) As mentioned above, the incorporation of potassium chlorate (or, better still, of barium perchlorate) into the rocket mixture will increase its propelling power, but it is, as a rule, *highly dangerous* to grind such mixtures. Also, by incorporating wood flour (or "meal powder") with the rocket mixture to increase its porosity and then by tamping down the mixture tightly into the case, the energy of the burning fuel will be increased. In all cases, however, the burning fuel must have free access to the air below it, otherwise an explosion may occur.

(5) So far as we are aware, a rocket may be fired in any area, but, of course, if any harm is done by it in its descent, the individual firing the rocket will be responsible. The use of scheduled explosive materials is prohibited in rocket making.

A PARLOUR GAME

"HAVING made and tried out a parlour game that I think is new and novel, I would like to make a search through the specifications dealing with this class of patent. I understand that classified abridgments of patents are contained in certain volumes in a patent library. Please let me know what volumes to look up dealing with this subject, there being a patent library in this district. Also, I use $\frac{5}{8}$-in. diameter balls in this game and I have tried steel balls which are rather heavy, and glass balls that are not quite satisfactory. Could you please tell me where I could obtain balls made of some composite material." (C. D., Glasgow.)

ABRIDGMENTS of specifications relating to games prior to 1930 are in Class 132 (11) and after that date in Group XV. These abridgments as well as the specifications and other patent office publications may be consulted at The Commercial Library, 21 Miller Street, Glasgow.

With reference to balls which might be suitable for the improved game, it is suggested that balls made either of a synthetic resinous composition (e.g. bakelite) or celluloid or india-rubber might prove suitable. For the first named write to Bakelite Ltd., of 68 Victoria Street, London, S.W.1, or A.B.C. Plastic Moulded Products, 61–63 Old Compton Street, London, W.1. For celluloid balls, British Xylonite Co. Ltd. Hale End, London, E.4., and for india-rubber balls, Warne Williams & Co., Ltd., Barking, Essex.

A DEVICE FOR CUTTING BREAD

"I ENCLOSE sketches of two devices for use in the home or restaurant. They comprise (1) an improved saw for cutting bread easily and quickly, and (2) an instrument for buttering bread. Could you please tell me whether it would be worth while patenting these devices, and, if so, what firm would be likely to be interested in their manufacture." (C. O., Kent.)

THE improved bread knife and the butter spreading device are both fit subject matter for protection by patents, and as far as we know are thought to be novel, but it would probably be advisable to make a search amongst prior patent specifications to ascertain the novelty.

It is known to employ multiple knives or cutters for mincing devices, but the particular arrangement of blades and guiding board for the object in view, is thought to be novel.

The bread knife is apparently a practicable construction, but it would be as well to actually construct the butter spreading device, since it is thought some difficulty may be encountered in causing the butter to be readily extruded.

If you have satisfied yourself as to the practicability of the two devices, it would be worth while protecting the inventions by filing applications for patents with provisional specifications which would give you protection for about 12 months in the least expensive way.

During this period of protection you should be able to ascertain whether the inventions are likely to prove commercially successful by approaching manufacturers interested in such like devices, for instance —Staines Kitchen Equipment Co., Ltd., 94 Victoria Street, S.W.1.

AN ENGINE SILENCER

"I ENCLOSE drawing of an aero exhaust and silencer which has been used successfully, in several petrol engined model 'planes. It is so successful that the engine can hardly be heard. There is, however, a certain amount of back-pressure, this being the only drawback. Could you advise me if this type of exhaust would be satisfactory in a full-size machine?" (J. P., Wormit-on-Tay.)

THE proposed exhaust silencer for internal combustion aero engines is not considered to have sufficient subject matter or invention to support a valid patent. The silencer proper appears to comprise a relatively large diameter or pipe provided with smaller pipes which is not novel *per se*, and locating the silencer in the leading edge is also not thought either to be novel or involve invention.

The idea is not thought to be a practicable construction for a full-sized airplane, or have any commercial value.

RADIOLARIA

"WHILE reading about sea-water the other day mention was made of some microbes known as radiolaria. I have a microscope and wish to inspect some of these microbes but apparently they only exist in very deep water. Does that therefore mean that radiolaria could not be found in water near the shore, and if so, how far out would I have to go for them?" (J. B., Lewes.)

