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HIGH FLYING DEVELOPMENT

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PRACTICAL MECHANICS

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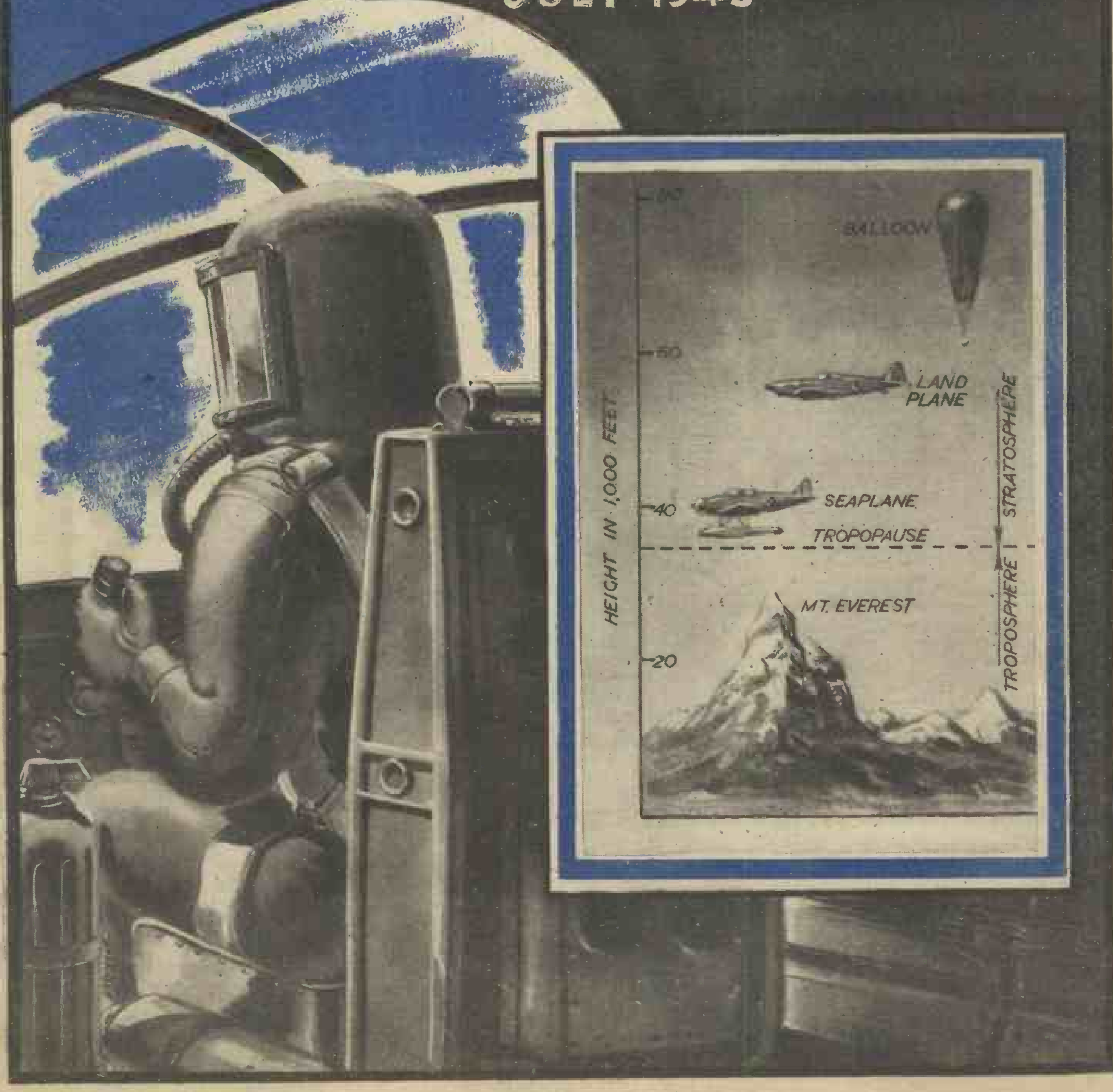
JULY 1943



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Editor : F. J. CAMM

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The Importance of Models

THE Chinese were probably the earliest model-makers, and examples of the early mechanisms which they produced, such as the Clepsydra or water-clock, are still in existence. It is fair to assume from discoveries in the Egyptian tombs that the Egyptians were skilled in the practical and manipulative crafts, and it is beyond all doubt that Hero of Alexandria produced the first reaction turbine. An illustration of Hero's reaction engine appears in most textbooks on mechanics. The myth which has been promoted that Watt discovered the power of steam, and that he invented the steam-engine thus cannot be supported. It is doubtful whether Watt invented anything. The Greeks and the Babylonians, the Romans and the Ancient British were model-makers. Their materials were chiefly wood, stone and bronze, until the dawn of the Iron Age. Students of the Paleolithic and the Neolithic Ages have unearthed some splendid examples of stone models of buildings, evidently prepared by the architects of the time.

As the natural laws were discovered and centuries of philosophical research led up to the dawn of the mechanical era and the harnessing of power, it was inevitable that working models should be produced.

They have played a most valuable part in the development of science. In the Science Museum at Kensington can be seen the models and the drawings used by famous scientists such as Sir Isaac Newton, Michael Faraday, Gallileo, and which have led to such remarkable scientific progress. In almost every museum one may see models, and to-day it is not only a pleasant and instructive pastime, but an important branch of industry.

In the experimental departments of factories, in the Royal Aircraft Establishment at Farnborough, at the Woolwich Arsenal, in schools and colleges, models are used to demonstrate principles or to test new ideas. In this war the model has played an important part. Models of wing sections are tested in wind tunnels; hull forms are tested in tanks, and the flow past bodies measured and photographed. The tester of models is a highly trained scientist, and the professional model-maker a highly trained practician. Very early in this war the Government realised the importance of the amateur model-maker, thousands of whom were encouraged, through the good offices of Mr. Percival Marshall, to turn their small workshops over to the manufacture of small parts for munitions. They contributed valuable service at a time when our Services were ill equipped and had lost most of the equipment they did possess in the epic event of Dunkirk. Thousands of other amateur model-makers are now engaged full time upon munitions in factories.

Some of our most famous men are keen modellers. Lord Brabazon of Tara is a keen model railway enthusiast; Sir Malcolm Campbell, who holds the land speed record, is also a model railway enthusiast. In the ranks of the Junior Institution of Engineers, whose annual luncheon I recently attended, are hundreds of men who have achieved fame as a result of their early interest in model-making. Amateur radio enthusiasts created the radio industry.

Model Aeroplane Enthusiasts

AVIATION in this country would have been unknown but for the keen model aeroplane enthusiasts such as C. R. Fairey, A. V. Roe, H. V. Roe, de Havilland, H. O. Short, T. O. M. Sopwith, and many others. That was at the time when the Wrights had successfully demonstrated that power-driven flight was possible. From that point France was early in the field, and encouraged by the knowledge which Penaud, the French aero modeller of the 1870's, had passed on to them. Many French modellers such as Santos Dumont, Tabutean, Bleriot, Hanriot, the Farman Brothers, Breguet, and others, carried out experiments with models, and later with full-size machines, which finally culminated in the successful crossing of the Channel by Bleriot on July 25th, 1909. That very short flight, just over 20 miles, on a monoplane equipped with a 15 h.p. engine, fired the imagination of the Roe's, Cody, C. G. Grey, Howard Wright, C. R. Fairey, R. F. Mann (a schoolboy who made a very successful aeroplane and went into business with his schoolmaster!), my brother Sydney Camm, and myself. Model aeroplane clubs started up all over the country, and the Windsor Aero Club, which my brother and myself jointly founded, became nationally famous. Our members designed and built models and we flew them in the many model competitions organised by the national body, the Kite and Model Aeroplane Association, of which Baden-Powell was one of the leading lights (the governing body is now the Society of Model Aeronautical Engineers, of which I am a founder member, and which is recognised by the R.Ae.C.) and other competitions which were run by the *Daily Mail* and other newspapers. Most of these competitions were flown at Hendon, the Crystal Palace, or Wimbledon Common, and I well remember A. V. Roe winning the £100 prize offered by the *Daily Mail* for a clockwork model aeroplane.

From models we went on to the construction of full-size gliders, and finally in 1914 we designed and built our first full-size power-driven aeroplane. It was powered by a 15 h.p. horizontally opposed two-stroke engine which had originally been fitted to a machine built in Ireland and appropriately termed the "Mayfly," but it did not! Well do I recall the pleasure with which the members of the W.Ae.C. tackled the construction of that powered machine. We not only sawed the timber from plank, made all of the streamline struts, made all of the metal fittings and the wire strainers, but we tuned the engine, made new parts for it, carved our own airscrew, proofed our own fabric, covered the wings, did our own stress calculations, and saw the thing through from start to finish. Although it was a biplane of 30ft. span, it weighed, with engine, only 550lb. We carried out our full-size gliding experiments at Bourne End, and for this purpose we made a special trailer upon which to pack the dismantled glider, which we towed to Bourne End behind our bicycles. To-day the model-maker is catered for by many firms, who put up kits of material which merely need assembly. This has resulted in model-making being taken up at an even earlier age. Some thousands of model-makers are employed in the war effort, and in our experimental departments.

A keen model-maker nearly always makes a good engineer, and when I am consulted by parents on the question of a career for their sons my first question is to inquire of their hobbies. If a boy has never had a desire to make models, he usually does not make a first-class engineer.

"A Refresher Course in Mathematics"

MY new book, entitled *A Refresher Course in Mathematics*, has just been published from the offices of this journal at 8s. 6d., or 9s. by post. It has been specially prepared to assist those who need to have a knowledge of mathematics and who have forgotten their previous education in the subject. It will also be of value to those who wish to study mathematics and who have not had previous training. The subjects include fractions, decimals, logarithms, algebra, quadratic equations, simultaneous equations, cubic equations, square root, cube root, the binomial theorem, the differential and integral calculus, trigonometry, mensuration, planimetry, longimetry, stereometry, the metric system, and, in fact, all of the usual branches of mathematics. Useful reference tables and standard formulæ are included. In view of the fact that most examinations in the Services and out of them now require a knowledge of mathematics, I believe that this book will be of especial benefit to those who wish to study for such examinations.

High-flying Development

Notes on the Equipment Used for Flying at High Altitudes

By T. E. G. BOWDEN

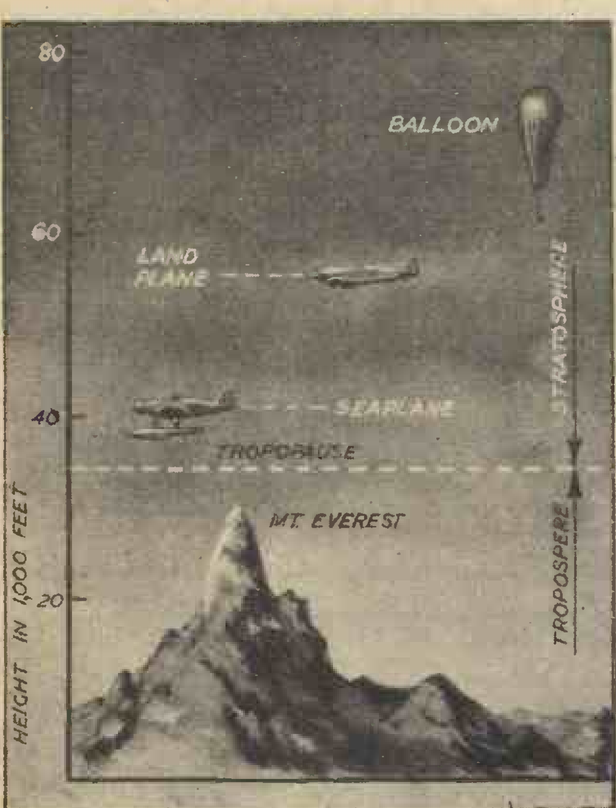


Fig. 1.—Diagram indicating altitude records.

THE height at which aircraft are capable of flying has steadily increased from the very first days of aviation. The maximum altitude has risen from several feet to over 56,000, or more than 70,000ft. in the case of balloon ascent. Height records have been continually broken as further advances have taken place in the design and construction of aeroplanes and balloons. The stratosphere is attracting considerable attention at the present time, both as a possible traffic route for the future, and, unfortunately, as a safe region in which bombers may fly and release their bombs without fighter or anti-aircraft fire attacks.

At the moment development work is being carried out in many countries, but naturally the results obtained are not being released for general study. After the present conflict is finished we shall no doubt hear of some unusual experiments and extremely interesting results. The development of the high-flying fighter-plane has become a matter of extreme importance in the fight for air supremacy. The latest Spitfire fitted with the Rolls-Royce 61 engine marks the present peak of design, although the German designers have produced and are producing some dangerous rivals, such as the Messerschmitt 109G.

Before going on to the methods and equipment utilised for high-flying aircraft a description of the historical development during the past years is extremely interesting, and a few details of several of these flights, both by aeroplanes and balloons, follow.

Historical (Balloons)

In the year 1862 a height of over seven miles was gained by Glaisher and Coxwell in an open gondola. No oxygen or heating equipment was carried and intense physical discomforts experienced. To these pioneers goes the honour of first ascending into the sub-stratosphere.

A height of over 44,000ft. was reached in 1927 by an American, Captain Grey, who unfortunately died in the attempt. In this flight oxygen was used, but the gondola was still of the open type. He left scientific notes of his flight before being overcome by exposure.

Professor Piccard, a Swiss, with an assistant attained the height of almost 52,000 ft., using a hermetically sealed gondola. In the year following, i.e., 1932, he again broke the record by rising to a height of 53,000 ft., using the same balloon (500,000 cu. ft. capacity) with another gondola. One of the troubles experienced in the first flight was the heat inside the gondola. One half of the body had been painted black and the other portion white. The idea was to turn the appropriate side to the sun according to the temperature inside the gondola. Unfortunately the motor installed to rotate the gondola did not operate and the black side was continually facing the sun. Outside the temperature was 100 deg. of frost and in the gondola rose to as high a figure as 104 deg. F. For the second flight, the gondola was painted all white.

A Russian ascent in 1933 gained a new record as a height of 61,000ft. was reached. The capacity of the balloon used was almost 900,000 cu. ft. One of the interesting discoveries was that the humidity of the air dropped by half as the balloon gained height and reached the stratosphere. Cosmic rays were also studied.

Later in the same year this height was again exceeded when an American balloon reached just over 61,000ft.

Four attempts were made in 1934, a maximum height of 72,000ft. being attained by a Russian balloon, the crew of which were all killed. Instead of being constructed from aluminium, non-magnetic stainless steel was used for the gondola.

The U.S.A. retook the record when, in the following year, a height 400ft. greater than that of the Russian was reached. The size of the balloon used may be gauged from the fact that the top portion was 315ft. above the ground level. Apparatus for cosmic ray detection was carried and also many other scientific devices for testing the air and conditions prevailing in the stratosphere.

Historical (Aeroplane)

The altitude record for aeroplanes commenced with the very humble figure of approximately 500ft. set up by the Frenchman Latham in the year 1909. This height was gradually increased year by year, but it was not until 1932 that a British aeroplane gained a height of 43,976ft. Flight-Lieutenant Uwins was the pilot and the aeroplane a Vickers "Vespa" fitted with a Bristol Pegasus S.3 engine. This height was attained without the aid of a variable-pitch airscrew although the engine was supercharged.

In 1933 a French aircraft increased the maximum altitude to 44,775ft., and in the following year, for the first time, an Italian gained a height of 47,360ft. This last attempt was made with a Caproni 114 aeroplane fitted with a Bristol Pegasus engine.

The limit of human endurance without mechanical aid seems to have been gained with the Italian attempt, as an open cockpit had been used, causing great distress to the pilot.

The record was regained for Great Britain in 1936, when a Bristol 138a aeroplane, fitted with a Bristol Pegasus engine, was constructed. A height of 49,967ft. was gained, and an important new feature for high altitude flying used. A special high pressure suit with a sealed face-mask was designed, and enabled the pilot to maintain full control and to suffer very little discomfort, even at the maximum altitude.

A metal helmet similar to a deep-sea diver's type with a large transparent face-piece was attached to a rubberised-fabric suit inflated to a definite pressure. Pipes supplying oxygen, with the necessary controls, were attached, and it has been found that it is possible for human beings to remain alive at heights as great as 80,000ft. by tests carried out in low-pressure chambers.

The aeroplane was constructed of wood, with a wing loading of only 8.5lb. per sq.ft. A four-bladed fixed-pitch airscrew also of wooden construction was used. An electric-heated blanket to warm the accumulator was fitted, and also the camera required to be electrically heated.

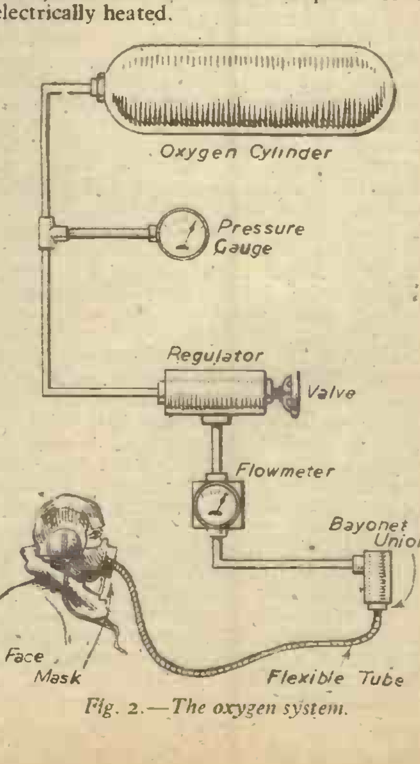


Fig. 2.—The oxygen system.

An Italian aircraft later attained a height of 51,362ft. This was exceeded in 1937 by Flight-Lieutenant Adam flying the Bristol 138a aeroplane to a height of 53,937ft. It is interesting to note that this aircraft was calculated to have a maximum ceiling of 54,000ft.

The present altitude record is held by Italy with a figure of 56,000ft., although it is almost certain that greater heights would have been possible but for the present conflict. The aircraft used was a Caproni 161 biplane with a Piaggio XI-RC engine, piloted by Mario Pezzi on October 22nd, 1938.

Fig. 1 illustrates the relative maximum heights attained at the present time for the various types of flying machines.

Oxygen Systems

Due to the reduction in the quantity of oxygen available at high altitudes it is essential to have a supply, so that the aircrew may continue to carry out their duties. If no oxygen is available the perceptions and intellect become dull, the effect being gradually increased as higher altitudes are gained. Different types of pilots are affected in various ways. Some may become extremely confident and firmly believe that they have the aircraft under perfect control whereas they may be performing all sorts of manœuvres or disobeying orders. If no oxygen is administered, paralysis will occur, followed by death.

An oxygen system is, therefore, essential at heights of over approximately 10,000ft., and there are two main types of supply.

High Pressure

First, there is the high pressure installation, which is illustrated in Fig. 2. As will be seen, the oxygen is stored in a steel cylinder at a pressure of nearly 2,000lb. per sq. in. From the storage bottle the oxygen passes via high pressure pipes to a regulator which reduces the pressure down to 50lb. per sq. in. A valve is incorporated in this regulator to switch the supply on or off as required. To indicate the rate of flow, which varies for different altitudes, a flowmeter gauge is fitted and the regulator is adjusted to obtain the necessary supply.

An oxygen mask is connected to the system by means of a flexible tube and a bayonet union. A pressure gauge is usually incorporated to check the pressure available. It is essential that there should be no moisture in the system, otherwise ice may form and cause a blockage.

Low Pressure

In the low pressure type the oxygen is stored in liquid form. A type of Thermos flask is utilised, and the oxygen is transformed into a gaseous state by means of an evaporator.

As in the high pressure system, a control valve is fitted together with a flowmeter. Instead of measuring the actual flow, the indicating dial is often marked out in thousands of feet, so that the valve is turned until the needle rests against the appropriate altitude, i.e., the height at which the aircraft is flying.

The chief advantage of the low pressure system is the fact that it is lighter than the high pressure design, the main disadvantage being that the liquid oxygen evaporates continually.

Heating Systems

For aircraft which are designed to fly in the stratosphere a heating system is as necessary as an oxygen system. The problem of heating the aircrew or passengers without increasing the aircraft's weight by a considerable amount is extremely difficult. Various systems have been devised and each has its own advantages and disadvantages.

One method which has been proved satisfactory is the heating of air by means of a small boiler and passing this hot air to the various crew positions. A small flash type boiler is operated by the exhaust system of one of the power units. The steam generated is passed to a radiator through which air is flowing from a suitably placed inlet, e.g., the wing leading edge. The air passing through the radiator is consequently heated and is then guided via large diameter pipes to wherever it is required. Flexible pipes are fitted to allow hot air to be directed in any desired direction and a control valve fitted which enables the air supply to be by-passed to the atmosphere instead of being delivered through the pipes. In order to compensate for loss of fluid in the boiler a small tank is usually incorporated in the system.

Hot air is usually passed to all the aircrew's

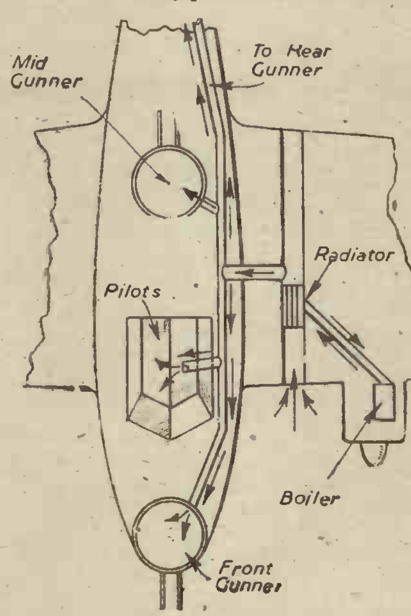


Fig. 3.—Heating system.

different positions, e.g., pilot, wireless operator, rear gunner, etc., and also may be used to heat any special equipment such as cameras or guns (see Fig. 3).

As an alternative to the above system it is possible to pass the actual exhaust gases through pipes and then discharge them to the atmosphere. The danger in this system is, of course, the risk of carbon-monoxide poisoning as, however much care is taken in the manufacture of the system, there is always the possibility of leaks developing. In the case of military aircraft there is also the additional danger of anti-aircraft fire which may easily puncture the system, admitting dangerous fumes which may not be noticed for some time during the excitement of action. The first system described does away with this danger, as only pure air is passed to the cabins, the exhaust gases being discharged in the usual way.

Heating by means of electricity has also been developed, especially in the case of small aircraft. By incorporating fine heating elements in the clothing a temperature which allows normal functioning may easily be obtained. There is also the fact that there is an electric system in the aircraft already and so the additional weight required is not excessive. Plugs are usually fitted at different points to allow free movement, and switchboards mounted in convenient positions to allow easy control. Guns and cameras, etc., may also be heated electrically without any great complication in design.

Pressure Cabins

Although military aircrews may be expected to put up with cumbersome flying suits, oxygen systems and such like, civil passengers cannot be expected to travel under such conditions. Pressure cabins have therefore been developed to enable great heights to be maintained without any noticeable discomfort to the occupants of the aircraft. A pressure cabin is one in which the air pressure is maintained at a sufficiently high figure so that no special equipment need be worn by the passengers.

The difficulties of designing a pressure cabin are numerous as there are many problems to be solved. The doors and windows must be airtight and the points at which the control rods or cables pass through the walls have also to be made leak-proof. A circular cross-section is the most suitable from the theoretical point of view and this shape is generally utilised. A small air compressor is usually fitted to maintain the air inside the cabin at the required pressure. Instead of a pressure equivalent to ground-level being maintained it is usual to allow the pressure to drop to that occurring at several thousand feet. This has no ill effect upon the passengers and eases the problem of maintaining the pressure to an unnecessarily high figure.

The pressurising of military aircraft is extremely difficult, due to the armament and the danger that the cabin walls may be holed by anti-aircraft fire with disastrous results to the occupants. In the case of single-seater fighters a small heavily armoured shell is definitely necessary.

Conclusion

The development of high flying has now reached the stage when it is a definite practical proposition, although there are many problems still remaining to be solved.

A Stirling bomber being refilled with fuel and oil from tankers preparatory to a trip over Germany.

Gliding

By Professor A. M. LOW

The Problems of the Modern Glider Explained

A troop-carrying glider, with a jeep on board, being towed by a transport 'plane.

SERIOUS heavier-than-air flying began with the gliders made by Lilienthal and his contemporaries. Early aeroplane designers made a number of flights in unpowered machines, taking off from the top of a slope and losing height slowly in comparison with forward movement until they came to earth. This gliding taught the pioneers many of the secrets of flying; but having learned, as they thought, all that gliding had to teach, they turned to the more practical business of fitting an engine to their machines, and gliding was forgotten for nearly twenty years. After the war of 1914-18 gliding was revived as a sport, notably in Germany, where opportunities for normal flying were limited. It developed rapidly, and on unsuspected lines. Very soon gliders were not making straight flights back to the earth, but were actually gaining height and travelling considerable distances. A flight of an hour in an engineless 'plane in 1922 attracted great attention, but it was not until some years later that other countries took up the sport, and gliding in Britain is now little more than 14 years old.

High Altitude Flights

Except in strength, "cleanness of line" (or streamlining), and in low weight, the modern glider is not very different from the gliders used by the pioneers of aviation. How is it that a modern pilot can stay aloft for hours on end and climb to 10,000 feet or more, whereas the early exponents of gliding could manage flights of only a few minutes or even seconds? The answer is to be found in the way in which the glider is "sailed" rather than in the machine itself. Sailing is a good word for this art, and the glider is now often called a "sailplane," while gliding is referred to, more correctly, as "soaring." A glide often implies downward motion, and a sailplane may travel upwards.

In still air the modern glider, like its predecessor, falls. The rate of fall is very slow, 2ft. or 3ft. a second. The pilot launched from a 100ft.-high hill can expect to come down to the ground in less than a minute. Yet, if we watch an experienced glider leave the top of a hill, we often find him quickly climbing, or he may travel round and round in an ascending spiral as if mounting some invisible staircase. This, in fact, is what he is doing, the staircase being an upward current of air or a "thermal," so called because it is usually comparatively warm air and therefore moves upwards over the cold air. The problem of a glider pilot is to find an ascending current of air moving upwards faster than the natural rate of fall of his machine, say 3ft. a second. Then he is carried upwards in spite of his tendency to lose height. If the thermal is ascending at 5ft. a second, he may travel up 5ft. and fall 3ft. in every second, giving a net gain of 2ft.

During the 1914-1918 War Professor Low commanded the Royal Flying Corps Experimental Works, where he was responsible for the invention and building of the first radio-controlled aeroplane—now the Queen Bee.

Rising Air Currents

The pilot does not rely entirely on thermals, for currents of air may also ascend because they are obstructed at some point. A wind striking a low hill will be swept upwards over it, and this often provides the upward movement for the beginning of a flight. The pilot chooses a spot for his take-off where there are rising currents of air due to the contour of the ground. Certain places have become favourite sites for gliding simply because of the presence of these upward currents on most days. When he reaches the top of the current, the skilful pilot descends in such a way that before he reaches the ground he is once more able to climb the same current of ascending air, and he may continue this process all day until the air fails him or he is unable to pick up the current again. No great distance can be travelled in this way; he will beat up and down a ridge at different heights.

If the pilot wishes to ascend higher or travel farther, he seeks another thermal due to the riding of a column of warm air. Such patches are generally to be found on sunny days, and the pilot is aided in his search by the position of the clouds. The existence of a cloud usually indicates the presence of a thermal; the cloud is the result of ascending air containing a considerable amount of water-vapour. He quickly learns the particular type of cloud most likely to help him in the prevailing conditions. If he can get under a cumulus cloud being rolled out by the wind, he may travel its whole length.

Thermals are also likely to occur above certain features in a landscape. The pilot looking round for a current of warm air may expect one on the edge of a lake or over a small town in the country, for the roofs become hotter than the grass. He may find unequal heating set up by quite small areas with different absorption powers to the sun.

Long Duration Flights

The longest flights in gliders have been made in circumstances often associated with thunderstorms. One very common condition is that a mass of cold air from one direction pushes its way under warm air so that the latter sweeps up in a great curve, as if it had met a hill. The instability associated with such a layer, when thousands of cubic miles of unequally heated air meet, explains why the "front" of a thunderstorm can carry a glider for many miles. The rough conditions experienced would have broken up the old gliders, but modern machines are strongly built, and often carry instruments similar to those on an aeroplane to enable the pilot to navigate if he reached the centre of a cloud so that the horizon is invisible.

The duration records for gliding are now limited almost entirely by the stamina of the pilot. Some years ago the German Schmitt made a record flight of over 36 hours, and he also ascended to a height of about 14,000ft. Gliding is now a fascinating sport, of very great value to "serious" aviation, so that it has been encouraged and subsidised by a number of Governments, including that of Great Britain.

Methods of Launching

Gliders are usually launched either by rapid towing or by an elastic catapult; they can also be towed to considerable heights by aeroplanes and then cast off, as in the case of their ordinary military application. It has been suggested that this may provide a means of releasing mails at intermediate places from long-distance planes. At first sight it would seem that the parachute offers a far more simple, cheaper and safer way of accomplishing the same result. Expert gliders can cover great distances. At a single meeting nearly 40 flights of over 100 miles have been made in one day. Great skill is required, and so much depends on weather conditions that this type of flying can hardly be seriously considered as a convenient means of commercial transport under present conditions.

At the same time, gliders are not so dependent upon cross-currents as might be supposed. Many flights have been made across the wind, although the number of days suitable for long flights, especially in the winter months, are few.

Engineer-built Houses of the Future—6

Pre-built Ground Storey Floors : Building By-laws

By R. V. BOUGHTON, A.I.Struct.E.

(*Continued from page 308, June issue.*)

GROUND storey floors of the pre-built type should satisfy the essentials in connection with the following: (1) stability; (2) durability; (3) transportability; (4) resistance to moisture penetration; (5) thermal insulation; (6) avoidance of vermin infestation; (7) economic initial cost; (8) economic maintenance costs; (9) speed and ease of erection; (10) light weight; (11) good appearance, and (12) resistance to fire to a reasonable extent.

These essentials undoubtedly set many problems for designers to tackle and solve in a manner which will be creditable to all concerned. They incorporate main groups of construction, stability, hygiene, comfort, æsthetics and finance.

Disgusting Sights

If engineers have seen the under-the-ground-floor sights which my duties have so often forced me to see they would be surprised in their thoughts as to how any civilised country could permit such methods of jerry construction, and they would be determined, as I am, to give of their best to ensure simple good honest construction in the future. The following are a few of the sights of some of the ordinary pre-war type of ground-floor houses: Surface concrete of wrong mixes and wrong thickness—so thin in some cases that I have asked whether it was laid by a concretor or applied by a painter; sleeper walls looking like a rockery built by a "three-year-old"; damp courses in wrong positions; insufficient air bricks; hearths supported on miniature hardcore dumps without proper fender walls; dampness; refuse dumps under the floor; dry rot, often with its festoons and smell. All due to lack of thought, ignorance, and the "business" instinct to save a very little money initially and damning the future high expenditure by the house-owner in rectifying the trouble.

Compliance with the Essentials

The following essentials, although in connection with ground floors, apply to many other parts of a pre-built house. The subjects are expounded at this stage to guide designers as to the great importance of them. In future articles these essentials will be referred to briefly only in conjunction with others connected with walls, upper floors and roofs, etc.

(1) Stability of construction will be attained if (1) the pre-built units of floors are made strong enough to withstand safely any reasonable superimposed load to which they may be subjected as well as the dead or actual load of the units; (2) the bearings are sufficient, and (3) the substructure or foundation is capable of resisting safely all the loads. As to (1) the structural parts should be designed to support 40 lb./ft. super superimposed load and in addition the calculated dead weight of the parts. This will comply to the reasonable requirements of by-laws. The bearings as (2) should not be stinted and should conform with the general details shown in this article. Stability of substructure or foundation was explained in articles 4 and 5. Although excessive deflection does not necessarily mean instability, but can cause inconvenience, it is required by most by-laws as well as the principles governing good practice to limit deflection to 1/360th of span of all structural parts which act as beams, or, in other words, are suspended.

(2) Durability calls for the use of materials which are capable, under ordinary conditions, of long life, of resisting as much as is practicable any influences or conditions which induce rotting, and withstand reasonable wear and tear of surfaces subject to traffic.

(3) Transportability of pre-built units is a matter of great importance and governs the maximum size of units which can be conveniently placed on ordinary or special lorries, railway trucks, etc.; it makes it essential to consider sizes and weights for handling and the limitation of risks of breakages in transport and handling; transportability means the study of close packing and weight to economise transport charges. It is not prudent to give any hard-and-fast rules as to sizes, as so much depends on what the units are made of, the machinery, if any, used for loading, unloading and placing in position. Main fairly heavy structural units may have to be limited to 8ft. or 9ft. long and 2ft. to 3ft. wide; lighter units may be longer and wider. In practice it will be found that most ground-floor units will be about half the length of an ordinary-sized room, the full length of small compartments, and in width will not be above the limits given above. It is almost certain that the programme of scientific and practical pre-built housing work will incorporate appliances, including cradles, to facilitate the handling of units and to prevent damage to them.

