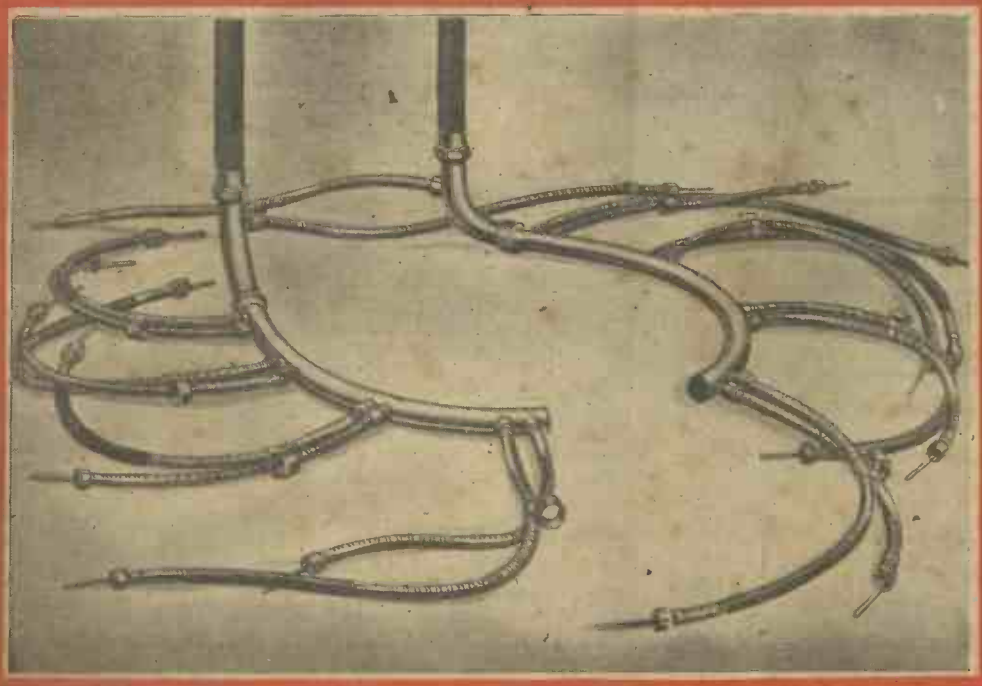
AERO IGNITION SYSTEMS

NEWNES

PRACTICAL MECHANICS

9D

APRIL 1943



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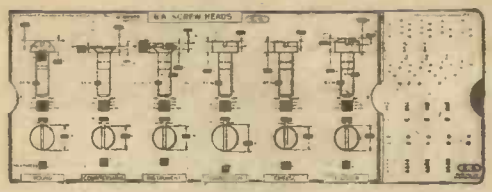

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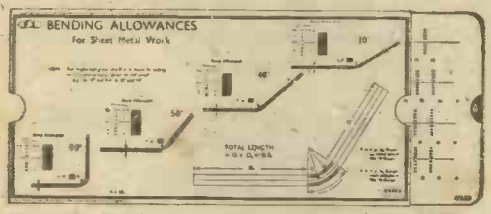

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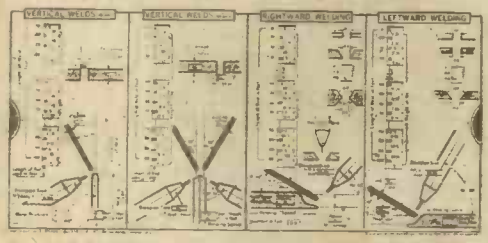

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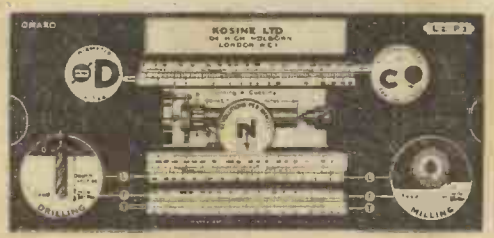

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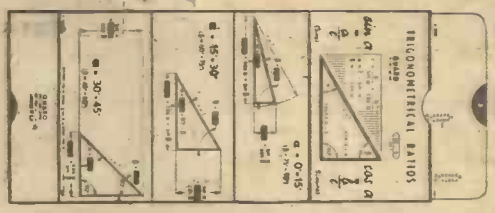

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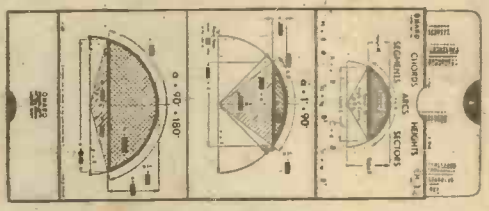

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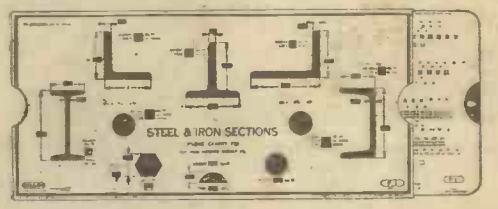

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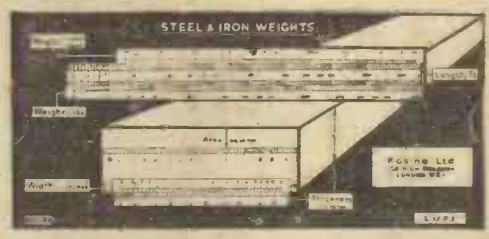

L.I.

Side 1 (Illustrated).

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(*b*) Weight per foot.
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Owing to the paper shortage "The Cyclist," "Practical Motorist," and "Home Movies" are temporarily incorporated.

Editor : F. J. CAMM

VOL. X. APRIL, 1943 No. 115

FAIR COMMENT — BY THE EDITOR

Civil Aviation After the War

THE Government has decided that plans may be prepared for post-war civil aviation and designs for suitable types of aircraft put in hand at once. The Government intends to back this project, and has stated that it cannot be left to private enterprise. As far as international airways and commercial aviation are concerned it makes the broad hint that it is prepared to co-operate with other nations to mutual benefit as distinct from cut-throat competition, but that if other nations prefer competition Great Britain will be equal to it, with the best machines in the world. The desire is to link up the Empire by air, in the first place, but obviously air communications with other nations will fall into a general scheme.

The development of air travel must not take place too suddenly after the war, for the railways and shipping companies will need time to accommodate themselves to this newest rival. We do not need to solve one problem, that of rapid international travel, at the expense of another. Here is one of the beneficial services of war. It develops particular inventions and discoveries to a point which it would take 50 years of private enterprise to attain. In the debate in the House of Lords Lord Londonderry said that the Government desired this branch of aviation to be separated from the Air Ministry, and that a monopoly should not be given to any aviation company. At the same time these companies should be told the Government policy so that they could make plans and prepare designs for aircraft production. The future of air transport depends primarily on the arrangements made about military aviation after the war. Freedom of the air must be established by rules and regulations internationally agreed and administered by the United Nations with an international police force. It is known that America is thinking and planning for post-war commercial aviation, and it is essential that this country should not be behind the times. Of course, in America there are efficient privately run air-lines as there were in this country before the war. After the war transport 'planes will be needed in tens of thousands to fly food to areas which cannot be reached by sea, and to transport, war supplies in the expected war against the Japanese.

Careers in Aviation

NOW that the Government has announced its plans, interesting opportunities are opened up for careers in aviation—a point we have so often stressed in this journal. But whilst the Government is to control the development we must not be unmindful of the fact that the Government did not create the aircraft industry in this country; it was built up by private experimenters, backed by those with long vision who saw no immediate prospects for the return of their money, and who thus can claim some credit for remaining in the industry at a time when they received no encouragement whatever from the Government.

The Debt

VERY few aviation companies ran at a profit prior to the war. Few, if any of them, are able to make much out of the war owing to the excess profits duty. This country owes a great debt to the small and struggling industry which remained alive and was a going concern when this war started. Without aircraft we should have lost the war, for aircraft staved off the German attacks and gave us breathing space to rearm. We have ample evidence now of the important part it plays in warfare. It can equally play an important part in peace, when commerce gets going again. Sea travel is slow, though reliable, and it is not suggested that aircraft should entirely replace ships. In the first place the pay load of an aeroplane must always be considerably less than a ship of comparable power. An aircraft to carry 500 people must necessarily be large and highly powered. It will be some years, no doubt, before we can develop the large transcontinental air liners. The War Cabinet has taken the decision that the design of a limited number of types of aircraft shall proceed with the assistance of the Government as and when it can be arranged without interfering with aircraft required for the war.

Much will depend on how this present war ends, and the sort of agreement reached between the Allied Nations.

A Young Man's Job?

FLYING is essentially a young man's job, and if commercial aviation is to be established on a large scale, there must be a constant influx of new pilots and other personnel who actually take the machine into the air, or, alternatively, the flying life of the personnel must be raised. The present standard of physical and mental fitness required for pilots is severe, because of the high speed. But then a commercial 'plane of any weight will not conceivably have a speed much lower than a fighter, so it may not be found possible to lower the medical standard. This will create employment problems. If a pilot's flying life is found to be, say, at most, five years, what is to happen to him after that time? Is he to be demoted to a ground staff job? Obviously the design side could not absorb so many who would be released from flying duties. However, a new industry has been born, and only practical experience when it gets going will solve the difficulties. In any case, the aircraft factories have by the Government statement of policy received an assurance that they will not be cast aside as they were after the last war and left to peddle around in foreign markets to keep their factories running. Aircraft workers, too, will be reassured that they are not to be thrown on the unemployment market when orders for military aircraft do not flow so freely as at present.

There can be no doubt that when this war is over we shall continue to build military aircraft, for we shall have the task with the United Nations of policing Europe, and ensuring that the world does not again suffer from Hitlers, Mussolinis, and all the other pocket Napoleons and imitation jack-booted Cæsars.

Queries

WE continue to receive a very large number of queries of a highly involved nature, occupying far more time than the Technical Staff is able to spare during the war when there are so many other calls, official and otherwise, upon their time. We ask our readers, therefore, to limit their queries and to refrain from asking non-essential questions such as those "to settle an argument," mathematical puzzles, and the more idle questions such as who first invented gunpowder.

We do not undertake to answer queries relating to legal matters, and in certain circumstances we may not answer questions relating to military aircraft owing to the censorship. Owing to staff shortage we cannot guarantee to reply by return of post as hitherto.

All of this means that we are asking for the co-operation of our readers in reducing the number of queries submitted and to keep those which they do submit as brief as possible.

Indexes

INDEXES for Volume 9 are now available; they cost 9d. each, or 10½d. by post from The Publisher, George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2. Every reader should obtain a copy of the index if he keeps back copies, and we suggest that he should. If readers before submitting queries consulted the indexes they would find most probably that their particular problem has been dealt with in past issues.

Aero-engine Ignition Systems

Their Function and Development

By T. E. G. BOWDEN, M.I.E.T.

THE function of the ignition system is to provide a series of sparks with which the combustible mixture of air and petrol vapour inside the cylinders is fired. With present-day engines running at 3,000 r.p.m. and having up to 24 cylinders with 48 sparking plugs, it will be seen that very great care is necessary in the design and construction of the various detail parts.

There are two main methods of producing sparks, i.e., coil ignition and magneto ignition. For aircraft purposes the coil system is not generally used, and systems involving the use of magnetos are the general rule. The reasons for this choice are as follows. Firstly, the magneto can supply sparks at a greater rate. Secondly, the fire risk in the event of a crash is higher where a coil ignition system is fitted due to the necessity of installing batteries and the attendant wiring. Thirdly, the effect upon the radio reception when the main aircraft batteries are used to supply current for the coil is very marked and renders good reception impossible due to the interference. On the other hand, however, there are several advantages on the side of coil ignition. No hand-starter is required as the sparks produced at low engine speeds are as good as those produced for normal revolutions due to the fact that the current is supplied from a battery. Magnetos are not efficient at low revolutions, and require an additional hand-operated booster magneto which turns at a far greater speed than the engine, thus supplying a sufficiently strong spark. Coil systems are cheaper to produce and easier to manufacture due to the fact that there is no complicated magneto.

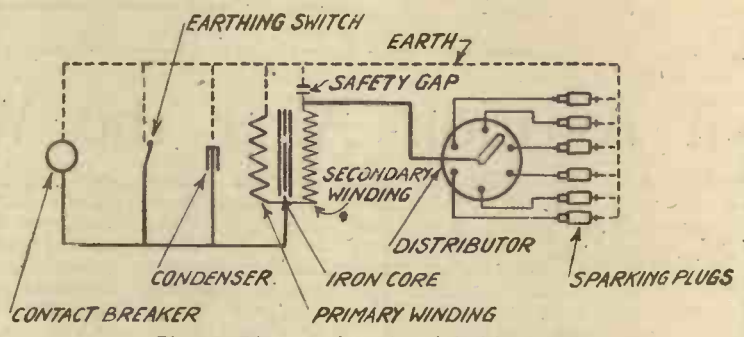


Fig. 1.—Diagram of an aircraft ignition system.

Magneto Ignition Systems

A typical ignition system is illustrated in Fig. 1, on which are indicated the relative positions of the main items of equipment. These include:

(1) Magneto.
(2) Condenser.
(3) Contact breaker.
(4) Earthing switch.
(5) Distributor.
(6) Sparking plugs.

A description of these details is of interest.

Several types of magneto are available at the present time, each with its own advantages and disadvantages. Firstly, there is the rotating armature type, illustrated in Fig. 2, which operates as follows. The rotating portion consists of an iron core constructed from a series of H-sections which are insulated from each other, usually by means of shellac varnish. Round this core are wrapped the primary winding, consisting of a number of turns of a comparatively thick copper wire, and the secondary winding. This outer layer is built up of very much finer gauge wire than the primary winding and the number of turns is anything up to 40 times as great. The two windings are insulated from each other. At position (a) in Fig. 2 the magnetic flux through the armature is a maximum, and the rate of change of flux is obviously zero. When position (c) is gained, the flux is a minimum, but the rate of change is maximum and at this point the generated current is also a maximum. This current is induced in the primary winding due to the fact that when a conductor moves in a magnetic field in such a manner that the lines of force are cut, a current is induced in the conductor or wire provided that the circuit is closed.

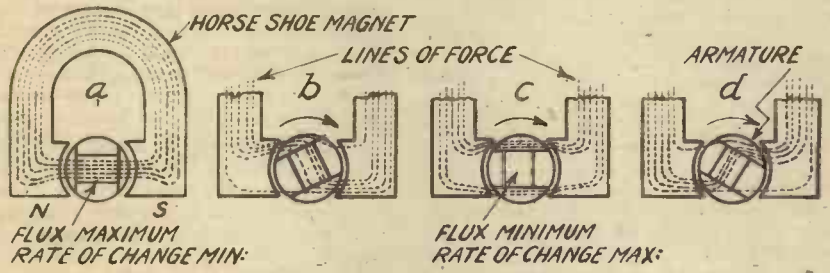


Fig. 2.—Rotating armature magneto.

The contact breaker, a description of which will be given later, is adjusted so that the primary current is broken when position (c) is reached. By this sudden collapse and reversal of the magnetic field a high voltage is induced in the secondary winding due to electro-magnetic induction. The collapsing magnetic lines of force cut both the windings and generate a flow of electric current. This current is passed to the sparking plugs and thus the combustible mixture in the cylinders is fired.

The main disadvantage of the rotating armature type is the fact that only two sparks per revolution are obtained and a high speed rotation is required when the number of cylinders is excessive, e.g., in the case of a 14-cylinder engine the magneto must turn at $\frac{14}{2\times2}\times$ engine revolutions. One spark is required for every two crankshaft revolutions per cylinder, i.e., taking an engine turning at 3,000 r.p.m. the magneto must revolve at $\frac{14\times3,000}{2\times2}=10,500$ r.p.m.

To increase the number of sparks per revolution, the inductor type of magneto has been developed and this is illustrated in Fig. 3. In this design the coils remain fixed and only the inductors revolve. At position (a) the core flux is maximum, in position (b) zero, and in position (c) it is reversed and is again a maximum. Thus it will be seen that four sparks per revolution may be obtained and consequently the speed of rotation may be halved when comparing with the rotating armature type. By varying the arrangement of the magneto it is possible to obtain 12 sparks per revolution and by using this design a very light system may be evolved, at the same time reducing the amount of space required.

Rotating Magnet Type

A modern development in magnetos is the rotating-magnet type. The permanent magnet rotates and the pole pieces are stationary. The electrical system in this method is extremely efficient.