THE radiolaria (or, as they are often called, "polycystina") are not microbes but are minute soft-bodied creatures which inhabit minute siliceous shells which present a great beauty and variety of form. Radiolaria are found on the mud of the ocean bed, not on the sea shores. Thus it would be impossible for you to obtain them for yourself, as you suggest. Fossil radiolaria are also found in great abundance and nearly three hundred different species of them have been described.

Under the microscope, the shells of the radiolaria (or polycystina) make very beautiful objects, especially when viewed under low magnifications on a black background. You can purchase microscope slides of these interesting objects from Messrs. W. Watson & Sons, Ltd., High Holborn, London, W.C., or from Mr. H. J. Gray, 40 Grange Road, Lewes.

WHITE SAPPHIRES

"LAST week I purchased a solitaire ring from a certain jeweller in Hull. The ring was advertised in the window as 9 ct. gold 'real white' sapphire. When I asked the jeweller to state on the bill 'real white sapphire' he did not do so but wrote 'synthetic white sapphire.'

"Of course I questioned this and received the reply that there was only one natural sapphire and that is the blue and all white sapphires he declared are synthetic.

"Will you kindly inform me if this is correct and if so what is the hardness of a white sapphire compared with that of the blue one." (G. B., Leeds.)

THE jeweller is quite correct. The best natural sapphires are blue and bluish-grey in colour, the better and clearer being the blue, the higher the value of the sapphire. Lower grades of natural sapphires may be greyish-brown in colour, but these are useless for jewellery purposes.

There is certainly no natural white sapphire. The natural blue sapphire has a hardness of 9, which is next to the hardness of a diamond. It is impossible to estimate the hardness of a synthetic white sapphire, for this may be merely a piece of fused and cut glass or it may comprise a fused mass of aluminium oxide, closely imitating the natural sapphire in chemical composition, if not in colour. If your white sapphire is of the latter variety, its hardness should be very considerable, but we do not think it will approximate to that of the natural sapphire.

If, when you purchased your ring, you honestly thought that you were buying a natural sapphire, you ought to acquaint the jeweller with this fact, with a view to his rectifying the matter. From a purely legal standpoint, the jeweller is not guilty of any deception.

HYDROGEN AND OXYGEN

"WOULD you please answer the following questions.

(1) "Approximately how much (by volume) hydrogen and oxygen are produced in one minute when sea-water is electrolised, using carbon electrodes and a 6-volt bicycle dynamo. The dynamo will be running about 1,000 r.p.m.?

(2) "What are the proportions of hydrogen and oxygen for the best explosive mixture?

(3) "Has hydrogen and oxygen been used successfully as a fuel for rocket propulsion. The hydrogen and oxygen being carried in a liquid form and used free from any other explosive?" (D. P., Glasgow.)

(1) YOU would obtain very little oxygen and hydrogen under the conditions of electrolysis which you describe. Approximately 0·7 c.c. of hydrogen and 0·2 c.c. of oxygen would be the yield, but probably some of the oxygen would become absorbed into the electrode, thereby decreasing the above yield of this gas.

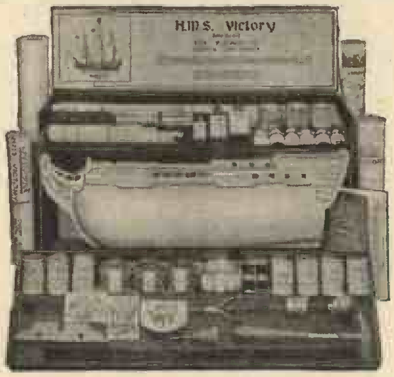
(2) $2\frac{1}{4}$ parts of hydrogen to 1 part of oxygen, the gases being reasonably dry, will, in practice, be found to comprise the best explosive mixture.

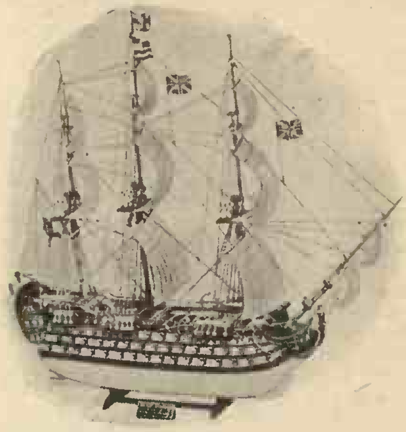
(3) Liquified hydrogen and oxygen have not been employed as a rocket fuel, mainly in view of the great weight of the apparatus which would be necessary to contain them. Rocket fuels consisting of liquid oxygen and various light petrols have from time to time been suggested, but they have not yet come to any practical use.