(4) Resistance to moisture penetration needs the most careful thought, because a ground floor is liable to penetration of moisture and dampness which rises from the ground, by

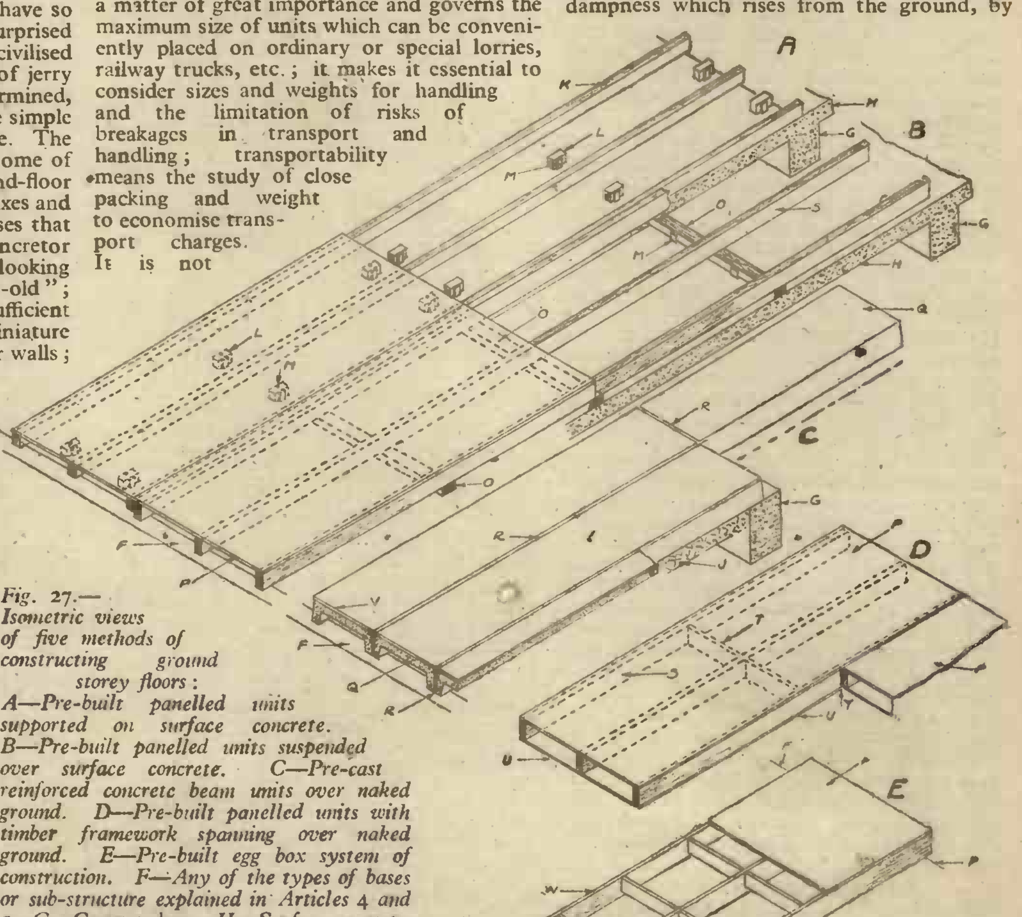


Fig. 27.—Isometric views of five methods of constructing ground storey floors: A—Pre-built panelled units supported on surface concrete. B—Pre-built panelled units suspended over surface concrete. C—Pre-cast reinforced concrete beam units over naked ground. D—Pre-built panelled units with timber framework spanning over naked ground. E—Pre-built egg box system of construction. F—Any of the types of bases or sub-structure explained in Articles 4 and 5. G—Concrete base. H—Surface concrete. J—Hardcore. K—2in. x 2in. timber bearers or framework. L—Timber fixing blocks to allow panelled units to be screwed through flooring to substructure. M—Metal clips bedded in concrete with upper parts nailed to fixing blocks or plates. N—Screw. O—Timber plate. P—Flooring forming part of unit. Q—Pre-cast R.C. beam units. R—Sealed joint. S—Timber frame. T—Nogging or transverse stiffener. U—Tear-, rot- and water-resisting sheeting. V—Paving or flooring. W—Longitudinal beam member. X—Transverse member. Y—Special sealing.

gravitation of water to under the floor, and also by any water used for cleaning the surface working downwards into the floor. Constantly recurring dampness is of course injurious to health and can rot any timber and certain other materials. Dampness rising through a floor from ground which is not covered with surface concrete is a menace to health. These conditions demand, in the design and construction of a hollow or open suspended type of floor, means being taken to combat them, and there are two ways in broad principle by which this can be done, viz.: (a) Laying surface concrete in accordance with by-laws and using pre-built units placed very near to or a little way above the concrete, which latter, together with beams or other sub-structural members, may act as a support for the units. The open space under the floor must be well ventilated to ensure drying out of any moisture, and to keep the floor well aerated and healthy. (b) Using pre-built units, which in themselves are resistant to moisture and its rotting influences, and having joints which will not permit the passage of moisture or ground odours. These are rather drastic but essential conditions to cause the floor to be good, dry and hygienic. As will be understood later, these conditions can be met, but both (a) and (b) point strongly to the probability that the solid concrete floor (as described in article 5), although it is not pre-built, is the best and most economical.

(c) Thermal insulation must be considered as it is more important than first thoughts may show. A ground floor should not easily conduct the coldness from ground, and the flooring or covering should check or insulate against coldness which may be in the main structural parts, particularly concrete. It should be borne in mind that a cold floor or flooring does not conduce to comfort, and, what is important, requires more fuel for keeping a room warm than a floor which is thermally insulated and what is known as warm. Timber is a good material to use.

(d) Vermin infestation may be divided into two main groups: First, vermin, which include rats and mice, which will find habitation, however clean the house is; and secondly, vermin due to neglect and dirtiness on the part of the inhabitants of a house. It is very difficult to avoid spaces and crevices in which vermin may congregate, but it is believed that the majority of house-owners know the value of cleanliness, and post-war education will include the subject of vermin infestation and their prevention and destruction by pestologists. The chief aim of designers is to ensure that a ground floor be dry, well ventilated, and that crevices on the surface of a floor be avoided as much as possible. It is a good principle to include a few access points to permit occasional inspection of any open spaces under the floor and to allow fumigation or other means to rid vermin.

(e) Economic initial cost is manifestly of great importance, but should always be compatible with compliance with good principles and details of design and construction. Initial cost should never be cut down merely to save money if eventually it will entail extraordinary expenditure in maintenance and repairs. There should be a well-considered balance between initial and maintenance costs; it should be borne in mind that the maximum economy is essential in post-war times, as capital expenditure, even of small extent, can mean adding to the rent of a house, or affect adversely the pocket of a purchaser; on the other hand, the saving in initial cost by shoddy work can cause a great loss in the future.

(f) Economic maintenance costs and their relation to initial costs is explained above. Additionally it is advisable that all pre-built housing units and parts be designed to reduce the costs of maintenance, also re-decorative works, as much as possible. All property owners, including the individual owner, have to allocate a certain percentage for repairs, protection and necessary decorations. Hitherto this percentage has been fairly high to efficiently execute these works, and in many instances has caused property owners to shirk their duty to their tenants, and incidentally themselves. It will be found that pre-built houses of the future will eliminate many of the expenses which pre-war houses caused to their owners and others in repairs and upkeep.

(g) Speed and ease of erection need but brief comments; one of the many fundamental principles of pre-built work is to ensure precision, speed and easy erection, and all these are coupled with the economy which they should ensure.

(h) Light weight of pre-built houses was dealt with in the first article of this series, and it is obvious that a house weighing about 40 tons, instead of the pre-war house heavy load of about 125 tons, has many advantages in regard to transport and erection.

(j) *Good appearance*, by character, proportion and detailing of the main and various parts, presents no difficulties, and, although this statement is contested by many people, it will be found on analysis that they are fostered by certain vested interests and by old-fashioned minds. I will go one step further and say that pre-built houses of the future, with co-operation of architects, will æsthetically be much better than some of the hideous pre-war houses which masqueraded under such titles as "Tudor," "Georgian," and "Architect-designed."

(k) Resistance to fire is a subject which does not raise many difficulties. While it is absolutely essential to prevent combustible materials being in close proximity to fires and their flues, etc., it may be allowed otherwise that the risks of fire are practically the same

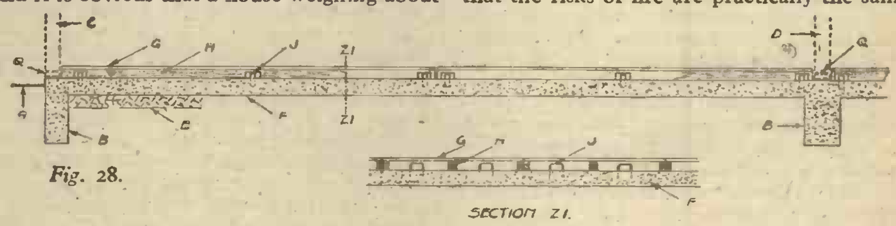


Fig. 28.

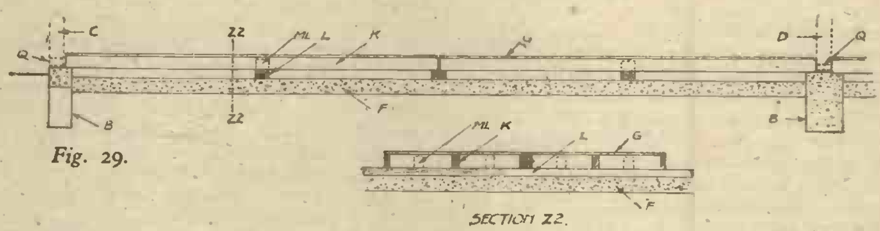


Fig. 29.

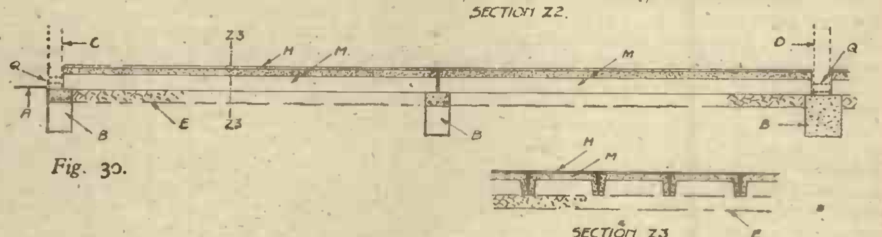


Fig. 30.

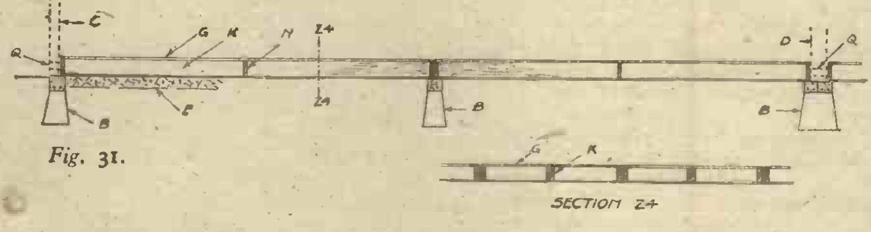


Fig. 31.

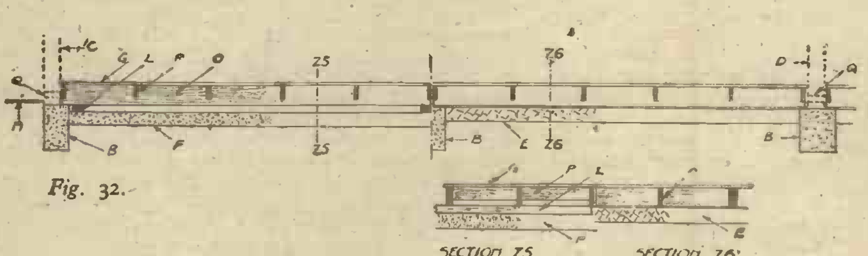


Fig. 32.

Fig. 28.—Pre-built panelled units supported on surface concrete.
Fig. 29.—Pre-built panelled units suspended over surface concrete.
Fig. 30.—Pre-cast reinforced concrete beam units over naked ground.
Fig. 31.—Pre-built panelled units with timber framework spanning over naked ground.
Fig. 32.—Pre-built egg-box system of construction.

A—Ground. B—Any of the types of bases or sub-structure explained in articles 4 and 5. C—External wall units. D—Internal partition units. E—Hardcore. F—Surface concrete. G—Flooring. H—Timber bearers or framing. J—Fixing block. K—Timber joists. L—Timber plate. ML—Fixing block, if desired to allow units to be screwed through flooring to sub-structure. M—Reinforced concrete beam units. N—Transverse bearers. O—Longitudinal beam member. P—Nogging or transverse member with ventilating space under. Q—Air brick or vent.

for most methods of construction. There is the school of thought which contends that the brick-built, tiled or slated roofed house is highly resistant to fire. This is a fallacy because, whereas the brick walls are resistant, by far the greater proportion of an ordinary house, its structure, finishings, equipment and household goods are definitely inflammable. Now study what the United States of America have proved about fire risks:

"Recent statistics disprove entirely the belief that the fire risk in a timber house is greater than that in one of brick or concrete. In order to appreciate this fact the very slight actual difference in construction must be realised. Normally both types of houses have brick or stone foundations. Both have wood framing, wood floors, wood roof timbers. The only difference is that the walls of one are of timber and the other of brick. When a neighbouring fire has become sufficiently severe to ignite a wood wall it has become sufficiently severe to break the windows of a brick one and attack the interior wood construction. The cause of fire in any type of building is almost invariably an internal one.

"A few years ago the National Board of Fire Underwriters in the United States made a survey covering 1,254,192 buildings in various American States. Of these, 75.3 per cent. were timber houses. The result showed 1.65 fires for each 100 timber houses, and 2.43 fires for each 100 brick and stone buildings. The greatly increased number of fires in brick and stone buildings was attributed to the forcing of heating plants as a result of the inferior insulating properties of these materials as compared with wood.

"The common belief that timber houses form a fire menace because of their encouragement of fire to spread was also disproved. In the survey mentioned, 98.7 per cent. of all fires were confined to the buildings in which they originated."

An examination of property burnt out by enemy action certainly does not prove that the traditional method of house construction is a good fire risk.

Methods of Pre-building

With the above 12 essentials in mind it is possible to advance to the designing stage. Fig. 27 is an isometric composite drawing showing in principle and detail the five methods of construction which are shown by the sections, Figs. 28 to 32. All the drawings should be studied carefully in conjunction with the following descriptions of each method.

Pre-built Panelled Units Supported on Surface Concrete as *A*, Fig. 27 and Fig. 28. This system of construction, although coupled with the use of cast-in-situ surface concrete, which is so necessary to avoid ground dampness, is simple and good. The timber framework is light, is composed of 2in. by 2in. framework spaced at 18in. centres or such as to suit the flooring material and width of panel or unit; the framework rests directly on and derives support from the concrete. It is essential to avoid common errors which many designers make when designing floors which are supported by concrete slabs. They are: (1) It is wrong to allow that timber bearers or joists will remain in position by simply bedding and/or packing up. The timber warps and twists and looseness occurs, and a springy and creaking floor is most irritating to the home-owner. Therefore the floor should be fixed down to the concrete as shown. (2) The method of such fixing should not be by means which look excellent "on paper"—precision by engineers can be relied upon, but not necessarily by builders, who have to lay the surface concrete, and, owing to little inevitable movements in timber, it is necessary to adopt practical means of fixing. If timber-fixing blocks, as shown, are used, they may be set out easily, a little tolerance is allowable, and a very great advantage is gained by it being practicable to screw the panels through the flooring material, *and not the framing*, in such a way that any panel may be removed easily for repairing, renewal or inspection of the space under the floor, and refixing is a simple matter. It is very necessary to ventilate the floor by "air-bricks" or "air openings" as depicted. Flooring materials or coverings are described later.

Pre-built Panelled Units Suspended Over Surface Concrete as *B*, Fig. 27 and Fig. 29. This method of construction, although lending itself to pre-building, is heavier than "A" owing to the joists being of greater size to meet beam stresses. The design provides ample air space under the floor. If desired small blocks may be fitted on top of the plates as depicted to allow the units to be screwed through the flooring and not fixed by nailing the joists down to the plates.

Pre-cast Reinforced Concrete Beam Units over Naked Ground as *C*, Fig. 27 and Fig. 30, is a method worthy of serious attention, as, despite the rather heavy weight of the units and care required in handling, transport, and fixing to prevent damage, the principle avoids any surface concrete which is cast-in-situ work. The modern advancement of building makes it quite practicable to effectively seal the joints between the units, and there are flooring materials which are resilient, warm and comfortable which can be applied to the units at works and be neatly jointed on site at the same time as the joints are sealed. If considered necessary the ground may have a layer of hardcore.

Pre-built Panelled Units with Timber Framework Spanning Over Naked Ground, as *D*, Fig. 27 and Fig. 31, is a suggestion of mine which may be considered to have merits well worth analysing. The design obviates the use of surface concrete and therefore makes the floor entirely pre-built, with the exception of the bases, etc. The units are protected against ground dampness, may be effectively sealed at the joints, are light and flexible, and may be covered with any of the good kinds of flooring materials which are on the market, or will be soon. Each unit consists of a timber framework of joists of sufficient size to span between the substructural parts, and the underside would be covered with a stout tear, rot, and water-resisting sheeting. The joints must, of course, be sealed with a resilient material. The sealing of the various joints in pre-built work—a subject of much importance—will be dealt with in a future article, in which will be explained various practical ways of sealing joints between various materials and in different positions. The floor should be well ventilated by air bricks.

Pre-built Egg-box System of Construction, as *E*, Fig. 27 and Fig. 32, ensures a light and rigid framework which may be constructed with timber boards. Each longitudinal board which runs in the direction of the span of the suspended panel must be in one length, and the cross or transverse boards are fitted between, and nailed to, the longitudinal members. The general arrangement allows any concentrated loads to be fairly well distributed over adjoining parts of the structure. Ventilation of the floor is necessary.

Flooring Materials. All the methods of construction, excepting type *C*, permit the use of many kinds of excellent flooring materials, such as softwood, hardwood, hardboards, plywood, rubber, cork, and coloured asphalte on sub-flooring, and others. Type *C* is generally suitable for those flooring materials which may be applied direct to concrete, such as cement and sand pavings, coloured asphalte, certain compositions, rubber-faced asbestos, cement, tiles, etc. This subject is of great importance and brings in many varieties of materials, their use for pre-built work, transportability and protection until completion; it will be explained fully in the next article.

Building By-laws

The authorities commenced revising the *London* Building Acts about 15 years ago, and since then considerable advancements have been made in regulating ordinary and traditional construction, reinforced concrete, structural steelwork and timber construction. The model by-laws governing construction *outside London* underwent a great and welcome change in 1939. There is unmistakable evidence that the authorities are fully alive to the necessity of further revisions and augmentations of the by-laws to suit the many new methods of construction and materials which have forced their way by merit into building and engineering. In my opinion, the future by-laws will be based on good standards of strength in construction, the use of many kinds of suitable materials, and will not permit those low standards which some promoters of pre-building think probable. It will very likely take many years to bring the by-laws up to post-war requirements, but this need not cause much apprehension to designers of pre-built houses; it is practically certain that the authorities will grant waivers, or otherwise pass all methods of construction which can be proven to be of sufficient strength, and of a quality which is best in the national interests.

Royal Society of Arts

Awards for the Improvement and Encouragement of Navigation

THE Council of the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2, offer the following prize under the Thomas Gray Memorial Trust, the objects of which are "The advancement of the Science of Navigation and the Scientific and Educational interests of the British Mercantile Marine":

(1) A prize of £50 to any person of British or Allied nationality who may bring to their notice an invention, publication, diagram, etc., which in the opinion of the judges is considered to be an advancement in the science or practice of navigation, proposed or invented by himself in the period January 1st, 1938 to December 31st, 1943. Entries which have already been considered by the judges in the years 1938–42 are not eligible for further consideration unless they have since been materially modified.

The Council reserve the right of withholding the prize or of awarding a smaller prize if, in the opinion of the judges, no suitable invention is submitted.

The Council do not claim any rights in respect of any invention to which a prize may be awarded.

Competitors must forward their proofs of claim between October 1st and December 31st, 1943, to the Acting Secretary, Royal Society of Arts, at the above address.

(2) Offer of an award of £50 for Deed of Professional Merit.

The Council of the Royal Society of Arts, as Trustees of the Thomas Gray Memorial Trust, in recognition of the remarkable skill which is so constantly displayed at sea during the present struggle, have decided to offer a further award of £50 to any member of the British Merchant Navy for any deed brought to their notice which, in the opinion of the judges to be appointed by the Council, is of outstanding professional merit. The period to be covered by the offer will be the year ending September 30th, 1943.

Cable Telegraphy

The Working of the Hughes and Baudot Instruments

By W. T. LOWE and E. PHILLIPS

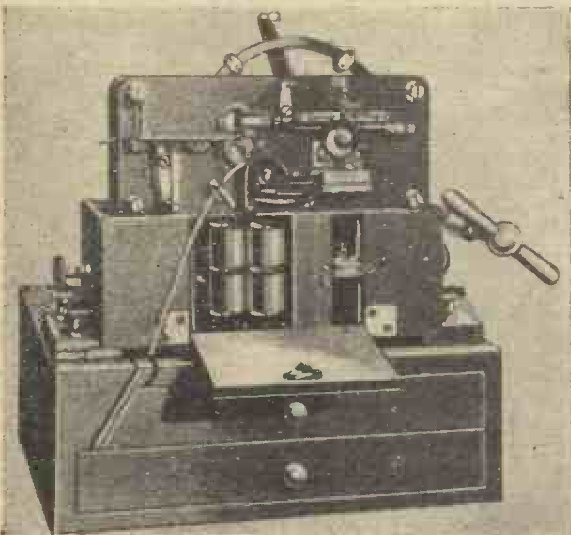


Fig. 1.—Automatic Wheatstone Morse receiver.

CABLE telegraph apparatus has been very slow in its evolution, and telegraph practice, in fact, did not approach standardisation until Colonel Morse, of the United States, devised, in 1844, the system of dots and dashes which is now universally used. Messrs. Cooke and Wheatstone invented instruments that enabled morse signals to be sent at high speed (Figs. 1 and 2). But other inventors were doing their best to introduce apparatus whereby telegrams could be received in printed form.

Hughes' Printing Telegraph

The first practicable printing telegraph was made by David Edward Hughes in 1855 Born in London, Mr. Hughes went to the United States with his parents at an early age.

Later he became a Professor of Music in Pittsburgh University, and whilst holding this post invented the apparatus which bears his name—The Hughes Printing Telegraph (Fig. 3). It consists of a piano-like keyboard of 26 keys, black and white alternating. Twenty-four of these keys are allotted to a letter, figure or punctuation mark. The remaining two keys give respectively "letter space" or "figure space." Essentially, the apparatus works by varying the time when electric currents pass over a wire. Each key is connected by a lever to a pin in a circular plate set in the base of the apparatus behind the keyboard. A moving arm on a vertical axle, termed a "chariot," moves continually round this plate. When a key is depressed, the corresponding pin is raised. This pushes up the "chariot" as it passes over the pin, and the upward movement causes a flexible flat steel tongue to make contact with a stud whereby an electric current is sent to the line. At the receiving end a type-wheel is revolving synchronously with the sending "chariot," and, at the moment when the current is received, the appropriate letter is opposite a paper tape. The current causes the paper to be lifted into contact with the type-wheel, the letter is printed and the paper tape moved forward one letter space. By this means the message is spelt out, and the tape is gummed to a message form. It is, of course, necessary to have synchronism of speed, and also to arrange that the two instruments start with the same letter. To ensure this, the sender and receiver instruments, when at rest, have the type-wheel held stationary by a "detent" arm, with the "letter-blank" space opposite the paper tape.

Transmitting

The sending telegraphist always commences by touching his "letter-blank" key; this causes the receiver "detent" arm to be knocked away from the type-wheel, which can then revolve, and subsequent letters should be correctly printed. If the first letter to be sent is E, this will be received five spaces after the blank, N will be nine spaces after E, and so on. For mechanical and electrical reasons, after one key has been depressed, the next that can be utilised is the fifth after it. Thus, after the blank, the next key that can be depressed in the same revolution is E; then J; then O and T, etc., a maximum of five letters per revolution. Consequently, words will vary in the time of transmission according to the arrangement of their letters. "NO" requires two revolutions, while "HOT" can be sent in one.

Although apparently a clumsy apparatus, the "Hughes" held the field for telegraphy on the continent of Europe until quite recently. A skilful operator can dispose of a large amount of traffic, all ready printed, at a high speed, and the telegraphic administrations of the Continent took it readily to their hearts. (Professor Hughes received many decorations from continental rulers.) The apparatus was not favoured in this country. The various telegraph companies had their own systems of working, and when the internal telegraphs were taken over by the Government in 1870, the Morse system was adopted.

But submarine communications between England and Europe were almost exclusively worked by the Hughes apparatus, until superseded by the Baudot in the early years of this century.

Professor Hughes also invented the microphone, and, working independently, discovered the principles of wireless telegraphy many years before it could be brought into actual use. A Fellow of the Royal Society and one-time President of the Institution of Engineers, he died in 1900 at the age of 69.

A considerable amount of practice is required before a telegraphist can work the "Hughes" easily and economically. It seems a simple matter to pick out the letters of the alphabet on lettered keys, but this has to be done at speed; and, as anyone can discover for himself, locating the letters under such conditions is not easy. In addition, one has to remember the limitation of the four spaces between letters, and a long period of practice is required to make the choice of these letters automatic. After a year or two, however, the Hughes operation becomes easier, and the skilled telegraphist can dispose of messages quickly and correctly.

Weight-driven Instruments

Cumbersome apparatus to begin with, early models of the "Hughes" were weight-

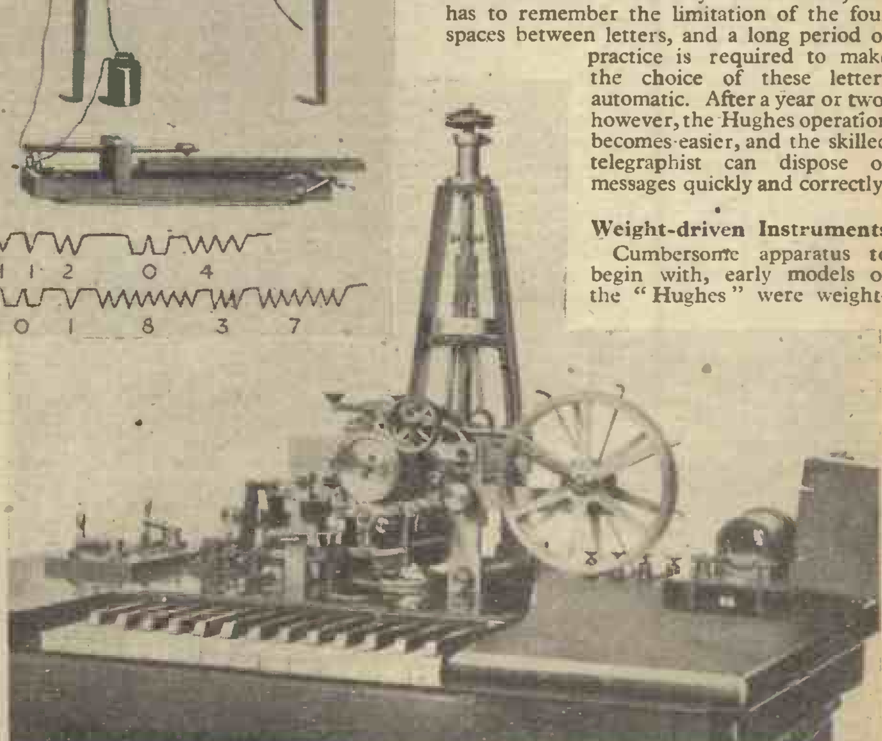


Fig. 2 (inset).—Morse's first recording telegraph (1857) and specimen writing. Fig. 3.—Hughes' telegraph keyboard.

(By courtesy of the Postmaster-General.)

driven, and set up on high tables to allow of a long drop for the weights before winding up became necessary. The clerks consequently had to be perched up on high chairs. Before the introduction of electric motors, the weights were wound up by foot-operated pedals worked by the operator. Hughes working was, therefore, not a job for a weakling. Later, electric motors were used to wind up the weights and, after that, for driving the apparatus itself, leaving the operator only manipulation to do. The instrument can be worked "simplex" or "duplex."

With the development of the industrial era in the latter years of Queen Victoria's reign, telegraph traffic increased enormously. This caused engineers to seek means for increasing the number of telegrams which could be transmitted over the limited number of lines available. The Multiplex system was evolved to meet this need. By this means, a number of messages, two, four or six or more, could be transmitted over the same wire at apparently the same time. Actually, by the use of what is called a "distributor," the telegraph line is allocated to the various operators for minute fractions of time in sequence, and as the reaction of the operator is slower than the making and breaking of the time allotted to him, each is, in effect, sending, or receiving continuously, without discomfort.

Letters	Figures, Etc	Keys 5	4	1	2	3
A	1			●		
E	2				●	
Y	3					●
J	6		●	●		
X	,	●			●	
U	4			●		●
G	7		●		●	
T	!	●		●		●
H	H̲		●	●	●	
W	?	●			●	●
C	9		●	●		●
M	)	●	●		●	
S	;	●				●
FIGURE SPACE			●			
t̲	.	●		●		
É	&			●	●	
I	º				●	●
B	8		●			●
K	(	●	●	●		
Z	:	●		●	●	
O	5			●	●	●
D	0		●	●	●	●
P	%	●	●	●	●	●
N	№	●	●		●	●
Q	/	●	●	●		●
L	=	●	●	●	●	
V	'	●		●	●	●
F	£		●		●	●
R	—	●	●			●
X	X	●	●			
LETTER SPACE		●				

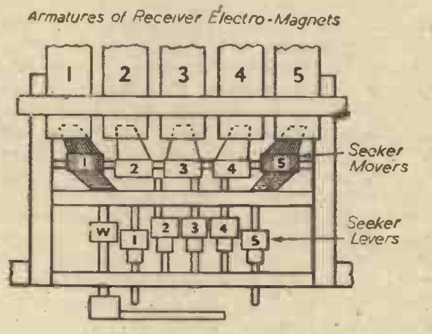
Fig. 8.—The Baudot code.

Baudot Printing Telegraph

This Multiplex system was adopted by the French telegraph engineer, M. Emile Baudot, for the remarkable printing telegraph which bears his name. His endeavour was to break away from the method of having a separate key for each letter, and by using a small number of keys, or "tappers," in various combinations, to enable the necessary signs to be printed.

Jean Maurice Emile Baudot was born at Magneaux, France, in 1845, the son of a farmer. After spending his youth on his father's farm, and having some elementary education, he entered the French Telegraph Service in 1870. He soon became interested in the scientific side of his new profession, and studied assiduously both the mechanical and electrical sides of telegraphy, which was being revolutionised at this time. Professor Hughes' apparatus was systematising telegraphy on the Continent, and other scientists were experimenting with Multiplex methods.

The double problem of obtaining Multiplex transmissions over single wires, and of receiving the messages in typed form, engaged the attention of many investigators. Baudot entered the lists in 1872 and set himself to study and solve the problems involved. While recognising the advance made by the Hughes apparatus, expanding telegraph requirements made it necessary to increase the number of signals sent over the wires. The Multiplex method made this possible, but there was no mechanical apparatus available to use the facility. Two scientists, Messrs. Gauss and Weber, had in 1855 evolved a system whereby all necessary letters, figures and signs could be telegraphed by means of a code of five units only; Witehouse had produced a system using six units, and Davy a system of three units, but here again the apparatus to use the systems was lacking.



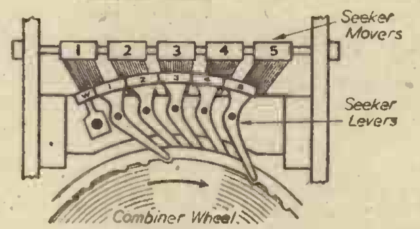


Fig. 5 (above).—Shows a plan of the top portion of the Baudot receiver. Electro-magnets 1 and 5 have been actuated, pushing forward seeker-levers 1 and 5 into the marking position. W is the pivoted head of the printing lever. Fig. 6 (below).—Shows the same portion from the front. In the position shown a full stop or small "t" is printed.

Baudot produced and patented his first multiplex printing telegraph apparatus in 1874. This used the six-unit code invented by Witehouse, and the multiplex method devised by the Austrian scientist, Professor Meyer. The French Administration were very interested in the apparatus and voted a credit of 2,000 francs to produce an experimental installation. Meanwhile, Baudot had improved upon his original apparatus, and when the installation was at last completed, the receiving apparatus contained an ingenious and effective method of the "combiner" which has held the field ever since. Baudot employed the five-unit code in this new apparatus and it was registered on the 2nd of March, 1876.

As the apparatus proved successful, the French Administration gradually extended its use to their internal lines, and after a while, administrations in other countries began to adopt it. Italy was the first in 1887, then in succession Holland, Switzerland, Austria, Brazil, Great Britain (for foreign cables only), Germany, Russia, India, Spain, Belgium, Argentine, and Rumania (in 1913). The inventor was decorated with the cross of Chevalier of the Legion d'Honneur in 1879, and promoted an officer of the same in 1898. Baudot died in 1903, worn out by a life of labour, but having the fortune, rare among so many inventors who fail under the strain, of seeing the general adoption of his invention, and the results of his genius, spreading to the four corners of the world.

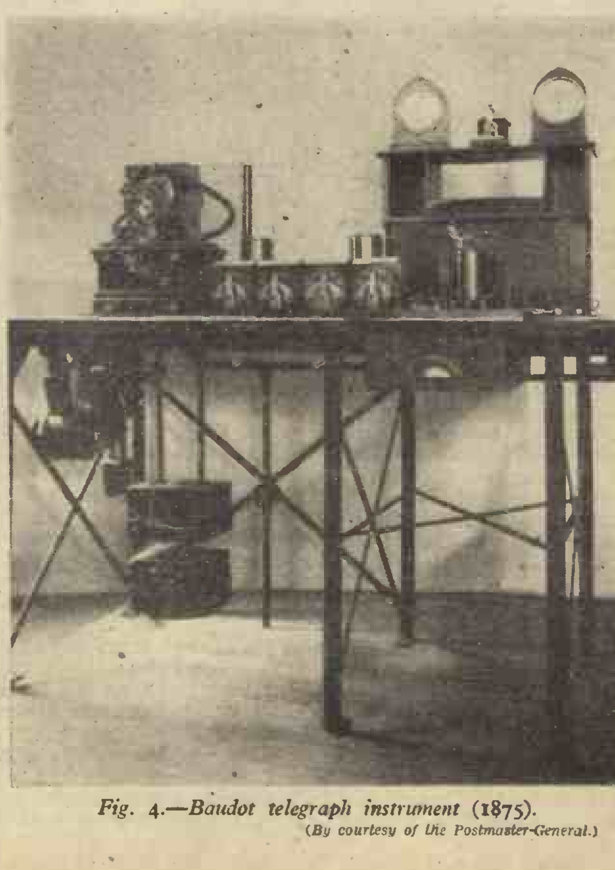


Fig. 4.—Baudot telegraph instrument (1875).

(By courtesy of the Postmaster-General.)

Baudot Keyboard

The Baudot keyboard consists simply of five ivory keys. They are arranged in the order, 5, 4, space, 1, 2, 3 (Figs. 5 and 6). In this code, key 5 is the letter-space and key 4 is the figure-space. As the apparatus was intended for hand-working, it was found most convenient to have these two together. They are separated from the other keys by the "cadence" magnet and armature. This is connected to a segment of a ring on the distributor which is slightly in advance of the segments connected with the keys. When current passes through the magnet and the armature is attracted, it knocks sharply upon a metal stop. This indicates to the operator that the brushes are approaching his key segments, and that the combination of keys for the next letter must be prepared. When keys are depressed they are held by catches

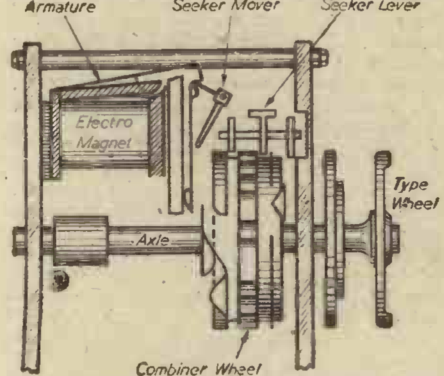


Fig. 7.—Side view of the top portion of the receiver, showing positions of electro-magnets, seeker levers and combiner wheel.

which slip over metal tips on their undersides. These hold them down until the brushes of the distributor have passed over the segments and allowed the currents, spacing or marking, to go to line. It is now necessary to free the keys again and this is done by an extension of the "cadence" armature which tilts back the bar to which the catches are fixed and so releases the keys, which spring back to the position of rest. When the automatic transmitter is used, the seeker rods for each letter are also kept in position until the distributor brush has passed over the relative segments, after which the "cadence" current causes the rods to return to normal.