At one time safety spark gaps were incorporated in all magnetos to prevent damage to the windings should the voltage exceed the safety limit. If there is a breakdown in the electrical distributing circuit the voltage may reach as high a figure as 15,000 volts, and when this occurs the current is allowed to short-circuit to earth. At the present time spark gaps are not being fitted to several types of magneto, due to the fact that many aircraft are operating at altitudes above 25,000ft. Owing to the reduced density at these heights the gap breaks down at a much lower voltage than designed for, e.g., the current at 25,000ft. may be short-circuited at 10,000 volts instead of 15,000. The disadvantages incurred by this premature earthing are obvious, as the engines will misfire and finally cease functioning. Where a spark gap is fitted it usually takes the form of two metal points,

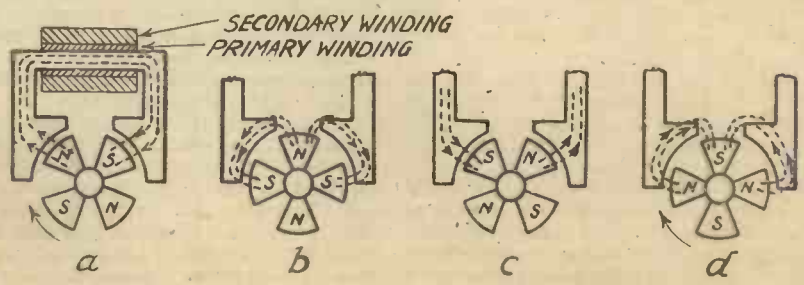


Fig. 3.—Diagrams illustrating the operation of a polar inductor magneto.

one of which is secured to the magneto frame, i.e., it is earthed, and the other to the electrical connection between the secondary coil and the distributor. As an alternative to two fixed points, some magnetos have a rotating safety spark gap. This retards ionisation owing to the fact that the air between the two points is constantly being changed.

Ionisation occurs when an electric current jumps the gap and the air is split up into ozone and other chemical components. When this occurs, the electrically charged particles reduce the normal resistance of the gap and currents lower than designed for will be short-circuited. Also, should there be any dampness, nitric acid is formed and corrosion is probable. By constantly changing the air, this danger is reduced.

Contact Breaker

The next item of equipment is the contact breaker, a typical design being illustrated in Fig. 4. The function of this particular item, as explained in a previous paragraph, is to make and break the primary circuit so that a high voltage is induced in the secondary winding. The operating cam is usually incorporated as part of the magneto shaft and moves a hinged lever, which in turn causes the two contacts to part, thus breaking the circuit. These contacts are arranged to open at definite times so that the maximum current may be obtained, i.e., when the rate of charge of flux is maximum. The materials used for the contact points are either tungsten or platinum-iridium, both tough metals which can stand up to the continuous making and breaking. From the shape of the cam illustrated in Fig. 4 it will be seen that the current will be interrupted four times per revolution, i.e., the magneto is a polar inductor type. The gap between the two contacts must be set accurately and is usually between .011in. and .014in.

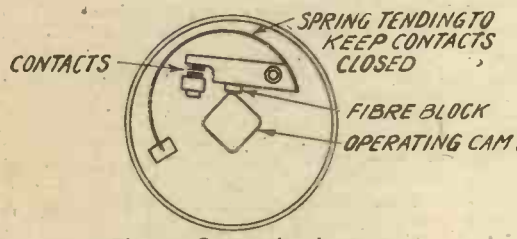


Fig. 4.—Contact breaker.

Fig. 5.—Condenser.

Double-contact Breaker

A development of the simple contact breaker is the double-contact breaker, which allows the sparks to be advanced or retarded either automatically by being connected to the throttle lever, or independently by the pilot of the aircraft. This type of contact breaker incorporates two sets of levers and two sets of contacts operated by the same cam. A switch is installed which allows the current to flow to either the retarded or the advanced breaker. This switch is usually operated by means of a cam which in turn is moved by a lever connected to the throttle linkage. At high cruising engine speeds the spark requires to be advanced, and when the speed is reduced the spark is automatically retarded. At maximum engine revolutions the spark is also retarded to reduce the tendency to pre-ignition due to the high boost pressures.

The above design of contact breaker is usually fitted in combination with another automatic retarding and advancing mechanism. This device operates centrifugally, the driving shaft from the engine being separated from the magneto shaft by means of several springs and weights. As the engine speed increases the weights are forced outwards due to centrifugal force, and the position of the magneto shaft relative to the driving shaft is altered. By this means the primary circuit is interrupted earlier, consequently advancing the sparks.

As modern aero-engines turn over at 3,000 r.p.m. and require 40,000 sparks per minute, it will be seen that very careful design and construction is needed in the case of the contact breaker. One trouble often experienced is the transferring of metal from one contact to the other, causing uneven surfaces and consequently inefficient operation.

Condenser Details

A condenser is always incorporated in the magneto and the construction of a typical one is illustrated in Fig. 5. Its main function is to reduce the possibility of arcing between the two contact points when they are open. It consists of several tinfoil plates separated by layers of non-conducting material called the dielectric. One set of sheets is connected to the positive and the other to the negative. The condenser operates as follows. As the primary current is built up the condenser is charged and absorbs current, as the tendency is for the current to flow into the condenser, following the path of least resistance. When the contacts open the current induced in the primary winding also follows the easiest route and passes to the condenser instead of jumping across the air gap between the contacts. Another advantage is that the rate of collapse of the primary magnetic field is quickened, thus increasing the voltage in the secondary winding.

In order that the engine may be stopped, an earthing switch is installed, positioned as shown in Fig. 1. When closed the switch earths the primary current before it reaches the contact breaker, thus preventing any induced current in the secondary winding.

Distributor

The high tension current is conveyed from the magneto to the distributor, which, as its name implies, distributes the current to the sparking plugs when and where required. A brass ring is usually fitted to the magneto shaft and a carbon brush carries the current to the distributor, a typical design of which is illustrated in Fig. 6. A series of metal segments, all insulated from each other, are fitted into a case and connected with electric leads to the plugs, i.e., if there are 12 sparking plugs, there are 12 segments. The high tension current is passed to each plug in turn by means of a rotating arm driven by gears from the magneto drive. These segments are usually manufactured from nickel or gun-metal and the case from a non-conducting material.

The rotor brush does not actually come into contact with the segments as a rule, but is given a clearance of approximately .015 in. This gap is incorporated for the following reasons. Firstly, there is less wear as no rubbing contact occurs. Secondly, the maximum current is passed to the sparking plugs, due to the fact that the air gap insulates the secondary winding until the maximum current is available. Another factor is that as the segments are not flush with the casing the jumping of the current from one segment to another which is likely to occur when actual contact is made due to particles of carbon becoming detached, is reduced.

A trailing brush is often attached to the main distributing brush being set at an angle of approximately 30 deg. When a hand starter magneto is used the current produced is passed to the trailing brush. The reason for this is to ensure that the spark occurs late, so that pistons will be over top dead centre before the mixture is fired. This prevents any possibility of backfiring and consequent damage to the engine.

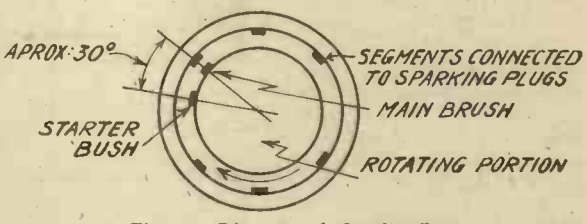


Fig. 6.—Diagram of the distributor.

Sparking Plugs

After passing through the distributor the current flows to the sparking plugs, the design of which has reached a high standard of efficiency Their function is to provide a spark at regular intervals, and at the correct time. H.T. current is passed down a central electrode constructed of steel and surrounded by an insulating material. At the lower end of the electrode is the firing point, at which the current jumps across a gap, thus giving a spark, and passes to the outer casing, i.e., to earth. Sparking plugs have to stand up to extremely hard conditions, due to the high temperatures in which they work and their liability to be oiled up. The deposition of carbon must be resisted and overheating avoided, if pre-ignition is not to take place. Most aircraft engines have two plugs per cylinder, each supplied with current from a different ignition system.

Various developments in plug design have taken place in recent years, but still more are required before they can be said to be absolutely reliable.

From the above description of the various details and the path of the current, a good idea is gained of the arduous conditions under which the ignition system functions. The main difficulty that requires overcoming is the reduction in efficiency which occurs when flying at high altitudes. An important factor when dealing with this problem is that sparking plugs, when set at the correct gap, allow a greater altitude to be gained than when the gap has widened due to erosion, Another serious disadvantage is the leakage of the current from the brush to incorrect segments in the distributor due to ionisation.

Future Development

Coil ignition will undoubtedly be utilised when further development has taken place, and interference with radio reception avoided. Sparking plugs using mica as the insulation are being superseded by plugs using synthetic materials. Mica tends to become pinholed and leaded fuels cause deposits which lead to pre-ignition troubles. Sintered aluminium oxide has been found to possess very good insulating properties.

All the ignition system should be screened to prevent bad radio effects, and most magnetos and sparking plugs are enclosed in metal casings for this purpose. The electrical leads are also metal covered (see inset on cover).

Summing up the position as to the future type of ignition system, it will be seen that firstly, magnetos using rotating magnets will become the standard; secondly, that coil ignition will be developed; and thirdly, that sparking plugs, with further research, will need less attention than at present.

Engineer-built Houses of the Future—3

Planning, Building By-laws, Advantages of Pre-built Houses

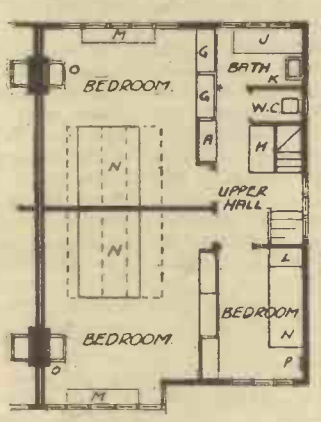
By R. V. BOUGHTON, A.I.Struct.E.

THE planning of engineer pre-built houses represents the fundamental basis and the starting point in the design and detailing of the various units to meet domestic, structural and æsthetic requirements. There is a tendency for enthusiasm in new methods of construction to override common-sense principles and requirements. This tendency really must not exist if a full measure of success is to be attained. The chief fundamental and essential requirements in any house are: (1) good planning to provide the required number of sufficiently large and well located rooms and other compartments to ensure comfort to the inhabitants; (2) the disposition of windows, doors and fireplaces in the rooms so as to allow furniture, beds, furnishings, curtains and all other domestic articles to be placed, and used, so as to obtain the maximum comfort and comply with hygienic essentials; (3) the provision of well designed and constructed equipment to ease the housewife's duties, and to contain those many articles and things which are so necessary and valued by all home-lovers; (4) a house which is easily kept clean; (5) and, although not closely connected with actual planning, may at this stage be mentioned the important matter of thermal and acoustical insulation of floors, walls, partitions and roofs. If these five essentials are borne in mind by the structural experts in pre-building, then a good moiety of the battle of engineers versus jerry builders will have been won.

One of the cries of opponents to pre-building is that the widths, depths and heights of houses, and the sizes of rooms, must be governed by the size of the units, or, in other words, there will not be such dimensional fluidity as to avoid a few simple mathematical calculations to get the best number of houses in a given frontage or acreage. My comments to this cry, preambled with "rot!", are: strip, undersize and oversize filler units will permit dimensional fluidity to meet the most fastidious and practical requirements. Does the modern householder and his family care whether a house is a few inches under or over in frontage, depth from front to rear, height or size of rooms if all comfort conditions are provided? Certainly not. Are the stereotyped designs and dimensions of the pre-war houses a criterion of dimensional fluidity? No. Of paramount importance to the householder, the housewife and their family are much more vital matters; those which allow choice, freedom and ease in furnishing, colour schemes, warmth and the economical enjoyment of home as apart from business life.

Figs. 7, 8 and 9 provide only a very small proportion of the great range of planning to suit post-war requirements. The key plans at the foot of this page are only a small variety of general layouts. Architects will undoubtedly provide many other types of layouts, and well proportioned elevations to assist the engineers in the manufacture and supply of pre-built units and sets to suit the New Order.

Fig. 7 may be taken as the basis for explaining many principles of good planning. It typifies one of the most popular pre-war layouts for the ordinary six-roomed semi-detached house. The main rooms of the pair of houses are adjoining the party wall, this arrangement giving the minimum amount of external wall to each room, thereby providing thermal advantages, the staircase and main door to each house are not close together, thereby giving privacy, the fireplaces and chimney stacks are well grouped together, which is an advantage in keeping the flues warm and with a good up-current and the disadvantage of neighbours' noises being a nuisance may be avoided by proper acoustical insulation. An alternative to this planning is to place the stairwell and kitchen of each house next to the party wall, and the main rooms adjoining the flank walls; Fig. 8, although of different planning, depicts the general idea: The ground storey, as in Fig. 7, comprises a lounge and dining room of reasonable size, each having built-in cabinet fittings, ample window space, and heating stacks for coal, electricity or gas, or a combination of coal and one of the other heating mediums; a kitchen of suitable size, well equipped; a hall and stairwell of



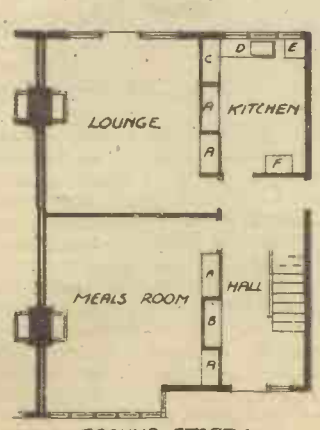
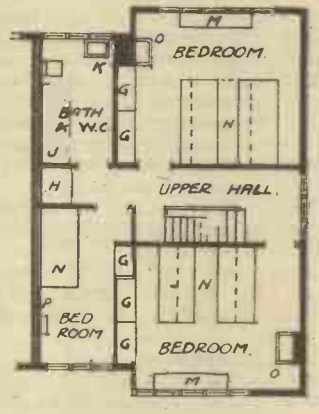


Fig. 7.—*A popular type of planning for a 6-roomed house.*



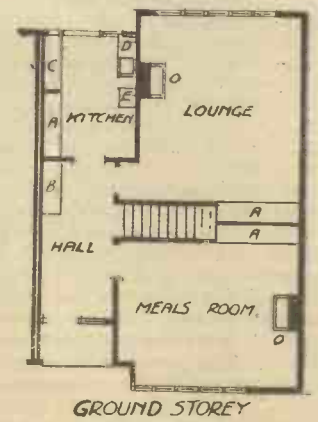
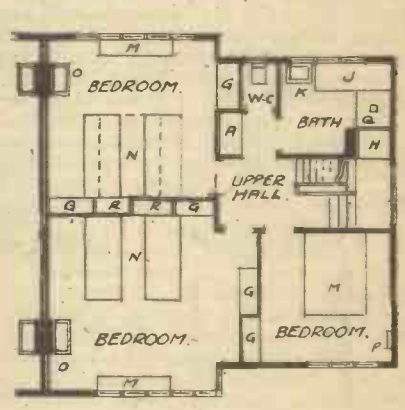


Fig. 8.—*A 6-roomed house, with unique planning having several advantages over that of Fig. 7.*



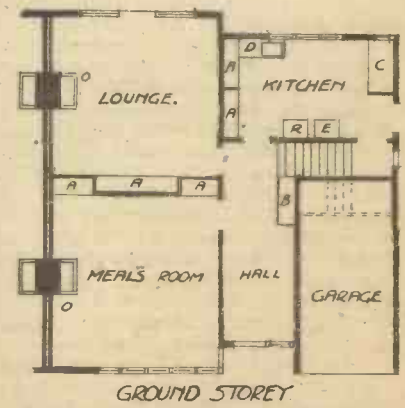


Fig. 9.—*Planning of a garage type 6-roomed house.*

Fittings and equipment: A.—Cabinet; part of the specially-designed structural and utility equipment. B.—Hall cabinet. C.—Larder. D.—Sink and draining board. E.—Boiler. F.—Cooker. G.—Bedroom wardrobe. H.—Linen cupboard. J.—Bath. K.—Lavatory basin. L.—Bulkhead. M.—Built-in dressing-table. N.—Beds. O.—Fireplaces. P.—Electric or gas fire, in smallest bedroom. Q.—Shower. R.—Refrigerator.

good width and length is provided with a tradesmen's and garden door, plenty of space for a baby-carriage, and a clothes cabinet. The first storey contains two large bedrooms, suitable for beds as shown, each room having double built-in wardrobe cabinets, also dressing-table cabinet by window, and fire stacks situated in sensible positions, as suggested in our Women's Column, at the

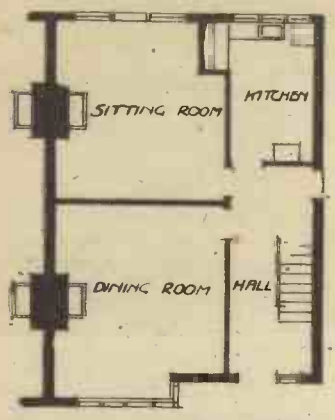


Fig. 10.—A typical pre-war ground plan of a 6-roomed house.

end of this article. There is a small bedroom with a single wardrobe. The bathroom and W.C. are in separate compartments. The upper hall is spacious and well lit, contains the stairs leading to ground storey and also roof garden, also a linen cupboard which houses the hot water tank with cold water cistern over in roof stairwell.