MODEL GALLEONS

STUDIETTE Handicrafts, Kent Street, Birmingham, have produced the attractive model of H.M.S. *Victory*, which we show on this page. The kit for building the model which is also shown costs £5.

The kits, which are entirely British, contain every single component necessary, including full instructions and diagrams for constructing the models. Dimensions, heraldry, armaments, etc., are correct on this type of model, so far as historical detail

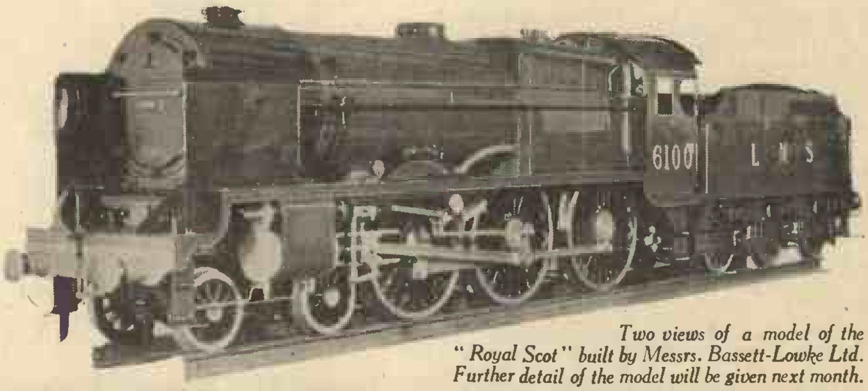




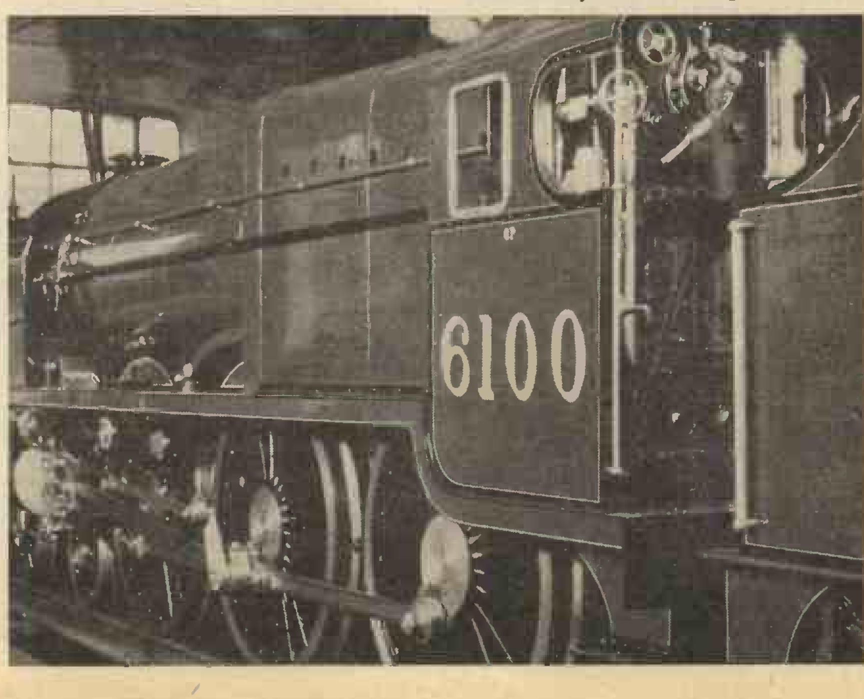
The kit of parts for making a model of H.M.S. "Victory" shown on the right.

is available. Information has been gleaned from every port in the world where these ships have touched and left record in days gone by. These models have decorative value in the modern home, more so when you can show it to visitors as something you have made.

A REMARKABLE MODEL



Two views of a model of the "Royal Scot" built by Messrs. Bassett-Lowke Ltd. Further detail of the model will be given next month.