The receiver, however, is a masterpiece of ingenuity. Its function is to receive the five currents, spacing and marking, sent from the transmitting keys, and transform them mechanically into printed letters. Currents from the key, spacing or marking (negative or positive), go to the sending distributor, where they are put on the line in proper sequence. They are received in the same sequence at the receiving distributor, and then passed to the proper receiving apparatus. This consists of a brass case, mounted on a wooden base, and having at its top five electro-magnets, with armatures of special design. Normally, the armatures are held away from the magnet poles by fine springs, but when a current is received the armature is attracted. In its descent it strikes upon the flat head of a "seeking lever" which is fixed just below it. This finishes the electrical action in the circuit; the rest is entirely mechanical.

Mounted on an axle at the front *interior* of the brass case, and underneath the heads of the armatures of the electro-magnets, is a composite metal wheel. The rim of this wheel is divided into four parts. There is a narrow back slot round the wheel into which the lower part of the "seeking lever" mentioned above can engage, when the appropriate armature descends under the influence of a "marking" current from the sender key. The middle portion of the wheel consists of a bevel gear which engages with the main driving bevel below it. Next, there is a rim with shallow "slots," at various intervals, divided by a metal ridge from another rim, also slotted, but having the slots placed opposite the blank spaces in the previous one. The ridge is not continuous, but has a narrow break at one point.

The Type-wheel

On the same axle, but on the *outside* of the brass case, the type-wheel is mounted, in addition to the levers, clutches, springs and paper-wheel—by means of which the proper letter is printed and the paper moved on. Above the metal wheel in the interior of the case, five metal "seeker" levers, or pins, one to each armature, have square metal heads and are supported between two metal rods by axles which pass through these heads. They are able to move forward and backward.

Another square-headed lever holds the tops of the five seeker-levers in close contact with each other. This does not move laterally, but its axle is extended outside the case, and forms the end of a long brass lever which actuates the printing mechanism. Held by a thin flat spring, the head of this lever presses all the other heads together in the direction of the revolution of the wheels, viz., left to right.

Now, assume that it is desired to print the letter "A", which, in the Baudot alphabet, comprises the depression of key 1 only; keys 2 to 5 remaining at rest. The action of the distributors at the sending and receiving stations ensure that this current shall be received on electro-magnet No. 1 only; the other four will not be affected. Armature No. 1 is pulled down, and knocks down the head of No. 1 lever. This knocks seeker-lever No. 1 from the back to the front of the slotted portions of the rim of the inner wheel; the other four seeker-levers remain over the back part of the slotted rim. There is only one position of the slotted wheel where the seeker-levers can find one slot at the front, and four at the back. When this position arrives, the seeker-levers fall into the slots under the pressure of the sixth lever and its steel spring. The wheel, however, is revolving at the rate of 180 revolutions per minute. Consequently, as soon as the seeker-levers drop into their slots, they are knocked out again, causing all the heads to jerk from right to left, against the pressure of the spring-held head, which is also jerked back. The long lever attached to the last head is jerked upward, and as its lower end is pivoted over the paper-release spring, the paper-wheel is released and forced against the type-wheel at the moment when the letter "A" is in a position to be printed. The paper is then moved on one space by the action of the instrument, and the paper-wheel restored to its normal position.

All other letters, figures, and many signs of punctuation can be telegraphed and printed by varying the combination of the transmitting keys. For instance, the letter "T" is formed by depressing keys 1, 3 and 5, leaving keys 2 and 4 untouched. The currents are received via the distributor on electro-magnets 1, 3 and 5. Fall of the respective armatures causes the relative seeker-levers to be pushed from the back slotted rim to the front one, and when the correct series of slots comes under the ends of the levers, viz., 1, 3 and 5 at the front, and 2 and 4 at the back, *which can only be found at one part of the rims*, the ends sink in, are immediately jerked out again, and the paper is raised against the type-wheel to print the letter "T." The letter "P" is formed by depressing all the keys, so all the levers are pushed to the front, and must find the position where there are five slots in the front only. On the surface of the type-wheel, letters and figures alternate, viz., A 1 E 2 Y 3, etc.; not in alphabetical sequence, be it noted, but in accordance with the Baudot alphabet.

Simplex Quadruple System

The Baudot can be worked as a simplex quadruple, i.e., two senders and two receivers on a simplex line; or as a duplex with two or three senders and two or three receivers. The French genius prefers simplex quadruple; in this country duplex is preferred. The instrument can also be "forked" with simplicity, e.g., a four-armed set (two senders and two receivers) could be arranged to work, say, from Paris to Lille and Calais. This is simply a matter of the arrangement of the extensions of the distributors at the appropriate station. The set is usually in the charge of a technician termed a "dirigeur," who sees to the correct functioning of the communication and attends to the faults and difficulties which may arise.

Actual operations of telegraphing are performed by skilled operators.

(To be continued.)

Two Portable Testing Sets

Accidents resulting from inefficiently earthed portable electrical apparatus are frequently due to the earthing conductor being broken or wrongly connected. There are, of course, various means of testing earthing conductors, but the most satisfactory test is one in which a reasonably heavy

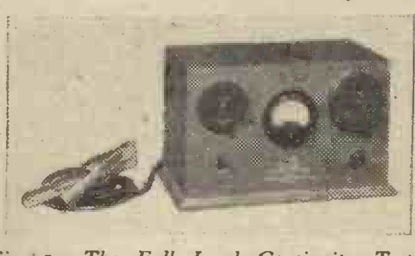


Fig. 1.—The Full Load Continuity Tester designed for use on any 200/250 volt 50 cycle supply.

current is used. Testing continuity of conductors by means of a bell and battery is not entirely satisfactory, as it is possible for a bell and battery test to indicate good continuity although the conductor may be broken and making only a butt contact. By testing with a heavy current any such weak points in a cable should be found. The General Electric Co., Ltd., is now marketing a testing set known as the "Full Load Continuity Tester" (Fig. 1), which is a compact and handy instrument for carrying out continuity tests by means of a reasonably heavy current. The set is self-contained and designed for use on any 200/250 volt 50 cycle supply.

Using the Instrument

To test a portable tool or appliance, the plug attached to the flexible is inserted in the appropriate socket in the test set and the crocodile clip, which is attached to the lead from the test set, is clipped to the body of the appliance under test. If there is an open circuit in the earthing conductor or a wrongly connected earth lead, the indicator lamp will burn brightly when the test key switch is pressed, and there will be no reading on the ammeter. If the ammeter reading fluctuates this will indicate a loose connection or broken conductor. If the indicator lamp burns dim or does not glow and there is a fairly high reading on the ammeter, the conductor under test is in good condition.

A leaflet (No. 9562) is obtainable from the G.E.C., which gives further details of this set. This leaflet also gives details of another instrument known as a "Break Locator," for locating breaks in unscreened flexible conductors.

The instrument is illustrated in Fig. 2 and consists of a high frequency generator and accessories all accommodated in a wooden carrying case. The operation for locating the break is quite simple. The ends of the cable under test are connected to appropriate terminals on the test set, and the position of the break is located by the searcher and headphones.

Fig. 2.—A high frequency generator is employed in the Break Locator which is designed to facilitate the location of breaks in unscreened flexible conductors.

Masters of Mechanics

Joshua Billcliff—Camera-maker

A Brief Account of the Work of a Pioneer in the Photographic World

EARLY one fine summer's morning just a little more than 100 years ago a couple of stalwart Yorkshire lads set out upon a nearly 40-mile tramp over the Pennine moorlands to the then rapidly rising town of Manchester.

It was a long tramp even in those days of pedestrianism, and as it was necessary for the two rustic travellers to reach the city of their destination before the early evening of the same day, they were glad to avail themselves, after more than half of their journey had been made, of the offer of a lift into Manchester which was given by a kindly carrier who chanced to overtake them on the road.

For the two youths, it was a holiday outing, one which they had long determined to take when next they heard of the renowned Jenny Lind giving one of her recitals in musical Manchester.

That, in brief, was how Joshua Billcliff, whose name, in after years, was to attain quite a degree of celebrity in the world of technical craftsmen, first visited Manchester, the city in which he was to work out the greater portion of his life's career.

The Two Joshuas

There had been Billcliffs around Penistone for generations. Farmers who tilled the hard land and eked out an honest subsistence amid the surrounding moorlands. It was in one of these moorland villages, that of Ingbirchworth, a couple of miles north-west of Penistone, that Joshua Billcliff, the son of a working farmer of that name, was born on August 27th, 1820, the year which saw the death of the mad King George III and the first crossing of the Atlantic by a steamship.

Joshua Billcliff, the youngest son of his

Front view of Billcliff's snapshot miniature camera of 1870. It was 5in. high and 1¾in. wide, and the shutter was operated by an elastic band.

father, was bred and brought up on the land. If he had any schooling at all, it was that which he received weekly in the Sunday-school at Penistone. The remainder of his knowledge and education he gained for himself subsequently in the great University of Life.

Because Joshua Billcliff had an elder brother, Benjamin, who was to succeed to the family farm, it was decided that he should be apprenticed to a trade. It was a wise decision, for, from his earliest days, the youthful Joshua showed a decided inclination, if not an actual genius, for all things mechanical and constructional. In his 'teens, therefore, Joshua was apprenticed to the trade of joinery, his master being a joiner and builder at Holmfirth, Yorks.

Billcliff remained for seven years in his apprenticeship, after which he worked as a journeyman for a short time with a local employer. But, somehow or other, the countryside never appealed to the mind of

Joshua Billcliff—1887.

the growing Joshua. He longed for the pursuits of the town. Eventually, he broke with country avocations, and, bag in hand, he tramped again to Manchester, which was apparently the town of his dreams. It is on record that Joshua Billcliff arrived this time in Manchester on the afternoon of July 20th, 1844—nearly a century ago. He would then be 23 years of age. His first job in Manchester was as a working joiner, and he was given the task of removing the old-fashioned wooden cornices which then adorned the roofs of the Manchester cotton warehouses in order that they could be replaced with more enduring stone parapets. For this work, Billcliff was paid the sum of exactly 24s. weekly. Perhaps on account of his reserved disposition, his workmates regarded him as a stupid country yokel, or perhaps it may have been in consequence of not a little jealousy at his excellent workmanship that they were inclined to treat him with derision. At all events, Billcliff, finding his existence anything but congenial or even comfortable in this sphere of employment, set himself to discovering other means of livelihood.

He had, about this time, married an attractive young widow, in whose house he had taken lodgings when he first arrived in Manchester. The marriage was a happy one, and it brought into his life a helpmate whose initiative and energies were somewhat on a par with his own.

Caretaker-manager

Striking out for independence, Billcliff set up a greengrocery shop at No. 56, Stretford Road, Manchester, and was soon running a thriving business with market produce and other commodities. After a few years, however, Billcliff found the selling of vegetables and the daily early-morning visit to market too unattractive and too onerous an occupation for a man of his temperament. Eventually, therefore, he gave up his business and became the caretaker-manager of one of the then fashionable recreation gardens which had been brought into existence near Manchester by Ben Lang, a well-known local character with whom Billcliff had formed an acquaintanceship. After a couple of years or so with Lang, Billcliff threw up his post and returned to his former shop which, this time, he opened up as a provision dealer's establishment.

Not content with running a grocery business, Billcliff commenced operations as a dining-rooms proprietor at the same address. Both businesses were reasonably prosperous and they gave Billcliff the necessary leisure for the pursuit of other sundry activities in which he was interested.

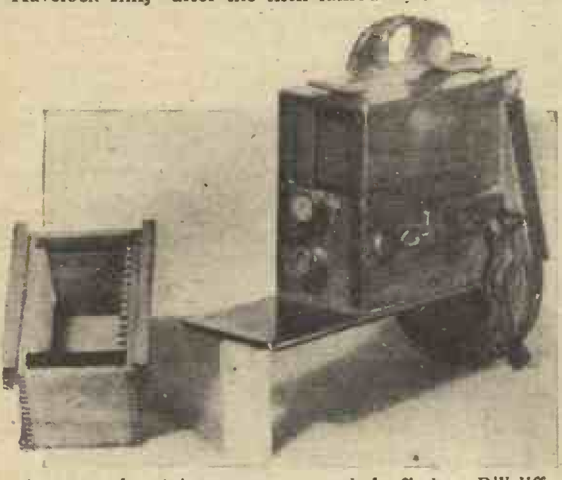
During his career as a dining-rooms proprietor, Billcliff let one of his cellars to a man named Robinson who was supposed to be engaged in the experimental development of a rotary (turbine) steam-engine. Robinson had been an amateur daguerreotypist, that is to say, a man who had practised the first process of photography on silvered copper plates which had been invented in 1839 by the Frenchman Louis Daguerre. Billcliff seems to have allowed himself to be infected with Robinson's photographic interest, for he built for Robinson a studio in the top room of his premises in which, after a time, on Robinson's suggestion, he commenced the making of photographic printing-frames.

Making camera bellows by hand in the Billcliff workshop.

Printing-frame Manufacturer

Portrait photography in those days was just coming into its own, and Billcliff's little sideline of printing-frame manufacture turned out to be surprisingly successful. In the little upper attic over his dining-rooms premises, three workers toiled away daily at the hand-making of wooden printing-frames. Enoch Lloyd (an old man who had been employed at Ben Lang's Gardens, in Manchester), Joshua Billcliff and his eldest son, William, then about 10 years of age, comprised the sole "staff" of the embryo photographic business. For the fashioning of the metal parts of the printing-frames, Billcliff introduced an actual forge and anvil into his attic-room.

But even this new development was not sufficient to satisfy the energies of Joshua Billcliff. Not only did he endeavour to create a small shop-fitting business, thereby practising his erstwhile trade of a joiner, but he actually set up an inn on his dining-rooms premises, which hostelry he named the "Havelock Inn," after the then famous and popular military General of that name. For many years, Billcliff's Havelock Inn prospered exceedingly, becoming the resort and rendezvous of many of the stage celebrities visiting Manchester.



A very early miniature camera made by Joshua Billcliff about 1870. It held 12 plates 1¼in. square.

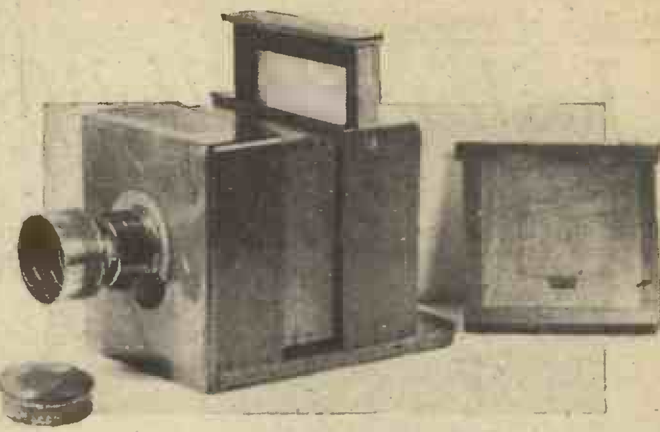
It was on the suggestion of another acquaintance of his, a man named Benjamin ("Ben") Hollowell, who had, during his visits to the Havelock Inn, learnt of Billcliff's printing-frame manufacture, that Billcliff himself first turned his attention to camera making.

When Hollowell first mooted the idea, Billcliff was inclined not to regard it favourably, since, as he said, he knew nothing at all about cameras and cared, perhaps, even less about them. Nevertheless, Hollowell persisted in his suggestions, so much so that the upshot was that Billcliff agreed to make the wooden parts of a few box cameras for Hollowell, the latter individual, with the aid of his wife, assembling the parts together on his kitchen table during the long winter evenings.

Billcliff Founds His Business

It was not long after this that Billcliff started making cameras on his own account. There existed a demand for such instruments, not only for professional employment, but for amateur use, also. Comprehending the possibilities of the situation, and confident that his manual dexterity and practical experience of woodworking would stand him in good stead, Billcliff set himself out in all seriousness to embark upon the unknown waters of the camera and photographic apparatus trade, a small industry which was at that time mainly run by a small coterie of London instrument-makers.

At first, Billcliff made only small cameras of the amateur variety, similar to the ones which old Ben Hollowell had put together from the parts which Billcliff had made. But it was not long before he launched out upon the construction of professional and studio cameras. Extending his premises, Billcliff brought his family of sons into the business, and gave them all a thorough and severe grounding in the essence of craftsmanship.



One of the early cameras. An instrument made about 1847 for portrait photography.

Enlargers and other photographic apparatus followed Joshua Billcliff's first marketing of studio cameras. Somehow or other, all Billcliff's camera creations earned for themselves a peculiar celebrity on account of their sound, common-sense design, exquisite workmanship and foolproof enduring qualities. A Billcliff camera then, even as it is at the present day, was an article to be proud of and to rely upon. Only the most highly seasoned of timber was used in its construction, and every instrument which left the Billcliff premises underwent the personal inspection and adjustment of the master.

With his continually increasing camera and photographic apparatus business, Joshua Billcliff finally said good-bye to his older avocations.

Greenheys

About 1881, the Billcliff firm moved into new and more spacious workshops in Greenheys, Manchester. Very quickly, the volume of business became so large that Joshua Billcliff, at the height of his career, was employing no fewer than 42 trained and proved craftsmen, each of whom he personally and patiently instructed in his own methods and system of workmanship. Before the use of electricity became common, the Billcliff factory was powered by eight little horizontal steam engines having 4in. diameter cylinders, each of which had been designed and made in the Billcliff workshops.

Early camera craftsmen. Four sons and a grandson of Joshua Billcliff.

Much experimental work in camera and photographic apparatus making was carried out under Billcliff's auspices. In his workshops, the "revolving-back" principle of camera construction was first brought into being. It was actually the invention of Billcliff's eldest son, William, who first hit upon the notion through witnessing the operation of a locomotive turntable in a railway goods-yard. This invention was patented in 1887. It was the only patent which Billcliff ever took out. Yet, in spite of its legal protection, the principle was soon freely copied and made use of.

First Miniature Camera

An instrument which was, perhaps, the world's first snapshot camera, and certainly one of the first miniature cameras, was worked out in Billcliff's factory. This type of camera was made to the order of Warwick Brookes, a then fashionable Manchester photographer. It held 12 miniature glass plates, and its primitive shutter was operated by means of an elastic band!

Some of the world's first stereoscopic cameras were constructed by Joshua Billcliff, and during the concluding quarter of the last century there was hardly a camera novelty which had not some association with this famous craftsman.

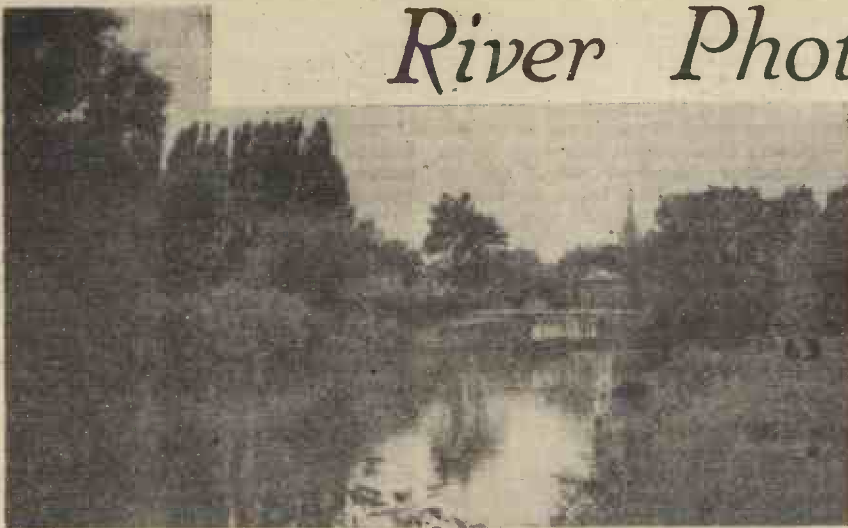
The products of the Billcliff workshops went all over England. The fashionable London photographic studios as well as the more individual and isolated Victorian camera workers used Billcliff equipment.

Almost to the last, Joshua Billcliff kept up his active interest in his business. And when, ultimately, during the final year of his life, he was forced into his bed by reason of infirmity and continued ill-health, his constructional urge refused to leave him, for in that bedridden condition, he still insisted in performing a few turning operations by means of a small lathe which he had brought up to his bedroom and which was daily treadled for him by a kind-hearted niece who remained in attendance upon him. It was in this condition of persistent albeit necessarily enfeebled activity that Joshua Billcliff, the craftsman camera-maker, gradually faded out of life, the end coming on May 5th, 1899, he then having reached the age of 78 years.

River Photography

Selection of Subjects

By JOHN J. CURTIS, A.R.P.S.



A pleasing riverside study.

HAVING given our attention to the subject of seascapes in the June issue, let us, while our minds are on the subject of water scenes, devote some thought to the broader and general one of river photography, which is a subject within the reach of most, and to many it can be practised almost at any time of the year. Those who dwell in some of our large manufacturing towns, such as London, Glasgow, Liverpool, Bristol and Nottingham, where a river runs through, or is close handy, know what a valuable friend they have in this river; it can be the background of many different types of work, including pictorial, industrial, shipping, historical, pastoral and even architectural. Londoners are particularly favoured in this respect and, in normal times, it is not an uncommon practice for the suburban clubs to choose for their photographic outings certain sections of the river Thames; sometimes the upper reaches for pictorial and restful landscape scenes.

At other times the lower reaches of the river are visited, with all the bustle of the shipping and wharves, and the historic connections which abound in the neighbourhood. Sometimes another party will limit its wanderings to the district lying between Chelsea and the Tower Bridge and specialise in the buildings on either banks.

There are, however, many thousands of camera owners who have not got such facilities; there is no such river close to their homes, but they may have a lake near at hand. Certainly they may choose a district for their holidays where there will be a river, stream, or even only a running brook, and it is fairly certain that the desire will be there to make the best of such surroundings.

Suitable Subjects

When walking beside a fairly good sized river with plenty of trees and pasturages on its banks, I have found it sometimes rather puzzling to decide what to take. If the sun is shining everything is so "pretty"—and we must be careful of that type of picture—wherever we turn we see something which might make a good picture, in fact there are pictures everywhere; it is like going into a library of good books, there are so many that we cannot make up our minds what to select. It is also easy for an amateur to be so impressed by the general beauty of a district through which he happens to be rambling as to lose sight of the one particular spot which perhaps has all the necessary features for making a first-class exhibition print, but, obviously, we have to allow that personal taste is the factor that influences experts and beginners alike, therefore it becomes difficult to suggest any one type of picture that should be the aim of all.

I believe it is a very good policy when selecting and taking a picture to endeavour to include in it, if possible, that "something" which not only attracted your attention, but created in your mind a sense of pleasure and enjoyment which you would be able to feel again each time you looked at the print if the negative proved a success. Let me illustrate this point, but first I will agree that most happy snaps of friends taken in happy and jolly circumstances will do this, but those are merely records of an occasion, whereas I am hinting at pictures such as you might with pleasure hang on the wall of one of your rooms.

Supposing you were walking along the bank of a winding river, on a sunny day with a nice breeze blowing and some light fleecy clouds about; at a particularly nice spot, just where the river bends, a couple of small sailing boats are making their way towards you. You will, or should, get the camera ready, and select the actual place from which to take the scene, marking in the viewfinder the best position for the boats to be for the right composition of the whole setting. There is likely to be a nice breeze at the bend, and a good amount of ripple on the water, so that at the time of the exposure there will be just that suggestion of movement to give life to the scene. You have given a little careful thought to the subject and you are rewarded, everything fitting in as anticipated.

Now consider that same scene under different conditions; a sweltering hot day, not a breath of air to stir the water, a cloudless sky, the boats are coming round the bend, but they are so slow as to be almost standing still. If you did take the scene those boats would be like two toy models standing on a sheet of glass and the print would be a bald-head. I venture to suggest that you would not get any sense of enjoyment in the taking, neither could you expect to have any at a later date when viewing a print of the scene. It would, in fact, be simply a record of your ramble and nothing more.

A few months back I waited nearly an hour for some cows standing in a shallow part of a river to arrange themselves so as to give me a picture, but they would not do so; in desperation, hoping for the best, I exposed a film, but the result, as expected, was no good, and I would not waste more paper than a contact print.

There are many items along a river in the upper reaches; reeds, overhanging trees, willows, reflections, rustic bridges and even patient anglers can be included, provided the other parts of the scene will permit the inclusion of a figure.

It is a good plan when walking along a picturesque bank to conjure up in your mind a scene having as its background that piece of the bank, with that bunch of reeds you passed a few yards down placed in position over there, and a nice group of clouds casting reflections in the stream half-way across, and the bridge in the distance. This is the way in which, I imagine, the artist starts visualising his result before he puts pencil or brush to his board or canvas; you have discovered the items for your effort but they are not together, retrace your steps and see if it is possible to key them up at some other

Old cottages make an admirable background to this charming river scene.

spot. Never hurry over the ground if it has possibilities of a picture.

Industrial Surroundings

The general appearance of the river and its banks in the industrial part of a town does not always appeal; perhaps there is a distinct absence of variation, the buildings are much the same, the water is murky and lifeless and you feel that any result will be devoid of half-tones, but you would like a shot at that tug coming along with black smoke pouring out of its funnel and leaving such a trail. Get the camera ready, use a large aperture so as to diffuse the background of warehouses, turn a little to one side and get that spot of cloud and be sure to have plenty of water in the foreground so as to take advantage of the ripples formed by the bows of the tug forcing a way through. You would, of course, refer to your meter for the exposure time.

That ship lying alongside the wharf might provide a subject for two or three exposures; it has perfect lines which link up rather well with that building in the background, and that little group of men standing on the wharf under the bows as though they belonged to the ship. The hawsers by which it is safely moored, together with the small gangway, and the opening in the side of the deck rail, and even the masts all seem to harmonise.

The landing stage where liners discharge their passengers is a happy hunting ground for those with imagination, the liner making its way by the help of fussy little tugs, the men standing ready to receive the hawsers, even the placing in position of the gangways and the men and women waving to waiting friends, and the derricks swinging their loads of passenger luggage to the men below; these and similar incidents are opportunities, but what I am trying to indicate is that it is often the commonplace which can be turned into pictures; experience is necessary before really first-class exhibition prints can be obtained and a few shots taken at random of such examples as mentioned may provide that experience; they will at least give you some negatives on which to work.

Those who are able to use a cross river ferry should be in a position to get many interesting river scenes, a good sky and its reflections with perhaps a barge nosing its way up the river can produce a very choice picture.

Canals

Talking of barges brings the thought of canals to mind; there are in various parts of the country open stretches of canal sometimes used by anglers on Saturday afternoons, and from the opposite bank some good results may be obtained; but do not attract the attention of the anglers when shooting, and be sure to choose a spot where trees are in the background. Try to avoid a straight line of bank, and select, if possible, a spot where the canal takes a bend; a straight line across the centre of the negative will dismiss your result from any competition or exhibition. The canal barge is a fruitful source, and very frequently the "bargee" and his wife will pose for you for a few pence; but do not let them know when you actually take them, as camera consciousness is sure to spoil the result. You could also find a good subject in horses on the tow path; usually they are fine animals, and if you can take them just at the moment when every muscle is straining to get the barge going you will be rewarded with a fine "action" picture. If you wish to give the full story you will have to include the barge and the canal which means, more often than not, that the tow rope must be shortened, but if the man is friendly he will do this for you. I mention this point because the composing of such a group requires extra thought; a long rope would place the horse right in the foreground, and the barge well in the back, but by the slight concentration of items you are more likely to get a well-balanced picture. If the water for any of these canal subjects is too still, pitch a stone in it to form some surface ripples.

It has not been possible to say much about architectural or historical subjects; most rivers have buildings somewhere along their banks which come under this heading, and usually when one takes photographs of such it is for record purposes rather than from the pictorial, but it is surprising how often a picture can be made with such buildings as the principal object. To Londoners the Tower and the Embankment are outstanding examples, and I have no doubt the Liver Building is at Liverpool, but it should be noticed that where such subjects are included it is not only the building that makes the picture, it is most frequently the lighting, so when doing this work watch the light and the clouds; many beautiful results owe their merit, as pictures, to a glorious sunset or picturesque sky.

Electric Alarm Clock

WE have received the following interesting letter from Mr. R. W. Lewthwaite, of Plymouth:

"Sir,—As there has been such a lot of discussion lately about the short supply of alarm clocks, I thought it possible that other readers would be interested in the electric-

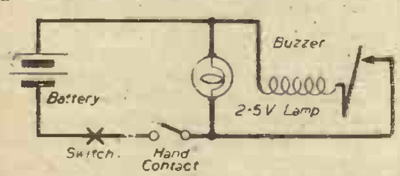


Fig. 1.—Circuit diagram of electric alarm clock.

cum-mechanical alarm clock that I have had in use for some years.

"The basis of the idea is as follows:

"An eight-day car clock has an extension soldered on to the hour hand, which makes contact with a small bolt on the face glass. When contact is made this operates a small buzzer and lights a 2.5v. flashlamp bulb. A switch in the circuit cuts the alarm off when not required, or to avoid waste of the battery. Sufficient slack is left in the wire connecting the contact on the glass, so that the time setting can be carried out by turning the face glass in its mounting. The circuit diagram is as Fig. 1.

"After obtaining a suitable car clock, mount it in a five- or seven-ply frame, shaped as in Fig. 2. Drill a ⅜in. hole at the top, and mount a miniature screw lamp-holder behind the panel, with a shade over it. Remove the clock glass, and drill a ⅛in. hole as close as possible to the edge of the glass, so that it just clears the mounting. This is best carried out by placing the glass in a tin lid with sufficient turpentine to cover it. Using a hand-drill with very light pressure, mark the glass. Then using an old drill ground off practically flat gradually drill the hole. As soon as the hole starts to appear on the under side of the glass, turn it over, and drill from the other side. Fit a nut and bolt through the glass, so that it just clears the dial of the clock, first soldering an insulated wire to the head. If necessary, snip the tip of the minute hand off, so that it does not come in contact with the bolt in the glass. Clean off the tip of the hour hand, solder piece of $^5/_{10}$ thous. in. phosphor bronze strip about ½in. long and $\frac{1}{16}$in. wide, then twist this strip at right angles so that it is at right angles to the face (Fig. 3). Fit the glass in the clock, and cut the contact strip off to sufficient length so that the contact with the bolt clears itself in from 10 to 15 minutes. It will be found that no slowing down of the clock takes place. If the clock stops when in contact it means that the strip is too thick. The battery consists of two U2 cells connected in series and clipped to the panel. Remove the cover of the outside cell, and the metal clip then carries the negative current. A bent strip contact screwed to the panel picks up the positive contact, the positive lead being connected through the switch to the frame of the clock. The glass contact is connected to one terminal of the bulb-holder and buzzer. The other terminals of the bulb-holder and buzzer are connected to the negative side, as in Fig. 1."

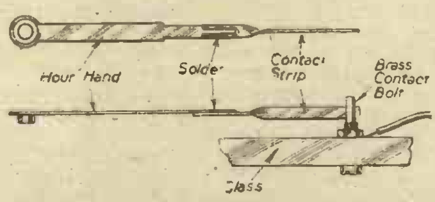
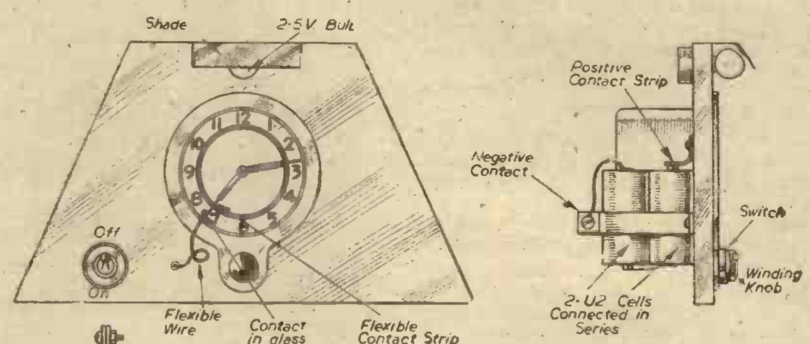


Fig. 3.—Details of hour hand and contact.



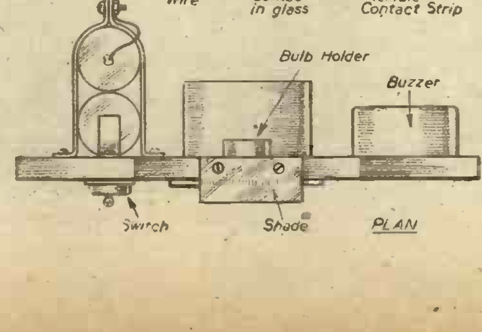


Fig. 2.—Front, side and plan views of a simple electric alarm clock, showing how the parts are mounted on a plywood panel.

Glass in Pipe-line Construction

Commercial Applications, Methods, Characteristics and Advantages

By W. J. ROBERTS

THERE must be few engineers who have not at some period in their experience sighed over some difficult pipe problem and wished it were possible actually to see what was happening in a pipe-line or a system, or alternatively, have been faced with a problem of corrosion or chemical action and wished for a chemically inert line to convey the particular fluid.

The advent, some years ago, of boro-silicate glass as a material for such application opened up considerable possibilities in this direction. The most familiar application of the material is, of course, the oven-table ware marketed under the title of "Pyrex"; further examples are to be found in the range of analytical and laboratory glassware of the same material and characteristics.

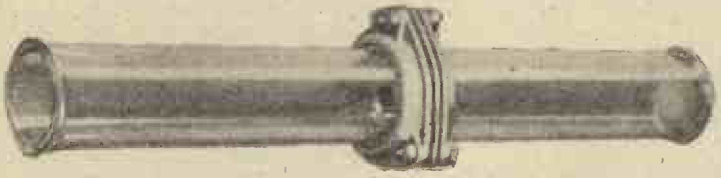


Fig. 1—"Pyrex" pipe-line with flanged coupling in position.

Physical and Thermal Characteristics

Before passing to consideration of its application in engineering practice a brief study of the characteristics is perhaps advisable. The traditional weakness of glass as a material has always been its fragile nature and its thermal weakness, or to be more precise, its liability to fracture with sudden thermal change. The production of boro-silicate glass, however, provided a glass with great powers of resistance to thermal conditions. The linear coefficient of expansion being only 0.0000018 per deg. F., between 19 deg. C. and 350 deg. C., which, combined with a thermal conductivity of 7.8 B.T.U./sq. ft./h.r./in thk/deg. F., represented a remarkable advance on any known glass or similar transparent substance.

Chemical stability and mechanical strength are additional features in which this type of glass scores over standard material. Being chemically inert to most solutions and stable in the presence of all acids and alkalis in solutions of pH=8 or less (except concentrated hydrofluoric and glacial phosphoric), it offers exceptional properties in chemical engineering. It must also be stated that even the above exceptions are resisted to a remarkable degree, if in dilute solution, while concentrations or solutions of alkalis above pH=8 will not have very bad effect.

From the foregoing it will be apparent that the adoption of the material for pipes and vessels provides a transparent unit which is invaluable. Being unaffected by sudden and wide change of temperature, the practice of flushing with steam, hot water or acids is quite permissible, providing a ready means of sterilisation, cleaning or swilling.