The plans, as Fig. 8, are departures from the common pre-war type of planning, and have a few advantages when compared with Fig. 7. The hall and kitchen adjoin the party wall, and the absence of any stairs in the former allows for spaciousness. The stairwell situated between the front and back main rooms in each storey permits the width of hall to be less than if it contained the stairs, the space under stairs is utilised for cabinets as shown, and the lower and upper halls are well lighted. The planning of the first storey does not permit quite such large main bedrooms as indicated in Fig. 7, unless the depth of house is increased; but they are of a size preferred by many people. The small bedroom is of very comfortable size. The bathroom may, if desired, be varied to permit a separate W.C.

Fig. 9 depicts the plans of a very good garage type house, which requires a frontage greater than the other types; but, when considered in relation to houses having "garage-spaces," such extra frontage is often economical.

Fig. 10 is of a pre-war type of plan.

Planning detached and other houses presents no difficulties as regards pre-building, and the use of standardised units, and any particular variation or requirement may be met with "filler units." The block plan layout will indicate to the designer many possibilities in planning.

The effect of thin walls plays a rather important rôle in the allocation of frontage to houses, especially if land is expensive. As an example, if a pair of semi-detached houses require a frontage for actual building (not including side passages, etc.), of 40ft., the two flank and one party wall, if one brick thick brickwork, takes 2ft. 3in. of the 40ft. With scientifically designed pre-built work the flank walls will not exceed 4in. thick, the party wall either the same, or 6in. if any special sound insulating principles are adopted, and therefore the three walls will total 1ft. or 1ft. 2in. This reduces the frontage of each house by about 6in., and, with land at, say, £5 per foot, this is certainly a consideration. Engineer-built houses will certainly not have fireplace breasts, mantels and hearths, taking up such a valuable amount of space of living and bedrooms, and in this respect it is right to conclude that any reduction of floor space caused by using lesser lumps of brickwork, etc., may cause a little reduction in the width of rooms and thereby in the frontage as well.

By-laws

Building by-laws have received much attention by the authorities in the interim of the last and the present wars, and particularly during the few years preceding 1939. I feel sure it is the intention of the authorities to modernise and augment existing by-laws to allow full scope for the great advancement in building. It is almost certain that waivers from existing rules will be readily and freely granted in the case of all applications which are substantiated by evidence, which I submit can be incontestable, as to the adequacy in strength and fire-resisting qualities of engineer designed and built houses, which will be explained in detail in this series of articles.

(To be continued.)

The Woman in the Home

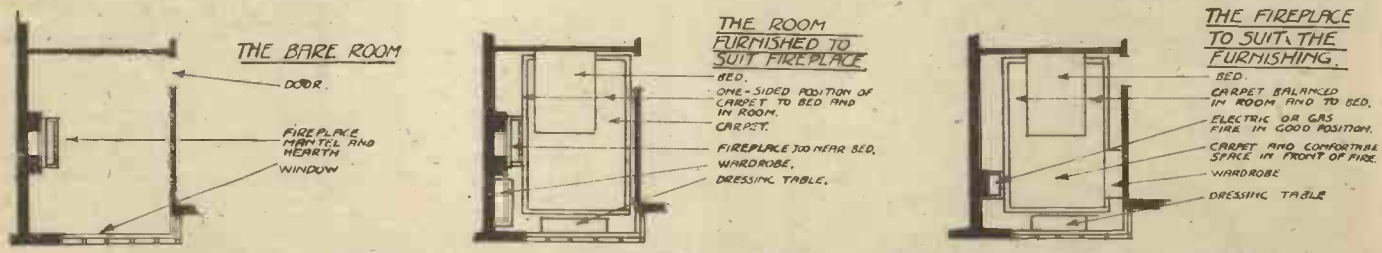
(This Month It is by Mrs. R. V. BOUGHTON)

I MUST confess a little timidity when I was asked to approach the Editor of this journal for permission to place women's ideas on how their homes should be designed, and not leave all matters to "mere man." You see, I had never written an article before, and I feel that there are many women like myself who know only too well what is wanted in a home, but cannot express themselves journalistically. The success which I have achieved with the Editor I am sure other women can do as well, and a particular appeal is made by me to all men readers to discuss with their womenfolk some of the home matters which affect the designing and equipment of the home. Don't say you cannot draw or put into words your idea. I cannot draw, so just do what I did—make a shot at it and get your husband, or another of your menfolk, to do the necessary; if they cannot, then send your little sketches, however rough they be, to the Editor, who, if he thinks the subject good, will have a drawing prepared, your written matter, if necessary, licked into shape, the subject published under your name, and paid for at usual scale rates for non-assisted or assisted short articles.

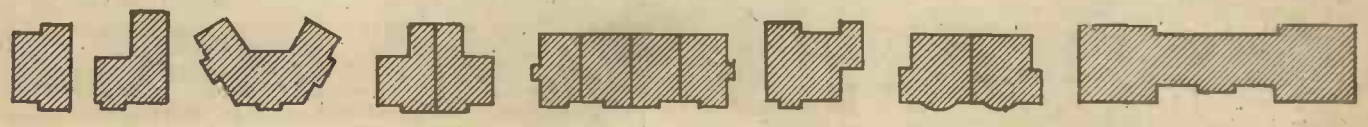
It happened like this; just before the present war my future husband and I looked over quite a number of houses with a view, on his part, of living in, and with my view of making a home—two that can be quite different things. He thought he knew a lot about building, and I felt convinced he didn't know enough, so that started it. We commenced on the ground floor (he calls it "ground storey" which is perhaps correct), called everything well planned and convenient, and I said it could be better, and that some things were the silly results of men's and not women's brains. Of course, it was all said very nicely, but I knew I was getting my way. Well, as there was no basement to the house, I suggested it would be as well to have a look at the bedrooms upstairs.

Fig. 11 is a plan of the "best" bedroom, into which we wandered, with the builders' salesman, "tub-thumping" his usual dope about the chromium plated fittings and about the proof that the house must be good because the building society would advance 95 per cent. of its value (questionable). It was mutually agreed that the great lump of brickwork sticking out into the room to take a small fire, and, so I was told, a flue from the room underneath, together with the projection of mantel and hearth, meant, with the normal and only practical way of arranging the furniture and bed (as Fig. 12), that the bed would be roasted, and no one could sit or robe or disrobe in front of the fire. Unless the carpet (if used) was cut (and thereby partly spoilt) around the hearth, it would have to be placed one-sided on the floor with most of it under the bed and none, or little of it, on the fire-side of the bed for feet to rest upon. I was told these great disadvantages were due to a belief that the great lump of brickwork looks nicer in the centre of the length of a wall, and that it is easier and cheaper to place the brickwork where it is usually placed. What all this means to the practical housewife is of no importance, but an arrangement as shown in Fig. 13, which is self explanatory, is of much more interest.

(To be continued.)



Figs. 11, 12 and 13.—A typical bedroom plan, and diagrams showing how a better furnishing arrangement is obtained.



Outlines of a few of the many layouts obtainable with pre-built houses.

About Asphalt

Nature's Own Plastic, and Its Rôle in Modern Times

By J. F. STIRLING

THE history of asphalt and bitumen takes us back almost to the beginnings of the biblical era, to the days when Noah built the Ark and caulked it with a material which, in the written record of the event, is termed "pitch," but which, clearly enough, refers to bitumen.

The Tower of Babel record in the Bible is also associated with bitumen and asphalt, for "slime had they for mortar" (says Genesis), this material, too, constituting a natural bituminous deposit which was found in the locality.

The Egyptians were well aware of the properties of bitumen and asphalt. Among other things, they used it as a preservative and a damp-proofer for the mummy-wrappings of their dead. Indeed, the very term "mummy" is derived from the Arabic word *Mumija*, which was a term meaning "asphalt."

It is only within comparatively recent times that economic advantage has been taken by for the surfacing of pavements and for waterproofing purposes. Gradually the idea of employing one or more of the many natural forms of asphalt and bitumen spread to this country and, with its eventual acceptance by civil engineers, was founded the asphalt industry of modern times.

The commencement of manufacture. Native Cuban asphalt being collected from a stock pile for processing.

Rock Asphalt

Bitumen, which is the essential raw material of all our present-day manufactured asphalt, is a material which occurs naturally in several forms, and in many different areas of the earth. It is present in the so-called "rock asphalt" which is mined in large quantities in Sicily, France, Switzerland and Germany, and which, before the war, was imported extensively into this country. This "natural rock asphalt," as we have already seen, consists merely of limestone rock which, at some far distant epoch of the world's history, has been exposed to the over-running of liquid bitumen (probably ejected volcanically from the earth) and which, as a result, has absorbed a considerable amount of the natural bitumen. Rock asphalt may contain anything from 1 to 15 per cent. of extractable bitumen of very high quality.

Another source of natural bitumen which is made much use of at the present day are the "natural asphalts," as, for example, Cuban asphalt, a black, earthy material containing more than 50 per cent. of natural bitumen. There is, too, the American "Gilsonite" (named after its discoverer, S. H. Gilson) which is practically 100 per cent. hard bitumen, and there is, also, "Trinidad Lake Asphalt," a product of a remarkable natural lake in Trinidad which, instead of containing water, contains a special kind of natural bitumen mixed with clayey matters and earthy debris. The Trinidad asphalt lake was known to Sir Walter Raleigh in Queen Elizabeth's time, it being on record that this patron of the tobacco industry actually used Trinidad asphalt for the caulking and waterproofing of some of his ships.

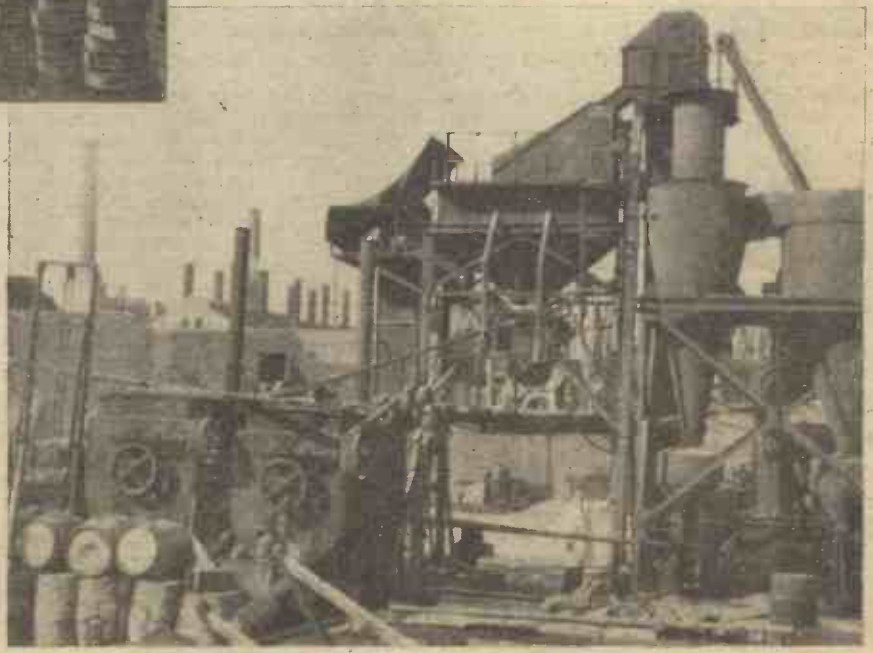
Millions of tons of native asphalt have, during the last half-century, been taken from the Trinidad Lake. Yet the level of the lake remains much the same as it originally was, this remarkable lake comprising quite an excellent example of the "ever-filled purse."

The finished product. Asphalt blocks being loaded into railway waggons for quick despatch to factory and other building sites.

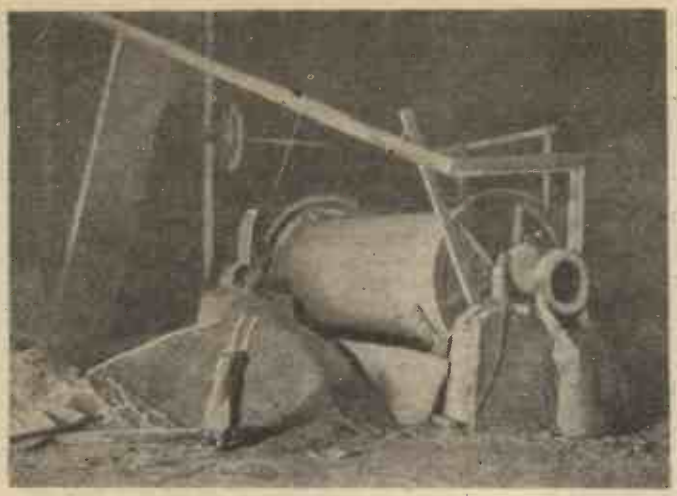
the nations of the almost unique properties of asphalt and bitumen. True it is that the old Romans knew of bituminous substances, but they never used them for their constructional works. We have, in fact, to travel through history until we arrive at the year 1712 before we are able to discern the first dawn of the present-day world-wide asphalt industry.

In that year a certain Dr. Eitini d'Eyrinys, a Greek professor living in Berne, discovered on the Swiss border a peculiar sort of mineral which actually burned when it was placed on a fire. This natural product was found to consist of limestone impregnated with about 10 per cent. of bitumen, and its discoverer was able to distil a natural oil from it from which he afterwards prepared a mortar-like sludge which could be used for cementing purposes.

Considerably more than another century had to elapse before the asphalt and bitumen industry arose, first in France and then in England. At first, artificially processed bituminous products were used in France



An asphalt manufacturing plant in operation.



A revolving tube mill in which limestone for asphalt manufacture is reduced to fine powder.

A third class of bitumen of which enormous use is made in present-day asphalt manufacture comes from the distillation of crude petroleum, this black, sticky material being the final product of the refining of petroleum. For this reason it is known as "residual" bitumen—the bitumen of petrol residues—or else as "petroleum bitumen."

Manufactured Asphalt

Manufactured asphalt is nowadays used the world over on account of its truly excellent waterproofing qualities and, also, in view of the cleanly, hygienic, durable surface which can be obtained with it either on roads or on floors or roofs.

Unlike the hard and unyielding concrete, asphalt is "kind" not only to human feet but also to the wheels of motor vehicles. Asphalt, besides being absolutely non-penetrable by water, is thermally and mechanically resilient. That is to say, it is able to take the strains and stresses of heat-expansion and contraction, as well as the varied stresses due to blows and mechanical impacts and to vibratory movements of all kinds.

For these reasons, and for many others, asphalt is nowadays universally in demand for the making of factory floors, for the construction of damp-courses, for the surfacing of flat and sloping roofs, for the waterproofing of basements and foundations, for the building of A.R.P. shelters and for literally hundreds of other vital purposes, in addition to its widespread employment in road construction.

Asphalt Mastic

Manufactured asphalt—known in the building trade as "asphalt mastic"—comprises essentially two main ingredients, viz, the "asphaltic cement" and the "aggregate." The asphaltic cement usually consists of a blend of bitumens, as, for example, Cuban bitumen and petroleum bitumen, whilst the "aggregate" comprises merely a definite amount of mineral matter, usually English limestone and mineral grit with which the bituminous matter or "asphaltic cement" is intimately incorporated.

The process of asphalt manufacture is usually carried out in large mechanically-stirred, coke-fired iron "pots" or "mixers" which may hold a charge of anything up to 10 or 12 tons of material.

The carefully blended mixture of natural bitumens is run into the mixer, and, subsequently, the various ingredients of the mineral "aggregate" are added slowly and in the right proportions. The whole is then "cooked" for a definite time at a predetermined temperature, after which the mixer is "discharged" by the simple process of allowing the thoroughly mixed material to run out into a series of cast-steel moulds of round, hexagonal or triangular shape, in which it slowly solidifies.

Such material constitutes the asphalt blocks which are to be seen near the site of building and road-constructional operations.

Applications

For use, these blocks are broken up by means of a heavy hammer and are flung up into the "road pot," which is merely a smaller edition of the mechanical asphalt mixer employed during the process of making the blocks. From the "road pot" the molten asphalt is run out into buckets, the contents of which are flung out on to the floor, roof or other surface which is to be covered with asphalt, the hot material being then spread evenly over the surface by means of a flat piece of wood provided with a handle and known as a "float." A skilled asphalt-

Asphalt mastic being run out from a mechanical mixer and cast in steel moulds.

spreader, by means of his wooden "float," can bring up an asphalt surface to a perfectly smooth, satin-like texture which retains its characteristic lustre when cold.

Usually, asphalt surfaces are made up of two "coats," each from ½in. to ¾in. thick, the first coat being allowed to cool off completely before the second one is spread on top of it.