Making a Hydraulic Press

(Continued from page 241)

constructed, a small cross-section iron or brass pipe is screwed. This pipe communicates with the operating piston of the press, the construction of which is precisely similar to that of the ram with the exception that the piston diameter should not be more than about a quarter or a third of an inch.

The cylinder of the operating piston or "pump" is inserted into a cross-tee which is fastened to the baseboard by means of a plugged piece of piping passing through the base and provided with a heavy nut which clamps it tightly. On the upper end of the piston rod is fixed a cross-bar to act as a convenient handle.

On each side of the pump cylinder is fixed a one-way or "check" valve, the valves both opening in the direction of the ram cylinder. It is impossible for the ordinary individual to construct these valves for himself, but they may be obtained from most engineers' stores and similar factors.

The Release Valve

Between the ram barrel or cylinder and the inner valve it is necessary to fit some type of release valve or stopcock in order to release the pressure on the ram when it is required to do so. This stopcock should preferably take the form of a small yet substantially made steam or water opening valve, although, provided the pressure obtained in the ram is not too high, an ordinary heavily made stopcock will suffice.

To the small length of pipe projecting from the outer one-way valve a piece of rubber tubing is secured, the end of this tubing dipping into a basin or bucket of water.

The press will now be complete and ready for operation. The stopcock valve between pump and ram cylinders is turned on and the rubber tubing attached to the outer valve of the press is allowed to dip into the bucket or can of water.

The piston of the pump is now worked up and down with a steady motion. Upon each upward stroke of the piston, water is sucked into its cylinder or barrel. The ensuing downwards thrust of the piston forces the water into the ram cylinder, causing some upward movement of the ram piston. At each downward movement of the pump piston the pressure on the ram is increased. Hence, by operating the pump repeatedly, a very heavy pressure can be set up.

Lever Mechanism

If desired, a lever mechanism can be designed to operate the pump piston. This will render its working easier, but it is not really to be recommended, since if the hydraulic pressure within the ram becomes excessive there is some danger of a burst somewhere in the system. Direct up-and-down hand operation of the pump piston is, therefore, the more advisable.

The exact lengths of the pump and ram cylinders are quite immaterial as is, also, of course, their actual diameters. What is important, however, is that the diameter of the ram barrel and piston must be several times larger than those of the pump unit. As mentioned previously, a ram diameter of about 2 in. and a pump piston diameter of approximately ¼ in. are the most suitable for use in a small press of this type.

Naturally, all the various pipe joints must be strongly made, the screw threads being red-leaded. In actual practice, however, there will usually be some slight water leakage somewhere in the system, but this leakage is of little consequence unless the pressure of the ram has to be maintained for a long time.

If for any reason it is desired to build a press capable of generating greater pressure than the one described in this article, this can be done simply by increasing the diameters of the ram and cylinder in proportion to the diameters of the piston and pump. For ordinary workroom and experimental use, however, the beginner is advised to stick to the approximate relative sizes of pump and ram advised above.

THE HISTORY OF THE LAND SPEED RECORD

(Continued from page 199)

Daytona in his modified "Blue Bird" and did 206·95, only to see it beaten in the same year by an American, Ray Keech, who did 207·55 m.p.h. on a White Triplex. His machine was a powerful looking monster, but streamlining was not much in evidence. The same year saw the fatal attempt by Frank Lockhart, an American, who drove a Stutz in which he lost his life. 1929 saw Segrave make another attack on the record with the "Golden Arrow" designed by Capt. Irving. He clocked 231·44 mp.h., and this proved to be Sir Henry Segrave's last attempt, for he was drowned some time later when attacking the water speed record.

Campbell's Lone Attempts

Campbell was thus left alone in the field, although Kaye Don made an unsuccessful attempt with his Sunbeam-engined "Silver Bullet." An Australian, Norman Smith, built a car, but he never attempted the land-speed record. In 1931 Campbell put the record up to 246·09 m.p.h., 253·97 m.p.h. in 1932, and 272·108 m.p.h. in 1933. The car he drove in his last attempt weighed about four tons and was powered by two supercharged Schneider Trophy Rolls Royce engines of 2,300 h.p. It was Sir Malcolm Campbell's hope that he would achieve 300 m.p.h. and the car had been designed to do that, but now Daytona Beach was proving unsuitable for record breaking. He tried again but only succeeded in registering 272·46 m.p.h. No further attempts were made for two years, during which search was made for a more suitable track. A great mud flat in Africa known as Verneuk Pan was considered, but owing to its comparative inaccessibility, and the question of cost, the idea was discarded. Then in Utah, U.S.A., a gigantic dried up lake was found.