Flanged Pipe Units

So much for the characteristics; let us now discuss the methods and fittings adopted to provide for complete systems. The illustrations accompanying this article will give the reader a working knowledge of the fitting procedure. Fig. 2 shows three lengths of pipe, the first two lengths coupled and the third set of coupling parts "exploded" to show the various parts. Fig. 3 shows a sectioned view of the completed joint, and Fig. 4 gives details of the flanges used for pipes up to 4in. diameter.

The procedure adopted in installation is similar to that for standard metallic systems,

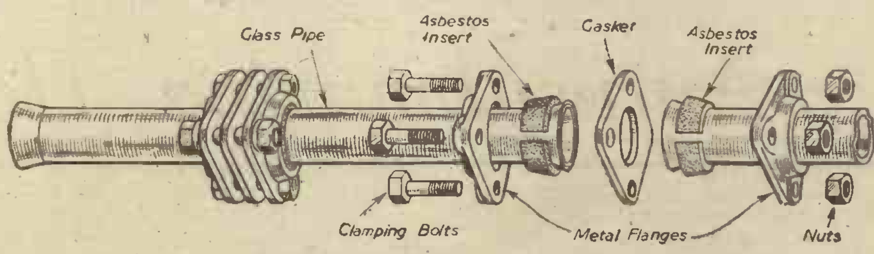


Fig. 2.—Diagrammatic illustration of method of assembly.

but requires certain variations owing to the peculiarities of the material. Assembly should proceed from a fixed or central point of the layout; coupling to the metallic unit, tank, pump, etc., is effected by drilling a blank flange to the bolt circle dimensions for the size of pipe in use (see Fig. 4).

The pipe ends are conical flanges and are compressed to a gasket of metal flanges and clamping bolts, the gaskets are self-centring and are held in position by the flange bolts. The gasket will, of course, vary as regards material, with the nature of the fluids or gases conveyed and with the pressures in the line. Having fitted the blank flanges and coupled the first pipe unit to it, the flanges should be drawn together with the faces parallel and the nuts *gradually* tightened up in rotation about ¼ to ⅜ of a turn at a time. Uniform compression of the gasket and a tight joint are thus assured; tightening more than necessary for a firm gasket contact and a leak-proof joint should always be avoided (see Figs. 1 and 2).

Support Considerations

Glass lines, in common with other pipe-line systems, require consideration of the support details, provision for longitudinal expansion and contraction and protection against impact or other accidental damage. The method of suspension is usually simple; any of the standard methods may be used. The bottoms of hanger brackets should be provided with covering, preferably asbestos sleeving, in order to eliminate "scuffing" or chafing during installation.

The recommended *maximum* span lengths between supports are as follow: For pipes conveying gases or water solutions of SpG=1.00 (0.036lb./in.^{3}), 10ft. for lines up to 1½in., and 11ft. and 12ft. for 2in. and 3in. lines respectively. Where the liquids conveyed are heavier or more dense, closer spacing is desirable, say, 8ft., 9ft. and 10ft. respectively.

The actual lengths of pipe available in straight runs ranges from 6in. upwards in multiples of 6in. to 48in., then 60in. and longer lengths to special order. A full range of all the usual fittings is also available, sizes being maintained to within tolerances of plus or minus 1/16in.—illustrations are given in Figs. 5 and 6, and a table of dimensions is also given as a matter of interest. In determining pipe lengths, allowances must, of course, be made for the thicknesses of the gaskets of the type desired for the particular work.

During installation the pipe should be placed in its hangers or supports, with malleable flanges loosely in place. Abutting pipe ends should be checked for parallelism and the gaskets inserted in place. The same careful tightening as with the first unit should follow throughout the line, care being taken when connecting branches or T-lines that no strain will be put on the main trunk by later tightening or fitting work on the branch

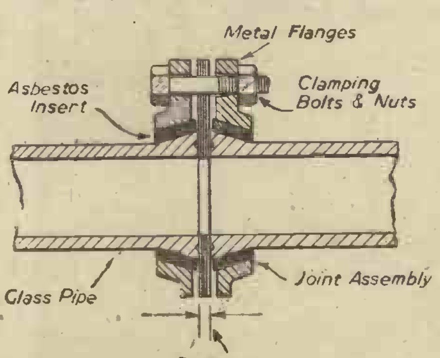
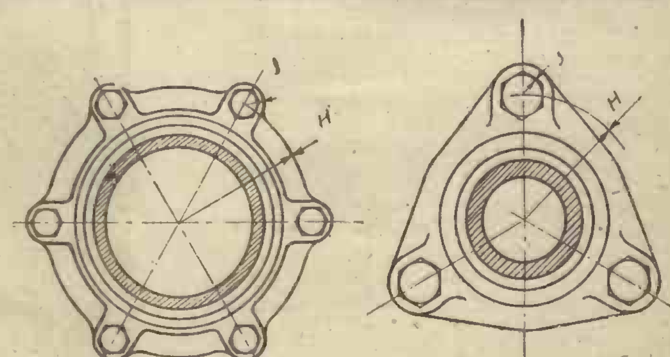


Fig. 3.—(Left) Sectional view of completed joint.

Fig. 4. — Flange for 1in., 1½in. and 2in. pipes. (Left) Flange for 3in. pipe.



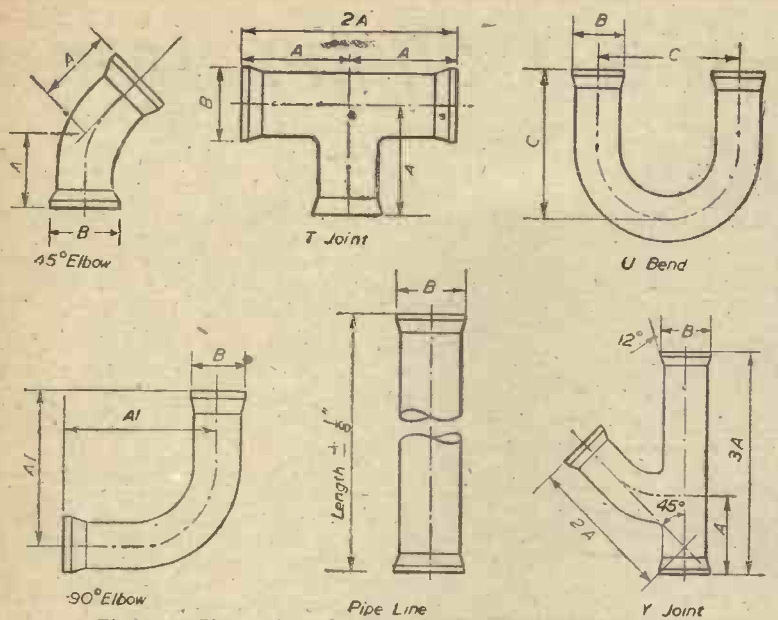


Fig. 5.—Glass pipe fittings, dimensions and tolerances.

DIMENSIONS OF GLASS PIPE FITTINGS

Size.	A=1/16"	A=1/16"	B.	C=1/16"
1"	2¾"	4¾"	1.9/16"	5⅛"
1½"	3½"	6"	2½"	7"
2"	4"	6"	2⅝"	7"
3"	5"	7"	3.25/32"	9"

line. Connection to valves, filters, traps, etc., is carried out in the manner described earlier, i.e., by the drilling of a blank flange which is in turn coupled to the malleable flange of the glass unit.

Maintenance and Upkeep

In the matter of upkeep, the unique properties of glass show to considerable advantage, the very nature of the material being such as to permit and invite visual inspection of flow with resultant improvement in quality and cleanliness of product; a glance tells of crystallisation, sediment, discoloration, etc., and provides a valuable aid to quality maintenance.

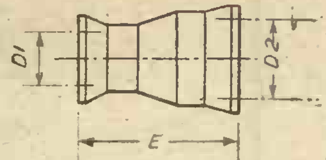


Fig. 6.—Reduced and dimensions.

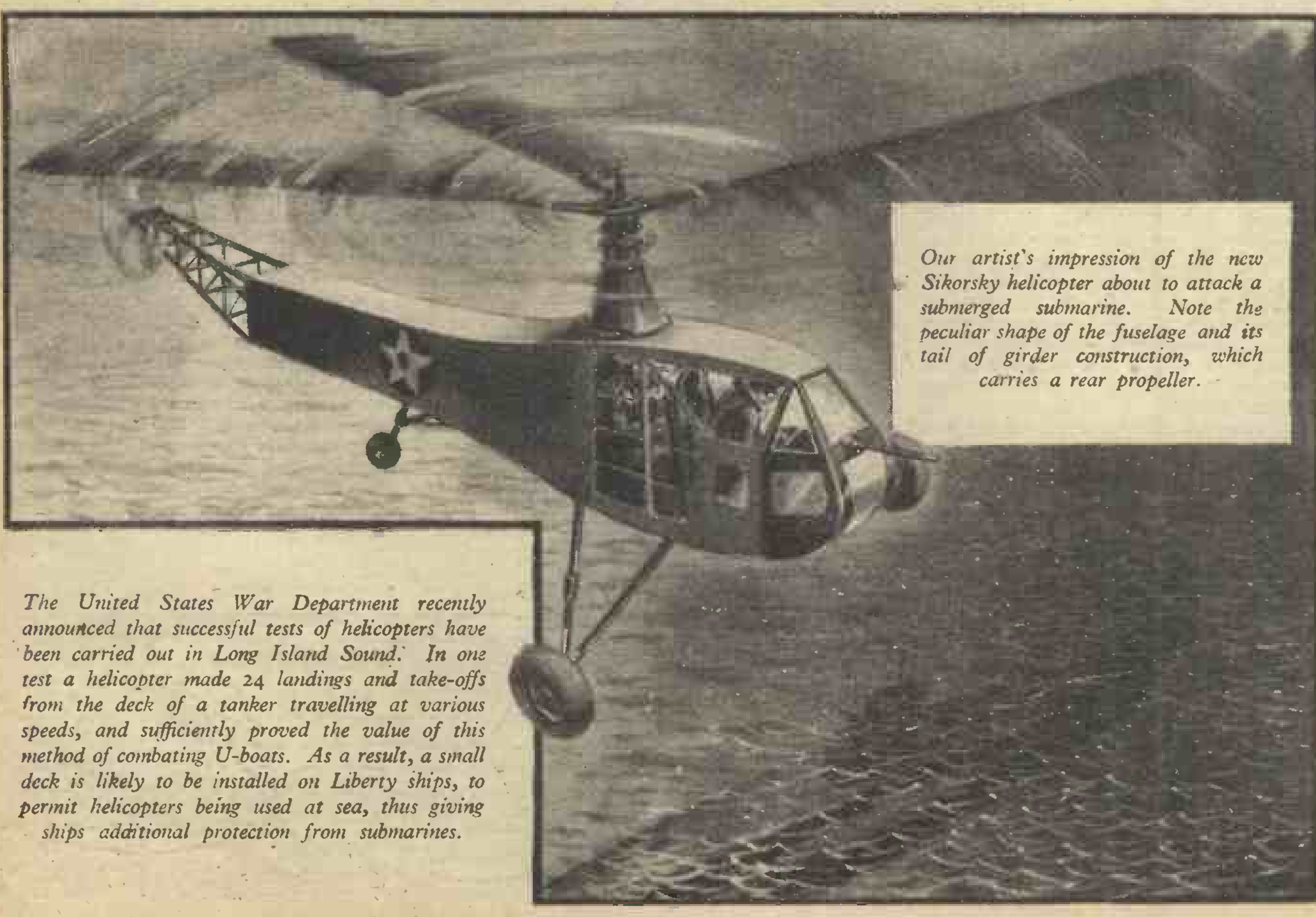
D1.	D 2.	E=1/16"
1"	1½"	4"
1"	2"	4"
1"	3"	5"
1½"	2"	4"
1½"	3"	5"
2"	3"	5"

The natural corrosion resisting properties also contribute to low maintenance cost; in fact, when the life and service continuity of glass lines are considered, the cost per year or per thousand gallons conveyed is negligible; the first cost also compares very favourably with metallic lines and fittings.

Mechanical strength of the units is ample for a very wide range of industrial applications. All standard pipes and fittings being suitable for operation at pressures up to approximately 50lb. per sq. in., while for certain applications service pressures up to as high as 100lb. per sq. in. may be handled, although consultation with the manufacturers' engineering department is advisable in the latter case.

The range of sizes has recently been increased and it is now possible to obtain the glass equivalent of any metal pipe-line or fitting from 1in. to 4in. in diameter, the latter size, however, using a slightly different style or coupling flange to the smaller sizes, the flange being in this case of split type and located by means of taper pins.

Anti-submarine Helicopter



Our artist's impression of the new Sikorsky helicopter about to attack a submerged submarine. Note the peculiar shape of the fuselage and its tail of girder construction, which carries a rear propeller.

The United States War Department recently announced that successful tests of helicopters have been carried out in Long Island Sound. In one test a helicopter made 24 landings and take-offs from the deck of a tanker travelling at various speeds, and sufficiently proved the value of this method of combating U-boats. As a result, a small deck is likely to be installed on Liberty ships, to permit helicopters being used at sea, thus giving ships additional protection from submarines.

A Bird Bath in Concrete

At a Cost of a Few Shillings You Can Make This Ornamental Addition to Your Garden

By "HANDYMAN"

A PERMANENT bird bath is always an interesting addition to any garden, and the one shown in the accompanying illustration, Fig. 1, is intended for use in a small garden. The materials required consist of nine small packets of mixed cement and sand (such as is obtainable at any cheap stores), and a few odd pieces of wood.

The bird bath is made in three separate sections which are arranged to fit together, and the first step is to make the moulds.

Making the Moulds

The mould for the top of the bird bath consists of a shallow box, or tray, 10in. square and 2in. deep. Around the bottom inside edge strips of 1¼in. by ¾in. wood are nailed, as at A, Fig. 2. In each corner a

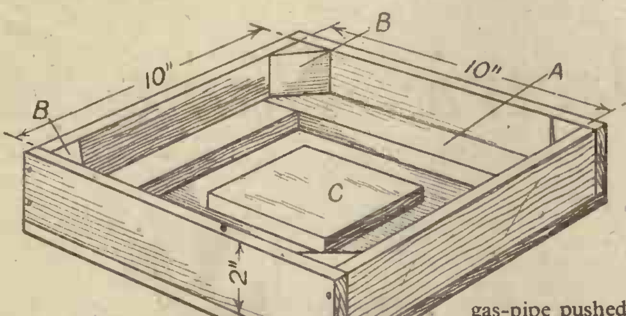


Fig. 2.—The mould for casting the top of the bird bath.

trianglar piece of wood (B) is nailed. These pieces are obtained by splitting a 2¼in. length of 1¼in. square batten. Each triangular piece is then sawn in half. In the centre of the bottom of the box, on the inside, another piece of ½in. wood, 4in. square, is nailed, as at C. This completes the mould, which can now be put on one side while the mould for the base is prepared.

This mould, shown in Fig. 3, is very similar in construction to the mould shown in Fig. 2, except that it is 12in. square inside, and has a deeper stepped centre part. In making this mould it is as well to make the part D of one piece of ½in. plywood, and to cut out the central square opening before nailing the part in place. Flush with the edge of this opening, strips of 1¼in. by 1in. batten, E, are nailed on to form an inner wall 1¼in. deep.

The wooden block, F, which is 4in. square and 1¼in. thick, forms the recess into which the bottom of the square pedestal rests, as indicated in Fig. 7. The block is nailed to a board, G, which in turn is nailed to the batten strips E. In the centre of the block, F, a hole is made to take a short piece of dowel rod, but more will be said about this later.

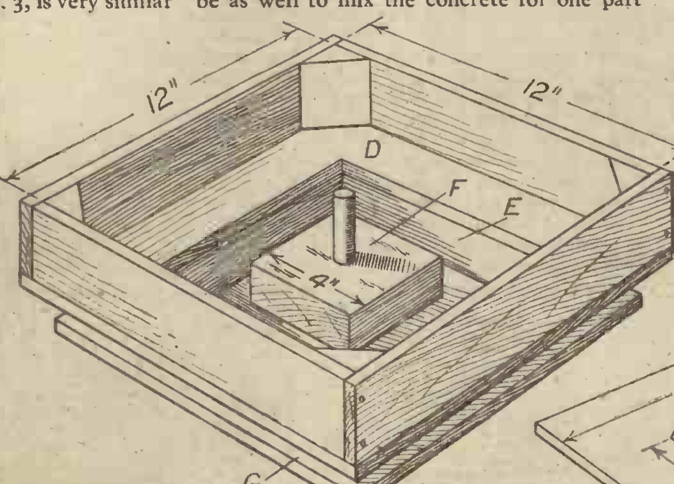


Fig. 3.—The mould for the base, or plinth, ready for filling with the concrete mixture.

To complete the mould another board, H, about 14in. square, will be required, and in the centre of this is nailed a piece of wood 6in. square and ½in. thick, after chamfering the edges, as in Fig. 4. A central hole is afterwards bored through a loose fit for the piece of dowel rod previously mentioned.

It will be noticed, by reference to the lower diagram in Fig. 5, that the corresponding mould, shown in Fig. 3, is upside down. This is because the mould has to be that way up when filling it with the concrete mixture.

Pedestal Mould

The mould for the square pedestal is of simple construction, as shown in Fig. 6. Assuming that wood ½in. thick will be used, two boards, 17in. long by 5in. wide, and two the same length but 4in. wide, will be required, and these are nailed together, as shown, to form a long box exactly 4in. square inside.

In the bottom end of the box a piece of wood 4in. square and about ¾in. thick is nailed, after having a 5in. length of old iron gas-pipe pushed through a hole bored in the centre of the piece of wood. The pipe should be about ¾in. outside diameter, and must project a distance of 1in. below the wood block. It is important to see that the piece of iron pipe is square with the surface of the wood block. Before nailing the block in place plug the top end of the iron pipe with a tight-fitting cork.

The moulds are now ready to receive the concrete filling.

Mixing the Concrete

As the bird bath is in three parts it would be as well to mix the concrete for one part at a time. Each part will take about three packets of mixed cement and sand. Nail a few odd pieces of matchboarding together to make a mixing board, or use a concrete garden path on which to mix the cement and sand with water. Add a little water at a time and thoroughly mix the concrete till it is of the consistency of mortar.

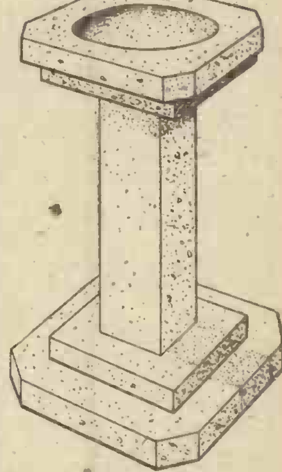


Fig. 1.—The finished bird bath.

Filling the Moulds

Commencing with the top part, take the mould (Fig. 2) and place it on a table or bench in the garden shed. Gradually fill the mould with the concrete mixture, using a trowel for the purpose. Press the mixture down in all the corners as the filling proceeds. When the concrete is nearly level with the top edge of the mould take an old hand bowl, or any utensil of similar shape, and about 9in. diameter, and lightly press this down in the centre of the mould, partly rotating it at the same time till a saucer-shaped impression is made in the plastic mixture, as indicated in Fig. 5. While the bowl is still in place remove any concrete mixture which is pressed out of the mould and level off with the

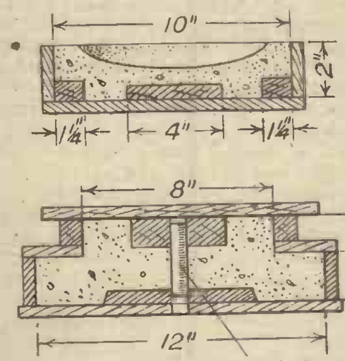


Fig. 5.—Sections of the two moulds filled with the concrete mixture.

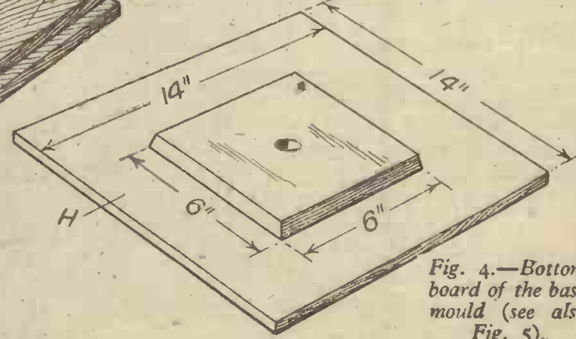


Fig. 4.—Bottom board of the base mould (see also Fig. 5).

trowel. The top diagram in Fig. 5 shows a section of the mould with its concrete filling and the saucer-shaped " bath."

The Base Mould

To prepare the base mould (Fig. 3,) for filling, obtain a 3in. length of dowel rod, the same diameter as the gas-pipe used in the pedestal mould, and fix it in the centre hole in the block, F, so that it projects about 2in. Smear a little grease on the dowel, and, after preparing the cement mixture, proceed to fill the mould till almost level with the edge. Now take the board, H (Fig. 4) and press it in place so that the end of the dowel rod enters the central hole, as shown in the lower diagram in Fig. 5. Make sure that the board is square with the sides of the mould, and then place a weight of some sort on to keep it pressed down while the concrete is setting.

To fill the pedestal mould, stand it on end, as in Fig. 6, and drop in the concrete mixture, a few trowelsful at a time. As the filling proceeds tamp down the mixture with a piece of square batten, and level off at the top flush with the edge of the mould. This can then by put aside with the other filled moulds till the concrete has set hard, and this usually takes three or four days.

Having made sure that the concrete has set hard, proceed to remove the wooden moulds by carefully prising apart the sides, bottom, etc., with an old chisel or broad-bladed screwdriver. The short wooden dowel in the base mould can be knocked out, leaving a hole in the concrete base into which fits the gas-pipe projection at the foot of the pedestal, when the latter is placed in position. The top of the pedestal fits in the square recess in the underside of the top part, as will be clear on reference to Fig. 7.

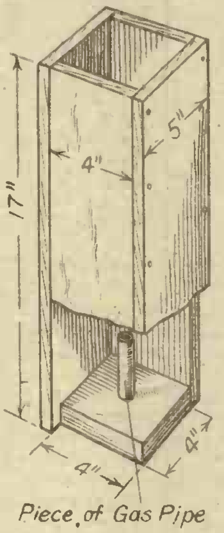


Fig. 6.—View of mould (part broken away) for the square pedestal.

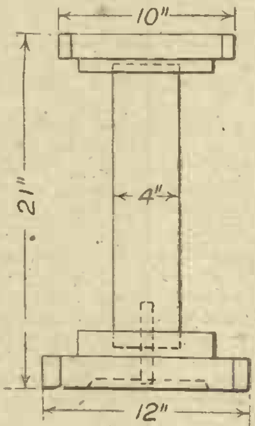


Fig. 7.—Side elevation, giving dimensions of the bird bath.

After removing any superfluous concrete around the edges, and brushing down with a stiff brush, the finished bird bath will be ready for standing in its permanent position on the garden path, or lawn.

Modifications

Although the dimensions given in the accompanying illustrations are suitable for a small bird bath, a larger one can be made to the same design by increasing the dimensions of the moulds in proportion. In this case a larger quantity of cement and sand will be required, and this can be obtained either by additional packets of mixed sand and cement or by purchasing separate quantities of cement and sand in the proportion of one part of cement to two parts of sand.

If desired, a tint can be given to the finished bird bath by incorporating a little powdered umber or yellow ochre when preparing the cement mixture.

Wind-driven Electric Plant

A READER, Mr. C. Weaving, of Bolsover, sends us the following letter:

" Having read with interest the description of Mr. F. G. Hales's Wind-driven Electric Plant in the February issue of PRACTICAL MECHANICS, I append an account of my own wind-driven electric light plant.

" I commenced to build the plant in 1936, and completed same in 1937. It is still in operation, and, as will be seen by the illustration, Fig. 2, it stands 30ft. high, with a 7ft. square base and 1ft. square at top. The tower is built entirely of bedstead sides, 88 being used in its construction. On the top was mounted a Morris car back axle, the road wheel shafts and driving shaft. The driver and driven wheels were reversed, thus giving a gearing of one revolution of the wind wheel to 6¼ to the driven shaft, which was then coupled to a car dynamo, 12 volt 10 amp. four brush type. The wind wheel was 6ft. 6in. in diameter, with eight fixed vanes 2ft. long × 12in. × 8in., and set at 30 deg. The rudder was 3ft. long and 2ft × 1ft. 6in. This was made to work on a hinge, and in the running position was secured by a pin, and at the front of rudder a pair of governors were installed. They were to control the rudder at 80 revs. of the wind wheel per minute. They opened, pressed against a plate that controlled the pin, and the rudder was pulled alongside of wheel by a spring, and that caused the vanes to fall edge on to the wind as the rudder turned into the wind, thus bringing the machine to a standstill.

" I have a 200 amp. capacity storage battery, and also Milnes unit. High tension and low tension batteries are charged up, and, with the exception of oiling, the set has been trouble free.

" And now a few words on moving vanes. Mr. Hales no doubt has spent a lot of time and trouble in building his variable vanes wheel; and I am not much in favour of governors being installed at the extreme edge of wheel. I think it is a complicated job swinging about, so I will describe the wheel I have built with moving vanes, and the same has been given a fair test of two years' hard work. The wheel is 6ft. in diameter, having six moving vanes 2ft. long and 10in. × 8in. The vanes were made to revolve around a galvanised tube, which was securely fastened to a steel disc on the drive shaft. At the front of this another smaller disc was made to work along the shaft on a keyway, and from this disc six rods were coupled one to the bottom of each vane at the rear. At the front of this disc a pair of governors were installed and spring-loaded, being set to suit the owner according to the wind-pressure he wanted them to work at. It will be understood, by reference to Fig. 1, that as the governors opened they pushed at back of vane and brought the front edge of vane direct into the wind line, so bringing the wheel to a standstill.

" In the electrical circuit are included amp. and volt meters, and also a cut-out."

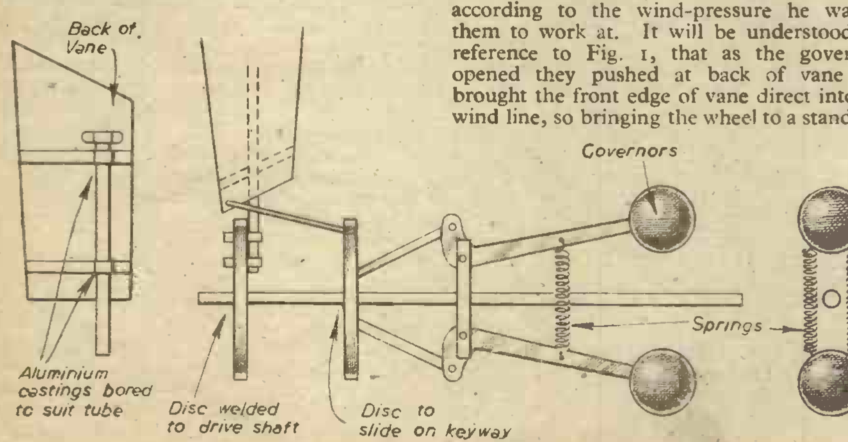


Fig. 1.—Details of the spring-loaded governor gear.

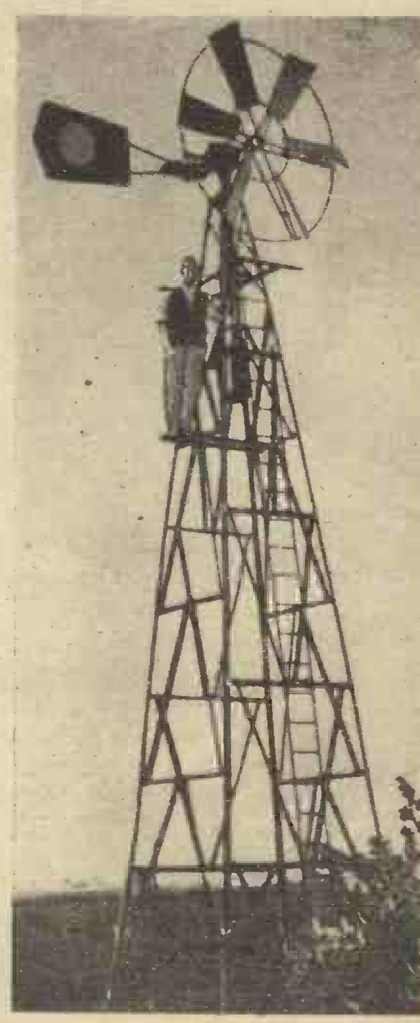


Fig. 2.—The finished windmill, with the owner aloft.

Our Busy Inventors

By "Dynamo"

The information on this page is specially supplied to "Practical Mechanics" by Messrs. Hughes & Young, Patent Agents, of 7, Stone Buildings, Lincoln's Inn, London, W.C.2, who will be pleased to send free to readers mentioning this paper a copy of their handbook, "How to Patent an Invention."

Easy Washing-up

THERE has been applied for in this country a patent for an improved machine designed effectually to cleanse plates and dishes with a minimum quantity of effort.

This new machine has an outer stationary drum and an inner drum, each arranged with its axis horizontal. The inner drum, which rotates, has within it a wire gauze chamber. This extends practically the whole length of the inner drum and opens out to an aperture in the wall of this drum. In the outer drum is an opening, possibly more than one, through which the articles to be cleaned can be inserted and removed from the gauze chamber. Outside the latter are tubes to which hot water is supplied. These tubes have holes directed towards the chamber, whereby jets of hot water may pass through the gauze on to the articles within. Means are provided for driving the inner drum.

In Lieu of Leather

"THERE'S nothing like leather," affirms the venerable adage. But the present scarcity of that incomparable material makes it imperative, as regards the soles of shoes, to find a locum tenens. And it is proposed that wood should come to our aid.

Wooden footwear is uncomfortably rigid. It lacks that flexibility which is an indispensable condition of easy walking.

It has hitherto been proposed to make a sole consisting of a flexible backing sheet with transverse strips of wood or other solid material attached.

An improved invention of this type has been submitted to the British Patent Office. The device provides a flexible backing sheet with cross strips attached. These strips have a plane face in contact with the backing sheet. The front and rear edges of the plane faces of successive strips are touching or only slightly spaced apart. And the adjacent faces of successive strips are convexly curved away from each other.

Preferably the strips are of practically semi-circular cross section and they may be arranged in parallel position.

A non-metallic substance other than wood might be used. For instance, a synthetic resin would answer the purpose.

New Beverage Plan

TO produce a head on beer and other beverages is the object of an invention for which a patent in this country has been applied.

The desired effect is caused by the interior of the terminal portion of a pipe—designed to deliver the drink under pressure—being subdivided into a number of tapered ducts. And each of these ducts converges to a separate delivery orifice.

The result is a miniature cascade which crowns the liquor with a mass of tiny bubbles.

To Test Glass

GLASS bottles are sometimes tested for strength by the impact of metal weights or hammers. An inventor who has aimed at improving on this method states that, when glass articles have been tested by dropping steel balls upon them, or by a hammer on a swinging pendulum, the impacts have been made against only one point, or against only a limited number of indefinitely located points.

He contends that such tests are not adequate. An effective test requires that the impacts be delivered at many points along the neck and body of the bottle, since there is usually a lack of uniformity in the thickness of the wall at various points.

Briefly described, the new invention comprises means for moving a bottle longitudinally of its axial line past a point at which impacts are applied while the bottle is rotated. As a consequence, not only are impacts imposed at a desired number of points spaced lengthwise of the bottle, but also at points on its circumference. By this method of testing, weak spots are likely to be detected.

One more phase in the contribution of science to the waging of the Battle of the Atlantic has recently been successfully demonstrated in tests of a fireproof lifeboat. The illustration shows the new lifeboat surrounded by smoke from burning oil during the tests. Note the canopy of asbestos treated material.

Dental Chair

A NEW variety of the adjustable dental chair emanates from Pennsylvania in the United States. The inventor has aimed to provide a chair in which the seat raising and lowering mechanism, which is telescopic, has been reduced to a minimum. Another feature of the device is that the operative parts are readily accessible for adjustment, repair or replacement.

Supple Soles

THE flexibility of the leather sole of a shoe is a factor which makes for the comfort of the wearer. It is often considered desirable to produce this flexibility prior to the attachment of the sole to the shoe bottom. One method whereby it may be effected is to submit the sole to a series of bending actions, which apparently loosen the fibres of the leather.

An improved machine for performing this bending operation has been devised. One of the objects of the invention is to provide a simple and efficient means of subjecting a sole to a number of bending actions in such a manner as will produce marked flexibility without injuring the material of the shoe.

This invention should not only minister to the ease of the pedestrian but should also enhance the grace of his gait.

To Retain Hairpins

THE hairpin has for many generations played an important rôle in the coiffure of the fair. In the reign of Queen Victoria it consisted of a wire forming a parallel with a curve at one end. However, this hairpin had a bad habit of working loose from the hair. Then a wave was introduced into the wire which made for the retention of the hairpin.

Akin to this latter kind is a hairpin which is the subject of an application to the British Patent Office. It consists of the usual parallel prongs, but it is differentiated from its corrugated predecessor by each side limb having parts cut away to form square-shaped indentations. However, no indentation is in such a position that it faces another on the opposite prong.

These hairpins may be of any colour; therefore, by being of the same tint as the hair, they could camouflage their presence.

Stereoscopic Television

AMONG the inventions recently submitted to the British Patent Office I note an apparatus for producing images by television in stereoscopic relief; in other words, a three-dimensioned picture.

This effect is obtained by a television system for transmitting images in stereoscopic relief by electronic apparatus which includes a cathode-ray tube for producing a moving light spot on a single field area of its screen.

A single lens focuses the light on to the required spot on the scene.

Close to the lens on the side remote from the cathode-ray tube is a multiple mirror. This is to convert the light into two spots which scan the scene from positions spaced apart the required distance to correspond to right and left eye views.

Toy Manufacture: Principles and Practice

Details of Construction of a Further Selection of Easily-made Mechanical Toys

(*Continued from page 313, June issue*)

A Small Sailing Boat

HERE is an easily made boat which will sail well if care is taken in building it.

The hull is made from a piece of wood, 9ins. long, 2½ins. wide and 1in. thick. Mark a centre line along the top and bottom of the wood and then carefully outline the shape of the hull, as shown in Fig. 96. With a tenon saw, roughly cut away the parts CC, and also the corners at the back (see Figs. 95 to 97). Now proceed to carve the hull to shape with a chisel. You will see by looking at diagrams A and D (Fig. 96) what the front and side of the hull should look like when finished. Give the hull a good rubbing all over with glass-paper. To represent planking, the parallel lines along the deck can be scored on with a bradawl, using a ruler as a guide.

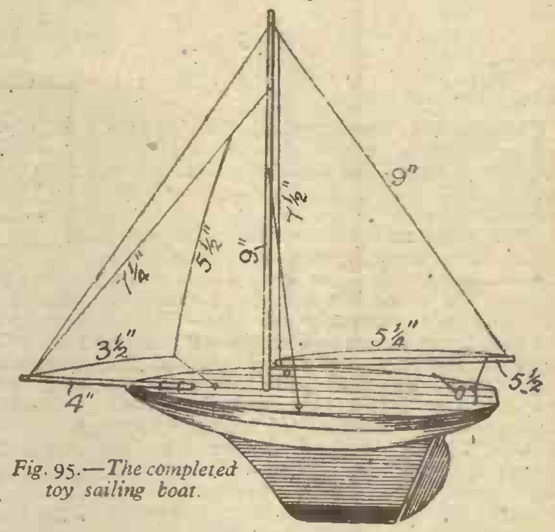


Fig. 95.—The completed toy sailing boat.