Modern research has devised special types of "acid-resisting" asphalts which are nowadays extensively employed for the laying of floors in chemical works and in other industrial factories. Such asphalt surfaces resist chemical attack to a high degree and remain strong, smooth and durable over long periods.

Coloured Asphalt

Perhaps the most spectacular triumph of the modern asphalt industry is to be seen in the introduction and the very extensive use

The making of an asphalt road. In the foreground, natural rock asphalt powder is being scattered on the road "bed." The illustration shows the asphalt being raked and tamped into position, whilst in the background is seen the mechanical rolling of bitumen-coated granite chippings on the asphalt surface in order to provide a non-slip surface.

of *coloured* asphalt. This was the invention of a young Manchester scientist. The introduction of coloured asphalt has brought a new era into the annals of asphalt, for, by means of suitable treatment with mineral pigments, the normally black asphalt mastic may be converted into brightly coloured material which is at once fadeless and durable and which, in addition to its pleasing and decorative appearance, partakes of all the excellent qualities of the normal black asphalt.

There are several different methods of applying asphalt to roads. A favourite method for the asphalt surfacing of busy town thoroughfares consists in grinding up natural asphalt rock and then running this out to the road site in specially constructed vehicles which enable the material to be delivered in a warm condition.

The powdered asphalt rock is quickly shovelled and raked over the prepared road "bed," after which it is "tamped" down firmly by means of heavy metal weights attached to the ends of long poles. This compressive treatment consolidates the warm asphalt rock powder into a firm, homogeneous layer, which, when cold, provides an enduring waterproof surface of natural asphalt material on top of which a light layer of flint or granite chippings, previously coated with bitumen, may be scattered. The surface of the road is then mechanically rolled, whereupon the "pre-coated" granite chippings sink slightly into their bed of consolidated rock asphalt, in addition to adhering firmly to one another. In consequence, a very enduring road surface is brought into being, a surface which, in these days of fast-moving motor traffic, has the very decided advantage of being non-skid, even in wet weather.

Natural bitumen, in its many forms, enters into the composition of a multitude of varied products. The ink with which these words are printed contains a little Gilsonite or other hard natural bitumen to give it "body" and adhesion. Numerous electrical insulating materials are compounded from one type of bitumen or another. Natural asphalts and bitumens are made up into various waterproofing paints and varnishes. Many kinds of enamel have bitumen or a natural asphalt in their make-up. It is even possible to manufacture bitumen emulsions, that is to say, stable mixtures of bitumen and water, which are capable of being sprayed cold on surfaces, the bitumen consolidating itself into a thin film after the water content of the emulsion has evaporated.

Nature's Own Plastics

Bitumen and asphalt are truly Nature's own plastic materials. They have properties which are not to be found in the artificial plastics of our modern era. Yet it is possible that bitumen and asphalt will, in post-war times, find their way into a number of these synthetic plastics and, also, into the composition of various rubber-like materials in order to modify and improve the properties of such substances.

Chemically, bitumen is a mixture of hydrocarbons; that is to say, of materials containing only hydrogen and carbon. The precise composition of the various bitumens is far too complex to permit of chemical analysis. For this reason, the technical control of modern asphalt manufacture is enforced by means of physical rather than chemical methods.

As a result of the inevitable restriction of shipping space, the amounts of bitumen imported into this country during the war have necessarily been diminished. In consequence, attempts are being made to produce manufactured asphalt from the various coal-tar and other pitches instead of from the natural bitumens. Pitch mastics ("British asphalts," they are sometimes called) have met with varying degrees of success. Most probably they will be improved in the future, yet there is little doubt that for the purpose of modern asphalt manufacture the various natural bitumens reign supreme. There is, therefore, little likelihood that asphalt and bitumen will ever be ousted from their traditional usages by pitch compositions which, for these purposes, are merely substitute materials, possessing few of the durable and resilient properties of the natural bituminous substances.

A Synchronous Electric Clock Motor

By L. F. ROWE

(*Concluded from page 187, March issue*)

AFTER a little practice it was found that a winding speed of about 1,000 turns in 10 minutes could be averaged. It is not, of course, necessary to count the turns. The figure 19,000 turns given earlier was calculated from the length of the average turn and the total length of wire on the bobbin, this in turn being calculated from the resistance. The winding was found to be a somewhat tedious process but was eventually accomplished after four sittings of approximately an hour each. The end of the winding was soldered to a connection lead in a similar manner to the commencement, and anchored to the coil by binding round with several layers of the insulating paper firmly fastened with Seccotine. Finally a layer of black varnished silk insulating cloth was put on and fastened by the same means, giving the coil quite a professional appearance.

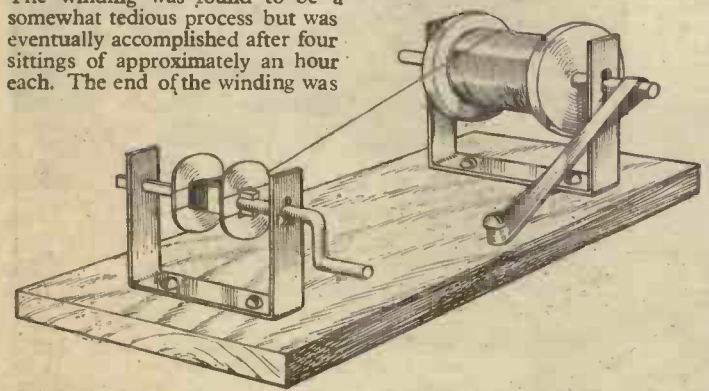


Fig. 9.—A simple form of winder.

It is not essential to use silk-covered wire for the coil; enamelled wire would do equally well, but if this is used it is advisable to insert the insulating paper between the layers at more frequent intervals. Enamelled wire of this size can often be obtained from old radio transformers and is quite suitable providing the enamel covering is in good condition.

Alternative Low-voltage Coils

For those readers who lack the patience to wind the coil described above, or do not consider it worth while, there is the alternative of operating the clock from a bell transformer or one of the miniature lighting transformers which have recently been placed on the market, and are used for lighting a small bulb of the flashlamp type from a mains lamp socket.

In this case the bobbin can be made smaller in accordance with the alternative dimensions given in Fig. 8, and is wound with fewer turns of a heavier gauge wire. If the small bobbin is wound to capacity with 42 S.W.G. enamelled wire it will operate the motor on eight volts. The resistance should be in the neighbourhood of 725 ohms. The writer has not experimented with coils suitable for lower voltages, but using the above coil as a basis, it is suggested that 40 S.W.G. would be suitable for six volts and 38 S.W.G. for four volts, as many turns as possible being wound on the bobbin in both cases, using enamelled wire. When used on voltages of this order no insulation is required between the layers, providing the enamel insulation is in good condition.

The Winder

This is of the simplest form, consisting essentially of two bent-up strip-metal bearing brackets for the wire-reel and bobbin, screwed to a wood base. The arrangement is shown in Fig. 9. The handle was cranked to give a 1in. throw so that with the forearm resting on the table the winding spindle could be turned with a wrist movement only, thus enabling a high speed of winding to be maintained without discomfort. Care was taken to make the spindles for reel and bobbin a good bearing fit in the brackets so as to obtain a smooth action, which is essential to avoid frequent breaking of the wire. The spindle for the bobbin was made $\frac{5}{32}$in. diameter, one end being cranked to form a handle, the rest being filed flat each side until it just fitted into the bobbin, which was wedged into a central position by means of a matchstick each side between bobbin and spindle. In order to provide the necessary slight tension in the wire, the reel was made a tight fit on its spindle by the use of suitable bushes each end, and an elastic band was slipped over the spindle and hooked over a screw in the base,

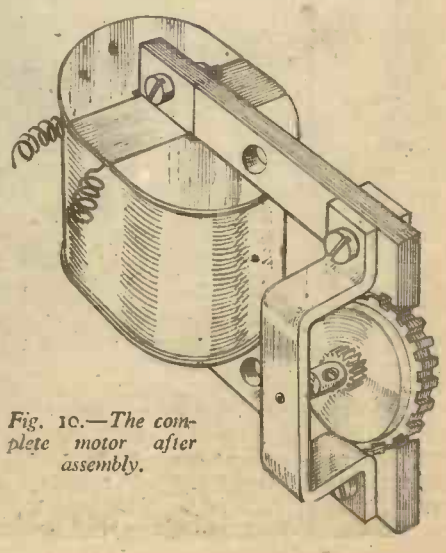


Fig. 10.—The complete motor after assembly.

the position of the screw being adjusted to give the required braking effect. Without this the reel was inclined to overrun and cause the wire to kink and form loops—with a consequent risk of breakage.

Assembly

Before being assembled, the metal parts of the motor were polished with fine emery cloth and given a coat of colourless cellulose lacquer to prevent oxidation. The parts, together with the coil, were then assembled as shown in Fig. 10, and the positions of the pole pieces were carefully adjusted until the minimum air gap was obtained which would allow the rotor to spin freely. A trace of light oil was then put on the arbour bearings, and the unit was ready for its trials.

With a coil of such small dimensions it is not possible to obtain sufficient resistance to limit the current to the desired value when used on 230-volt mains, and therefore a one-watt resistor of the radio type, having a value of 100,000 ohms, is connected in series with it. The value of this resistance may be varied over wide limits to suit the requirements of the motor, which will vary according to the care with which it has been constructed. If insufficient trouble has been taken over the truing of the rotor so that it is necessary to have a fairly large air-gap, the resistance may have to be reduced to 75,000 or even 50,000 ohms so as to allow of the increase in current needed to produce the required field strength. If, on the other hand, the air-gap can be adjusted to something in the order of 10-thousandths of an inch, the resistance may be increased in value, and the consumption reduced, although there is not much to be gained by this, as the consumption is already of negligible proportions.

Current Consumption

In the case of the motor described it was found that satisfactory operation was still obtained when the resistance was increased to 125,000 ohms. Including the resistance of the coil (12,600 ohms), the total resistance in the circuit was then 137,600 ohms, and the total consumption less than .4 watt. This is the total consumption of motor and resistance, and since the consumption of each is proportional to its respective resistance, it will be seen that the energy actually consumed by the motor itself is only $^1/_{10}$ of the total, i.e., approximately .04 of a watt, a rather surprising fact leading one to conjecture as to what microscopic proportions the consumption could be reduced if the motor were precision built and provided with needle point or jewelled bearings.

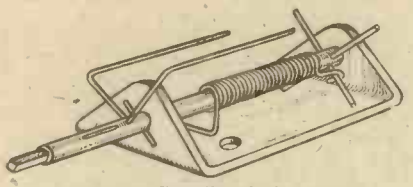


Fig. 11.—Details of the starter.

While the motor would run quite satisfactorily with this high value of resistance in circuit the torque developed was insufficient to stand the jars and shocks sustained when the clock was moved (often none too gently) for dusting, etc., which often stopped the motor. Accordingly, the resistance was reduced to 100,000 ohms, at which value the torque is able to stand normal usage with ample margin, the total consumption then being less than half a watt.

If a low-voltage coil is used it is, of course, not necessary to use a series resistance, as it is comparatively easy to provide sufficient resistance in the coil itself.

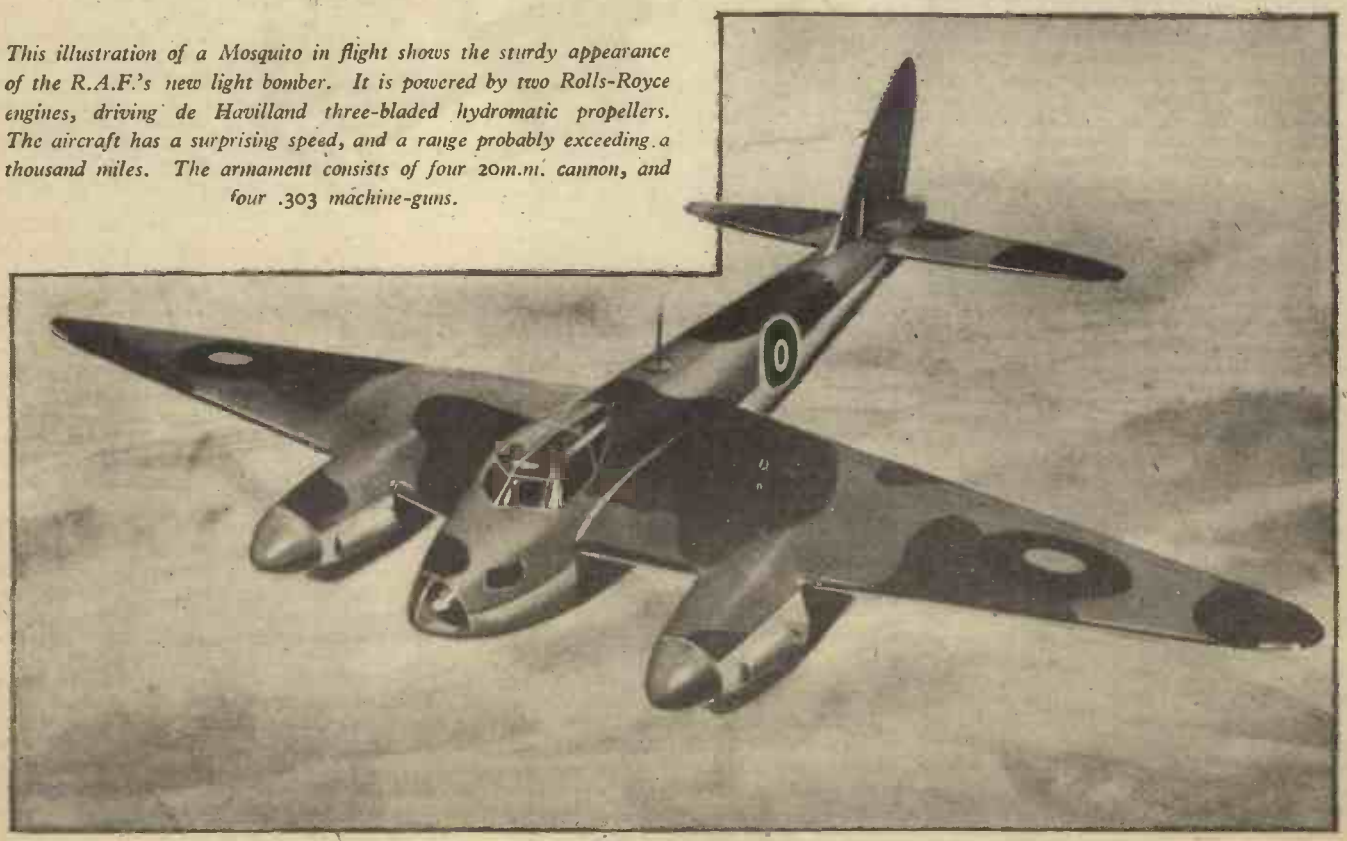
The Starter

When the motor was fitted in the clock case a simple starter was provided, so constructed that it is impossible to start the motor in the wrong direction. Details are shown in Fig. 11. It consists of a spring-loaded spindle with an arm arranged to engage in the teeth of the wheel driven by the motor pinion when the starting knob is turned. On releasing the knob, the arm on the spindle drives the rotor via the pinion and gearwheel, until the arm reaches the end of its travel, when it disengages with the teeth of the wheel, leaving it free to rotate under the action of the rotor, which has by then dropped into its synchronous speed. The strength of the spring is adjusted until it is sufficient to bring the rotor up to synchronous speed without giving a violent "kick." The driving arm which engages with the teeth of the gearwheel consists of a short length of spring steel wire bent to the required shape and held in position by threading through two small holes drilled in the spindle. The end of the wire was bent over as close to the spindle as possible to secure it firmly in place. The starter was screwed to the wood case of the clock, as can be seen in Fig. 2, but it can, if desired, be mounted in a position convenient to the gear train by means of a metal bracket attached to the clock frame if necessary.

Fig. 2 also shows the miniature two-pin plug used for connecting up. This is a Belling-Lee clock connector, although any small two-pin plug would do. The back plate of the clock was drilled to suit the plug and arranged so that it was necessary to withdraw the plug before the back plate could be removed, thus providing a safety feature. The terminal block seen above the plug was only provided for convenience of connecting up when experimenting with various coils, and may be dispensed with, the coil leads being connected straight to the two connector pins via the series resistance if the mains coil is used, the resistance also being housed in the clock case.

R.A.F.'s New Twin-engined Bomber

This illustration of a Mosquito in flight shows the sturdy appearance of the R.A.F.'s new light bomber. It is powered by two Rolls-Royce engines, driving de Havilland three-bladed hydromatic propellers. The aircraft has a surprising speed, and a range probably exceeding a thousand miles. The armament consists of four 20m.m. cannon, and four .303 machine-guns.