Thus it was here that Campbell achieved his desire. For in 1935 he took the "Blue Bird" there and pushed it along at 301·13 m.p.h. Campbell was at last satisfied, and unless a foreigner came along and annexed the title, he was quite willing to give up record breaking. Thus the struggle for the right to be called the fastest man on land has been carried on over a period of over forty years, and now Capt. George Eyston holds the title. Four hundred m.p.h. is the next milestone to be passed. Who will achieve this?

STARGAZING FOR AMATEURS

(*Continued from page 222*)

The Stars

The superb constellation Orion once more adorns our night skies. It is now due south at 11 p.m. and will reach that position four minutes earlier each evening. It can be readily recognised by the conspicuous row of three bright stars arranged in an upwardly slanting straight line and known as Orion's Belt. As was briefly mentioned in a previous article, these apparently small points of bluish-white light are actually colossal suns—among the hottest known—consisting of globes of incandescent helium gas. Long-exposed photographs reveal that the entire constellation is involved in a nebulosity. This strange cosmic fog is particularly dense in the neighbourhood of the multiple star Theta Orionis. There the glow of the six suns composing the latter (commonly termed the Trapezium) is perceptible to unaided vision, shining through the translucent interposing medium as a misty patch. Astronomers call it the Great Nebula in Orion. The least optical assistance will show its diffused character which, in a small telescope, becomes an extensive greenish haze. Photographs taken at the big observatories disclose a complicated texture of tangled convolutions and whorls, intersected by tortuous rifts and dark areas. The whole formation is edged with far-flung wisps and streamers. Betelgeuse, the dull reddish star above the "belt" (see star chart) is a giant of the pulsating type. It is believed to consist of a dense central core wrapped in an immensely thick atmosphere of glowing gas. This outer envelope contracts and expands to such an extent that the diameter of Betelgeuse varies from 150 to as much as 260 millions of miles. Rigel, the dazzling white star beneath the "belt," is another magnificent sun. It sheds 15,000 times the radiance of ours and is attended by a comparatively tiny "companion." The average distance of the Orion group is estimated at 600 light years.

Notes

A Japanese astronomer is said to have been able to observe the Zodiacal Light to its extreme limits, during the total solar eclipse last year. The method adopted was to previously render the eyes more sensitive to light by sitting for a while with a bag of dark material over his head. At the first moment of totality this covering was thrown off and a large black disc held up to screen the Sun. The observer claims that, in this way, he traced the extension of the Zodiacal light much farther than is possible under normal conditions. The phenomenon is usually perceptible only before sunrise or after sunset.

* * *

At a recent lecture the Astronomer Royal ascribed the Sun's capability of maintaining its lavish radiation of heat and light as largely to the transmutation of hydrogen into helium. Dr. Spencer Jones told his audience that the Sun is giving out four million tons of energy every minute. But its bulk is so enormous that in a million million years hence, it will have lost only about 7 per cent. of its substance. The world, he added, will then be rather colder than it is now: but life will still be possible, though it may be less comfortable. The time will, however, surely come when all the Sun's store of energy will be exhausted; but long before that, life will have ceased to exist upon the Earth.

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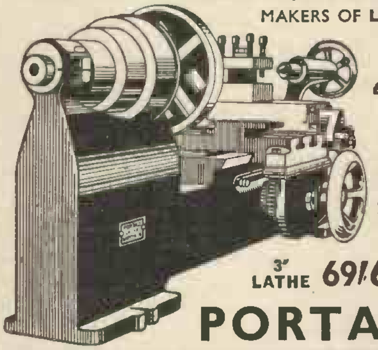

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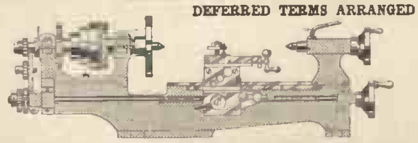

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