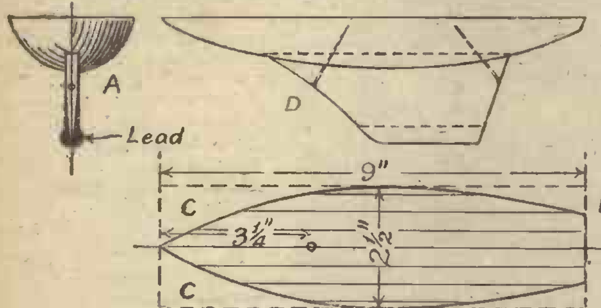


Fig. 96.—The hull is marked out and shaped as shown here.

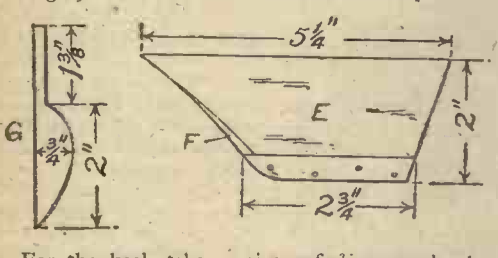


Fig. 97.—Diagrams showing how to make the keel and rudder.

For the keel, take a piece of ⅜in. wood, 5¼in. long and 2in. wide, and saw it to the size given at E (Fig. 97). Taper the front part at F so that it forms a narrow edge. On each side of the bottom of the keel nail on a strip of sheet lead about ⅛in. wide and file this to a round shape.

To fix the keel in place, cut a slot ⅜in. wide along the centre of the bottom of the hull, and after gluing the keel in place, drive in a couple of long, fine nails, as shown in D, Fig. 96.

The Masts, Spars and Sails.—Wooden knitting-needles, about 3/16in. diameter, can be used for the mast and spars, the lengths of which are given in the sketch of the finished boat. The bowsprit is fixed to the deck by two wire staples, and the bottom of the mast is pushed into a hole about ¾in. deep in the hull.

The sails can be cut out of fine white linen to the sizes given, allowing about ¼in. extra all round for hemming. Use very thin twine for the rigging and attach the ends of the shrouds to small screw eyes fixed in the deck.

The Rudder.—To complete the boat, a rudder can be fitted, fashioned out of a piece of 1/16in. fretwood to the dimensions given at G, the top part working in a hole in the hull, while the bottom part is held by two wire staples.

Give the hull two coats of white enamel and paint a ¼in. band of bright red or blue all round the hull. When quite dry, your smart little craft will be ready for its trial trip.

A Model Road Crane

This strong and instructive toy can easily be made with odd pieces of wood, a cotton reel, and pieces of wooden knitting-needles. For the platform (A) saw a piece of ⅜in. wood, 8in. long by 3½in. wide. Plane it on both sides and around the edges. Cut out four pieces of ⅜in. wood to the sizes given at B for the wheel bearings. These are screwed to the platform, as shown in Fig. 98, at a distance of ¾in. from each end. Now saw the two side pieces (CC) to the dimensions given in Fig. 99, and carefully smooth the edges with a chisel. On the centre line of each piece make two holes as indicated, just large enough to allow a thick wooden knitting-needle to pass through.

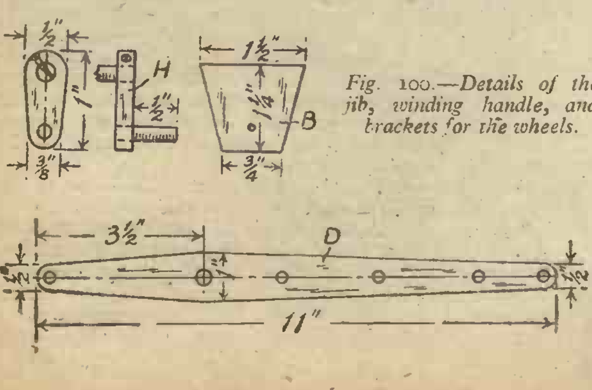


Fig. 100.—Details of the jib, winding handle, and brackets for the wheels.

Making the Jib.—To make the jib (D) cut two pieces of ¼in. wood to the shape shown in Fig. 100, and make the holes in each a tight fit for pieces of knitting-needle. Cut five pieces 1in. long, and one piece 2½in. long. Glue the end of the short pieces in the holes in the sides of the jib, after slipping a boxwood pulley between the top ends of the jib. The long piece passes through the hole E in each side piece, also through another pulley F, the rod projecting ⅜in. on each side. There should be a space of ⅛in. between the jib sides for the full length.

The Winding Drum.—This consists of a deep flanged cotton reel just long enough to fit nicely between the side pieces (CC), which are 1⅜in. apart when fixed to the platform. Now get a wooden rod or stout knitting-needle to fit the hole in the cotton reel, and cut off a piece 3in. long. Screw one side piece to the platform from underneath, place the jib and winding drum in position, and then screw down the other side piece. To strengthen the sides, screw two pieces of wood (GG) between them at the front and back, and also to the platform. Make the little winding handle (H) out of wood 3/16in. thick, and fix one end on to the winding drum shaft with a small screw, and glue a short piece of round wood in the hole in the other end. The rear end of the jib can be held down by a short piece of chain and a small screw-hook. The front part (J) and the driver's seat can be made

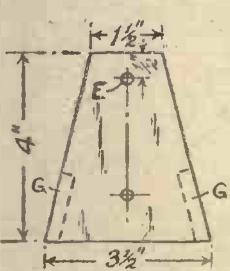


Fig. 99.—The measurements of the side pieces, C, C (Fig. 98).

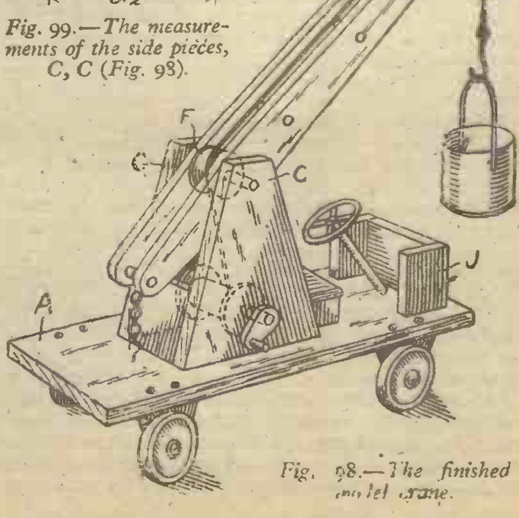


Fig. 98.—The finished model crane.

rom pieces of ½in. wood, and are nailed or screwed in place. The steering wheel is simply an iron toy wheel about 1½in. diameter, screwed on to the end of a piece of dowel rod glued into a hole in the platform. The running wheels are wooden ones, 1½in. in diameter, and are fixed to the bearing brackets with round-headed screws and washers.

The Finished Crane.—To complete the crane you will require 5yds. or 6yds. of thin twine, one end of which must be attached to the winding drum and wound up. The

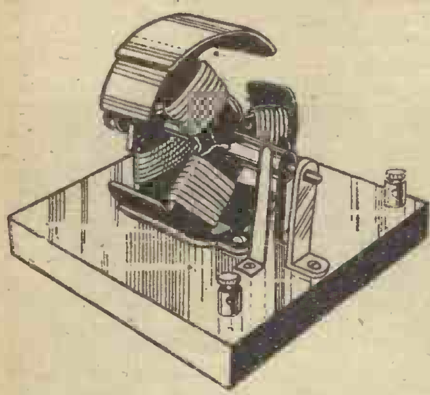


Fig. 101.—*A miniature electric motor.*

other end is passed over the two pulleys (see Fig. 98), and tied to a small hook, which you can bend to shape from a piece of thick wire. The little bucket can be made from a tin and a piece of bent wire.

The finished toy can be painted with enamel in one or two colours.

A Toy Electric Motor

Many of the simpler types of home-made electric motor have a fair turn of speed, but not much power. The motor we are about to describe, however, is quite powerful enough to work models, and at the same time quite easy to construct. The finished machine is shown in Fig. 101. It will be noticed that it has a three-pole armature revolving between a two-pole field magnet.

The materials required are some 20-gauge sheet iron, a few turns of insulated wire, a wooden base, and one or two odds and ends, including a small steel spindle and some brass strips, etc.

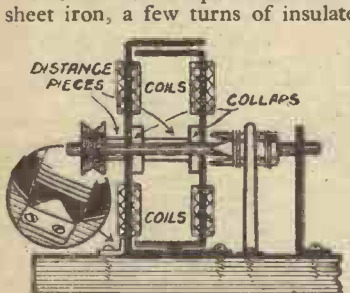


Fig. 105.—*Details of the brackets supporting the field magnet and armature shaft.*

Fig. 107.—*How the commutator is made.*

The Field Magnets and Armature.—First of all, carefully mark out on the sheet iron the shape for the field magnet and armature, as shown in Fig. 102. Cut these out very carefully with a pair of shears, using a file, if necessary, for the corners. The next job is to shape these "blanks." This should be done with care. It will be noticed that little triangular pieces are cut away where the blanks are bent to form the pole pieces (see Fig. 102). This is necessary if the pole pieces are to be properly shaped. To strengthen this part a little solder is run along the inside edge. Should you be unfortunate enough to break off one of the poles do not solder it on again, as this will offer a high resistance to the lines of force. Cut out another blank altogether. The best way to shape the poles is to model them round a piece of 2in. piping, or anything similar of the right diameter, using a hammer, as shown in Figs. 103 and 104. The whole performance of the motor depends on how well this part of the work is done. The idea is to have the smallest possible space between the magnet and armature poles. It is for this reason that the boring of the holes for the spindle should be left until the blanks have been shaped, otherwise after the shaping it may be found they are quite central.

Mounting the Armature Core.—The next step is to mount the armature core on the spindle. It should be soldered to the centre of a ¼in. steel rod, 2½in. long. A brass collar, sweated on, will give added support and help to square the armature on the shaft (see Fig. 105). A similar collar should be sweated to the field magnet concentric with the hole for the spindle to give increased bearing surface. A small brass bracket is sweated on the back of the field magnet to enable it to be mounted on the base.

Winding the Coils.—Now comes the winding of the coils (Fig. 106). First bind the magnet and armature core with Empire tape, so as to prevent chafing of the insulation, then wind three layers of 22-gauge D.C.C. wire on to the field magnet and each of the armature poles. The magnet coils are really one coil in two sections, and the same direction of winding must be observed when passing from the one section to the other. To prevent the finished coil unravelling, the last turn should be bound to the next with a needle and thread. The armature coils are each wound separately and in the same direction. The *inner* end of each coil is bared and twisted together with the *outer* end of the next, thus there are three pairs of wires ready to be connected to the three segments of the commutator.

The Commutator.—This latter is made from a piece of brass tubing ¾in. long and about ⅜in. diameter, cut longitudinally into three segments. Each segment is tapered at one end to make a tag, to which is soldered the ends of the armature windings. A fibre or wooden collar, ¼in. long by about ⅜in. diameter, is pushed on the spindle, and the three segments glued to it with a small space between each. Each end of the commutator is also bound round with strong thread and glued. Fig. 107 will make the construction of the commutator quite clear. The spaces between the commutator segments should be opposite the armature poles, but slight adjustment can be made, if necessary, when testing the motor by rotating the commutator on the spindle.

Mounting the Motor.—The motor should now be mounted on the base. This is a piece of wood, 3½in. by 3½in. by ½in. The field magnet is fixed in position first by means of three small screws. The hole in the centre of the field magnet forms the main bearing.

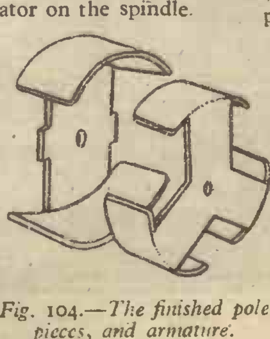


Fig. 104.—*The finished pole pieces, and armature.*

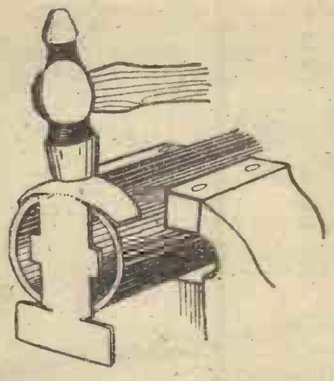


Fig. 103.—*How to shape the pole pieces.*

The other is made from a strip of the same sheet iron as is used for the magnet and armature. Two distance pieces made from a narrow brass tube are used to prevent lateral play, and a small pulley is soldered to the shaft to take the drive (see Fig. 105). The brushes consist of two strips of springy brass from a flash-lamp battery.

The Connections.—Two terminals are mounted on the base, the connecting wires being carried in grooves cut with a chisel in the underside of the base. A wire passes from one terminal to one end of the field magnet coil. The other end of the coil is connected to one of the brushes, and a wire taken from the other brush to the second terminal.

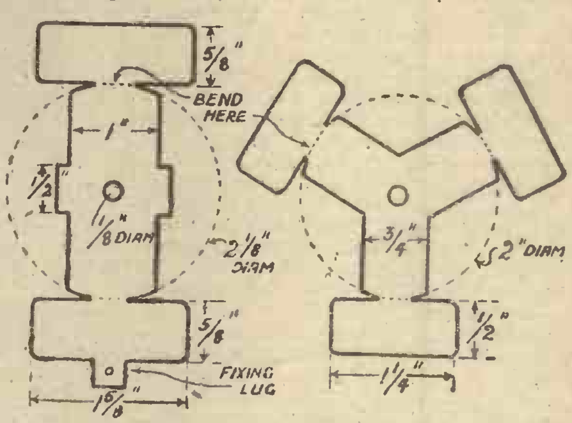


Fig. 102.—*The pole-pieces and armature cut out and ready for bending.*

Testing.—The motor is now complete, and may be tested. If it is sluggish in starting or excessive sparking occurs at the brushes, it means that the position of the commutator is not quite right. A little experimenting will soon determine the best position. Should the commutator work loose on the spindle through twisting it, a small "blob" of liquid glue will secure it. The brushes should not press too heavily on the commutator, but at the same time firmly enough to make good contact. A two-volt or four-volt accumulator will be found suitable as the source of power.

(To be continued)

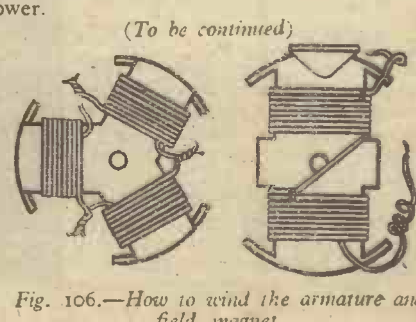
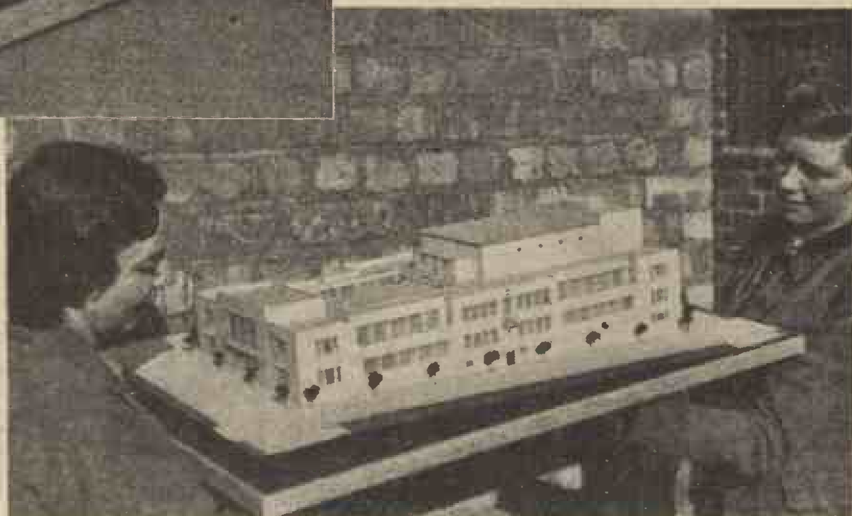


Fig. 106.—*How to wind the armature and field magnet.*

Front view of the model of the proposed Youth Centre, ⅛in. to 1ft., made by Bassett-Lowke, Ltd., Northampton.

THE WORLD

Proposed Memorial to Famous Aircraft Post-war Development



A rear view of the model.

Mitchell Memorial

THERE are few people—particularly, I should think, those with a mechanical bent—who have not heard of R. J. Mitchell, C.B.E., A.M.I.C.E., F.R.Ae.S., the famous designer of the Spitfire.

But not so many folk know he was a native of Stoke-on-Trent, and early this year his fellow townsmen decided that a memorial to Mitchell should be erected, and the Lord Mayor of Stoke-on-Trent, Mr. C. Austin Spoor, began the organisation of a scheme to perpetuate the memory of this aircraft designer in the way he would have wished.

He writes, in the special booklet prepared this year: "BUT FOR HIS GENIUS"—"As Lord Mayor of Stoke-on-Trent, I am proud that the designer of the 'Spitfire' was a Stoke-on-Trent boy. In his all too brief career, Reginald Joseph Mitchell designed aircraft that gave Britain pre-eminence over other countries in aero-construction. When war clouds gathered over Europe it is to his lasting credit and the salvation of his country that he turned his genius to the creation of a fighter-'plane. Although a sick man, and knowing he had but a short time to live, he gave Britain his master creation—the 'Spitfire.'

"In June, 1937, Mitchell died at the age of 42, and he cannot receive from a grateful nation the honours that were his due. I am sure, however, every one of us desires that a fitting memorial should be raised in homage to him.

"R. J. Mitchell had a tremendous belief in youth, and the youth of Britain vindicate his confidence in them by their supreme mastery of the air.

"It is my scheme to erect, as a memorial to Mitchell, a centre where youth may receive training in arts, science, engineering and sports.

"The extent of the scheme will be governed by the response of the public. . . . Building work will be commenced immediately after the war, and I shall welcome suggestions from donors as to how best they think the proposed building may meet the needs of youth."

In the booklet is an illustration of a suggested building designed by a Stoke-on-Trent architect, Mr. Harold Goldstraw, A.R.I.B.A., a youth centre which would provide the desired facilities and satisfy the needs for social enjoyment of leisure and cultural interest, where the friendships of youth might be formed under almost ideal conditions.

Self-managed

The centre would be self-managed by a committee of members with the voluntary co-operation of adults, and would cater for theatricals and instructional films, gymnasia and handicrafts. A combined theatre and cinema is provided with seating capacity of 750, and the auditorium floor made flat with removable chairs to enable the cleared space to be used for exhibitions of boxing, table-tennis matches, and so forth.

Club meetings, assemblies and dances would be held in the main hall, with refreshments for dances served in the canteen, with accommodation for 120, which can be opened up out of the main hall. Adjacent to the main hall are the boys' and girls' club rooms; and near the canteen is a kitchen and servery with an additional demonstration kitchen for members interested in cookery.

The games room adjoins the main hall, and caters for table-tennis, darts, billiards, etc., while there is also a full-sized gymnasium equipped with modern apparatus, including proper boxing ring, with adjacent showers and changing rooms for both girls and boys.

There is also a devotional room, capable of accommodating 200 people, and a large library adjoining.

One of the aims of the movement is that of the upkeep of the buildings—with the excellent idea that painting, decorating, electrical work, the replacement of furniture, and making of scenery should be done by members—and a room on the lower ground floor is devoted to woodwork, engineering and electrical work. For the girls, too, there are rooms for basket work, dressmaking, and so forth, including the making of stage costumes and draperies.

Two rooms are provided for art—one for life and modelling, and the other for general design. It is intended that the club should cater for all types of instrumental and vocal music, with lecture facilities and practice room, and the music room is sound-proof, and well removed from any of the quiet rooms. A photograph dark room is housed in the sub-basement, and first-aid instruction and treatment of minor injuries is provided by a clinic and first-aid room.

How much more fitting a memorial to Mitchell than a dead statue; let us hope before many years have passed it will be in being.

Two views of the model of

View of a 9in. model lifeboat as she would look converted to a model sailer.

OF MODELS By "MOTILUS"

Designer : An Interesting Boat Conversion for Ingenuity in Model Locomotives

the Youth Centre are included in the accompanying illustrations. The model, made by Bassett-Lowke, Ltd., is to the scale of ¼in. to the foot.

This model of the Centre was displayed at the King's Hall, Stoke-on-Trent, in April, in connection with the "Wings for Victory" Exhibition, and evoked great interest among both the local folk and those visitors who came from out of the district, for Mitchell's name is one of national note.

Model "Motor Sailer"

Before the war there was increasing activity in the motor-boating world frequenting our rivers and waterways and also taking short coastal trips. Some people owned expensive and luxurious boats, not within the reach of the man of moderate means, but a friend of mine who is a constructional engineer on one of our Catchment Boards dealing with river development, is also very keen on motor-boats and model-making.

After the war he has the idea of converting a ship's lifeboat, and the accompanying diagrams show what a pleasing effect could be obtained with such a conversion. He is also an amateur model maker and has made a model about 8ins. long, showing a 32ft. by 9ft. 6in. lifeboat (to a scale of ¼in. to 1ft.), converted into a "Motor Sailer." The engine suggested is about 25-30 h.p., which would give a speed of 7 knots, and she has a sail area that would make her independent of the motor except in the lightest of winds.

A boat of this type would have a moulded depth of about 4ft., and my friend's idea is to raise the planking some 9ins. amidships and then further raise the cabin sides about 15ins., with a camber of 9ins. to the cabin top. This would give approximately 6ft. head room in the cabin.

The design, which is of attractive appearance, comprises fairly good accommodation — folding bunks, a saloon, cook's galley, and saloon amidships. The boat is given a 12in. keel for nearly the full length, and therefore can sail well into the wind. The "top hamper" is not excessive but at the sacrifice of head room could be cut down for anyone who wanted a boat capable of carrying out more ambitious voyages than coastal cruising. The draught of 4ft. would allow of inland waterway cruising.

There may be some of my readers who doubt the wisdom of lifeboat conversion, but these are well constructed craft, and I know of many who have had pleasant cruises in smaller craft and in real "weather"!

Those who are able to "commandeer" a ship's lifeboat for post-war reconstruction should find in this conversion the germ of an excellent idea.

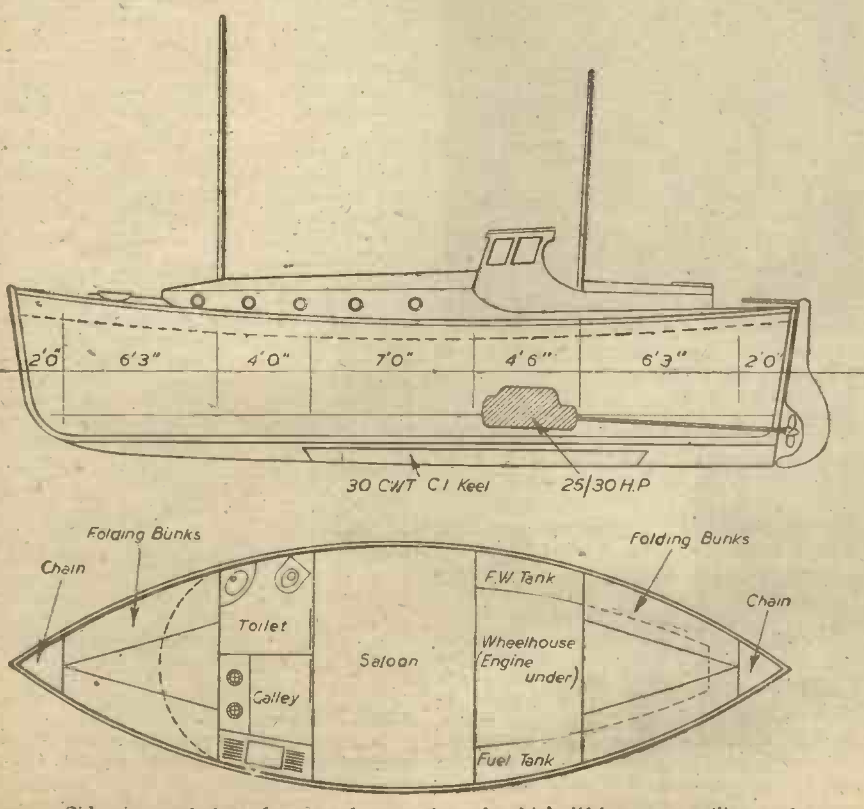
Novel Model Loco Conversion

Looking in at Bassett-Lowke's London shop when in the metropolis the other day, I was rather amused at a novelty which that alert and bright member of the technical staff, Mr. H. M. Sell, had to show me.

It was one of their standard gauge "O" Enterprise steam locomotives, which some ingenious owner had converted into a streamline model. As will be seen from the illustration the casing was simply constructed of tinplate and fitted neatly on to the main frames of the model, and was easily removable to deal with any oiling or adjustments that might be required for the model.

This arrangement enabled the owner to use the model either as an ordinary locomotive or as a modern streamliner, the tender being suitably camouflaged as required.


An ingenious streamlined locomotive model.



Side view and plan of proposed conversion of a ship's lifeboat to a sailing craft.

The Story of Chemical Discovery

The Secrets of Sugar

A Modern Revelation of Synthetical Chemistry

THE ancient Greeks were, as a race, endowed with more than ordinary attributes of imaginativeness and curiosity. They sought out stories and legends from the very ends of their known world. These they collected and classified with a view to incorporating any worth-while information into their prevailing systems of knowledge and philosophy.

One of the occasional travellers' tales which the old Greeks treasured up in their memories concerned the supposed existence, in the mysterious lands of the East, of certain tall reeds which imbued themselves with sweet honey without the intervention of bees. That was all, however, the Greeks ever got to know about the sugar cane which grew in India in the uncultivated state. It was the Arabs who introduced sugar into Europe via Spain; and it was not until the seventeenth century, when European colonists began to discover fresh countries, that the West Indies became a rival to the East Indies in the matter of sugar growing.

It is rather amazing to think that in medieval times common sugar was unknown in England, and such a fact becomes more remarkable still when we consider that immediately previous to the present war the average world output of cane and beet sugar was approximately 35,500,000 tons. Man, in modern times, has become a confirmed sugar addict. To our present civilisation, a sugarless diet is unthinkable, even as a tobaccoless age would be anathema to many of us.

Our modern sources of sugar are, of course, the sugar cane and the sugar beet—the latter growing in Europe and even in this country. Beet sugar is one of the triumphs of early chemistry, for it was first discovered in 1747 by Marggraf, a Berlin chemist, who managed to obtain about 6 per cent. of a poor quality sugar from his beets. One of Marggraf's pupils, in 1801, set up a beet-sugar factory near Breslau. This, the world's first manufacture of beet sugar, was not particularly successful until Napoleon took up the idea in the hopes of rendering his country independent of overseas supplies of cane sugar and offered a prize of a million francs for a really practical process of extracting beet sugar.

And so, by degrees, beet sugar introduced itself into the world's commerce as a competitor of cane sugar. It was, indeed, a fortunate occurrence, for, if we had no beet sugar, the available supplies of sugar cane would be utterly insufficient to cope with the present world demand for the sweet product.

Chemically, "sugar" is a name which must be applied merely generically to a whole class of compounds. There are many natural sugars known, and these, taken together with the large number of artificial or synthetic sugars which have been created in laboratories, must nowadays total several hundreds.

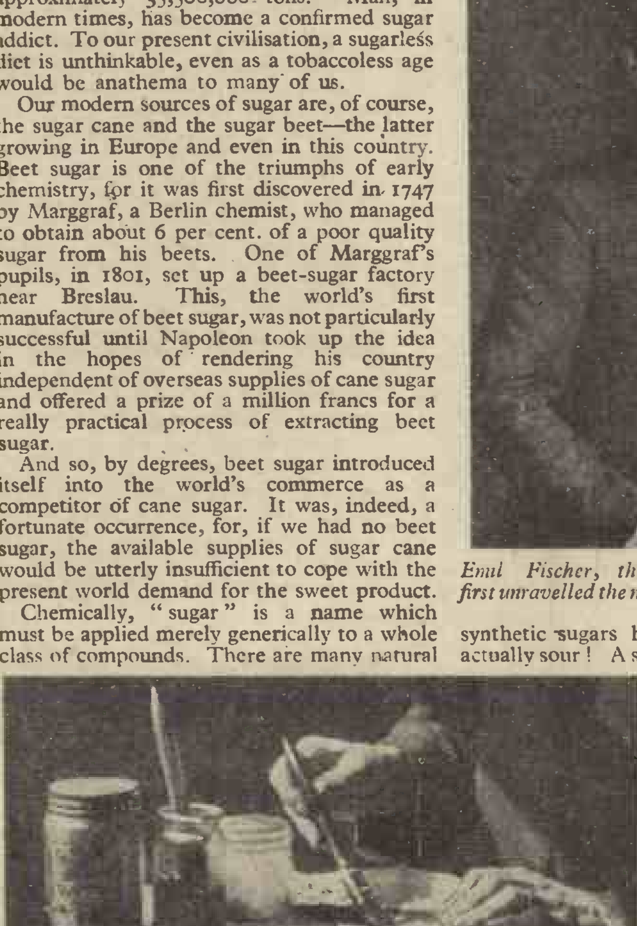
Sour Sugars !

Nevertheless, all chemical compounds to which the term "sugar" can be applied are all built up on similar lines, and have pretty much the same basic structure. Nature's different sugars are all merely variants of the one blueprint design, and when man comes in this scientific age to create for himself new and non-natural sugars in his laboratories he has, in every case, to adapt his chemical designs to Nature's one fundamental specification for this type of compound.

It is quite a fallacy to think that all varieties of sugar are sweet tasting. Raffinose, one of the constituent sugars of the beet, is quite tasteless, whilst a few artificial or synthetic sugars have been made which are actually sour! A sour sugar sounds something of a contradiction of terms, yet such things are possible.

Sugar canes growing to a height of 10–15ft.

Emil Fischer, the synthetical chemist who first unravelled the mysteries of sugar composition.



Dextrin, the basis of many modern pastes and adhesives, is a compound intermediate between sugar and starch. It has powerful adhesive properties.

Sugars contain only carbon, hydrogen and oxygen. They are, therefore, termed "carbohydrates." Pound for pound, there is no more nutritious food than sugar, for, as a food, it is unique in containing no waste. When sugar is burned it splits up into carbon dioxide and water on the following lines:

$$C_{11}H_{22}O_{11} + 12O_2 \rightarrow 12CO_2 + 11H_2O$$

(Cane sugar) (Oxygen) (Carbon dioxide) (Water)

and when man or animals feed on sugar, the result is exactly the same. Ordinary sugar, therefore, is one of Nature's concentrated fuels for the human body. It is, as it were, Nature's own smokeless fuel, which gives rise to no waste and no ash.

When the yeast plant feeds on sugar solutions it carries the oxidation of the sugar to a less complete stage than does the human body. It converts at least a proportion of the sugar into an intermediate compound known as alcohol, or, to be strictly correct, *ethyl alcohol* (for there are many different types of alcohols), as indicated below:

$$C_{12}H_{22}O_{11} + H_2O \rightarrow 4\,C_2H_6O + 4\,CO_2$$

(Cane sugar) (Water) (Alcohol) (Carbon dioxide)

The yeast plant, however, can never convert the whole of a given quantity of sugar into alcohol, for when the alcohol reaches a certain concentration (about 16 per cent.) it poisons the yeast cells, so that the production of alcohol ceases.

This technique of fermentation is quite a natural process, and it is on account of this fact that both sugars and alcohol are found existing side by side in natural objects. For example, sugar is found in ripe fruit, but when the fruit becomes over-ripe and begins to decay, alcohol makes its presence therein, some of the sugar having been fermented by the wild yeasts which fall upon the fruit.

For nearly a century after the first scientific examination of commercial sugar had been made, the chemical make-up of the sugars remained a complete mystery. True enough, it had been proved that sugars contained only carbon, hydrogen and oxygen, but exactly how this trio of elements was associated or combined together to make up the glistening white crystals of the various pure sugars was utterly an unknown speculation.

Emil Fischer

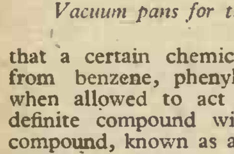
It is to the genius of one man that chemical science is indebted for the complete elucidation of this mystery of sugar composition. This scientific worker was the famous Emil

Fischer, Professor of Chemistry at Berlin, who during the sixteen years intervening between 1884 and 1900 patiently and painstakingly worked out Nature's own design in the creation of her sugars and who, in the bargain, imitated her so successfully that he made scores of new sugars himself.

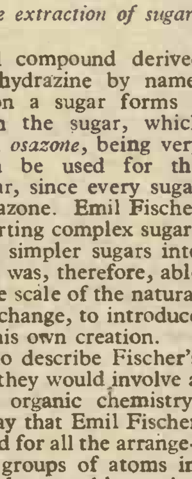
It was Fischer, too, who proved that sugar and starch are related. Fischer's working technique in the chemical elucidation of the sugar problem was a highly technical and complicated one. Briefly, Emil Fischer found that a certain chemical compound derived from benzene, phenyl-hydrazine by name, when allowed to act on a sugar forms a definite compound with the sugar, which compound, known as an *osazone*, being very specific in nature, can be used for the identification of the sugar, since every sugar has its own particular osazone. Emil Fischer found a method of converting complex sugars into simpler sugars, and simpler sugars into more complex ones. He was, therefore, able to ascend and descend the scale of the natural sugars and, by way of a change, to introduce into existence sugars of his own creation.

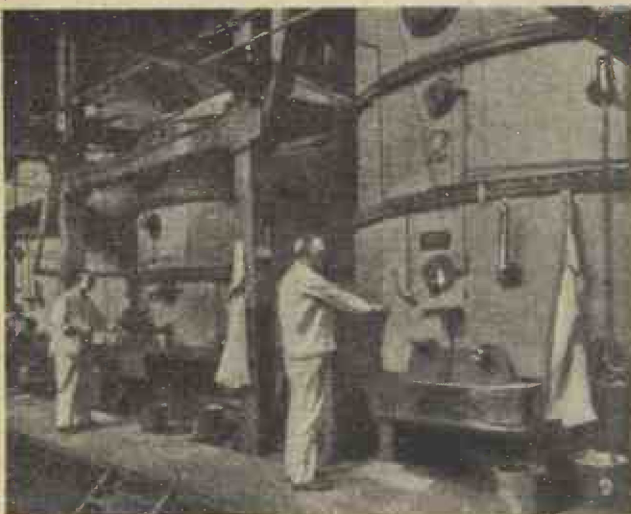
It is impossible here to describe Fischer's technical methods, since they would involve a knowledge of advanced organic chemistry. Suffice it, therefore, to say that Emil Fischer was able to prove once and for all the arrangement of the atoms and groups of atoms in sugar molecules and that he was able to give practical directions for the synthesis of any desired type of sugar.