The Distribution of Electricity

Second Cantor Lecture Given Before the Royal Society of Arts

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

(*Continued from page 194, March issue*)

Early Electric Supply Installations

IN the first lecture reference was made to some of the early installations of arc lamps for lighthouse work and for street lighting. As these lamps were not suitable for interior use, progress in the field of electric lighting generally was hampered; and so investigators then sought to "divide the electric light." This problem was solved in 1878 by making use of incandescent glow lamps, connected in parallel. This made possible the electric lighting of domestic premises and the interiors of public buildings.

Many installations using Swan lamps were soon in being; among them was the lighting of the Savoy Theatre, London, in 1881. The current was obtained from Siemens alternating current generators. In the same year a small generating station was installed and operated by Siemens Bros. and Co., at Godalming in Surrey. The power was developed by making use of a waterfall on the River Wey. Certain streets were lit by both arc and incandescent lamps, which were connected to cables laid along the street gutters. As there seemed to be no prospect of a demand for electric lighting by the householders in the district, the supply was discontinued in 1884.

At the end of the year 1881, Mr. Robert Hammond went to Brighton to stage an exhibition of the Brush arc lighting system in the town; this proved a success and resulted in the formation of the Hammond Electric Light Co., which, in February, 1882, was giving supply to 16 arc lamps for illuminating the premises of certain shopkeepers. At the same time, the company were offering to supply current to any prospective consumers.

In January, 1882, Edison's agent in London obtained the permission of the city authorities to undertake the lighting of Holborn Viaduct and some of the neighbouring streets by means of Edison incandescent lamps. Steam-driven dynamos generating at 110 volts were installed in a building near the east end of the Viaduct, and the main cables were laid along the existing subways. From these cables, services were taken to most of the premises on either side of the street. Soon afterwards the supply was extended to the General Post Office in Newgate Street. It was provided in the agreement between the two parties that the Viaduct and the streets were to be lighted, free of cost to the City, for a period of three months. The supply was commenced in April and, at the end of the three months' trial, fresh agreements were made and the service continued until 1886, when the station was shut down.

In 1882 Edison planned his first installation for New York City. He decided that an underground system of distribution would be necessary, and in September of the same year a supply was given from Pearl Street Station.

In 1883 Sir Coutts Lindsay put down a station for lighting the Grosvenor Gallery in New Bond Street, London. The plant was intended originally to supply arc lamps in series, and consisted of Siemens type engine-driven alternators generating single-phase current. Not long after it had been in commission, applications for a supply of electricity were received from shopkeepers and residents in the neighbourhood. These applications were met by installing a transformer in the house of each consumer and by giving a supply at 2,000 volts by overhead cables, supported from iron poles on the roof tops. The primaries of all the transformers were connected in series, the consumers' lamps being connected to the secondary. The demand from outside consumers continued to grow, and so a larger station was constructed and further overhead cables and transformers were installed, as before, with their primaries in series, an arrangement suggested by Gaulard and Gibbs. Trouble was soon experienced with this arrangement, and S. Z. de Ferranti, then a young man, was called in to advise. He entered the service of the Grosvenor Gallery Co., and one of the first things that he did was to replace the series transformers by others designed to operate in parallel across the mains and so introduced a method which remains to this day. He replaced the Siemens alternators by others of his own type. Later, a new company, called the London Electric Supply Co., was formed to take over the Grosvenor Gallery station, and progress was made. Subsequently a power station was built at Deptford for the purpose of sending current at high voltage to London. Ferranti, who was responsible for the installation, chose 10,000 volts for the transmission. He designed and built the cable and the transformer for stepping-up the voltage for transmission and for stepping-down again at the receiving end. By laying the cables underground along the railway track between London and Deptford, he was able to avoid certain provisions of the Electric Lighting Acts.

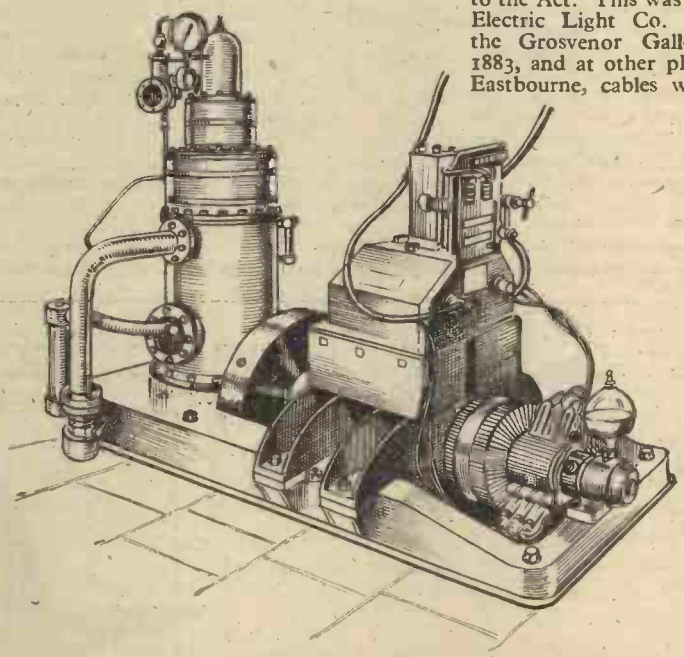


Fig. 5.—A 50-kilowatt steam-generating set used by one of the early electricity supply companies.

Electric Lighting Act

In August, 1882, the first Electric Lighting Act was passed by the House of Commons. This Act conferred powers on municipal and other undertakers to break open streets for the purpose of laying mains, and gave powers to local authorities to raise loans in connection with the supply of electricity. The Act provided that application for the necessary provisional orders or licences to supply were to be made to the Board of Trade. It also empowered the local authority, at the end of 21 years, to purchase the undertakings of the enterprising supply company, or so much of it as lay within the jurisdiction of the authority, without having to pay anything for the goodwill or increase in the value of the undertaking. The onerous character of the purchase clause produced universal dissatisfaction and this was reflected in the very few applications that were made to the Board of Trade.

The development in the supply of electricity, however, was not altogether held up, because wherever a company could obtain permission of the local authority to erect mains overhead, it could carry on its business without reference to the Act. This was done by the Hammond Electric Light Co. at Brighton in 1882, the Grosvenor Gallery Co., London, in 1883, and at other places. At Hastings and Eastbourne, cables were laid in the streets with the assent of the local authorities, without reference to the Act. The Kensington Court Electric Light Co., started by Colonel R. E. Crompton, was able to carry on without regard to the conditions of the Act by obtaining permission of the Kensington Court Co. to lay mains in the subways that existed under the roadways. Fig. 5 illustrates a 50-kilowatt steam-generating set of the type installed by Colonel Crompton.

In the meantime, efforts were being made by influential people to obtain the repeal of the 21 years' purchase clause. Ultimately, and due mainly to the efforts of Lord Thurlow, an Act was passed in 1888 which, amongst other provisions, extended the period of security to the companies from 21 to 42 years. The effect of this concession was immediate and manifested itself in the promotion of new companies and applications for the necessary powers to supply electricity in various areas.

Public Supply

Godalming may claim to be the first place in which a public supply was given, although Holborn Viaduct was the first place in which a supply was given for both public lighting and for private houses. Both of these installations, however, existed for only a few years.

If consideration be given only to those undertakings which have had a continuous existence, then priority should be given to Brighton. At first, the supply, which was provided by a special type of dynamo capable of delivering direct current at a high voltage, was used for arc lighting only. All the arc lamps supplied by any one machine were

connected in series, so that the same current flowed through each lamp. Soon, however, Mr. Wright, the station engineer, devised a scheme for supplying incandescent lamps from the arc circuits. The supply was given by overhead conductors, and the system continued until 1887, when it was changed over to single-phase alternating current, generated at 1,800 volts, and reduced to 100 volts for the consumers by means of local transformers. Subsequently, a further change was made, in 1891, when the municipal authority started a system of direct current supply at 115 volts. Following the completion of arrangements for the purchase of the original undertaking, the consumers were transferred to the mains of the corporation.

D.C. Systems

In most of the earlier methods of distribution a direct current supply was given, and, because the incandescent lamps then available were constructed for a pressure not exceeding 100 volts, the operating voltage of the system was limited to that pressure. The initial step was to run one or more pairs of main cables, radiating from the generating station, and to tap off from these wires two conductors to form a branch at the point where the supply was needed. Across these branch wires were connected the lamps or other consuming devices. With this arrangement, the supply to each branch was independent of the rest, but, with a common main and separate branches a fluctuation of voltage was introduced, owing to alterations of current flowing in the main cables. In addition, a voltage drop would occur proportional to the current density and the length of mains. One way to reduce this drop would be to increase the cross-sectional area of the conductors, but this would mean increased capital expenditure, apart from the difficulties involved in making the change. A less expensive method would be to install, in the first instance, mains tapered in section. In other words, the section of the conductor which, at the generating station end would be the maximum, would be reduced by joining on mains of a somewhat less cross section, and, as the distance from the station end increased, conductors of a still smaller section would be joined. This method had the disadvantage that the conductor at its smallest section would form a path of high resistance were it ever necessary to connect the ends of two pairs of radial mains for the purpose of feeding back in the event of a fault on a main near the station.

The introduction of incandescent lamps capable of operating at 200 to 220 volts was a useful step forward, because it enabled distribution on the two-wire principle to be carried out at double the pressure, and with half the current for the same power required.

Three-wire Distribution

In 1882, long before the advent of the 200 volts incandescent lamp, Dr. John Hopkinson invented a three-wire method of working, and in the same year this method was invented, independently, by Edison in America. In its original application, the use of the third wire was obtained by coupling together two similar dynamos in series, the positive and the negative cables being connected to the outer terminals of the set, while the third or middle wire was connected to the junction of the two inner terminals (see Fig. 6). If each dynamo were capable of generating current at 100 volts, then the pressure between each outer and the middle wire would be 100 volts, and there would be 200 volts between the two outer wires. With this arrangement there are the advantages of working at an increased voltage, with the consequent reduction in the cross section of the cables, and still retaining the low voltage lamps. If an equal number of 100-volt lamps, all of the same rating, are connected between each of the outers and the middle wire, then no current flows back through the middle wire to the generators; but there is certain to be some condition of loading when there are more on one side than the other. If the load on the positive side is greater than that on the negative side, the difference between the two currents will flow along the middle wire back to the dynamo on the positive side; a similar effect would take place if the greater load was connected to the negative side. Since there is current flowing through the middle wire only when there is an inequality or unbalance of load, it is usual in practice to make its cross sectional area not more than one-half of what either of the two outers may be, although, in some instances, a cross section equal to one quarter of that of an outer main has been used. The connection of consumers is carried out in such a manner as to secure as perfect a

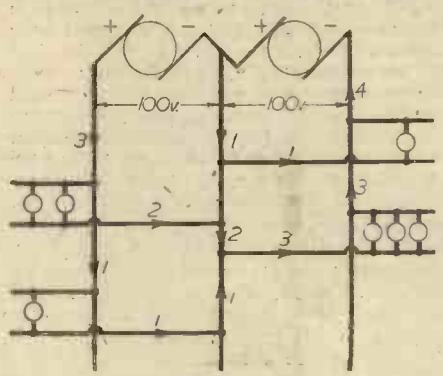


Fig. 6.—Diagram of the direct-current three-wire method.

balance or equality of load on the two sides of the middle wire as possible. Ordinarily, consecutive consumers would be connected alternately across the positive and the negative sides, two-wire service being used. But for large consumers a three-wire service would be used, the consumers' wiring would be divided into two independent circuits, as nearly equal as possible, one of the circuits being connected between the positive and the middle wire, and the other between the negative and the middle wire.

Five-wire Distribution

The next development was the introduction at Manchester, in 1893, of the five-wire distribution network with 400 volts between the outers. The distributors would consist of five wires, one of them being the equivalent of the middle wire in the three-wire system. Service connections could be made on either side of the middle wire to give 100 or 200 volts. A connection across the extreme outers would give the full 400 volts. This system operated for some years in Paris, and for perhaps a lesser period in Manchester. It was a system which gave great flexibility of distribution, but it was also complicated, and great care was necessary for its operation and maintenance.

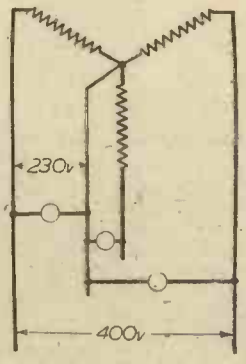


Fig. 7.—Diagram of 3-phase four-wire method.

A.C. System

Whilst many of the supply engineers had been developing the direct-current system of distribution, others were putting in networks for alternating-current working. The pioneer system of alternating supply consisted in running several independent alternators, each driven by its own engine, the distribution being usually effected by a number of high-pressure mains, from which branches, or services, were tapped off to feed small transformers fixed on consumers' premises. This system was adopted in 1889 by the House-to-House Electric Light Co., Ltd., later to become the Brompton and Kensington Electricity Supply Co., Ltd. Single-phase current was supplied at 2,000 volts and transformed down at the consumers' premises to 100 volts. A similar system was used at other places where the primary voltage was 1,000. As the system involved a large capital outlay in small and inefficient transformers, it soon gave way to one in which a low-pressure network was fed by larger transformers installed in substations.

Three-wire A.C. Distribution

A three-wire alternating-current supply can be given from two similar transformers, if their primaries are both fed from the same source, and their secondaries are connected in series. The third or middle wire would be connected to the junction between the two secondaries whilst the outer conductors would be connected to the two remaining terminals of the combination. The same remarks with regard to balancing the load applies as to the direct-current system. About the year 1899 a few 2-phase systems were being installed. In general the method was to install two groups of single-phase transformers in a substation, and to feed the primaries of one group from one phase of a high-voltage two-phase supply and to feed the other group from the second phase.

The low-voltage mains, consisting of two conductors, were connected to the secondary of the transformers and formed separate single-phase circuits to which the consumers' wires were connected. To maintain, as nearly as possible, a balanced load on the complete two-phase system it was usual to connect successive houses to alternate phases. The introduction of the two-phase system provided means for the development of a more satisfactory motor. If, therefore, in a district in which a single-phase supply had been originally installed, there arose a considerable demand for motive power, the change from single-phase to two-phase could be effected without replacing any of the original mains.

Three-phase Four-wire Distribution

Early in 1900 the three-phase four-wire method of distribution was being installed for new supply areas, and in many instances it has replaced existing networks originally put down to operate with three wires direct current. In this method the three line wires are connected to one end of the three secondary windings of a three-phase transformer, the opposite ends of the same three windings being connected together; this forms what is called the star connection. The fourth wire is connected to the star point, and, together with the three line wires, forms a four-wire circuit from which a supply is given to the consumers (see Fig. 7). The voltage between any one of the three-phase wires and the fourth, or neutral wire, is arranged to correspond with the normal lamp voltage, usually 230 volts, whilst the voltage between any two of the phase wires would be $\sqrt{3}$ times this value, namely 400. (This can be verified by drawing two lines of equal length with an angle of 120 deg. between them and measuring the length of a line to form the third side of the triangle.)

All service wires to domestic premises for lighting would be connected between one of the phase wires and the neutral wire, but for three-phase motors the three-phase wires only are required.

(To be continued)

Projecting Time on the Ceiling

An Ingenious Watch-stand which Throws an Enlarged Illuminated Image of a Watch and its Time on the Ceiling

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

Focused on the Ceiling

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

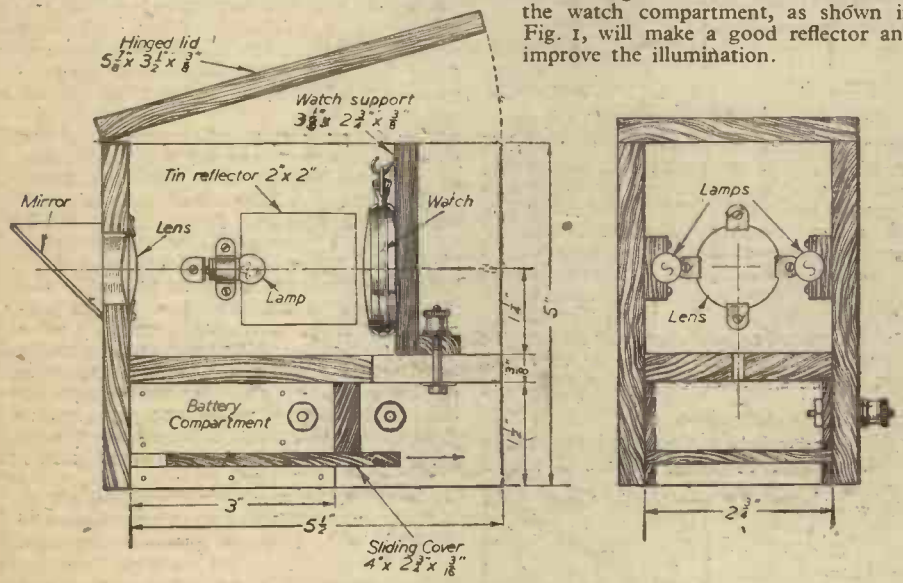


Fig. 1.—Sectional views of the complete apparatus.