The oldest and the best known pure sugar is cane sugar, which is, chemically speaking, *sucrose*. But sucrose is by no means the simplest sugar. A simpler sugar is *glucose* (or *dextrose*), whose composition is represented by the formula :



Glucose is often known as "grape sugar," for it is found in large amounts in grapes and other sweet fruits. Now, *maltose*, or malt sugar, is a sort of double glucose, since its molecule comprises two glucose molecules connected together through an oxygen atom :





Vacuum pans for the extraction of sugar from sugar cane.

Another sugar which often occurs in fruit juices side by side with glucose is *fructose*, or fruit sugar. This sugar is sometimes called *levulose*. It occurs, also, in dahlias and Jerusalem artichokes, from which it has been extracted on the semi-commercial scale. Of the ordinary sugars, fructose or levulose is the sweetest although the less common.

Saccharoses

Our ordinary cane sugar, or sucrose, is, in reality, a sort of combination of glucose and fructose. It is one of the "higher" or more complex sugars, a "di-saccharose," as it is called, since it forms a combination of two simpler sugar units. When sucrose or cane sugar is boiled with a dilute mineral acid, such as sulphuric acid, it gives rise to equal quantities of glucose and fructose, each of which, being simple or unit types of sugar, are known as a "mono-saccharose."

Maltose, above mentioned, is a di-saccharose, for it consists, as we have seen, of two glucose units. Consequently, when boiled with a mineral acid, maltose gives glucose only.

Milk-sugar, or *lactose*, when boiled with dilute mineral acid, forms two other sugars, glucose and *galactose*, both these being mono-saccharoses or simple sugars.

It was by combining together different simple sugar units that Emil Fischer, the great chemical apostle of sugar science, was able to bring his new synthetical sugars into existence.

Most of the sugars are vegetable products, but there are a number which are present in animals. Lactose or milk sugar, for instance, is found in the milk of all mammals to the extent of about 4 per cent. It is also obtained as a by-product in the manufacture of cheese. There are traces of special sugar compounds, called *glucosides*, in the heart muscles and in the other muscles of our bodies. Compounds of glucose constitute many of the wonderful colouring matters of foliage and vegetation, compounds whose true nature is only nowadays being fully revealed.

The Secret of Starch

Starch is a common material which has long been known to be made up in some way out of sugar, because when starch is mixed with water and a little weak acid is added to it, it is slowly converted into a well-defined sugar —glucose. The same thing happens when the acid juices in our body act on the starchy foods which we eat, the bread, the potatoes and the various other farinaceous articles of our diet. We cannot directly assimilate starch into our systems, but we have the means of ingesting or assimilating the simple sugars, such as glucose. Consequently, Dame Nature conveniently arranges that our digestive apparatus automatically breaks down all the starch which we eat into glucose, which sugar is then at once absorbed into our blood through the intestinal walls.

The sugar beet, from which much of our present-day sugar is obtained.

Despite the fact that chemists have long known that starch and sugar are somehow connected, that starch is a sort of complex of glucose molecules, the constitution of starch has remained a mystery until the last year or two, for it was only as recently as 1940 that starch was, for the first time in history, synthesised or created artificially by C. S. Hanes, who obtained it from glucose by a roundabout method. Starch, it has been now definitely proved, is merely a vast complex of glucose molecules. It is a "poly-saccharide" or a "poly-saccharose," the term implying that many sugar molecules are concerned in the composition of starch.

Between starch and sugar, there are two most interesting compounds. The first is *dextrin*, a white powder, with a peculiar faint, "gummy" smell, which dissolves in hot water to form an excellent adhesive, and which is made up into various commercial pastes and sticking compositions. Dextrin is made by carefully breaking down starch by heating it to 210 deg. C. or by treating it with dilute mineral acids. When dextrin is *boiled* with dilute mineral acids, it is changed into glucose.

Glucose and Glycogen

A still more interesting compound is *glycogen*. Glycogen is half-starch, half-sugar, and, like dextrin, it forms an intermediate compound between starch and glucose. Chemically, glycogen is composed of an assembly of about a dozen glucose molecules. In appearance (in the pure state) it takes the form of a white powder, not unlike starch or dextrin.

The great feature of interest concerning glycogen is its vital rôle in the mechanism of our bodies. When starch is taken into our stomachs and is broken down into glucose, the latter compound, as we have seen, is absorbed into our bloodstream through the intestinal walls. The absorbed glucose is immediately changed into glycogen, which substance is stored in the liver and in the various muscles of our body. It is as though our bodies, for economy's sake, at once exerted a concentrating action upon their supplies of absorbed glucose, changing the latter immediately into glycogen, which, on account of its greater structural compactness, is better suited for physiological storage.

The muscular fuel of our bodies is glucose, which latter substance is distributed to our bodily muscles from the glycogen of our livers. When we exert a muscle, we use up glucose. We oxidise it, or, as it were, burn it up and destroy it.

Dulcin and Saccharine

In dwelling upon the fascinating topic of sugar and its synthesis, it should be carefully borne in mind that sweetening agents of the saccharine type are *not* synthetic sugars. Saccharine, indeed, is a coal-tar compound, derived from toluene. Chemically, saccharine is *ortho-benzoylsulphimide*, $C_6H_4.CO.NH.SO_2$. It contains sulphur, and is made by acting upon coal-tar toluene with chlorsulphonic acid, and by treating the resulting product with ammonia.

Saccharine is about 450 times sweeter than cane sugar (sucrose). It is, however, no new product, it having been first discovered in the John Hopkins University, U.S.A., by two chemical workers, Ira Ramsen and Charles Fahlberg.

The only other non-sugar sweetening agent which has been made commercially is *dulcin*, which, chemically speaking, is *para-ethoxyphenylcarbamide*, and which possesses the formula, $C_2H_5O.C_6H_4.NH.CO.NH_2$. Dulcin is 200 times sweeter than cane sugar.

The Distribution of Electricity

Third Cantor Lecture Given Before the Royal Society of Arts

By E. AMBROSE, M.I.E.E.

(Continued from page 319, June issue.)

Distribution at Constant Current

ELECTRICITY may be distributed either at constant current or at constant voltage. With constant current all the consuming apparatus are in series with one another and with the generators; the breakdown of any one of the consuming devices results in the interruption of the service. Special arrangements must be provided for by-passing the faulty device so as to maintain continuity of supply. As the current remains constant, an increase of power at any point is possible only by raising the voltage. The system has been used for the lighting of street lamps in series, in which direction it found its greatest, and perhaps only, development on the side of distribution. A constant-current high-voltage series system for transmission, as devised by Thury, has been in operation for some years in France and Switzerland. One installation was put down in this country by Mr. J. S. Highfield for the Metropolitan Electric Supply Co., Ltd., in 1910. The cable was designed to work at 100 amperes, with increasing voltages up to 100,000. An electrostatic machine was specially constructed for testing the cable at 100,000 volts after it had been installed. The machine, together with the small motor for driving it, was enclosed in a steel casing in which the air was maintained at a pressure of 100 pounds per square inch.

This pioneer system was in operation until 1924, when it was replaced by an extra high voltage three-phase system.

Distribution at Constant Voltage

In general, the distribution of electricity is carried out at constant voltage. In this system all consuming devices are connected in parallel across the supply mains. Thus each device is independent of the other, and the failure of one piece of apparatus does not interfere with the supply to its neighbour, since each device—such as lamps, motors, heating apparatus and cooking appliances, etc.—is designed to be operated at a definite voltage. The supply engineer is required to maintain, as nearly as possible, a constant voltage at the consumer's terminals, the current being the variable quantity.

Regulations Affecting Distribution

The principal provisions regarding the mains and distribution networks of undertakings supplying electrical energy to the public are contained in the Regulations of the Board of Trade and the Electricity Commissioners under the Electricity (Supply) Acts of 1882 to 1926. They provide for the means to be taken to secure the safety of the public, and an efficient supply of electrical energy.

Before commencing to supply, the standard pressure on the distributing mains must be fixed by the undertaking and public notice given of the figure decided upon. The limiting condition affecting the design of the distributing system is that the variation of pressure at the consumer's terminals may not exceed 4 per cent. from the declared constant pressure at which the undertaking has stated the supply would be given. With alternating current systems the frequency of supply must also be declared and the variation of frequency may not exceed 2½ per cent. from that figure.

Principles of Distribution

One of the important principles of distribution which has to be considered is the location of the generating station or main source of supply, relative to the distributing network.

For preference the station would be placed in the centre of the demand for supply, thereby keeping all the mains as short as possible; in this way the losses would be reduced to a minimum. Unfortunately, as a rule, stations cannot be located in this way, owing to commercial considerations which are of the first importance. Another essential matter is the efficiency of the system. This necessitates the utmost use being made of the copper in the distributing network. Continuity of supply is also of great importance, and this requires that the maximum current densities be kept low enough to prevent over-heating of the cables and connections. Pressure regulation must also be borne in mind, and the system must be designed so that the pressure at any consumer's terminals should not vary beyond the limits fixed by the regulations.

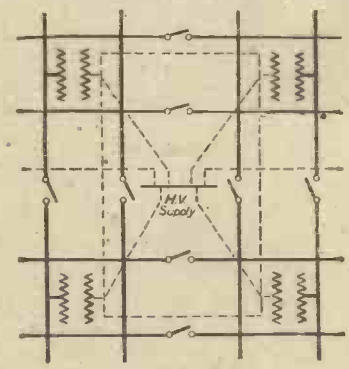


Fig. 10.—Diagram illustrating solid L.V. network.

The Distributing Network

A main is any electric line laid down in any street or other place, through which electrical energy is supplied. A distributor is a main which is used to give origin to the services of the consumer. The distributing network consists of mains arranged in the form of a network from which services can be taken to give supply to premises in a number of adjoining streets. In the past many of the smaller generating stations fed directly into the network through feeders, or cables, which conveyed current from the station to selected points in the network. Without this arrangement of feeders the consumers nearest the station would be getting the generated voltage, whilst consumers remote from the station would be receiving a much lower voltage due to the loss in mains. Networks of this type were usually supplied with direct current by the three-wire method with voltages not exceeding 460 across the outers for motors, and 230 between outer and middle for the ordinary domestic lighting and heating circuits. Naturally the first networks to be put down were for the purpose of supplying electricity to cities or urban towns as offering the best chance of making the greatest use of the network, and thereby obtaining a good return for the capital invested.

The engineers who put down the original low-voltage networks were faced with the problem of estimating the consumer loads, the growth of the demand, and the possible change in character of the district itself. To install insufficient copper would result in the necessity of opening the streets in a short time in order to replace the distributor cables with others of a larger cross section, and to remake all the service connections. Apart from this there would be an interruption of supply to several consumers whilst the work was in progress. On the other hand, to put in an excess of copper was considered by some to be the right course to adopt so as to provide for unseen development.

Although the problem is readily amenable to mathematical treatment, little can be gained by such investigation, as the engineer has to meet the conditions he finds in practice and cannot create such as would enable him to utilise his theoretical deductions.

In addition to the uniformly distributed load assumed for shop and domestic lighting, allowance had to be made for heavier concentrated demands, such as hotels, factories, office blocks, etc. In order that a fault, which might occur on a distributor or on a consumer's service, should cause as little dislocation of supply as possible, a

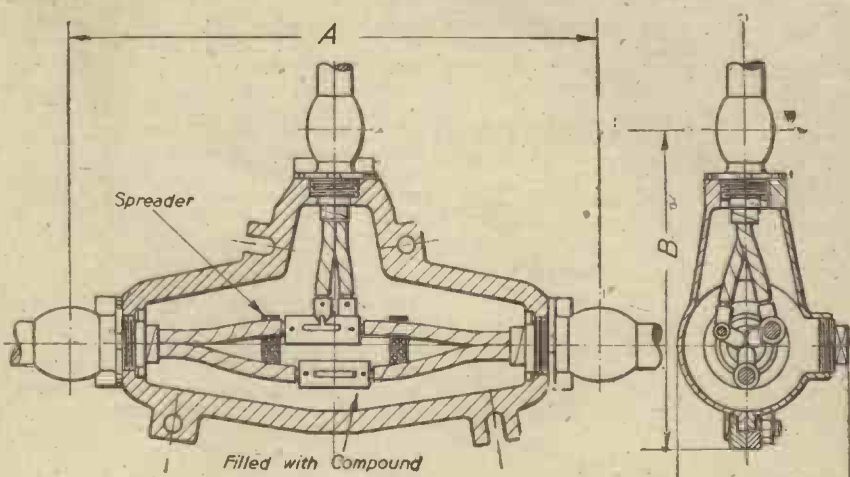


Fig. 9.—Method of making a two-wire service from a three-core cable.

number of network fused disconnecting boxes provided with light fuses were inserted at selected points. Should a fault develop at any one point, the fuses would blow in the network boxes on either side of the faulty section. Careful consideration had to be given in selecting the points at which to insert these boxes. The best positions were those at which normally no current would flow—called nodal points. In a network in which the load demand shifted, due possibly to the connection of a large hotel, the nodal points also shifted, with the result that in some of the network boxes current was normally flowing through the fuses, and not in others. In this way, fuses were often blown, on the occasion of a fault, in boxes which should not have been affected.

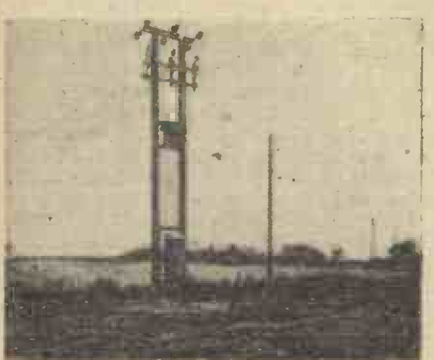


Fig. 11.—Overhead line showing pole mounted transformer.

In cities and large towns, the cables for the three-wire direct-current networks were usually of the concentric and triple concentric type, although later, three-core cables were used. They were drawn into earthenware ducts, fibre conduit, or iron pipes laid just beneath the footway with draw pits for pulling in the cables at suitable intervals. In some instances a small brick chamber with a surface cover was provided in the run of the pipes or ducts, opposite the dividing line between each pair of houses or shops, in readiness for making the service connection. In this way little obstruction was caused in the streets when service connections were being made, or when it became necessary to change a length of distributor for one of a larger section. Fig. 9 shows a method of making a two-wire service from a three-core cable.

In urban and country towns the cables were laid generally on the solid system devised by Callender. When properly laid, this method affords to the conductor perfect protection against mechanical damage, chemical action and other troubles, including those caused by vermin. It is also free from one of the great drawbacks of the culvert and the draw-in system, namely, the danger of accumulations of an explosive mixture of gases, or water in the spaces surrounding the conductors. Compared with the draw-in system, it has the disadvantage that should it become necessary to remove the conductor, this would involve the opening up of the street, and the breaking up of the mass of bitumen protecting material around the cables. Further, with this system it is not possible to lay down additional cables without breaking up the street.

In rural districts where the growth of the load develops more slowly, and the opening of the ground causes little or no obstruction, the armoured cable originally introduced by Siemens is very much used. Over the lead covering of the cable, an armouring of steel tape or steel wires is provided which gives mechanical protection, and this permits of the cable being laid direct in the ground without any other form of protection except, perhaps, a warning board or tile laid above it to draw the attention of any workmen who may be engaged in opening the street in the vicinity of the cable.

Feeding Points

When a distributing system is first projected, it is usually possible to fix upon likely feeding points to which the feeders might be connected. As the load demand increases, other feeders could be installed and put into use, and, if necessary, the first selected feeding points discarded and others substituted to meet the new requirements. Of course, with a system of mains laid either solid in bitumen or direct in the ground, changes of this sort were more or less out of the question. With a draw-in system, however, especially for the feeder cables, the original conductors could be removed and relaid, or any alterations in position and size of cables made when and where they seemed advantageous.

Feeders are not directly revenue earning, and any unnecessary increase of capital expenditure in this direction tells against the capital and maintenance costs and the cost of load losses. The feeders should be run by the shortest street routes to the centres of heavy load, and, if possible, to points where several streets intersect so that as many as possible of the distributors may be fed. In this way the pressure drop and the weight of copper can be minimised. In order that the engineer in charge of the system might know the pressure at the feeding points, it was usual to run underground with the feeder a pair of small wires called pilots. These wires were connected at the feeding points and gave indications on a voltmeter at the generating station.

As the load increased and the area of supply extended, necessitating the laying of additional feeder cables from the station, engineers began to find it difficult in some of the older direct current systems, fed directly by radial feeders from the station, to find space in the ground for the cables. The crowding together of a large number of cables at one point reduced their current-carrying capacity owing to the heating effect of adjacent conductors. As the area of supply continued to expand the current density of the cables had to be reduced in order to keep the pressure within the permissible limits. The whole network had to be interconnected either through fuse or link boxes, in order to make use of all available copper, with the result that the development of a fault on any portion sometimes caused network fuses to be blown at points far removed from the fault.

Where a supply of alternating current could be obtained in bulk in place of the small local generating station, an existing three-wire direct current network might be improved in efficiency and regulation by installing mercury arc rectifiers at selected points of the network. The rectifiers might be placed in small sub-station buildings to which a supply could be taken at high voltage three-phase alternating current. After rectification, the supply could be delivered to the network by short radial feeders, the copper for which could be recovered from the original feeders that gave supply from the generating station. As the network area increased it could be fed from a further mercury arc sub-station, or if it were intended ultimately to change over the network to alternating current, the extension of the area might be dealt with by laying down the nucleus of a three-phase four-wire system, and so gradually make the change over of the whole area.

Modern Systems

Although in the past there have been many different voltages and frequencies in the various undertakings of this country, there is now, following the passing of the Electricity (Supply) Act, 1926, a standardisation of voltage and frequency for new systems. The standard declared voltages measured at consumers' terminals are: (a) for direct current, 230 volts, with 460 volts across the outer conductors of a three-wire system; (b) for alternating current three-phase systems, 400 volts between phases, and for a four-wire system, 230 volts between the neutral wire and each of the principal conductors.

The standard of frequency is 50 cycles per second. (It is interesting to note that in America the frequency adopted is 60 cycles per second, and the voltage most favoured is 110, both for A.C. and D.C.)

For the three-phase four-wire network, the four-core cable is universally adopted, and, although in theory the fourth, or neutral, wire would only be required to carry the unbalanced current and, therefore, could be of a smaller cross section than the principal conductors, it is usually made of equal section, that is, all four conductors are of the same size.

The three-phase four-wire system has the most advantages for the distribution network. It provides in one and the same cable for domestic lighting and heating at 230 volts, and for three-phase motors for industrial purposes. It is as economical in copper as any other method of supply and further, alternating current is more flexible, due to the ease of transformation from one voltage to another.

In urban districts and small provincial towns where the character of the streets and premises does not change so rapidly as in large cities or industrial towns, the network could be designed to operate from comparatively small transformers in kiosks placed in selected parts of the network. To prevent radical changes in the sizes of the distributors or the disturbance of the streets as the character of the demand alters, it would be advisable to put down initially distributors all of one cross section, and as the load centres shift, additional transformers could be installed in new positions. The size of conductor to be put down in the first instance could be determined only from an estimate of the kilowatt demand per yard of street, or in terms of a given area. For the distribution in large cities the problem of providing

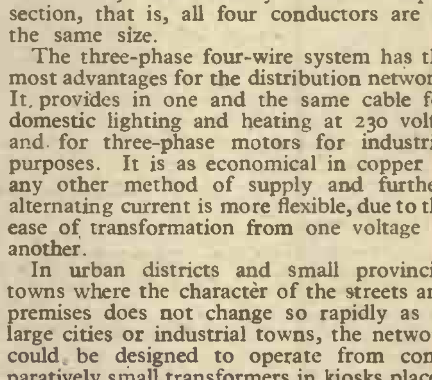


Fig. 12.—Outdoor transformer and switch kiosk.

the necessary amount of copper in densely loaded streets was becoming very acute. To lay down a low voltage network, capable of meeting the demands of such large business premises as are to be found in Oxford Street, London, and similar streets in provincial cities, and which would at the same time serve the much smaller business and residential houses in the immediate surroundings, would be enormously expensive, if not impossible.

The problem is solved by providing transformers in the basement of the large stores premises, and by feeding them from a high voltage main. The voltage is reduced by these transformers to give a supply to the stores and to feed on to a low voltage network outside for supplying the smaller premises. An extension of this system would be to lay down over the whole area of the city a low voltage network, and to feed into this from either grouped or distributed transformers situated at the more densely loaded points. An additional network of high voltage cables would give supply to the transformers from one or more high voltage sub-stations.

In order to make the most economical use of the copper in the mains, advantage must be taken of the diversity of load requirements at different times by the relative consumers. To do this, the low voltage network should be coupled up either solid through links, or semi-solid through network fuses. The coupling of a very large network as a whole, however, would be unwise and even dangerous, because, in the event of a serious cable fault, the whole of the transformer capacity would be available for feeding into it. This would mean that a large amount of power would have to be interrupted by switches incapable of performing this operation, and the dislocation of supply to the whole area.

Solid Network

The basis of the solid network system is to divide the area into a number of smaller areas, and to feed each of these through one or more transformers supplied from a high voltage network (shown diagrammatically in Fig. 10). The transformers may be grouped in one place or they may be distributed. With the latter arrangement a better regulation of pressure is obtained and some saving affected in copper.

Almost every large city has already a network of mains so that, in preparing a scheme of the solid network type, it would be possible to make some use of the existing material, such as cable ducts, draw pits, service pipes and the like. In general, the low voltage cables would be laid direct in the ground as they need not be disturbed except for making new services.

A reasonable size of low-voltage cable for a city area would be 0.25 square inches cross section. For the high-voltage cables, which might operate at 6,600 volts in the first instance, a cross section of 0.15 square inches might be used.

Rural Supply

For rural supplies current is conveyed by conductors of copper, aluminium or by compound conductors of steel and aluminium wires (Fig. 11). These lines are supported for span lengths up to about 450ft. by wood, steel or concrete poles; for larger spans lattice steel structures are used. The overhead lines, unlike underground cables, are not restricted to highways; they are more often than not taken across country. In this way distribution to isolated villages is given without the heavy capital expenditure of underground systems.

Depending on the amount of the load demand and the extent of the district over which supply is to be given, the voltage of these overhead lines varies from 3,300 to 33,000. The lines are operated at three-phase alternating current. Near the point of demand, if this be small, a small transformer is fixed to the supporting structure from which a low-voltage supply is fed by a short length of underground cable, or, alternatively, overhead wires, to the consumers. Where the demand is much greater the transformer is placed in a weatherproof kiosk, which contains also the necessary high-voltage switch (Fig. 12). The connection between the overhead line and the transformer is made by a cable which is led down the terminal support. As before, the low-voltage distribution may be effected by an underground cable or, alternatively, a low-voltage overhead line depending on the configuration of the load centres.

Repairing Alarm Clocks—2

Dismantling the Movement and Cleaning the Various Parts

By G. F. LEECHMAN

BEFORE going further, to the dismantling of the movement, it will be advisable to consider the principles involved in the clockwork itself. Briefly put, the apparatus consists of a balance wheel which vibrates or beats at a constant rate dependent upon its design (so far as its dimensions and density are concerned), and also upon the hair-spring with which it is associated. A certain amount of power is required to keep the balance wheel moving, and this is supplied through a series or "train" of wheels from the main-spring, also connected to which is a short series of wheels called the motion work which transmits the power necessary to turn the hands. Since these two series of wheels are connected together, the hands act as pointers, indicating theoretically the number of beats which the balance wheel has made, but for practical use the dial is, of course, marked in hours and minutes. Thus we have the balance wheel to provide a number of perfectly regular beats, the spring to keep it going, and the hands to act as pointers, so that a clock or watch is merely a device for counting the beats of a pendulum or balance wheel. The rate at which a pendulum beats depends, among other things, chiefly upon its length, and this applies also to a balance wheel and hair-spring system, so that great care must be taken that the effective length of the hair-spring, measured from the point where it is pinned in, is not altered when the clock is reassembled.

Escapement

Bearing this in mind, the next step will be to dismantle the escapement, which is the term used to describe the balance wheel, the oscillating lever which engages with it, and the 'scape wheel with which the lever also engages; the lever acts as an intermediary, transmitting power from the train and 'scape wheel to the balance wheel to keep it in motion and also from the balance to the 'scape wheel to prevent it from running down immediately the power of the spring is applied, and this will, of course, happen (unless we take steps to prevent it) as soon as the lever or any part of the escapement is removed. In order to prevent this happening it is best to put a bar of wood or smooth metal through some part of the movement where it will become caught up when the train starts to run down without causing damage to the gearing. A broken knitting needle or a piece of wire will do for the bar, and it is better to use something of this sort rather than press the fingertips on

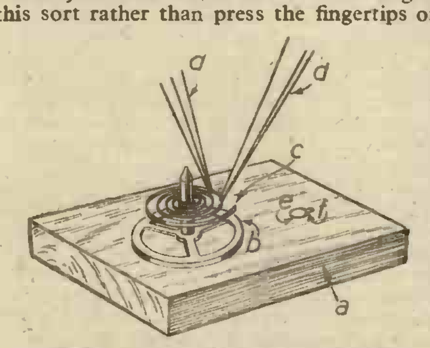


Fig. 5.—Correcting the hair spring.
a—Block of wood. *b—Balance wheel.* *c—Hair-spring.* *d—Tweezers.* *e—Spare hole in wood.* *f—Recess for roller.*

the edge of one of the wheels, for not only may the wheel be buckled by undue pressure, but also it may be pushed out of place and a pivot bent or broken. It is far better to take two or three inches of brass wire, pass it through the plates, and secure it in place by bending the ends over so that no likelihood of a sudden flying away of the whole train occurs.

Removing Balance Wheel

Having secured the train, the next step is to remove the balance wheel by withdrawing the pin from the hole in the lug where the end of the hair-spring is secured; this must be done very carefully, it having first been noted exactly where the extreme end of the hair-spring—which projects beyond the pin—is situated. In order to make sure of this, a very fine mark may be lightly scratched on some inconspicuous part of the brass plate to show where the end has got to come when reassembling. Alternatively, there may already be a mark of some kind which will serve as a guide, or the position with regard to some small detail of the plate may be noted, or even the exact direction of the end of the spring from the centre of the balance wheel. For instance, if it were exactly to the right that might be described as "90 deg. from north," or another way might be to describe it as on a target as "at 3 o'clock." Having made sure of this point the pin is carefully, but firmly, grasped with the smallest pair of pliers or a good pair of tweezers and withdrawn, the very greatest care being taken that the fragile hair-spring is not touched. The pin having been withdrawn and carefully laid aside, the movement is laid on the table and the balance wheel turned while the end of the hair-spring is carefully worked clear of the hole where it was pinned and of the regulator. When it is all clear the bearing screw which holds the balance staff at the end opposite from the regulator must be unscrewed a few turns to allow the balance wheel to be lifted out. This screw is, however, frequently very tight so that it may be difficult to unscrew, but on no account must pressure be made on the ends of the balance staff while unscrewing this, as by doing so the sharp points on which the staff runs will certainly be badly damaged. If the screw has a square head it must be unscrewed with pliers, and in order to avoid the pressure just mentioned the pliers must be held sideways to the screw and not endways, that is, not in line with the balance staff; for the same reason the fingers should not be allowed to press the plates together when holding the movement; this should always be held by the corner pillars as previously mentioned. The screw being sufficiently loose, the balance wheel may be lifted carefully out by means of a fine pair of tweezers, and after a brief examination to ascertain whether any damage is obvious it may be placed in the small jar of benzine to soak, the top of the jar being screwed on or otherwise closed to prevent the benzine evaporating.

Care of the Hair-spring

Great care must be taken that the hair-spring does not become bent or distorted in any way. Occasionally one sees an enthusiastic amateur struggling to unscrew some difficult nut while the balance dances merrily, hanging from the end of an uncoiled and strained hair-spring which has got temporarily "caught up in the works." Sometimes when the hair-spring is unpinned and taken out it is found to have several more or less serious kinks at the extreme end, but probably these do not matter if they were there when the clock was running; any new ones will have to be smoothed out, working very carefully with two pairs of tweezers or at least a pair of fine light pliers and the tweezers. In order to do this it is best to immobilise the balance wheel in some way, either by holding the staff very lightly in a hand vice (in which case it is better to protect it with lead foil or paper or wood between the jaws) or else a small piece of planking (a few inches wide and 9in. or 1ft. long) may be used, a hole being made in it large enough to take the balance staff easily without too much play (Fig. 5); but whether putting the staff in the hand vice or the piece of wood attention must be paid to the roller; this is the small steel pin which will be found near the centre of the balance wheel and it must naturally be treated with the greatest care. When using the hand vice it must be ascertained absolutely that the roller is standing clear between the jaws, and if it is found more convenient to use the wood, special provision must be made for accommodating the roller safely. If it should become bent it is very difficult to straighten it again as it is, of course, of hardened steel and is very likely to break off short, while if it is softened in order to straighten it, it cannot be easily rehardened correctly, and if left soft it will, of course, soon wear out; replacement of a broken pin is practically impossible except to the experienced worker, although sometimes a short length of sewing needle of exactly the right diameter may be pressed into service, but in general it is very much better to avoid any damage to the roller. A hair-spring which is past repair may be replaced with a new one even in these wartime days of short supply, but it is not an easy matter to fasten it afresh in the collet or small brass ring which secures it to the balance staff (Fig. 6); this may be worked off the staff with great care, the old hair-spring removed and the new one inserted in place of it, but even then the new hair-spring will have to be corrected for length, and the roller readjusted, both of which are delicate operations and will be left for later description.

Removal of Lever

Leaving the balance wheel and hair-spring immersed in the benzine we will now proceed to remove the lever. In most clocks this, as well as the train wheels, is held between the two brass plates, and it will be necessary to separate these before any of the components between them can be lifted out, but in some of the older or better made types it is possible to remove the whole escapement (balance wheel, lever and 'scape wheel) by loosening two nuts which will permit the whole ensemble to be swung clear when the train, if not already secured by some kind of stopper, will immediately run down very quickly. However, in most modern makes the corresponding brass nuts will have to be loosened and the various pieces lifted out separately. This operation also requires very considerable care and a light touch; the nuts which will be found at the ends of the four pillars must be unscrewed enough, but not too much, those two which are nearer the lever being unscrewed several turns while those two which are farther away need only be loosened very slightly, particularly as a pin in the set alarm staff will prevent the plates opening very much at that end in any case. If the other two nuts are loosened too much a number of parts may come out unexpectedly, while if they are not unscrewed sufficiently it may be that the pivots on the lever staff will be damaged. They should be unscrewed just sufficiently to allow the lever to come clear when the plates are gently opened with the fingers, when it may either be allowed to drop out or may be removed with a pair of tweezers. Once again it must be emphasised

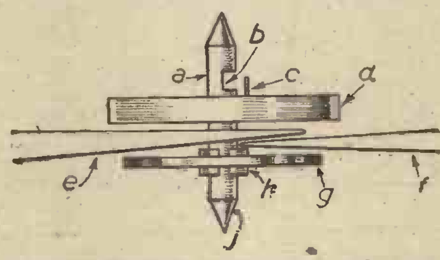


Fig. 6.—Removing hair-spring from staff.
a—Balance staff. b—Recess. c—Roller. d—Balance wheel. e—Pliers. f—Tweezers. g—Hair spring. h—Hair spring collet. j—Pivot of staff.

that these delicate parts are very easily damaged and care must be exercised that they are not pulled out by force. On the lever will be found two pins or palettes which are very likely to catch in the 'scape wheel and thus become bent or broken off; like the roller on the balance wheel they are not easy to replace, so that it is much better to go carefully in the first place. If in allowing the lever to fall out the 'scape wheel should also drop, no harm will be done, but it is better that none of the other wheels should come away, and if they do they should be replaced until their turn comes. In any case it is not

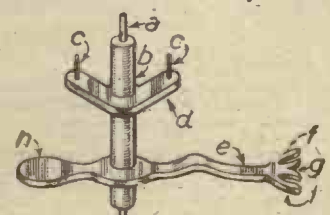


Fig. 7.—The lever.
a—Pivot. b—Staff of lever. c—Palettes. d—Palette adjusting piece. e—Arm of lever fork. f—Banking arm. g—Fork. h—Balancing piece.

likely that the third wheel (that is the one next the centre wheel which comes through the centre of the dial) will be loose because it should be held by the piece of brass wire or other material which was inserted to prevent the train running down, but the fourth may come away, and possibly some of the alarm release fittings, especially in repeater alarms.

Pivots and Pivot Holes

Having got the lever clear it should be examined to see if any part of it is damaged; it will usually be found to consist of two pieces of brass mounted friction tight on a steel staff which has a pivot of smaller diameter at each end. (Fig. 7.) These pivots run in pivot holes and (particularly with regard to the lever) they are apt to wear badly in the course of time, leaving the hole somewhat elliptical in shape while the pivot itself may be similarly worn; the only way to repair this fault is to turn the pivots up again in the lathe and to correct the holes either by cutting out the part and soldering in a new piece of brass, or else by judicious use of a hammer and punch to close the hole, when it may be opened out to the correct size again by careful use of a round file, a reamer or broach, and a round burnisher. The bearing surface of these holes should invariably be highly polished, as must the pivots, so that in any work of this kind care must be taken to finish with a really good surface. It has just been said that the brass parts on the lever staff are friction tight, and it should be noted that if the pieces are moved relatively to the staff several times they will become too loose, so that this should be avoided; but if, as sometimes happens, they are found to be already slack, they will have to be tightened up by carefully removing them by means of pliers or pin vice and the fingers, it having first been noted exactly where on the staff they fit, both with regard to height and also their relative angular positions to each other. They are both at right angles to the staff, but the angle between the long part which has a forked end, and the short part which carries the palettes is most important, and needs very accurate setting. The hole in either part may be closed by judicious hammering and punching until it again makes a tight fit on the staff, when it may be tapped back into place, using the pin vice and stake, of course, rather than running the risk of spreading the end of a pivot by tapping on that! If the palettes are bent it may be necessary to rectify them by careful bending, and if they are badly worn it is best to alter the height at which they make contact with the teeth of the 'scape wheel by a sufficient amount to bring a fresh surface into action, by moving the brass piece up or down the staff. In some of the cheaper clocks, however, the two brass parts of the lever are made in one, so that it is impossible to adjust the angle between them, and if a certain adjustment is needed it can only be obtained by deliberately bending the palettes. So that it must not be assumed merely because the palettes are bent that they must be immediately straightened; it may be necessary for them to be bent as they are. If the clock has been running fairly satisfactory so far as this point is concerned it is unwise to hastily make any alteration in previous adjustments. For other reasons the arm of the fork end may be bent, but this also should be left exactly as it is unless it is definitely known that it has to be corrected.

The 'Scape Wheel

The lever may now be placed in the benzine with the balance wheel and our attention turned to the 'scape wheel. If this is not already out of the movement it may be allowed to fall out by gently separating the plates with the fingers, or it may be lifted out with the tweezers. In this case be careful to notice first how it is placed. The larger piece which has angular teeth on which the palettes of the lever were working will be clear of all adjacent parts, but elsewhere on the 'scape wheel staff will be seen what is known as a "pinion," and this will be geared in with the teeth of the fourth wheel; it will be handy to notice whether this pinion is nearer to the dial side or to the back of the movement, but in either case when the 'scape wheel has to be lifted out it is the pinion end which should always come away first. In replacing it, it is essential that the pinion end should go in last, so that to remove it the staff is carefully, but firmly, held near the pivot at the pinion end and, the two plates being separated just enough and no more, according to how much

(*Continued on page 357*)

QUERIES and ENQUIRIES

Copper Oxide Coating : Barium Oxide

CAN you assist me on one or two points met with in my experimental work ?

(1) What is the method of oxidising copper plates for rectification purposes ?

(2) What is the composition and manufacture of fluorescent material with which to paint the end of a cathode-ray tube, and where can the materials be obtained in small quantities ?

(3) What is the deposition of barium oxide on to a tungsten filament, or metal grid ?—S. Watts (Southampton).

THE trade method of obtaining copper oxide rectifying surfaces is maintained a close secret. At all events, no published information on this subject has been made available. Coatings of this nature, however, can be obtained by simple air oxidation of the copper (i.e., by heating the metal), or by immersing the metal in fused potassium or sodium nitrate, which immersion may be followed by a short air heating in a non-luminous flame.

There is no doubt of the fact that if you adopt either of these methods you will have to put in a good deal of experimental work in order to hit upon the right conditions of the treatment. So far as our experience goes, electrolytical methods of obtaining such coatings have proved unsuccessful.

(2) Here again, the exact composition of the fluorescent material of commercial cathode-ray tubes is maintained a secret. Published formulæ are available, but these do not by any means attain the standard of the commercial coatings. The best coating you can use is natural zinc sulphide, which is obtainable in a specially prepared condition from The British Drughouses, Ltd., Graham Street, City Road, London, N.1. Such material may be employed in the form of a thin cellulose paint, but, for your purpose, it would be best to incorporate it into a little pyroxyline varnish in order to render the material well adherent to the glass.

(3) In your third query, also, you request information of what is virtually a trade secret ! We are afraid that we can give you little practical information as to the commercial method of coating a tungsten filament with barium oxide. It is understood, however, that a quantity of barium salt is actually incorporated with the sintered metal of the filament and that the oxide film consequently results from the heat effect on the barium material when the filament is heat-treated. It is, of course, hopeless for you to hope to fasten the barium oxide on to the film by means of cements or adhesives.

Speed Controller for Motor

I HAVE a 1/20 h.p. motor, A.C. 50 cycles, brush commutator type, running at 2,500 r.p.m., for use on a sewing machine, and desire to wind a speed controller for four or five stages.

Will you please specify the resistance wire necessary and any other particulars that may be of assistance ?

At full speed the motor is too fast, so can I leave a certain amount of resistance in action on the final stage of the controller ?

Where can I procure the necessary wire ?—F. J. Cundall (Hounslow).

THE value of the variable speed-controlling resistance in ohms, and its current carrying capacity in amperes, will depend upon the voltage for which the motor is wound. It is taken for granted that the motor is operating on a voltage between 200 and 250 volts, these being the standard commercial limits, in which case the current consumption when driving a domestic sewing machine averages one-quarter of an ampere at full speed. To obtain a good range of speed control the total value of resistance, all in, should not be less than 400 ohms, and the gauge No. 36 "Advance" resistance wire, obtainable from The Driver-Harris Co., Ltd., Gaythorn Mill, Albion Street, Manchester. This wire has a resistance of 110 ohms per foot, and the whole resistance can be divided up into five or six sections to give the speed variations most convenient.

Single-Phase Conversion

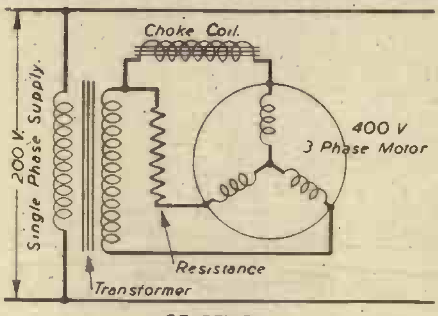
I WISH to convert a 200 volt single-phase electric supply to 3-phase 400 volts.

I understand this can be done by means of a 3-phase motor and condenser. Please supply me with information on the above, together with connection diagram.—E. Webb (Bournemouth).

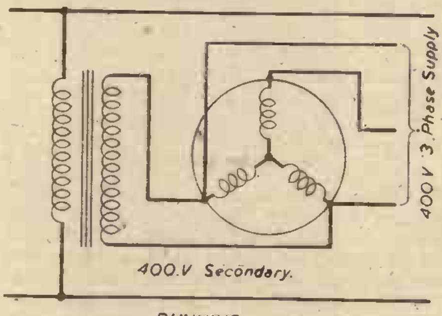
THE most satisfactory method of obtaining a 400-volt 3-phase supply would be to use a single-phase 200 volt motor driving an A.C. generator.

If you wish to obtain a 400 volt supply by means of a 3-phase motor this would require to be a 400 volt machine and would need a 400 volt supply. A step-up transformer would, therefore, be necessary. Two stator terminals of the motor will be connected to the secondary terminals of the transformer, and what is equivalent to a 3-phase 400 volt supply can then be taken from the 3-motor terminals when this is running. The h.p. capacity of the motor should be approximately equal to that of any three-phase motors which are supplied by it.

If the motor is only a small one you may be able to get it to start and run up to speed from the single-phase transformer by assisting it by hand. Once it is up to speed it will continue to run from the single-phase supply. If it is not convenient to start it by hand use a motor which has a star connected stator winding, and



STARTING



RUNNING

Diagrams of a single-phase convertor. (See reply to query—E. Webb.)

at starting, connect one motor terminal to one secondary terminal of the transformer, connect another motor terminal to the other secondary terminal through a resistance, and connect the third motor terminal to the second transformer terminal through a reactance or choke. When the motor is up to speed the resistance and choke are cut out of circuit as shown.

Vacuum Cleaner Motor

CAN you please advise me on the following points ? I have in my possession a 220-watt 220-volt electric vacuum-cleaner motor with which I wish to drive a 12-volt 10 amp. Lucas car dynamo. Can this be coupled direct to the motor, which is 50 cycles high-speed, or is gearing necessary ? If so, what ratio, please ?

Is it necessary to have a resistance to start the motor up slowly and then switch it out of the circuit ? And if so, what type ?—B. E. Willis (Bristol).

THE vacuum-cleaner motor is fairly sure to be of the series universal type, in which case its speed will fall rapidly on increased load. This is not very suitable for driving a dynamo, which requires a steady speed to give best results. It is quite possible, however, that the automatic regulating properties of the Lucas dynamo will compensate for the speed variation.

Assuming that the motor runs at about 5,000 r.p.m. on load, and that the dynamo would give its normal voltage at about 1,000 r.p.m., it is seen that a 5 to 1 speed reduction is required between the motor and dynamo. At this speed belt drive would be suitable.

The electrical input to the motor is 200 watts, and if the efficiency is assumed to be about 60 per cent. we have the maximum mechanical power output which the motor will give without overheating as 120 watts (in electrical units). When this power is applied to the dynamo, and neglecting losses in the power transmission, there will be further losses in converting the mechanical power at the dynamo into electrical power. Assuming 40 per cent. losses, we have the safe output of the dynamo as 72 watts. This means that the motor would probably overheat if used to supply more than about 5 or 6 amps. at 12 volts. It is not necessary to have a starting resistance, and the motor can be switched direct on to the line.

Differential Gear Assembly

IN a differential gear there are usually two "sun" wheels of 20 teeth and the planet pinions are usually of 10 teeth. I am told that it is the size of the planet pinions in comparison with the size of the sun wheels that causes one road wheel to go faster than the other when turning a corner.

What I want to know is : If the sun wheels and the planet pinions were of equal size, i.e., 20 teeth each, would this operate the same, or would it cause one road wheel to skid round when turning a corner ?—N. F. Driver (Luton).

IN a bevel gear differential assembly of the ordinary type, it is necessary only that the bevel wheels on the ends of the half axle shafts should be of the same size. The planet pinions may be of any size without affecting the correct working of the differential. The differential ensures that the turning moments on the half-shafts are equal and permits them to have any relative rotation that may be necessary to fulfil that condition.

Small Transformer

I HAVE a spool on which I intend to wind a transformer coil. The spool dimensions are 1¾in. cheeks, ½in. square base, and 2¼in. between cheeks. The coil is a step-down transformer coil working from 250 volts to sufficient voltage to get a bright glow from 1⅛in. of 600 watt element wire. Would you please inform me of the winding, and the arrangement and quantity of iron plates ? Also, what is the formula for finding windings for transformer coils ? — Malcolm Osten (Gateshead).

LOOK up the articles on Transformer Building in PRACTICAL MECHANICS for April 2nd and 30th, 1941, and make your transformer core of stalloy strips to a section of ½in. by ½in. to suit the bobbin you propose to use.

This core will require a winding of 32 turns per volt on 50 cycles, so that for 250 volts the primary coil must have 8,000 turns of No. 40 s.w.g. enamel covered copper. Probably about 1½ volts will be sufficient to cause your 1⅛in. length of element wire to glow brightly, with a current of 3 amperes approximately, in which case the secondary coil will need winding with 48 turns of No. 18 s.w.g. e.c. copper.

Reflectoscope Details

I WISH to make a reflectoscope, and shall be glad if you would help me with the dimensions ?

I wish to show a picture postcard either vertically or horizontally, i.e., the reflector area would be about 5½in. square. I propose using two electric bulbs one either side of the lens.

The dimensions I require are : Overall dimensions of box to suit postcards ; distance of lens from picture ; diameter of lens ; and magnifying power of lens.

I should also like to know if I could fit the lens in an old camera bellows in order to give some degree of focusing.—W. D. Liddle (Hixon).

We cannot give you the overall dimensions of your proposed reflectoscope, since such measurements will depend to some extent upon your own design of the apparatus, i.e., upon the size of the postcard holder or carrier, the size and type of the lampholders used, the distance of the illuminants from the postcard picture, and so on.

The distance which the lens must be placed in relation to the picture depends upon the focal length of the lens. The focal length of the lens which you use should approximately equal the length of a diagonal line drawn across the picture. Usually, a 6in. focal-length objective will meet the case.

The actual diameter of the lens has nothing to do with the case under consideration. It is the focal length of the lens which matters. The magnifying power of the lens is governed by the focal length of the lens, and the distance between the centre of the lens and the screen—the farther away the screen being, the greater the degree of enlargement of the projected image. It is a very good notion to fit the lens in some type of focusing mount. Indeed, such a device is essential in most instances unless the apparatus is going to be used always in one fixed position relative to the screen. All the reflecting surfaces of the instrument should be enamelled white. The rest of the instrument is best painted black.

Usually, amateur-made instruments of the reflectoscope type are not regarded as being satisfactory, the great difficulty being to get sufficient illumination to give a brilliant image. To effect this requirement properly necessitates a somewhat complex lens system which has been brought to a state of considerable perfection by the German firm of Carl Zeiss, but which is impossible (or almost so) for the ordinary amateur to imitate.

Slow-speed Dynamo

I HAVE a Lucas 12 volt dynamotor which I understand is a suitable type of car dynamo for conversion to slow speed running. The present cutting-in speed of these machines is 1,600-1,800 r.p.m., and I want to rewind it so that it will cut in at 350 r.p.m. (approx.).

Could you inform me as to what alterations will have to be made to effect this change, and if there is any book which would give me a knowledge of the theory of the speeds and different windings, etc., of dynamos ?

Also, would it be in order to bring a low voltage direct current a fairly long distance by transforming it by means of the make and break vibrator system, by using a step-up transformer at the supply end and a step-down at the other end ? Would it be satisfactory for lighting and battery changing at the destination ?—M. Maguire (Kilean).

SLOW speeds can only be obtained at the expense of reduced outputs, so that with a frame of standard dimensions it may be taken that a reduction of cutting-in speed to one-fifth of the normal will be accompanied by a reduction in output of like ratio. You will not need to alter the field winding of your dynamo, but the armature would have to be rewound, using wire of such size that the number of turns per coil will be five times as great as previously. The natural reduction in size of wire in order to accomplish this with the same dimensions of armature slots will lead to the output capacity in current suffering to a like degree. For general outlines of dynamo designing you cannot do better than read A. H. Avery's "Dynamo Design and Construction" (Cassell & Co., Ltd., 4s. post free). Replying to a further question it is quite impracticable to transform direct current by means of a mechanical vibrator, and transmit it by a step-up voltage-transformer to considerable distances, again stepping-down at the distant end to supply lights and charge batteries. The wave form of an alternating current produced in this manner is quite unsuited for voltage transformation by the ordinary static transformer with iron core.

Action of Magnesium on Water

I SHALL be glad of your advice on the following :

1. In connection with Fire Guard training, it is commonly stated that burning magnesium acts upon water by breaking it up into its constituent gases of oxygen and hydrogen. So far as I am aware, no Civil Defence text-book explains the chemical reason for this. My own theory, subject to your correction, is that the great heat expands the water into superheated steam so suddenly that the atoms of the two gases are forced instantly apart to such a distance that their mutual attraction within the molecule is destroyed, and they do not come together again. If I am correct, the change is not caused by the chemical action of the magnesium, and could result from heat applied by other agents.

2. Would you state briefly the principles underlying the adsorption of true gases by the charcoal filling of a respirator ? Here, again, no Civil Defence publication explains this. I believe it to be the result of the combination of the atoms of carbon with the atoms comprised in the gases, and, as this constitutes a surface attraction only, each charcoal granule has its available surface greatly increased by being made porous during the "activation" process.—T. E. Browne (London, E.5).

1. You are not quite correct in your explanation of the action of magnesium upon water. This metal has no action upon cold water, but it has a very slow action upon boiling water. When magnesium is heated in steam the metal takes fire and it continues to burn in the current of steam, abstracting oxygen from the steam and liberating free hydrogen (which itself then inflames) according to the following chemical equation :—

$$Mg + 2H_2O = Mg(OH)_2 + H_2$$

$$(\text{Magnesium}) + \frac{(\text{Water})}{(\text{Steam})} = \frac{(\text{Magnesium}}{\text{hydroxide})} + (\text{Hydrogen})$$

Here, therefore, is the solution of your problem. The heat of the burning magnesium generates steam from the water. Then the magnesium splits up the steam (in part), liberating free hydrogen, which, of course, at once takes fire. The action is purely a chemical one which proceeds in accordance with the above equation.

2. The adsorption of gases and vapours by charcoal and other "active" agents is not yet fully understood. The prevailing theory is that the gases are, in some little-comprehended manner, retained in close contact with the surfaces of the particles of charcoal or other adsorbent. So far as modern theory goes, there is no actual chemical combination of the adsorbed bases or vapours with the adsorbent, although, if some materials, such as potassium permanganate and/or soda-lime are present in the adsorbent mixture they can act in an oxidising and neutralising manner on certain acidic gases. In this case, a true chemical action takes place. But in all other cases the adsorptive action is a physical one and not a chemical one.

Your theory, in this instance, is pretty near the present-day accepted theory, your only error being that you postulate an actual chemical combination of the atoms of carbon with the adsorbed gas. It is, of course, impossible for a Civil Defence publication to deal with such an abstruse subject as this.

Conversion of Car Dynamo to Motor

I HAVE a C.A.V.-Bosch dynamo marked D.D.G. 12 volts (41 segments to commutator and there are 3 carbon brushes) taken from a car which is in good condition and I wish to use it as a motor.

(1) Can I use the dynamo without alteration by connecting it to the mains (230 A.C.) through a suitable transformer, if so, what type of transformer would I need ?

(2) Could I rewind same to work directly off the mains, and if so, what gauge and quantity, etc., of wire would I need for the fields and armature ?

(3) Could I run it off an accumulator, and if so, what type and capacity ?

(4) What would be the approximate H.P. of the converted machine ?—Evan John (Rhondda).

A CAR dynamo designed for generating direct current at a low voltage, and fitted with third-brush voltage control is unlikely to give good service as an A.C. motor, even if rewound. It cannot be used as it is, since A.C. commutator type motors must be series wound, and car dynamos are shunt wound. Moreover, they generally have solid field castings instead of being laminated, and are therefore subject to overheating when run on A.C. It could be run off an accumulator, of 12-volts 100 ampere-hour capacity, and might develop about ¼ h.p., but without details as to the diameter and length of armature this cannot be confirmed. If run from an accumulator the fields would be better if rewound and the third brush removed, using the machine as a plain shunt-wound motor. The armature can remain unaltered. About 3lbs. of No. 20 S.W.G. d.c.c. copper would be required for the two field coils.

Heating an Aquarium

I SHALL be very grateful if you will give me some information on the following questions. I have an aquarium which I want to make into a tropical type by using an electric heater immersed in the water. What would be the best method to make the heater, and would it be necessary to use a thermostat to keep the water constant at 70-75 deg. F. ? The size of the tank is 18in. by 9in. by 9in. and the amount of water approximately 5 gallons. The tank is made up of four sides of glass and a slate bottom.

Is it still possible to get the materials to make the electric heater, and where can these parts be obtained ? Also, would the amount of current consumed be very great ? The voltage in my house is 200/240 volts, 20 amps., 50 cycles.—J. E. Tordiffe (Southall).

IT would be necessary to use a thermostat if the temperature of the room in which the aquarium is situated varies more than about 5 deg. F.

It is not possible to calculate exactly what current would be required to maintain the desired temperature, as this depends upon the room temperature, whether the aquarium is shielded from draughts, and the thickness of the glass sides, etc., but it is probable that 25 watts of power would be adequate.

The simplest and safest method of heating would be to use a 25 watt transformer at 12 volts to feed a resistance wire laid on the bed of the tank. You might experiment with about 12yds. of 22 s.w.g. Eureka wire, reducing the length in circuit if it is found after a prolonged test that the amount of heat generated is too small.

You might be able to obtain a suitable transformer locally ; one designed for a toy electric train would probably serve the purpose. Messrs. London Electric Wire Co. and Smith, Ltd., of Church Road, Leyton, 10, may be able to supply the heating wire if you cannot get this locally.

Electric Light Plant

I WISH to light a building by means of a dynamo driven by a stationary engine. As the light will only be needed when the engine is running, I would like to dispense with storage batteries. Is this possible ? What type of dynamo and other equipment will be necessary ?—H. R. Croom (Carisbrooke).

THE best type of dynamo for your purpose will be a compound machine, and, if the lighting load is likely to vary considerably, it would be an additional refinement to use a machine with interpoles to assist commutation. It should be borne in mind that the higher the voltage adopted the smaller can be the cables used in the wiring ; there is much to be said for adopting the standard 230 volts, unless the output required is very small. There is no necessity to use batteries unless you require electric light to assist in starting up the set.

The switchboard controlling the dynamo should be fitted with a voltmeter, and a resistance regulator connected in circuit with the shunt field winding of the dynamo for controlling the voltage. An ammeter would also be useful for measuring the load current. A fuse should be connected in each pole to protect the machine against short-circuits on the wiring, and this may be of a size which will melt at about twice the full load current of the dynamo.

It is also useful to fit earth leakage lamps on the switchboard. These consist of two lamps, of dynamo voltage, connected in series across the supply, with the centre or common connection of the lamps connected to an earthing point such as a cold-water pipe. Should an earth fault occur due to failure of the insulation on the wiring or dynamo, one lamp will then light up fully and the other lamp go out.

Re-grinding Lawn Mower Blades

CAN you give me information on the following points : (1) Is there a machine at a reasonable price especially made for re-grinding lawn mower blades ? (2) Approximate cost and address of suppliers ? (3) Could they be re-ground on a 3½in. lathe, and how ?—G. Uzzell (Birmingham).

IT might not be possible to obtain a machine now, but you could apply to Buck and Hickman, Ltd., 2, Whitechapel Road, London, E.1, who would be as likely as anyone. We do not know present prices. Grinding can be performed in a lathe. Mount the cylinder between centres, arrange a tooth-rest on the saddle below the blade, and put an electric grinder on the slide-rest. As the latter is fed along slowly, keep the blade hard down on the tooth-rest. Take light cuts on each blade until an equal amount has been ground off each. Finally back off very slightly with an oilstone, leaving a facet.

Repairing Alarm Clocks

(*Continued from page 355.*)

the nuts have been slackened back (they should in no case be taken right off).

Raising the Staff

The staff is raised to let the pivot come just clear of the plate, when the staff can be drawn sideways in the direction away from the fourth wheel and towards a hole in the plate which will enable it to be lowered until the other end is clear of the other plate. (Fig. 7.) The 'scape wheel may now be examined for damage to pivots, pinion or wheel, the pivots being treated on the same lines as was explained in connection with the lever. The pinion may be either of two types, that is either having leaves which are similar to ordinary gear teeth except that they are wider, or else having a number of hardened steel rods supported at the ends by brass collars so that they form a kind of circular cage or lantern. In the former case it must be seen that the leaves are not unduly worn or bent, and in the latter case we have in addition the possibility that some of the bars may have become loose. It is fairly simple to tighten them by working up the brass firmly round their ends or to replace them if that should be necessary, but care should be taken that the material used is exactly the right size and sufficiently hard. The teeth of the 'scape wheel itself will frequently appear rough, but they should on no account be scraped or burnished in an attempt to reduce the friction between them and the palettes of the lever. Actually there is very little friction since the palettes are round, and only bear very lightly on the 'scape wheel teeth. So long as the wheel runs true, and the teeth have not been actually damaged, no further attention will be required except to get the wheel thoroughly clean by placing it in the benzine together with, but clear of, the balance wheel and lever.

(*To be continued.*)

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Comments of the Month By F. J. C.

Lt.-Col. Mervyn O'Gorman on Road Accidents

(*Continued from page* 65, *June issue*)

CONTINUING his speech on Road Accidents, Lt.-Col. O'Gorman went on to say:

A fillip to indignation makes livelier conversation than a call for careful inquiry, especially if the listeners have already been primed with the notion that "moral turpitude" or "homicidal lust" curdles the instincts of every Englishman as from the moment he steers a little car. As the full data are rarely available such tales go down well. My kind gentleman seemed disappointed at the mean way I concealed my homicidal lust.

That story is to introduce my first point: the need for relevant data. We don't know whether a high-power car is more or less safer than a baby car. We don't know if a street controlled by traffic lights is safer than by pointsmen. We don't know if any road or street junction of any shape or plan is safer than any other with the same traffic. We don't know whether the driver should be on the left or the right of his car, or should sit high up or low down in it. We don't know what accidents are due to dazzle, or to unlit bicyclists, or to twisty roads without footways. We know nothing! No single significant datum. We don't even know whether a side-road should enter a main road by a widely tapered entry or an abrupt one. We don't know the proper plan or the proper traffic control for a roundabout for maximum flow—nor do we know where to place pedestrian refuges, or the proper width for a pavement. Ignorance is no crime, but we *refuse* to find out in the face of 350,000 accidents a year.

Among a thousand subjects consider "traffic density"—which includes (without offence to present company) the density of roadfarers.

Trustworthy officials have marked maps with red dots at certain places, usually crossings like Hammersmith Broadway, to show they are extra risky. Other corners are not marked as risky. This would be a sound beginning were it not that the people who look at the red dots are not neutral investigators. Perhaps they have accepted that accidents are due to the "human factor" of road users, afoot and awheel. That statement (which was made by Hore-Belisha) is true, but it is half a truth or less. It suppresses the "big half." One's "human factor" doesn't develop immoderately on approaching Hammersmith Broadway, whereas the number of traffic units does. So also does the density of the pack in which they move (the traffic quantum). The number of accidents per quantum of traffic movement past any place might be called the "accident ratio" of the place. This is the most instructive datum of any. It is always suppressed. It ought not to be. It ought to be measured. That measurement should be related to the diversity of directions of movement, and in looking into this as a cause of accidents, we must inquire if any of the traffic units have any agreed and well-known means by which to foretell the direction of any other approaching unit, so that it may be avoided. Only trained researchers with instrumental help, such as aerial cine records arranged to show directions and speeds, etc., can disentangle the relation of all these variables to the number of accidents. Such investigations are alien to the training of policemen, coroners, magistrates or juries and quite impossible to the chance passer-by however full he may be of indignation or sympathy.

If I were to ask a nurse why that baby is howling and she replied that it had a bad temper (or a "human factor") but she suppressed that its bad temper was occasioned by a pin that I find sticking into its person—my thoughts would turn to the superior instructiveness of the fact over the opinion. To accuse the "human factor," even if true, is still, in this context, a shabby excuse by which the baby gets blamed for the nurse's slackness. If I think further on it I shall recall that she was not engaged to *accuse* the baby, but precisely to remove that very pin.

Traffic Density and the City

In the case of road accidents high traffic density is one of the pins which makes great calls on the "human factor." We have lots of proof of this: extra accidents attend the extra traffic density of the morning hour, the lunch hour, the evening hour. Crowding then prevails; everyone's speed is low; but that pin of traffic density calls out all the "human factor" there is. Extra traffic density can be cured and it should be cured. The choice lies between having accidents or a sane road plan. Some people won't make inquiries into the facts and will make pronouncements.

A bishop told the House of Lords that the City of London had less road fatalities than elsewhere because the traffic there is so slow. (I used to think so myself, but I took the trouble to inquire.) I found that the City, being only one square mile, has, in fact, more fatalities, not less, per square mile than the square mile of any other borough in London. Will the reverend gentleman now ascribe this excess of accidents to the *slow* speed, or is "speed" only a *one-way* prejudice—for deflecting investigation from the real causes?

The City displays a combination of circumstances, including traffic density and erratic pedestrian movement, that wants disentangling by skilful study much as do the complexities at Hammersmith Broadway. The ascribing of accidents by guesswork to any one imagined cause is a folly of the same order as the claptrap about the "human factor." Such assertions are not public-spirited, they are shallow talk, often utilised by interested people to exonerate those who would be exposed by research.

How Wide Should a Street Be?

There is something else about traffic density that has been neglected. On inquiry I have found that no one, whether architect or town planner, motorist or walker or policeman, has any idea of what width is proper for any street for any purpose whatever. To realise how grave that ignorance may be I recall to you that the Minister of Works a few days ago undertook to build £2,640,000,000 worth of houses (four million of them) in the first 10 years of peace. All houses must front on to a road. Three thousand of them, he says, are to be put in hand at once. So we are to build with no notion of how wide any road must be or what is the safe road plan for the daily movement of these 14 million inhabitants. Only in a nightmare would an engineer lay down a water main without the data to calculate its size for the amount of flow. No one is shocked at a politician knowing nothing, but it is saddening that none of them think of paying some intelligent persons.

We hear much of the cheering beverage of "social security." It is poured out of a bottle labelled "compulsory insurance." It ought to taste like watered beer to a worker who must reach his home by daily enacting the part of a ninepin in a skittle alley. As 360,000 ninepins fell in 1938-39 and three-quarters of those would have stood up if the skittle alley were remodelled—the effect of a good road plan on national security, health and wealth cannot be passed over as negligible. These small householders will accept any old road, as if roads were there by act of God, and are as likely to demand research into the problem as they are to pour their beer into the Thames. It is for administration to initiate this difficult study without waiting for guidance from the uninformed ninepins.

We know that 87 per cent. of accidents are collisions, that 80 per cent. of these are urban, that all collisions are due to two units of traffic seeking to occupy the same place at the same instant, and that no two would do so if they knew in advance where the other was intending to go. It would be common sense to evolve some way of using the streets whereby the moving units should each give to the other a clue to this vital knowledge, and to rule that all should respect the intention as shown by others. Such a rule would soon develop an instinctive habit. At sea and in the air they have it, and the rules are quite simple. Nobody asked the owners of tramp steamers whether they objected to the rules. Why not study how to do it on the roads? It is *not* impossible. Who has not seen a pedestrian bump into another after both had changed course to avoid the impact? That was not their human frailty; that was the lack of a rule of correct movement to create a correct habit.

(*To be continued.*)

The ruins of Girnigo Castle, Caithness, Scotland.

Dearer Camping

THE charge for camping at youth hostels in Scotland has been increased from sixpence to ninepence.

Record Approved

THE Glasgow Nightingale C.C. has approved the club 50 record of 2 hr. 10 min. 27 sec. broken in 1942 by James McGuinness.

Scots Handbook

THE Scottish Y.H.A. has again produced a first-class handbook and guide to its hostels, which stretch from Wester Ross to the borders.

Anti-massed Starts

DELEGATES of the West of Scotland T.T.A. have been instructed to oppose massed-start events on the road when and if these are proposed to the Scottish Amateur C.A.

Three New Hostels

THREE new youth hostels have recently been opened in the London area, at Goudhurst, Kent; Leatherhead; and Dunstable, Bedfordshire.

Bucks Landmark for Trust

BOARSTALL TOWER, near Brill, in Buckinghamshire, has been bought and presented to the National Trust by Mr. E. E. Cooke.

Running Again

THE St. Catherine's-Inverary ferry, across Loch Fyne, Argyllshire, is running once again.

Tramcar Fatalities.

OVER half the fatalities involving tramcars happen in Scotland, mostly in Glasgow.

New Wharfedale Hostel

A NEW youth hostel has been opened at Linton, near Grassington, in Wharfedale.

Synthetic Rubber

FRANCE is now making synthetic bicycle tyres.

Death of W. G. Howard Gritten

W. G. HOWARD GRITTEN, M.P. for the Hartlepools, who died last month, was a strong supporter of cyclists' rights. He was at one time a councillor of the Cyclists' Touring Club, and was also a conservator of the Cyclists' War Memorial at Meriden.

Hostels Support Parks

AT the annual meeting of the Y.H.A. of England and Wales, held at Rugby, the president, Professor G. M. Trevelyan, supported country holidays for war workers, and the meeting urged the Government to establish national parks.

Educating the G.T.C.

RONALD SUDBURY, Letchworth, Hertfordshire, cycle dealer and clubman, is helping to get the best service out of war workers' bicycles by teaching members of the local Girls' Training Corps how to repair and adjust their machines.

Newcastle Leads

NEWCASTLE and Gateshead Section of the National Clarion C.C. is still the largest section in the country. Other big sections are those at Bolton, Leicester, Eastleigh, Southampton and Kensington and Fulham.

Bridge Across Solway

A NEW bridge across the Solway Firth is proposed by Cumberland County Council, which is planning post-war road schemes.

Bridge Over Mersey

A NEW bridge across the Mersey between Widnes and Runcorn is proposed to replace the Transporter Bridge.

Hostel Membership

MEMBERSHIP of the Youth Hostels Association is more than 50 per cent. ahead of the 1942 figures.

Parks at Stratford

CYCLE parks are to be laid out in the main streets of Stratford-on-Avon.

Club President Dies

MR. R. E. WATKIN, president of the Southgate Cycling Club, which he joined in 1885, and of which he was champion in 1894 and 1905, died suddenly. He was 74 and a member of the F.O.T.C.

Pyramid Champion Killed

CHAMPION of the Pyramid Wheelers for four years, and a member also of the Kentish Wheelers and the Clarencourt C.C., Sergeant Pilot R. Berry, R.A.F.V.R., has been killed in action.

Clubman Repatriated

A MEMBER of the Portsmouth C.C., who was taken prisoner at Tobruk, has been repatriated. He is Able Seaman V. Dennett, who expresses joy in being back in this country.

Dora Biggs' Distinction

IN recognition of her many years' service to the club, Dora Biggs has been elected vice-president of the Rosslyn Ladies' C.C. She is the club's first vice-president.

K. Meyler Home

KINGSLEY MEYLER, Barras Road Club, who has been in the United States for the past 12 months with the Royal Air Force, has returned home.

Members Meet in India

LT. G. E. THOMAS and Lt. R. S. Philpot, both of the Southgate C.C., of which Thomas is reigning champion, met by chance in Mhow, India.

A Good Average

TO win the N.C.U. (Kent Centre) speed judging competition members had to ride for 12 miles at an average speed of 12 miles an hour. Points were deducted from a total for all errors at pre-determined checks. The winner only lost four points!

Bone Interest in Road Work

NOW busily employed in an aircraft factory, "Jack" Bone, Glasgow Wheelers, who put up some wonderful rides before the war, and took part in many massed start events in closed circuits, contemplates returning to competitive road work.

The Hat Trick

J. WAINWRIGHT, Walsall Roads Club, won the Crescent Wheelers "25" for the third consecutive year, and enabled his club to secure their third consecutive team race victory.

New R.A.F. Club

CYCLISTS at a North Yorkshire aerodrome have formed a cycling club known as the Nidd Valley Wheelers.

Harry Hill's Activities

HARRY HILL, Sheffield Phœnix star, who turned professional in order to attack records—he secured the straightaway 50—does little cycling now, but is still keen on the sport, and attends open events in Lancashire as a judge.

Highgate's New Venture

MEMBERS of the Highgate C.C., one of North London's oldest established clubs, have formed a special section for veterans, known as The Gate C.C.

Dutch Time Trialists

THREE Dutch riders made their debut in road time trials when they competed in the King's Lynn "25." None was placed in the prize list, all finishing outside "evens."

Penny-a-milers!

PROVIDED they cycle 30 miles a month on official business, certain members of London County Council can claim an allowance of a penny a mile.

Three Hours for a "50"!

A FIFTY mile road race, held in Eire, was won in 3 hrs. 1 min. 20 sec.—a good time considering that the winner, and all other competitors, rode Army machines and wore full equipment.

Lancashire Old-timer Passes

THE death is announced of Dan Jackson, 75-year-old cycling enthusiast of Nelson, a founder of the Nelson Wheelers C.C. He did not commence cycling until he was 45.

Pioneer Cyclist's Death

HANS REYNOLD, inventor of the Bush roller chain, has died. He founded the firm bearing his name in 1879, and was 90.

New North London Combine

FIVE prominent North London clubs—Finsbury Park, Southgate, Unity, Poly and North Road—are holding club events in conjunction with each other, although only individual club prizes will be awarded.

Southgate Men in India

LT. R. S. PHILPOT, Southgate C.C., has received his commission in the Indian Army, and has met reigning club champion, G. E. Thomas, who holds similar rank in a Punjab Regiment.

Presentation to N.C.U. Secretary

NORTHERN Ireland representatives of the National Cyclists' Union have presented a shillelagh to Mr. A. P. Chamberlin, the N.C.U. secretary.

Fewer Cycle Thefts

IN pre-war days the number of cycles stolen annually in London was accepted at 14,000. Last year the figure dropped to 10,000.

J. Cartwright Safe

REPORTED missing following the fall of Singapore, J. Cartwright, Midland Clarion C.C., is now known to be a prisoner of war in Japanese hands.

Welsh Rally

THE local N.C.U. centre anticipate staging a rally in Porthcawl during July. The programme will include a cycling "quiz" and a roller contest.

Club's Coming-of-age

KENT Road Club celebrates its coming-of-age this year. A special invitation team race—with clubs identified with it since its formation—is being held in the way of celebration.

Track Events Cancelled

NORTH Middlesex and Herts Cycling Association have had to cancel their proposed track events owing to the failure to find someone to run them. Former promoter, Wally Knock, is now busy with Home Guard exercises.

Cambridge Veteran Dies

AT the age of 74, J. A. Townsend has died at Cambridge. At one time he was champion of the Eastern Counties, and, 50 years ago, achieved fame as a trackman.