Wooden Casing and Lens

The body of the apparatus should first be made of ⅜in. wood to the dimensions given in Fig. 1. If wood of a different thickness is used, be careful to modify the dimensions where necessary to allow for this. The sliding cover for the battery compartment works in a groove formed by tacking ⅛in. wood on to the side walls, the space between two pieces of the ¼in. wood forming the groove. Most amateurs will find this easier than cutting the groove.

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

The Watch Support

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

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

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

The Mirror

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

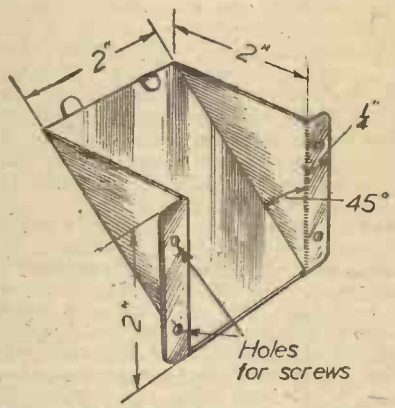


Fig. 3.—The metal bracket for holding the mirror.

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

Connections

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

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

If it is possible to place the projector on a permanent site, so much the better, as the operator then becomes used to looking for the image on one part of the ceiling. Don't place it tight up against a wall.

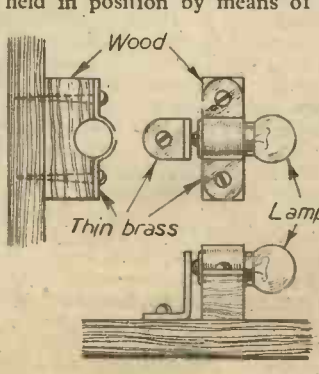


Fig. 2 (left).—How the lamps are fixed.

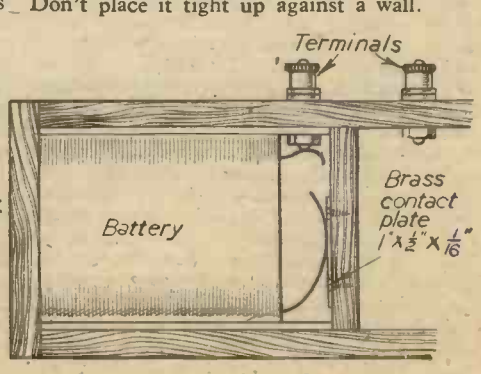


Fig. 4.—Section of bottom compartment, showing battery connections.

Photographing Trees

Notes on Selection of Subject, Light and Shade, and Sky Effects

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

FOR the second of my series of "specialised" subjects I have selected one which has always had a particular appeal to me, therefore the hints which I now give you are of my own personal experiences and feelings. Although there may be some with which you do not altogether agree, yet the reading of these notes may give you a different outlook on one of Nature's special subjects which, hitherto, may not have received much attention from you, probably because you have not considered it from the pictorial angle.

You who are fond of walking tours or hiking excursions know that the reason why you like this type of exercise or recreation is that it gets you into the country, away from "bricks and mortar"; you realise that when you are tramping through the fields or lanes or over the hills you are witnessing an ever-changing panorama made up of items which in themselves are things of beauty, and a joy for ever. It is not surprising, therefore, that large numbers of amateur photographers are keen walkers.

Nature gives us its own idea of colour schemes, its true conception of harmony, a correct rendering of perspectives and quite frequently we can find perfect composition; with such a combination of the essentials we understand the reason why so many more spools of film are exposed on subjects in their natural surroundings than on the artificial or man-made objects.

Selection of Subject

We have to admit that there are many times when it is quite impossible to reproduce with a camera all that is seen with the human eye, and there are also many occasions when the camera will persist in seeing more than we wish it to; we would like to avoid this or that branch of a tree, that interfering bush or old tree trunk, and what a pity that horse is going the wrong way, or how very much better if that path was not so straight. Yes, the artist has a pull over us in this respect, he can add or leave out anything he wishes; still, we are often tempted to try a "shot," hoping that something good can be made of it when it reaches the enlarging stage. You can, however, have the satisfaction of knowing that when you have reached this stage of discrimination in the selection of your subject, you have made a very decided advance in your hobby, and are beginning to show a knowledge in what to take and what not to, and your results should soon be approaching the 100 per cent. pictorial standard.

I have heard it said that an amateur photographer sees twice as much as his companion who has no camera, and I would not hesitate to put the difference as much more than twice, and to illustrate this point here is a true story. I was with a party of about 30 ramblers, the time was late autumn, and there were only about half a dozen cameras on this occasion, but everyone was a real nature lover; I turned aside to look more interestedly at a bush on which were hanging some hundreds of Nature's jewels in the form of drops of moisture which were on practically every point of each twig and on three or four large spiders' webs recently woven. I got my camera in position for the best lighting; this took a few seconds only, but sufficiently long to make the rest of the party curious as to what I had discovered. They retraced their steps and everyone was thrilled at the beauty of the "fairy tree," and the other cameras were soon making records of this simple but beautiful piece of Nature's handiwork.

Varieties of Trees

If I am ever fortunate enough to live near a forest or a large wood where there happens to be a number of various kinds of trees of a good size, I am certain that nothing will prevent me from making a photographic study of them at different times or seasons of the year, spring, summer, etc., in sunshine, mist and rain. I would want to capture their moods, for I am told that it is possible to detect every mood in trees. Presumably one has to use a good deal of imagination, but I pass on this idea for any of you to put into operation, feeling certain that you will find it a most fascinating addition to your hobby; besides proving a "specialised" subject to work on, it will undoubtedly produce for you a most interesting and instructive collection of negatives not only for print-making but for a really good lantern lecture.

Autumn in the woods.

Some few years ago there was a most interesting exhibition in London of photographs of trees, mostly of single trees, but it was surprising how very pictorial most of them were, and yet not so surprising when one really studies the subject; many of us are familiar with one or more fine specimens of old beeches, with thick, broad bases, and trunks gnarled and knotted as a result of old age. What a picture when the sun is in the right direction for enabling the details of that trunk to be captured by the camera. How everyone admires the silver birch with its grace and stateliness, and the fine lines of its branches and the twinkles which can be seen when the wind catches its myriad of small leaves; what a camera study! Another picture tree is the elm, especially when in early leaf or when the winter has removed all the leaves, and there is only the fine lace-like tracery of its thousands of small twigs; what a grand sight is a row of elms, heads erect and standing in regular formation up the hill. Catch this when the sun is sinking and throwing long shadows across the grass of the field, or, if they look better from the other side, get out early and "shoot" them with the early morning sun. I think any such row of trees will make a picture of which you can be proud. The oak is not, in my opinion, such a photographic tree as some others; it certainly must be studied to get it at its best, and I think this may be when it is fairly full of acorns, and the leaves just beginning to turn. Somewhere in the autumn is about the best time, but I must agree that in the spring when its leaves are fresh, small and not too thick, it does look very picturesque, but study the lighting before making the shot.

What about that most popular of trees, the horse chestnut? Singly or in avenues it offers countless opportunities; in the spring when its buds are just bursting and then a little later, you get the beauty of those charming spires of blossom cheering everybody with the fact that summer is close. A few months later we find those same trees with their fruit balls and fewer leaves ready for further films to be exposed.

We can go on adding to the list, but one must say something about that period of the year when it seems difficult to select any one tree that is better than another. It is the time when we wish to find our way into some fruit orchard where every tree is a picture. How can we resist taking a cherry or apple tree in blossom? You can take a single bunch of the flower, a sprig or a branch or the whole of the tree and you are certain of a result that will give pleasure, and add charm to your collection of prints. This is also the time of year when small fleecy clouds are quite a common feature, and just what you want for a background to that branch or spray of blossom. Put an X2 filter on the lens to ensure the small cloud being in the picture; if you would like something rather more decorative, hang a piece of black velvet, your focusing cloth will do, on the wall, and place the sprig of blossom on this and then make the exposure. If you have artistic taste in the arranging of flowers in vases, you might secure some very beautiful results with fruit blossoms.

Light and Shade

To return to trees generally, you will find

that it is essential to do some experimenting in order to find the right light for giving a true rendering of the tone values of the large range of colours, or shades of colour, which are to be found in almost all trees; you must not have heavy shadows void of detail. Those exquisite details of light and shade on the main trunk have got to be revealed in your print, and do not take your picture without some foreground, unless you wish to give the impression that the tree is growing in a small back garden. If it is a large oak or cedar, then give it space, which may mean looking around for another tree to take, but I am sure it is a mistake to attempt too much tree, and not enough ground.

If you are able to get the whole of the tree into the picture, be careful to study the sky. I do not like bald skies, even for tree studies, and I am sure you will prefer to have a cloud just passing across the sky so that it will help you to bring out the detail of those top branches. Here again the 2X filter will help you.

I want it to be understood that I am not too keen on the use of filters, because I think that this subject is not sufficiently understood by amateurs, and that the tendency is to overdo their use. Some of you may have seen results which in my opinion are the result of using a too deep or wrong colour filter, as for instance a white cloud overpowering all the other details of the photograph, and backed by a terribly black sky. Well, it may be pleasing to some, but I cannot imagine any of our painter artists producing such a result.

Background

I have suggested waiting for a small fleecy cloud as your background, and I also want to advise you not to be too keen on getting every little detail perfectly needle sharp. It is better to avoid strong lighting, especially if you are surrounded with fairly heavy and deep shadows. Then there is that strong lighting which one sometimes finds in the background, due to a small clearing, where the sunlight is stronger than at the actual spot you are shooting; you must be your own judge, but if the contrast is very great, do not waste the film. In all this class of work there must be no strong contrasts, but rather a long range of tones from black, through the greys, to the white, and if these are to be found in the subject, and your exposure and development is correct, then you will be certain of a good picture of trees.

When judging a competition recently I was very pleased to note that quite a number of the entries were tree subjects, but it was certainly disappointing to see the many ways in which the competitors had "missed the boat"; some had included figures, others had not troubled to clean up the foreground, and others through not noticing the light had got "soot and whitewash" prints.

The Story of Chemical Discovery

No. 21.—Modern Views on the Problem of Atom Structure and the Make-up of Matter

THE history of atoms dates back to the earliest records of human thought and philosophy. For some strange and apparently intuitive reasons, thinkers of all ages and civilisations seem constitutionally to have been imbued with the idea that material things are not continuous but are discrete or particled in their inherent make-up.

By this is meant that all existing matter does not, in its inner structure, form one continuous medium but that it is essentially an agglomeration of fine, ultimate particles to which we nowadays refer as "atoms." Matter, it has always been believed, has a "grained" structure, not a smooth, continuous one, if, indeed, the latter were theoretically possible.

The old Greeks, and even the Hindus before them, taught that matter is atomic in constitution, that the atoms of material things are separated by void spaces, and they even went so far as to advance the theory that the atoms of things are in a state of perpetual motion.

It was from these ancient ideas that Robert Boyle, the seventeenth-century "Father of Chemistry," and, at a later date, the perhaps still more famous John Dalton gave to chemical science its working hypothesis of atoms which resulted in the famous "atomic theory" upon which chemistry was and still is, to a great extent, based.

John Dalton in the early part of the last century considered the atoms of material things to be round, hard, impenetrable particles which were eternal, indestructible and more or less completely unchangeable. Atoms, according to Dalton's theory, were to be imagined as ultra-microscopic billiards balls.

The Dalton theory of atoms did good service to chemistry if only on account of the fact that it served to emphasise the chemical conception of an element, and the varying ratios of an element's combination or union with other elements. It was, in fact, upon the Daltonian conception and "laws" of atoms that the vast edifice of our present-day chemistry was reared.

Vortex Atoms

Towards the conclusion of the last century, however, there came a time when scientific thinkers were no longer entirely satisfied with Dalton's notions regarding the nature of atoms. Lord Kelvin, the famous electrical experimenter, for instance, suggested that atoms were anything but hard, impenetrable bodies. He put forward his "vortex" theory of atoms, which theory practically annihilated the supposed solidarity of the atom, for Lord Kelvin's atom was nothing more than a mere whirl or vortex in the ether of space, a mere "smoke-ring" in the ether. Since the ether was considered to be absolutely frictionless, this vortex motion, after having been once set up, would persist for ever, a condition which, according to Lord Kelvin, would be sufficient to account for the assumed indestructibility of the chemical atom.

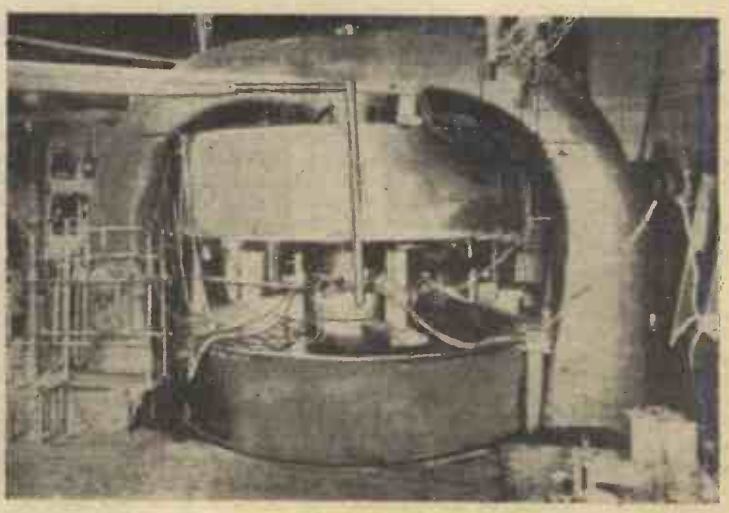
Lord Rutherford.

Lord Kelvin's atom had a few earnest believers, but, on the whole, the Kelvin "vortex" theory was far too unsatisfactory for the chemists, and for even the physicists of the day, so that, for want of something better, most of the Victorian scientific workers, and particularly the chemists, stuck resolutely and determinedly to their traditional conception of the Daltonian and the pre-Daltonian atom.

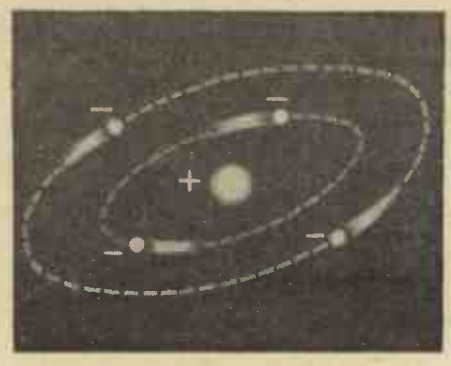
As far back as 1815 an English physician named Prout put forward the theory that the atoms of all the different elements were formed by a peculiar condensation of hydrogen atoms. Hydrogen atoms, on Prout's theory, were the real, ultimate atoms. The atoms of the other elements, as, for example, the atoms of lead, copper, tin and iron, were all agglomerate groups of hydrogen atoms.

Many experimental facts proved Prout's hypothesis to be untrue, yet, to us moderns, the theory is of great interest if only in view of the fact that it manifested the idea of there being one basic form of matter throughout the whole gamut of the chemical elements.

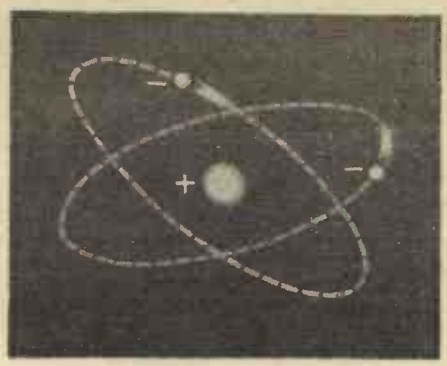
When, about 1896, the first radio-active substances were discovered and, closely following them, the electron was revealed, it came to be seen that, despite the non-validity of



The cyclotron. An electro-magnetic machine of high power for producing artificial radio-active atoms.



An atom of beryllium metal. It embodies a central nucleus having four electrons revolving round it in the manner shown.



An atom of helium. It comprises a central nucleus with two planetary electrons.

Prout's theory, the atoms of matter do really contain at least one basic constituent, for it was quickly ascertained that the electrons which were derived from widely varying chemical elements were all the same in properties. That is to say that such electrons were all almost inconceivably minute fast-moving particles of negative electricity, which, owing to their very nature, had properties peculiarly their own.

The discovery of the radium elements gave the final blow to the Daltonian theory of atoms as being hard, solid, billiards ball-like bodies. It became apparent that electrons are actually particles of negative electricity which are divorced from matter, and that small, indeed, as the atoms of matter are, the electrons are still very much smaller.

Atomic Dimensions

To take a concrete instance. The weight or, rather, the mass of an electron is 1/1,800 of the mass of a hydrogen atom. Yet, under normal conditions of pressure and temperature, the diameter of a single hydrogen atom is about one hundred-millionth of a centimetre, its weight being rather considerably less than one millionth of a gram.

Here were some tangible facts, derived from conclusive experiments which John Dalton had never even dreamed of. Atoms could be measured, and they had been proved to contain within them electrons which are particles of negative electricity.

But because experiments showed clearly that atoms are perfectly neutral bodies it was only logical to conclude that, in addition to electrons, atoms must contain particles of positive electricity to neutralise the electrons, or negative particles.

This was the reasoning upon which Lord Rutherford had worked when, in 1911, he put forward his modern theory of the chemical atom. According to this theory, every atom is composed of a central nucleus which consists of one or more particles of positive electricity, or *protons*, as they are called. Around the central nucleus revolve at high speed and at varying distances the atom's complement of electrons, just as the earth and the remainder of the planets rotate regularly around the sun.

Indeed, to a large extent, the sun and the planets present the Rutherford model of the atom upon a gigantic scale.

The central nucleus of protons, according to the Rutherford theory, embodies almost the entire mass or weight of the atom, for the revolving electrons are practically weightless.

The simplest atom, that of hydrogen, is made up of a central nucleus of one proton, around which revolves one electron. As the atoms of the chemical elements become progressively heavier the number of protons in the atomic nucleus increase, with a corresponding increase in the number of revolving electrons. Thus, an atom of helium has two protons and two revolving electrons, whilst an atom of lithium contains three protons and three electrons. Eventually, we have the element uranium, at the bottom of the list of elements, the atoms of which metal each have 92 protons and 92 electrons revolving in complex orbits around the atomic nucleus.

Professor Langmuir, the American theorist of atoms.

Such, in the main, is the Rutherford theory of atoms. Whatever its deficiencies may be, it serves to show us that, unlike the Daltonian atom of hard, impenetrable properties, the actual atoms of matter, although they are extremely stable and enormously strong in a mechanical sense, are definitely anything but hard and impenetrable. Indeed, modern knowledge has revealed the fact that the greater part of the atom is mere empty space, and nothing else. The atom's properties of weight and mass reside in its small but heavy nucleus, whilst its chemical properties are formed by its system of revolving electrons.

Lewis-Langmuir Theory

Two American chemists, George N. Lewis and Irving Langmuir, put forward an alternative theory of the atom which has received a good deal of attention. According to these workers, the atom contains a nucleus of protons, whilst the electrons are placed around this nucleus at given points on concentric imaginary envelopes or shells. These electron "shells" comprise imaginary planes or layers upon which the electrons exert their influence. The various electrons are not in rotational motion, but they are capable of oscillating or vibrating about the points which they occupy.

Just as the Rutherford conception of the atom is a *kinetic* one, the Lewis-Langmuir atom is a *static* or a stationary one, for in the latter atom the constituent electrons are considered normally to be in a state of rest.

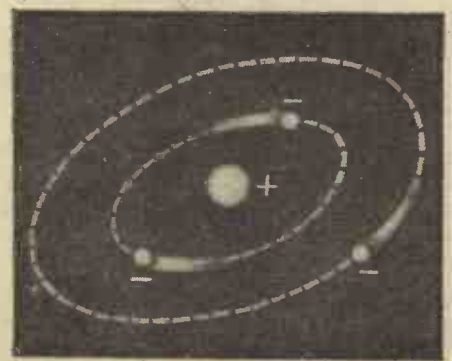
The Lewis-Langmuir atom is particularly the chemist's atom, for it accounts very satisfactorily for the "valency" or combining powers of various elements. Nevertheless, it is improbable that the Lewis-Langmuir theory gives us a perfectly true picture of the real atom, since it fails to account for a good deal of observed radiation phenomena associated with atoms.

A much simpler type of atom has more recently been put forward by Erwin Schrödinger, a German. The Schrödinger atom has a nucleus of protons or positively-charged particles of electricity, but, instead of having the outer electrons revolving around this central nucleus (as in the Rutherford atom) or vibrating in concentric "shells" or planes (as in the Lewis-Langmuir atom), the Schrödinger electrons spread out and surround the nucleus with a sort of "mist" or atmosphere of negative electricity, pretty much in the same manner as the atmosphere surrounds the surface of our earth.

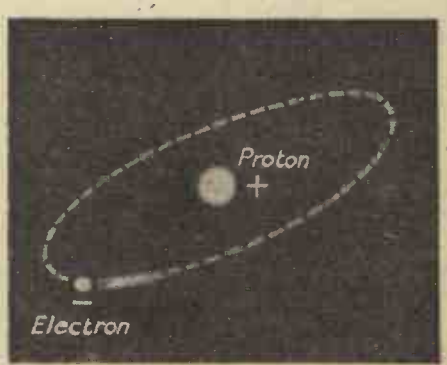
Just as the earth's atmosphere is densest near to the surface of our globe, so, according to Schrödinger, the electron "mist" is densest nearest to the proton nucleus of the atom. This density gradually decreases until the electron "atmosphere" of the atom tails off into nothingness.

The Schrödinger atom is the nearest approach to the ancient idea of atoms, for, according to Erwin Schrödinger, the atom vibrates as a whole, the smaller the atom, the greater being its rate of vibration.

This, one of the latest conceptions of the atoms, is by no means a forced notion. Nor, for that matter, can it be considered to be far-fetched, since, despite greater simplicity of construction, the Schrödinger atom to a



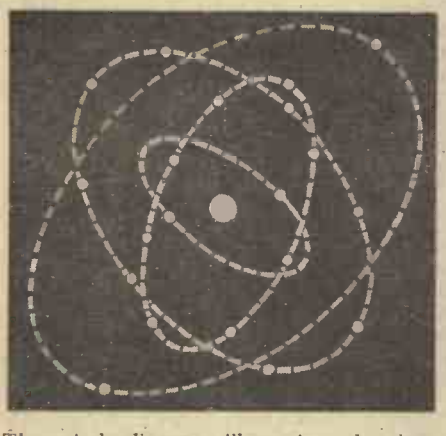
Lord Rutherford's idea of a lithium atom. It comprises a central nucleus with three revolving electrons.



Rutherford's hydrogen atom. It consists of a central positively-charged nucleus having one negatively-charged electron revolving round it.

large extent fulfils the many exacting demands of both chemical and physical science.

It is, of course, improbable that, with Schrödinger's ideas, we have had the last of the atom theories. It may be that the true solution of the problem of atom structure will remain for ever unattainable. On the other hand, a greater degree of elucidation of the problem may come suddenly, and from some unexpected direction. Considering the almost inconceivable minuteness of atoms, it is rather a matter for surprise that we know anything definite about them at all. The smallest particle visible to the average human eye is about a hundredth of an inch in length. Nevertheless, in such a length there could be laid in a row, like a line of pennies, no fewer than approximately four million medium-sized atoms. Such a fact is capable of mathematical or, rather, of simple arithmetical demonstration.



Theoretical diagram illustrating the inner make-up of an atom of calcium, according to the Rutherford theory.

Isotopes

With the increasing knowledge of atoms which was brought about by chemical and physical science came, some years ago, the discovery that the atoms of any one element need not necessarily be all alike.

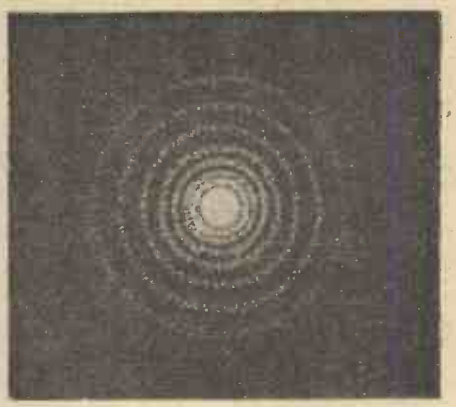
Take, for example, the gas chlorine. This, for many years, had been known to have an *atomic weight* of 35.46, which means that chlorine is 35.46 times heavier than hydrogen.

By means of certain physico-chemical systems of great complexity it was discovered by Dr. F. W. Ashton, of Cambridge, that many chemical elements, such as chlorine, could be separated into two or more components. Taking the case of chlorine gas as an example, it became apparent that there exist *two* chlorines, the first of these having an atomic weight of 35 and the other possessing an atomic weight of 37. Both these types of atoms possess identical chemical properties, but one is heavier than the other.

Such individual types of atoms are called *isotopes*. Ordinary chlorine gas having an atomic weight of 35.46 is, in reality, a mixture (in the proportions of 4 to 1) of the lighter and the heavier chlorine isotopes. Normally the isotopes of chemical elements are inseparable, and it is only by dint of applying tedious and complicated methods that a partial separation of such identical elements of different atomic weight can be effected.

Elements, such as oxygen, which have no isotopic forms, are nowadays termed "simple elements." Those which, like chlorine, are composed of atoms of identical chemical properties but of different weights are known as "complex elements." In some instances, as many as six or seven isotopes of the same element can exist. Hence the recognised atomic weight of such an element is necessarily merely an average of the atomic weights of all the isotopes of that element.

Modern notions concerning the structure of atoms, together with the introduction of the conception of chemical isotopes have, to some extent, greatly complicated the picture of the atomic world which is presented to the present-day chemical student and inquirer. Yet the age-old theory of the essentially "grained" or atomic structure of material things persists as strongly and as vividly as ever in modern science. It is with regard to the make-up of the individual atoms of matter that scientific and chemical theories continue to evolve themselves. The fundamental principle upon which matter is made up is as much taken for granted nowadays as it was thousands of years ago. It is upon the details of the question that modern chemical philosophers differ.



Schrodinger's conception of the atom as embodying a central positively-charged nucleus having an electron "mist" surrounding it.

Items of Interest

Carpet Sweeper for Lawns

MORE than one method has been thought out with the purpose of keeping lawns, bowling greens, golf courses and other places free from litter. An elementary practice is carried out by means of a stick with a sharp point. This spears leaves and wayward paper, which are placed in a basket. The process obviously is a long and tedious one.

There is on record an appliance composed of a frame with metal scrapers and a brush which can be adjusted to an angle from the ground. The contrivance is drawn by means of cords, the metal scrapers collecting, and the brush sweeping up leaves and other litter.

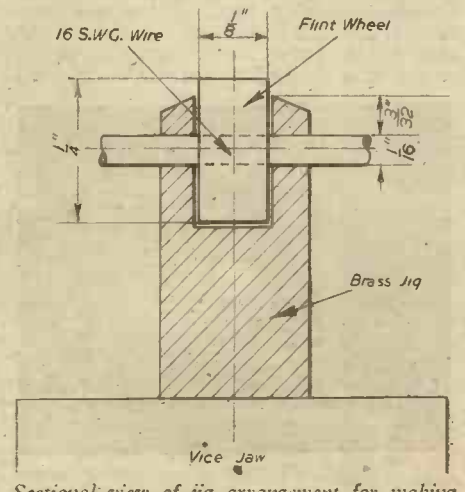
A new invention of this type has a row of prongs downwardly projecting from a back strip fitted with a long handle, in combination with a lengthy brush also projecting towards the ground. The brush has a back strip connected to the first named back strip. As a consequence, the brush trails behind the row of prongs, acting with them simultaneously. The prongs comb the grass and bring the litter to the surface. They also draw out coarse or wiry blades, and the trailing brush catches and pushes before it the blades and litter, while the prongs are loosening more of the same in front of the brush.

Preferably, the brush is arranged at an elevation higher than the ends of the prongs. This is effected to enable them to penetrate the carpet of grass, while at the same time the brush sweeps along the surface.

Making Flint Wheels

NOWADAYS, to combat the shortage of both matches and lighters, many people make their own petrol lighters. No difficulty is usually experienced until it comes to the flint wheel; but here the trouble usually begins. After several experiments I adopted the following method:

A piece of silver steel, or similar 1 per cent. carbon steel, is turned down to a diameter slightly less than that finally required, the requisite hole is drilled and the wheels are carefully parted off to length. My own wheels are ¼in. dia., and ⅛in. thick and are drilled $\frac{1}{16}$ in. to take No. 16 s.w.g. A piece of brass rod, or similar material, is now acquired, and a slot is cut in one end as shown in the illustration, slightly wider than the flint wheels. The slot may be cut by using two hacksaw blades simultaneously, and finishing with a ward file. A $\frac{1}{16}$ in. hole is next drilled through as shown. Now the brass rod is gripped in the vice, and the wheel inserted in the slot by a temporary wire spindle, as shown.



Sectional view of jig arrangement for making flint wheels.

Next, a new, or fairly new, well-cut second-cut file is laid on the wheel, and, under steady pressure, is moved to and fro, the pressure being maintained on both strokes. After a few strokes the wheel is cut with well-defined teeth of better form than those produced by knurling.

For heat treatment, the wheel is threaded on to a piece of wire and heated to a bright cherry red (760 deg. C.), whence it is quenched in oil. No tempering is necessary. Specimen dimensions are given for guidance—D. B.

Mechanical Haymaker

IN a few weeks we shall be preparing to make hay while the sun shines, and it is opportune to note that there has recently been accepted by the British Patent Office an application relating to an improved haymaking machine, which is capable of performing three different operations. It spreads cut grass, turns about the spread grass, and afterwards gathers the dried grass to form swaths.

The machine comprises rotatable tine fork carriers mounted on a common axis, and adjustable into three different positions. In two of these positions, the planes of rotation of the tine fork carriers are oppositely inclined in relation to the axis, and, in the third position, the planes of rotation extend at right angles to the axis.

Victory in the Desert

Incidents in the opening phases of the 8th Army's victorious drive across the Libyan desert, when the remnants of the German Panzer divisions were chased and rounded up by British armoured columns.

The remains of a German Mark IV tank after the Royal Engineers had finished with it, and (on the right) one of the many knocked-out enemy field guns found by advancing 8th Army troops.

Curiously enough the enemy left the electric power station intact at Appolonis, and it is here seen (below) being run by native workers.

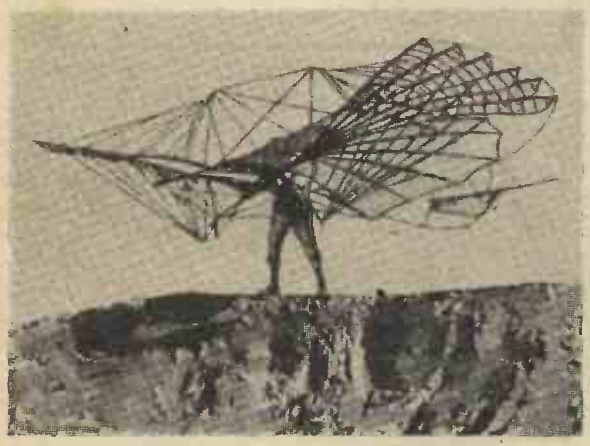
The extent of the defeat, and the enormous destruction of Axis tanks and other equipment were apparent to the British troops as they advanced through territory that was recently in the hands of the enemy. The illustration below shows a German 88mm. gun found abandoned near the coast road west of Alamein.

Much of the desert is rocky, and explosives have to be used before the guns can be safely placed. The illustration (left) shows a sapper placing ammonal in a hole for blasting purposes.

MASTERS OF MECHANICS

No. 84.—Otto Lilienthal, the Pioneer of Glider Construction

OTTO LILIENTHAL has been called "The Father of the Aeroplane." Whether he is legitimately entitled to such historic priority is a matter which is open to discussion, since Lilienthal himself never actually flew in a power-propelled aircraft. Nevertheless, this individual was certainly the aviation pioneer who, perhaps more than anyone else, paved the way for the first power-driven flights, because it was upon principles enunciated by him that the pioneer mechanically-propelled 'planes were designed.



Lilienthal with one of his early air-frames.

Because Lilienthal never succeeded in flying a power-driven aeroplane, his memory has suffered an unjustifiable degree of eclipse. But no greater enthusiast in the cause of human flight ever existed than the German, Otto Lilienthal. He was a man who spent practically the whole of his life in fundamental research into the question of aerial flight, and, had it not been for an unfortunate, and a purely chance, accident, to which he succumbed, it seems highly probable that he would have successfully made the first human flight in a mechanically-driven aeroplane several years before this feat was actually accomplished by the famous Wright brothers across the sand dunes at Kitty Hawk, California, on that memorable December 17th, 1903.

Otto Lilienthal was born on May 24th, 1848, at Anclam, Pomerania. From his early boyhood he seems to have been fascinated by the then unsolved problems of human flight. His brother, Gustav Lilienthal, harboured a similar enthusiasm, and, while still at school, the two lads built for themselves a set of fabric wings, which they fastened to their arms, and by means of which they attempted to glide through the air after running down a steep incline. These wings were based upon an earlier design formulated by an experimenter named Besnier, who lived in the sixteenth century. They were, of course, completely unsuccessful.

Franco-Prussian War

In 1864, Otto Lilienthal entered the Potsdam Technical School to be trained as an engineer. From that institution he proceeded to the Berlin Technical Academy. He was in his third year at that college when the Franco-Prussian War of 1870 broke out. Otto Lilienthal volunteered for service, and took part in the siege of Paris.