Ron Kitching's Position

LAST year Ron Kitching, winner of the North Road 12-hour event, and one of the greatest "stayers" of the sport, joined the North Road Club. He has now resigned, and thrown in his lot with a club affiliated to the British League of Racing Cyclists.

Racing in Finsbury Park

PERMISSION has been received by the N.C.U. from the London County Council to stage a massed start race in Finsbury Park, North London, on August 14th.

Widnes Transporter Doomed?

LANCASHIRE County Council are preparing plans for a toll-free bridge from Runcorn to Widnes to replace the famous transporter apparatus over the Mersey. The present link has been in use for 40 years, and is the only road link between Cheshire and Lancashire, other than the Mersey tunnel at Liverpool.

Southgate's Diamond Jubilee

SOUTHGATE C.C. celebrated its Diamond Jubilee with a Sunday afternoon tea at which president R. E. Watkin, champion in 1894 and 1905, presided over a company of fifty members and friends.

Killed Over Malta

FORMER track secretary of the Comet C.C., D. Clarke, R.A.F.V.R., was killed in action over Malta.

Barnet Boy Missing

BOB THOMAS, one of Barnet Cycling Club's brilliant hill-climbing team, is missing in the Middle East.

Cyclorama

By H. W. ELEY

A glade near North Warnborough Castle.

Tyre Economy

AS everyone knows, all the tyre manufacturers have for some time devoted their advertising space to appeals about tyre economy, and the constant reiteration of hints on how to make tyres last the maximum amount of time is bound to have a good effect on the general rubber situation—which, in view of the responsible Ministers, is still acute, and of such a nature as to cause grave concern. As a cyclist, I am glad to note that the appeal is not confined merely to motorists—that greatly reduced band of road-users! Recently, I heard that the Ministry of Supply contemplated issuing posters to all big firms for display in cycle sheds used by employees. One can imagine the usefulness of this; at every big munition works there are hundreds (possibly thousands) of workers who travel to and from their work on bicycles. Get the message home to *them*, at the right place and at the right time, and something very helpful will have been accomplished. It is sad to see the gross neglect of tyres which still goes on: no attempt to inflate tyres to proper pressures; cuts left unrepaired: stones and flints left in the treads to work their damaging worst . . . these are some of the things which need publicising, and posters displayed in and near to workers' cycle sheds are one of the best means of dealing with the situation.

Oak-apple Day

THESE notes were written on a perfect spring day. The sun was shining, and when I paused in my typing I could hear, over from the big elm tree at the bottom of the field, the sweet, if monotonous, call of the cuckoo . . . the "mysterious voice" of the countryside during those springtime days. In Dingle Wood there were carpets of blue-bells, and when, in the course of my morning ride into town, I reached suburban roads, they were a riot of colour—laburnums, pink hawthorns, lilacs, and red and white chestnuts. Mother Nature was profuse with her colours those May days, and it was good to be awheel. And I was reminded, when I looked at my calendar, that Oak-apple Day was but a week away. May 29th, when we commemorate the legendary "hiding-in-the-oak" by King Charles. I recall that in schooldays the day was observed with great reverence and strictness, and woe betide the luckless boy who did not wear a sprig of oak-apple in his coat on the 29th! The punishment was short and sharp—a stinging with nettles, which usually made the forgetful one make a special note of the date for the next year! I am afraid that such-like old customs have almost all disappeared in these swift and unromantic days. . . .

The Pickwick Club

POSSIBLY the Pickwick Bicycle Club is only well known to the older generation of cyclists, but I am reminded of this famous and somewhat exclusive club by a pleasant memory of a recent "austerity" lunch, which was held in London, and presided over by Lord Kenilworth, that genial and beloved man better known to a host of folk as J. D. Siddeley. The little affair was a happy one, and characterised by all the Dickensian humour and byplay which one associates with all functions of the Pickwick Club. As one may imagine, charity is a feature of every "Pickwickian," and on this particular occasion, an appeal was made on behalf of the Red Cross Fund; a pair of dumb-bells were auctioned; and, in the result, a bicycle manufacturer became the possessor of the muscle-developing bells, which brought in £250 for the Red Cross. Not a bad sequel to an "austerity lunch"! Lord Kenilworth is, of course, a member of The Roadfarers' Club.

Dunlop Slogans

ADVERTISING "slogans" always intrigue me, and I have been watching with keen interest the series of old-time slogans being run by Dunlop. "First in 1888—Foremost ever since" was featured, and I have been told that this is No. 1 on the list of Dunlop slogans. It originated away back in the very early days of the company, when it was concerned only with cycle tyres and accessories—long before the days of "giant pneumatics" and such products as "Dunlopillo" and Dunlop sports goods. When I saw the phrase on the cover of a trade journal my mind went back to days when Sir Arthur du Cros was chairman of the company, and to times when his six famous athletic sons were making cycling history on track and road.

Storing Covers and Tubes

HOW best to store covers and tubes? From inquiries I have received, it would appear that there are plenty of cyclists who would welcome advice on this subject. Well, in the first place, let me emphasise a golden rule: never expose stored cycle covers and tubes to light. Bright sunlight is an arch-enemy of rubber, and causes cracking. Secondly, keep oil from the tyres . . . oil is another "fiend" where rubber is concerned. So far as tubes are concerned, it is recommended that valve plugs are loosened before storing, to prevent sticking and creasing of the tubes. If tyres are on wheels, hang the wheels so that tyres are relieved of weight, and keep the tyres moderately inflated. These little "tips" are worth while adopting, as in these days anything made from rubber is precious!

Demands of War

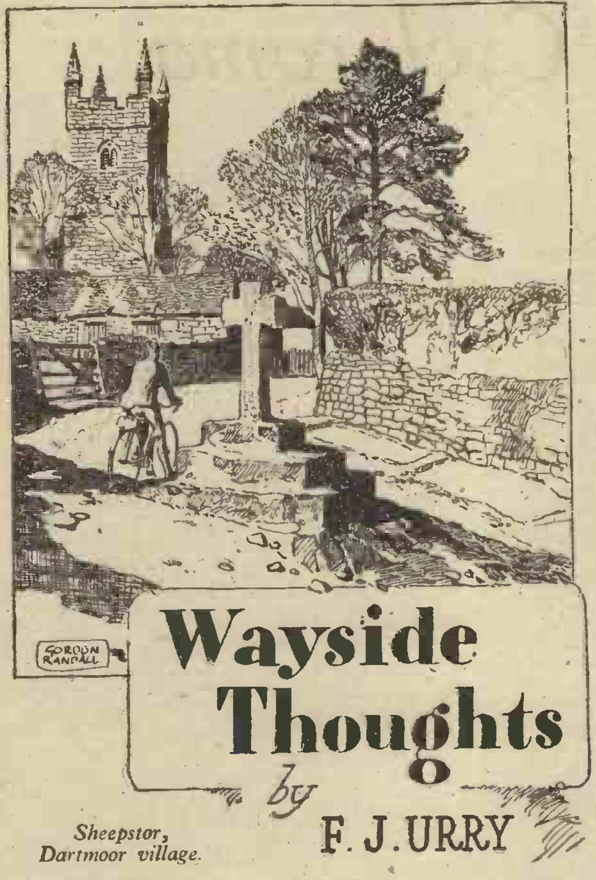
AT Easter-tide, I did a bit of cycling around some of my favourite Derbyshire villages, on the borders of Staffordshire, and I was saddened to find that the urgent demands of war had made it necessary to spoil some of the best of the countryside for the construction of aerodromes. Acres of lovely woodland gone; old farms obliterated; noble trees uprooted; devastation of the beautiful everywhere . . . and one could not help but feel sad and even angry. But modern war is a rapacious beast, and its appetite is never satisfied. I took comfort from the thought that from the devastated areas, "fighters" would go forth to meet enemy bombers, and that the great spaces where once farms flourished, and cottagers lived, would be bulwarks of defence, and "spring-boards" of attack in the long battle against the Hun. Still . . . that wood where once I gathered anemones and primroses; that old farm where the sleek cows grazed; that little inn where I used to sip my ale . . . they deserve a word, and perhaps a tear. . . .

Petts Wood

A FORTNIGHT ago, business took me into Kent, and I stayed a night at the pleasant place, Petts Wood. It is, I suppose, really a "London Dormitory," but it retains, in marked degree, its character, and is a genuine "bit of Kent." I know of few places near to London with a finer inn sign than that which adorns "The Daylight," named, of course, in honour of William Willett, the father of daylight saving—born in Petts Wood, and his memory is perpetuated there by a memorial in those fine and picturesque woods which lead one to Chislehurst. Silver birches abound in this pleasant Kent region, and everyone seems "garden minded," so that wherever one goes there is an abundance of colour.

Cycle Shortage!

IS there a "cycle shortage"? I have looked in the windows of many dealers recently and found good stocks of bikes, but whether they are all "bespoke" I cannot say. But it did strike me that, on the face of things at any rate, the dealers had plenty of machines to sell. If this is the case, it speaks well for the manufacturers, many of whom are engaged on "other things" connected with the beating of Hitler. And it shows, too, that the much-talked of "steel allocation" is working well in the matter. All things considered, we do not do so badly in this war-racked world! Or so methinks.



Wayside Thoughts

by

F. J. URRY

Sheepstor, Dartmoor village.

Valuable Aids

THE technical press has recently published a series of 3-speed gear repair charts of much wider interest than that confined to the repair man. These charts have been carefully compiled by Mr. Fred Keller, of Sturmey-Archer Gears, Ltd., with a view to assisting the dealer, and through him, the rider, to keep those useful hubs in full service until after the war; for until victory has been won no more gears or gear spares can be made. My object in mentioning the matter here is that if your 3-speed hub has "gone wrong," don't scrap it, but take it to your repairer who may be able to put it in working order by using spare parts taken from a discarded hub; or he may be able to give you the use of two of the gears, and can if the worst comes to the worst, convert the hub to a single speed, and so save the purchase of a new single speed hub. That information should be of service to many thousands of people, for it may be the means of keeping a bicycle in commission. While on this subject it may be as well to issue a note of warning on the care of speed gears generally, for from fairly close observation I am quite certain many of them are badly neglected in the matter of lubrication and adjustment. The former is important if the best service of delicate machinery is to result, and only the best thin oil should be used. But neglect of adjustment is the abuse of service, and I think far more gears are ruined by failure of the owner to take this simple precaution, than are ever worn out by fair means. Time and again I see 3-speed hubs only functioning on the high ratio, mainly because the owner is too idle or ignorant to adjust the cable, and I should imagine half the smashed pinions and carrier-cages are due to maladjustment. Such neglect is a crime against decent equipment at any time, but now that 3-speed hubs and spares are "off the market" it is specially heinous, and deserves the most severe censure. Therefore take care of a good engineering bit of help; it is well worth the slight trouble.

Getting the Advice Home

IT has been truly said on many occasions that if only people knew of the pleasure inherent in cycling there would be millions more riders. And that, I think, is true of the real lover of the country, of its sights and sounds and smells—if we old riders could only get him to learn how to ride. That is the trouble: to persuade a man or maid to learn cycling. Millions can ride, but only thousands can cycle. And it is all a question of fitness, not necessarily muscular, but fitness of the machine to suit the rider, and then the fitting of the man to the machine. And it is that latter need that requires so much breaking down of prejudice. Do I know it? Friends, dozens of them, have come to me for advice and I give it them freely; but when it comes to the positioning of their bodies awheel in order to obtain comfort and ease, and the ability to ride far without undue fatigue, then they dispute with me. "I do not want to become a racing man," they say, "I want to ride with head up and shoulders back as I would walk." Well, if a man really desires to enjoy cycling and its fullness, you can't do that, for "that" means a handicap imposed on your energy unnecessarily, and—strange as it may seem to people—the imposition of a discomfort increasing with the miles. The right way to ride for pleasure is to sit down to your job as you would to writing, the easy posture that prohibits fatigue and makes your body a spring as opposed to a board.

Little Hope

IF you have been wanting to buy a week-end cycle-bag to replace the ruin that has been so overloaded these last months, you have probably found it difficult, if not impossible. For they are in short supply, and now the shopping baskets of the women have been debarred, the call for the week-end cycle-bag has very naturally increased. A week or so ago I took this matter of shortage up with Mr. H. R. Watling, the Director of the Union of Cycle Manufacturers, who wrote to the Board of Trade asking for an increased quota of material with which to manufacture these bags, but the response was disappointing, notwithstanding the fact that authority admitted the shortage, yet could not give any hope of meeting the demand. Instead the B.O.T. suggested that hand shopping bags should be used, and that it should not be outside the possibility of adopting them for use as cycle week-enders. What I have seen of these bags, made of flimsy material, and what I know of strap shortage, does not encourage me to think the B.O.T. suggestion will be very helpful. If we are badly in need of a week-ender we may have a bit of luck in getting one—or we may not; but the recent refusal to release more material than the present quota, does suggest we take greater care of this portion of our property, and make it hang together and fulfil its duties for the longest possible period. Carpet thread and a bodkin are helpful, and a copper bifurcated rivet to secure unanchored straps—though it may not be sightly—is effective. In these days when most of us are serving as domestic carriers, our week-enders come in for a lot of rough treatment—I know mine do—nor can I see how it can be otherwise to-day; but the old story of a "stitch in time" is worth remembering in this connection.

These Evenings

WHAT a friendly world this is at the coming of spring. An idle hour of an evening and I can be away from the works into a strip of country where all is green and brown and lovely, where the birds carol their good-nights, and the slanting sunshine seems to love the earth as the earth loves it, and between them make pictures before which I bow down and worship. Is it peace you are seeking after a toilsome day? Then here it is *in excelsis*; nor does your coming disturb it with noise. Only the ripple of a tyre over the tarmac, or the light buzz of a free-wheel, sounds almost complementary to the quiet wind in the firs. I lingered by a pool on the way home, a pool shaded by tall Scotch firs that took the light of the sun on their rugged trunks and then went on to paint wonderful tints on the quivering waters of the tiny tarn, disturbed by the water hens seeking their supper. Farther on I passed over a brook chuckling to its stones and running like a rainbow with the sunset in its waters, through emerald meadows, to dive in the middle distance into the green arcades of a wood whence the throstles sent up a pæan of praise for so perfect an evening. I found enough violets in a secluded lane within a few miles of home to cull a small bunch as a thank-offering for domestic felicity; and all this within 140 minutes from the moment I left the works. These little cameos of time, so simple and so delightful, can only be undertaken with the aid of a bicycle, the one vehicle in the world that goes about its business silently, that fits your mood and gives you a service of incomparable delight, if you will only let it. This little testimony belongs as much to the machine as the man, for without the former the latter would be lost indeed.

At Easter

I WENT away at Easter on a bicycle, but my roaming was confined by the reason that family responsibilities, occasioned by illness, kept me fairly close to one area. I am not complaining, for I had a very happy time, and part of that joy, the major part, was to see the pleasure of other people, and feel the influence of the change working its little miracle in erstwhile pale cheeks. And I know a trifle more of the Berwyns now than was the case before Easter, for Llangollen was our anchorage, and I was given the grace of several days' roaming in addition to the ride out and home. There is a speaking joy of travel along the tops of these hills that guard the Dee Valley on either bank, and you can see more and find pleasure in the sight in 10 miles than five times the distance covered over easy ways. True, the going is hard, and when you are not climbing, the brakes are at work, and the speed is slow for you to pick your way along the rough paths. But with food in the bag and an upland farm to make a pot of tea, you are happy with the wind and sunshine, the glory of the visions, and the ever-changing colours on the hills as the quick clouds go galloping across the blue. Those were good days without many miles to their total, but perhaps they were more free on that account, for too often we are apt to make ourselves slaves to a schedule. On several occasions I met my people "up the line," and we walked into the hills with my bicycle acting as the handcart for supplies and spare coats; and most successful excursions they were, for they gave me a 20-miles wheeling trip that otherwise would not have been in the reckoning. So you see there are more ways of making a bicycle useful than the natural one of always riding it.

Restriction and Reaction

IN U.S.A. bicycles can only be obtained on the production of a certificate of need, which latter is based on the use of the machine for work, civil defence or business purposes (including school journeys) on at least four days of the week. So you see, the bicycle is an important article of transport over yonder, having emerged from its toy condition to some importance since the advent of war. We are not quite so tight on supplies here; but we might be yet, and wisdom suggests you should be prepared by equipping yourself with the machine and the needful spares. Certainly as the war goes on things will become more difficult, and I should not be a bit surprised if the now slender ration of petrol allowed for business journeys was not further clipped. It is strange to me that so many people are "forced" to take up cycling as a defence against walking. What a lazy nation we have grown when the main desire seems to be to go everywhere by car, and use our limbs the least possible number of hours per week. It is true that men now live longer, but also I think they live less actively and miss the enjoyment that makes a man more manly because he finds satisfaction in the use of his own powers. But the point I want to make is—the point I am for ever trying to push home—that if folk will only give something of themselves to cycling—mentally and physically—they will be happier, healthier and richer for the experience. If you burden your mind with the notion that you are "forced" to take up cycling, don't—walk! I do not want anyone to approach a great pastime like cycling with a diseased mind.

Club Notes

Keen Struggle

THERE is keen competition in the Scottish Amateur C.A.'s wartime championship, the leading contestants being Alex. Hendry, Glasgow Wheelers, and J. Allison, Edinburgh United C.C.

Another Jubilee

AMONG the clubs celebrating their Diamond Jubilees this year is the Darlington Wednesday C.C.

Clarion Champion

GEORGE HANNAH, West of Scotland, won the National Clarion 1942 Championship, with J. Ball, Manchester, second.

Good News from St. Neots

ST. NEOTS AND DISTRICT C.C. extend an invitation to any members of the Forces stationed in the club's area to take part in club runs. No fee is charged and details may be had from Cecil Paget, Eaton Socon, Hunts.

Long-distance Man Volunteers

ARTHUR AYLETT, long-distance star of the Bedfordshire Road Club, has volunteered for the Navy.

Harris Home

REG. HARRIS, who was one of the best Manchester sprinters in pre-war days, has returned to Britain from the Middle East.

Lee Returns

NEIL LEE, formerly a well-known member of the Ivy C.C., has joined the Glasgow Nightingale C.C.

Crawick Man Missing

FLIGHT-SGT. ANDY BURNS, of Crawick Wheelers, is missing from operational duties with the R.A.F.

Fastest Scots 25

UP to the end of May, J. Allison, Edinburgh United C.C., had clocked the best Scots 25 time of 1943. Riding in the Glasgow United C.C. Open 25, this 17-year-old clocked 1 hr. 2 min. 40 sec., beating several well-known riders.

Dundee Drops

THE Dundee Cycling Association has lapsed, and its open promotions have been taken over by other clubs. The association was formed in 1940 by combining the Dundee Road C.C. and the Forfarshire Roads C.C.

My Point of View

BY "WAYFARER"

St Mary the Virgin: Adderbury (Oxon) "For Strength"

Desirable Round-up

I HEARD the other day (or saw it in a newspaper) that the Government were about to round-up old motor-cars with the object of using for the war effort the material they contain. If this activity is intended to embrace the "liquidation" of the car dumps which disgrace so many points of our countryside, then the suggested round-up is a most desirable thing. Some of the car cemeteries one sees, particularly in the country districts, containing motor vehicles of all sorts in every possible stage of senile decay, are heart-breaking, and constitute a sad reflection on the mentality of the folks who are responsible for so gross and grievous a disfigurement of a lovely land.

Nothing Doing

DEPARTING from custom, out of respect for the abnormal conditions set up by the war, I wrote to an old and familiar house of call and booked a bed for the following Saturday night. The reply came back that the reservation was made with pleasure, "but we cannot serve supper after 8 p.m., as we are then busy in the bar. We hope you will endeavour to reach here by that hour." As it was physically impossible for me to complete my journey by eight o'clock, I sent a polite note of thanks for the reservation, and asked for it to be cancelled. Possibly I am old-fashioned, but my view is that, when I am paying the piper, I have a right to call the tune, and my idea of "calling the tune" at that particular house is to arrive at 9 p.m., as I have done for years. If, as a wartime measure, beer selling is of greater importance than catering for cyclists, then, as a wartime measure, I "stand from under," and there's nothing doing.

Cyclometers

I AM all in favour of cyclometers, always provided that the temptation to ride merely to push up the mileage total is resisted. These very handy little measurers, the machinery for which is necessarily crowded into a tiny compass, are interesting in that they tell of one's achievements—and help to explain why one begins (or ought to begin !) to feel tired ! They are useful, too, in helping one to keep a check on chain and tyre wear. On this point, it may be remarked that one of my bicycles recently started to talk to me, and I rather resented the suggestion of the chain that it was due for retirement. On looking up its record, however, I found that it was approaching a 6,000-mile total, on a fixed-gear bicycle which is ridden in all weathers ; and my feelings at once changed. I realised that the chain had "done its stuff" and owed me nothing, and the necessary purchase (including a new sprocket) was made. Cyclometers, too, are useful in another way—perhaps a curious way. Travelling on a recent occasion without a watch, and stopping for a moment, a man approached and asked me the time. (He probably said the "correct" time, because nobody ever seems to ask for any other sort !) I looked down at my cyclometer and said, without hesitation, "About 4.30." You see, I had left home just two hours before and had travelled 22 miles. The information turned out to be pretty accurate, as a post office clock told me a few minutes later.

The Day After

A WET and wild Saturday afternoon in May (when I had no hesitation in "giving it best," and remaining by the fireside), was followed by a day which made a bad start, and then turned from the error of its ways. The wind was still very tempestuous, and the rain was apparently waiting just round the corner, all ready to make a show on demand. I decided that the day after the storm was "O.K. by me," and sallied forth, having added a warm pull-over and thick gloves to my equipment. And they were needed ! What a day it was—strong winds, plenteous sunshine, and most wonderful visibility. The breeze hurried me, by a roundabout route, to the cottage, in the Forest of Arden, where I usually obtain my Sunday lunch. Then it fought me on the second side of a very rough triangle, gradually edging round so that it actually helped me on the last stage of my 60-mile journey. I had tea at a lonely farm-house looking towards the Malvern Hills, and then climbed up on to a ridge road which provided me with a superb panorama of the Cotswolds, Edge Hill, the Vale of Evesham, Bredon Hill, and the aforesaid Malverns. Altogether, it was a great day—a happy day. Much of the blossom had defied Rude Boreas and was still in a position to delight the eyes and noses of passers-by, while the scent of growing beans was deliciously strong. The glory of the day gradually faded, but I was only two miles from home when the Clerk of the Weather—at times a veritable kill-joy !—decided that he must interfere, causing me to put on my cape. But my day was then over, and I didn't in the least mind the moist finale, after all those hours of delight.

Can It Be Done?

THIS is *The Cyclist* supplement of a mechanical journal. Here are some views, and this is the most unmechanical mind in the world expressing them. A thought which came to me the other day, as I was scurrying down a long hill, was as follows : Why should not all this power which is running to waste be collected and stored for use on the next upgrade—why should not the excess of motion accruing on every downgrade be gathered up, in some way, and utilised in order to neutralise the deterrent effects of a headwind ? It is no new idea, but hitherto it has been treated as a music-hall item, or as the fetish of a half-wit. But, in these days of miracles, can we so dismiss the thought ? Can we accept X-rays and wireless communication as commonplace ; can we view the marvels of the aeroplane and the submarine as something automatic, and proclaim as the vapourings of a lunatic all suggestions concerning the storage of human energy ? I do not think we can. It will be for brains of a type very different from mine to suggest how the thing can be done, and I might as well say that I have not the slightest glimmering of an idea as to the method. But the recent discovery of the drug known as "M and B" and of that concerning the use of halibut liver oil—not to mention the dehydration of vegetables—impel me to say that I refuse to believe that the momentum generated by a cyclist on a long downgrade cannot be stored for future use. It may be a fanciful thought at the moment. I don't say it can be done ; he would be a bold man who said it couldn't.

Useful

THE bicycle comes to our aid in a variety of ways. I recall that my tandem went with me on the last seaside holiday I took (and that's many years ago), and that it proved extremely useful at the day's ending for conveying tired children from the shore to the farm, two miles away, where we were staying. Then, one day last summer, when I was at one of my country haunts, I encountered a man who had been rescued from a dilemma through the agency of his bicycle. His wife and two young kiddies had come by bus to take possession of rooms which had been booked, only to find that their prospective landlady had been laid aside through sudden illness and could not put them up. The man, having journeyed by bicycle, got to work to secure alternative accommodation, and dashed to and fro until he succeeded. He told me that but for the two-wheeler the party would have had to return home and lose their holiday.

Notes of a Highwayman

By LEONARD ELLIS

A Gloucestershire Treasure House

IN a county that is particularly rich in delightful old towns the ancient market town of Tewkesbury, on the Worcestershire border, calls for particular mention, and is well worth the attention of the tourist. Its general aspect is pleasing in the extreme and its individual charms are many and varied. The town is well blessed with old buildings, many with interesting histories. The Abbey is, of course, its crowning glory, with a story going back to the eighth century. The present church was begun early in the 12th century, and additions and rebuilding went on for several centuries. Tewkesbury figures prominently in the history of England, and in May, 1471, the rival houses of York and Lancaster fought a terrible battle in a meadow near the Abbey. Here Margaret of Anjou was decisively beaten and her son Prince Edward was captured and killed. The beautiful old Bell Inn, standing apparently across the end of Church Street, figures in "John Halifax, Gentleman," as the home of Abel Fletcher, the tanner, and the bowling green can still be seen at the rear of the inn. The Royal Hop Pole Hotel is the place mentioned in "Pickwick Papers," and the House of the Golden Key, with two overhanging gables, is regarded as one of the finest specimens of its style in England. Another very fine building is the Black Beare Inn, close to the old King John's Bridge over the Avon. This river effects its confluence with the Severn just outside the town, and two other small streams converge in the vicinity.

Lincoln Landmark

BOSTON, in Lincolnshire, is one of the many places in these islands that have a great attraction for American visitors. In 1630 John Winthrop and a party of emigrants sailed for America and founded the new Boston in Massachusetts. The name is really a corruption of Botolph's town, as St. Botolph, a hermit abbot, was the founder of the Benedictine Order in England. At one time Boston was the second port in the kingdom, but like so many other places it lost its importance owing to the silting up of the river. Unlike many, however, it has staged a fairly successful come-back. The tower of St. Botolph's church is one of the best-known landmarks in England and can be seen in suitable weather from the Norfolk coast over 40 miles away. The tower is 288ft. high and is commonly called "The Stump." The landmark is of considerable antiquity ; in fact, the base was begun in 1309, and is much older than the rest of the church. It is said that in cubic capacity this church is the largest in England. The town's charter was granted by King John in 1204, and further rights were bestowed by Queen Elizabeth in 1573.

The massive tower of Tewkesbury Abbey.

Around the Wheelworld

By ICARUS

Care of Tyres

W. B. STOKES, secretary of the Tyre Manufacturers' Conference, writes: "Those who ride bicycles and those who sell them can between them give further very welcome help in easing the rubber shortage.

"There are not enough cycle tubes to go round, which is as much the result of the lack of labour to make the tubes as the lack of rubber to make them from.

"The number of new tubes already required this year is several times those needed for new bicycles alone. Will cyclists help to save the old ones? A little army of new cyclists has sprung up since the war. May we appeal to them to learn how to mend punctures, and so keep their old tubes in use until peace returns?

"And if a tube is punctured beyond hope of repair will the cyclist remember to hand it in to the dealer when he has bought a new one? If the dealer can find the time to fit the new tube right away so much the better; but if he cannot, will he for his part see to it that the cyclist returns the old one later?"

C. A. Smith Injured

WHILST riding his bicycle through Byfleet recently C. A. (Bathroad) Smith was knocked down by a lady on a military bicycle as she emerged from a garage. He was knocked unconscious, and upon recovery found himself in a taxi bound for the Cobhams. He received a cut in the head and another on the elbow, but I am pleased to be able to report that he is recovering. Many years ago C. A. Smith had a serious accident, due to the collapse of his bicycle, and was unconscious for a number of days. Readers will join with me in wishing him a speedy return to his bicycle—and his tricycle.

The First London Road Race

THE first mass-start London road race, which was run between Barnet and Biggleswade on Sunday, May 23rd, proved to be a well-organised affair, and entirely free from untoward incidents. The police co-operated in the running of the event, and my inquiries indicate that they are favourably impressed. The event was won by E. Clements, of the Wolverhampton Racing C.C., who was recently beaten by Kitching, of the Bradford C.C., in the Chelkers event. The Barnet event was promoted by the London Section of the British League of Racing Cyclists, and there was an estimated crowd of 3,000 spectators to witness the very close finish. Hadley Common was packed. In the first bunch to approach the finishing line were 16 riders, with Clements and Kitching riding neck and neck. Only half a wheel separated the two at the finishing line.

This event attracted the best entry yet obtained for mass-start racing, and there were Belgian, Dutch and French riders, to whom, of course, this form of sport is well known in their respective countries. Well-known British riders included the fastest 25-miler of 1942, E. Jones, Ray Jones (the English international rider), H. Binfield, S. Pountney, A. E. Price, R. Whitcombe, Walter Greaves (the one-armed rider), whilst G. Clarke (who won the tour of the Wrekin race) did his best to uphold the traditions of Yorkshire, whatever those traditions are. W. Boyden took third place, whilst fourth place was occupied by three riders, namely, L. A. Hook, S. Honour and A. E. Hollis. Clements won in 3 hrs. 16 mins. 63 secs., and the team race was secured by the Southern Coureurs, with 22 points. Runners-up were the West London R.C., with 24 points. This form of race, in my view, has come to stay. As I have pointed out before, such races are not illegal; and I am still awaiting an explanation from the National Body as to why they have, for the past 30 years, consistently stated that mass-start racing is illegal. Quite obviously they had not investigated the mat er, because when I took up the question with the Ministry of Transport, the Home Office, and the legal department of the Government, I was told that the subject had never been raised before, but they would look into it. Finally, I was informed that mass-start races were quite legal. It seems to me that the myth of illegality has been advanced by those who did not wish to see a rival sport commence which might conceivably prove more popular. In any case, they have been made to look stupid in the eyes of the cycling public by the friendly attitude of the police. Whether National Bodies agree with this sport or not it is entitled to receive, and will receive, at the hands of this journal due publicity, for it is not the function of the press to suppress any movement with which it may not agree. A newspaper should contain news, all the news, and it should be non-partisan. The press and the associations should be co-operative but dissociated. They should be parts of the whole, not controllers of it. Associations should be democratic, and act upon resolutions passed at an A.G.M. The press should report even unpalatable things which may have happened, even though they may be contrary to policy. The public should be the judge of what it wants, and thus the public must be kept informed of both sides of any question.

The cycling world is already alive to the fact that in some cases this has not been so. I foresee the formation after the war of National Bodies, of which the Roadfarers' Club and The British League of Racing Cyclists are the precursors, whose policy will

C. G. Grey in the chair at a recent dinner of the Roadfarers' Club. Other well-known people seen in the illustrations are C. A. Smith (vice-president), A. H. Bentley, H. Boon, Dudley Noble, Victor Bowman, R. A. West (hon. sec.), H. Calkin and Capt. F. C. Day.

be more in keeping with modern times. We cannot blind ourselves to the fact that there is great dissatisfaction in cycledom.

Dunlop Rubber Co., Ltd.—1942 Results

THE net profit for the year 1942, subject to final audit, amounts to £2,433,307, compared with £3,186,269 for 1941. With the addition of £622,839 brought forward from the last account, the amount available for appropriation is £3,056,146.

The directors have transferred as provision for Excess Profits Tax, £827,368; to Income Tax liability, 1942-43, £910,587, less reserve provided in 1941 of £650,000, net £260,587; to Income Tax reserve towards the 1943-44 liability, £700,000; and to Contingencies Reserve, £100,000.

The preference dividends paid for the year 1942 amount to £193,750, and the directors recommend a dividend on the ordinary stock at the rate of 8 per cent., less Income Tax at 9s. 7.1276d. in the pound, which will absorb £346,855. The balance carried forward is £627,586.

Travel To and From Ireland

THE railway and steamship companies have given notice that they will not issue rail and steamship tickets for travel to or from Ireland between the following dates unless the passenger is in possession of a sailing ticket, which must be obtained in advance. The requirements regarding sailing tickets will apply:

(a) To travel via Holyhead from June 7th to September 30th, both dates inclusive;
(b) To travel via Heysham and Stranraer from July 1st to August 31st, both dates inclusive.

Application for sailing tickets, which will be issued free of charge, should be made at least ten days before the date of the proposed journey, and must state clearly the proposed route and date of travel, together with an alternative date. The application must be accompanied by a stamped addressed envelope.

Information as to the railway or steamship offices to which applications should be made for sailing tickets can be obtained on enquiry at the stations and offices of the companies.

Passengers to Ireland are reminded that they must also be in possession of the necessary exit permit.

Travellers to Ireland should have as little luggage as possible and should carry no documents except such as are absolutely necessary.

N.C.U. Recommended Touring Accommodation, 1943

WE have received a copy of the N.C.U. Recommended Touring Accommodation for 1943, cost 7d. by post. It has been compiled and published by the National Cyclists' Union, 35, Doughty Street, London, W.C.1. It contains a useful list of recommended addresses in the various counties. There is a small misprint on page 1, in the spelling of *supersedes.*

Road Accidents—April, 1943

FEWER road deaths were reported in April than in any month for the last ten years. The total of 396, compared with the total for April, 1942, shows a decrease of 169, or an average saving of five or six lives every day. Among adult pedestrians, the number of deaths fell from 170 to 106, and among motor-cyclists from 80 to 44.

By contrast, the reduction in the number of adults killed shows up more clearly the high rate of accidents among children. Nearly half the pedestrians killed were under 15, and the total of 93 is one more than in April of last year.

These figures underline the importance of regular instruction in kerb drill. It is given at hundreds of schools all over the country, and parents of small children are urged to do the same. The instructions are as follows: "At the kerb, halt. Eyes right, eyes left. If all clear, quick march."

There remains a responsibility on all drivers to keep a sharp look-out, and make full allowance for the inexperience of children.

National Association—New Secretary

MR. A. J. BALLANTYNE becomes the new secretary of the National Association of Cycle Traders. John Ballantyne is, of course, the well-known cyclist of the Southgate C.C., and was responsible for reviving activities at that old club since 1922. He is a member of the Roadfarers' Club. I wish him well in his new task.

Mr. A. E. Mayo

THAT veteran member of the cycle and motor-cycle industry, Mr. Arthur E. Mayo, has recently undergone a somewhat serious operation, from which, however, he is making good progress towards recovery. Both he and his family have been grateful for the many kind enquiries that they have been receiving from friends in the trade. Mr. Mayo, by the way, is still at the Radford Infirmary, Oxford, where he is likely to remain for the next week or two. He has been engaged in the industry for the whole of his business life, but retired from the Coventry-Eagle Cycle & Motor Co., Ltd., in 1938. He still retains the keenest interest in the affairs of the company and in those of the industry at large.

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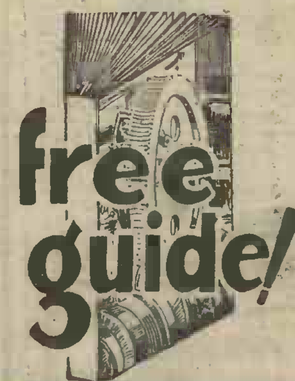

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