After the conflict had ended victoriously for Germany, Lilienthal obtained a number of posts in various engineering shops in Berlin. Finally, in or about 1880, he set up a machine shop of his own, and specialised in light precision engineering. He evolved a particularly compact form of lightweight steam engine, and he invented a type of marine signal which brought him, as a reward, the official Silver Medal of the State.

After the Franco-Prussian conflict of 1870 Gustav Lilienthal appears to have lost all practical interest in the solution of human flight. At all events, he relinquished all experiments, so that it was entirely alone, and practically unaided, that the more enterprising brother, Otto Lilienthal, embarked upon a course of spare-time studies, which, at that time, centred chiefly around the close and scientific observation of bird flight. Gradually, and with almost infinite patience, Otto Lilienthal garnered information relating to the behaviour of birds in the air. He noted their automatic responses to ever-changing air-resistances, and particularly did he study, by means of their observation, the properties of wing-like surfaces in relation to air currents.

Almost from his boyhood days he seemed intuitively to have realised that the solution of the problem of human flight must come mainly from a scientific investigation of the most fundamental aspect of the question, to wit, that of the design of the air-frame which was to be made to travel through the air. He did not, as others before him had done, endeavour to fit an engine into an air-frame, and then proceed to find out what might happen in practice. On the contrary, Otto Lilienthal concentrated upon evolving a practicable type of air-frame, which, after it had been thoroughly tested out and passed as satisfactory, could then have a power unit incorporated into it.

Otto Lilienthal making a landing with his biplane glider.

The Flight of Birds

In 1889, Lilienthal published the results of his observations of bird flight in a pamphlet entitled "The Flight of Birds as a Basis for the Art of Flying." The pamphlet was an historic one. It constituted the first really scientific onslaught on the problem of human flight after centuries of mere imaginings on the part of various would-be aeronauts.

He experimented with the lifting powers of various types of plane surfaces, and he made the fundamental discovery that the lift given by a curved or cambered surface is considerably greater than that produced by a perfectly plane surface.

In 1890, Lilienthal finished with his preliminary theorising. He got down to practical work, and in the following year (1891) he successfully completed his first scientific glider. The framework of this device was composed of willow rods which were covered with stout cotton fabric. The total wing surface of the craft was about 100sq.ft.

Lilienthal fastened the glider to himself by dint of pushing his forearms through padded tubes and by clinging tightly to a wooden cross-bar. In this manner he transported himself through the air with the glider above his shoulder-level and with his legs dangling more or less perpendicularly below him.

At first he got into the air by jumping off a strong spring-board placed at the top of an incline. Some months later he began to make use of convenient hills, and, finally, in 1892, he had constructed near Berlin an artificial hill or conically-shaped eminence some 50ft. in height, which was thrown up with earth and rubble dug out from the bed of a nearby canal.

The first scientific glider flights met with immediate success. Lilienthal was rewarded for his years of patient study of fundamental flight principles by finding that his glider behaved quite reasonably in the air, and that it showed all the characteristics of air-worthiness which he had expected.

After a few initial trials, Lilienthal found himself readily able to traverse distances of a hundred yards under good wind conditions. Thenceforward, his aim became that of endeavouring to improve the stability of his machine. This he effected, at first, by moving his body backwards and forwards or to and fro whilst in the act of gliding. Such actions, according to Lilienthal, rapidly became instinctive ones on the part of a glider pilot, and were similar to the instinctive balance of a bicycle rider.

Enter the Biplane

By changing the centre of gravity of his gliders as a result of the alteration of body position whilst in the air, Lilienthal found

Lilienthal about to commence a glide from the summit of his artificial hill near Berlin. (1895.)

that he could to some extent make the glider steerable. Then, in order to extend the range of his glides, Lilienthal discovered that he wanted a greater lifting surface. This he attempted to effect by increasing the area of his glider wings, but it quickly became apparent to him that there existed a very rigid limit to which this extension could be taken. Therefore, he hit upon the idea of having two relatively small planes, the one situated above the other—thereby introducing in a practicable form our present-day principle of the biplane.

Says Lilienthal, referring to his "biplane" flights :—

> "The flights undertaken with such double-sailing surfaces are remarkable for their great heights. I often reach positions in the air which are much higher than my starting-point. At the climax of such a line of flight I sometimes come to a standstill, so that I am enabled while floating to speak to the gentlemen who wish to photograph me regarding the best position for the photographing. At such times I feel plainly that I would remain floating if I leaned a little to one side, described a circle and proceeded with the wind."

With increasing experience of glider flights, Lilienthal perceived that the motions of a pilot's legs or body were not sufficient to stabilise the glider to the extent which it required for relative safety. Something extra was necessary, some additional control plane which could be operated by the pilot in order to bring the glider back to normal position after it had encountered a sudden gust of wind.

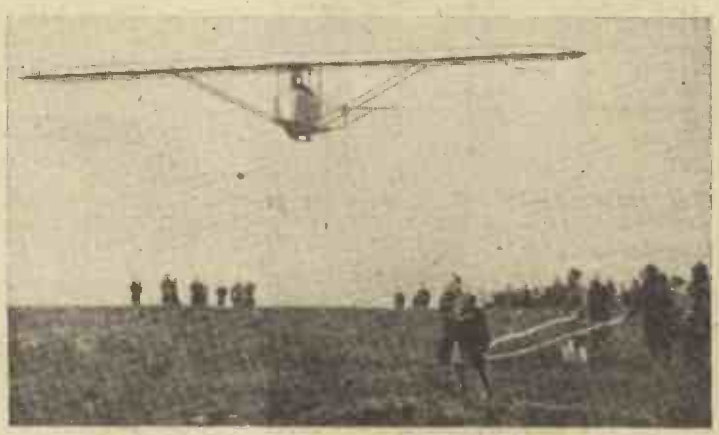
The Tail of the Aeroplane

For the purpose of effecting this requirement, Lilienthal devised a couple of smaller planes which he affixed by stays to the rear of his machine. Thus came into existence the "tail" of the future aeroplane.

At first, Lilienthal controlled these rear planes by means of movements of his head, but, later, the controls were operated by the arm movements of the pilot.

It was Lilienthal's avowed intention to proceed with the design and construction of a power-propelled glider immediately after he had satisfied himself as to the practical airworthiness of his ordinary gliders. The petrol engine at that time was not sufficiently developed to be applied to aircraft powering. The steam engine, despite the ideas and assertions of other inventors, was, in Lilienthal's opinion, an impossibility for aerial power flights. What he intended to try out was a form of "carbonic acid motor," that is to say, a motor actuated by gas expansion, the "working" gas being carbon dioxide (carbonic acid gas) contained in a liquefied condition in a small, lightweight steel cylinder.

Alas, however, Lilienthal never got to this stage of his programme, although he made active preparations for it. He actually constructed a large glider which, at a later date, he intended to "power" and thus to realise mechanical flight, but for some reason or other he became dissatisfied with the steerability of the machine. The glider was stabilised by means of a light form of tailplane worked by the pilot's head, and it was on August 9th, 1896, whilst testing this machine, that Lilienthal apparently became confused in his movements in the air, as a result of which he crashed heavily from a height of 50ft. He sustained a fractured spine and other severe injuries from which he died the next day in a Berlin hospital. Many people called him a madman, but in reality he was one of Science's martyrs.



A modern glider in flight, just after being launched. Note the team in the foreground with the towing rope.

Two Thousand Trials

All told, Otto Lilienthal made considerably more than 2,000 successful glider flights, the greater number of which took place from his own artificially-constructed "hill" near Berlin. If he could have conducted his experiments secretly in a back room, he would have done so, but of necessity Lilienthal's laboratory comprised his 50ft. conical hill or eminence outside Berlin, together with the air surrounding it, a testing-ground which was open to the observations of all comers.

Lilienthal had a kindred enthusiast in England, one Percy Pilcher, who carried out his experiments until he, too, met his death in a similar manner. As a result of Lilienthal's trials (and also of Pilcher's) it became difficult for thinking people to scoff at the possibility of mechanical flight, since these pioneer glider trials proved so conclusively the practicability of sustaining a heavier-than-air machine in motion in the atmosphere.

Otto Lilienthal, in fact, ushered in the era of controlled human flight. He reduced gliding flight to regular practice. And it is noteworthy that no less than seven years after his death Wilbur and Orville Wright, the first men to fly under mechanical power, acknowledged that they had closely followed Lilienthal's designs and principles in the construction of their aeroplane and that they had duly profited by his work.

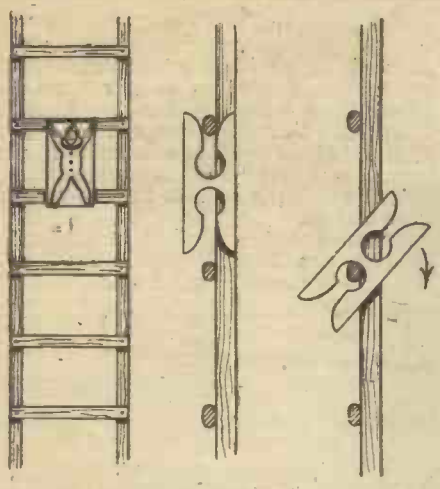
Indeed, not merely the brothers Wright, but many other early airmen owed a debt to Lilienthal, which in some instances they hardly troubled to acknowledge.

Gliders leave the ground before their towing 'plane, and here, at the U.S. Army Air Forces' Glider School at Elmira, New York, they are clear of the ground, riding higher than the 'plane. They take-off after a run of about 500 feet while a tow-plane needs a run of about 1,000 feet. In flight the gliders remain slightly above the level of the tow-plane, with nose a little down to maintain lift.

Toy Manufacture:

Further Methods of Operation,

(Continued from page 199)



Figs. 22 to 24.—Principle of the clown on ladder toy.

Toy See-saws

EVERY reader will have seen the see-saw novelty illustrated in Figs. 20 and 21. In this toy, which is merely symbolical of many variations, the action imparted by an inclined plane is allied to that of a rotating spindle to which the figures are attached. For example, in Fig. 20 is indicated a rod carrying two acrobats, and also a central spindle on which the arm and figures are accurately balanced. By depressing one of the figures the arm will steady itself for a fraction of time, and then, as the arm tends to return to equilibrium, the spindle will slide down the incline plane. These revolutions are repeated until the spindle reaches the bottom. Fig. 21 is an adaptation of the same idea. Here an upright having arched sides is engaged by two pins in the arm of the see-saw. Each arc is described from the point of intersection of two arcs on the opposite side. The arm is, of course, provided with suitable straddle pieces to pass over the upright standard.

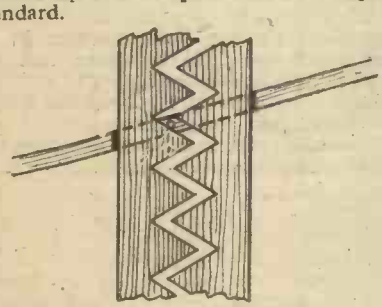


Fig. 20.—In this toy the see-saw action imparted by inclined planes is allied to that of a rotating spindle to which the figures are attached.

The Ladder and Clown Toy

It is not known when the toy illustrated in Fig. 22 was first produced. It is certainly over a century old. It will be seen that a clown is attached to a rectangular block of wood, having slots cut in it, as shown in Figs. 23 and 24. It will be understood that the rungs of the ladder must be of such a section that they easily slide into the slots, and the distance between rungs needs to be carefully gauged. It will be noticed that the slots have a circular hole at each end, and the rungs should be made of such a width that they will turn easily in these holes. When the clown is placed on one of the rungs it will tumble in a series of somersaults, one rung at a time, until it reaches the bottom of the ladder. Practical instruction on a typical ladder toy is given later.

Novelty Money-box

The figure of a clown is a popular figure to employ in working toys. The money-box shown by Fig. 25 has a clown suspended on a swinging pivot. Above the point of suspension is a pocket sufficiently large to accommodate half a crown. When a coin is placed in this pocket, the clown will capsize, and the coin drop into the box below, the clown then returning to normal position.

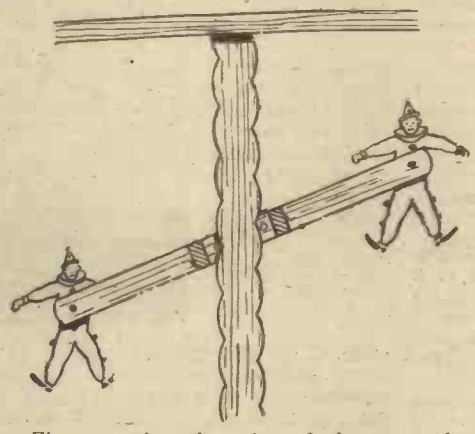


Fig. 21.—An adaptation of the same idea shown in Fig. 20. Here an upright having arched sides is used.

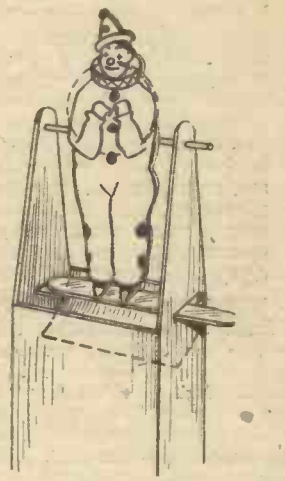


Fig. 25.—The figure on the money-box will deposit a coin in the money-box beneath.

Simple Moving Picture Devices

Under various names, such as metamorphosis, zoetrope, and thaumatrope, a number of interesting novelties, which really were precursors of the modern cinematograph, have been produced. Figs. 26 to 30 show the simplest of these. Here the figure of a man is shown to be drinking out of a bottle; a circular disc of card has on one side the picture of a man, and on the other the arm carrying the bottle. A string is attached to each side of the card, and when twirled between the fingers the card will rotate and give the illusion of the man continuously raising the bottle to his mouth.

Quite a number of such novelties can rapidly be devised. For example, the bird in the cage (Fig. 28). A more rapid and realistic action can be imparted by connecting a loop of elastic to the card and connecting the string to the elastic. The zoetrope or thaumatrope is clearly indicated in Figs. 29 and 30, showing two forms. Here a series of figures illustrating progressive movements are drawn at regular intervals on the inside of a slotted and open-ended cylinder, mounted on a suitable base in such a way that the cylinder can be spun. By sighting through the slots the sequence of movements will appear to be continuous; thus a dog can be shown as chasing a hare, and so on by this means.

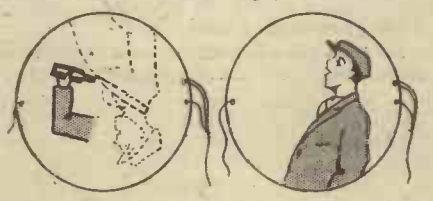


Fig. 27.—How to lay out the novelty shown in Fig. 26.

The Simple Buzzer

Figs. 31 and 32 show the simple buzzer. This consists of a disc of tin with two holes in centre, through which a loop of string is passed. Upon twisting the string and alternately pulling on the string and releasing the pull on it, the buzzer will continue to spin indefinitely. An improvement on this idea is shown in Fig. 32, where three cards are connected to a fourth and larger disc. When this is spun in the same manner as

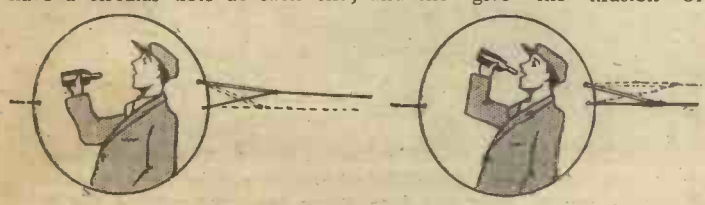


Fig. 26.—An optical illusion toy.

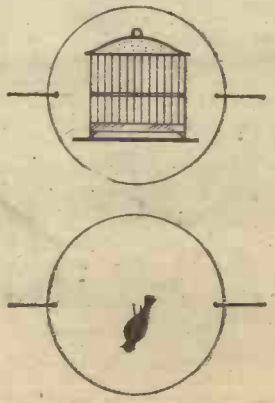


Fig. 28.—The "bird-cage" optical illusion toy.

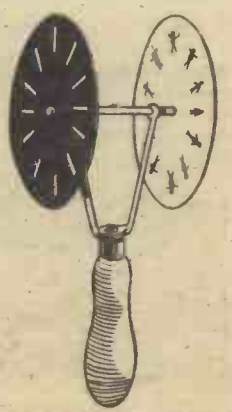


Fig. 29.—One form of thaumatrope or zoetrope.

Principles and Practice

and Constructional Details

March issue)

the buzzer a very puzzling spinning effect results.

A Metamorphosis

A little idea which works on the same principle as the zoetrope and the thaumatrope, already referred to, is illustrated in Fig. 33. Here a series of pages, each containing an illustration, slightly differing, but forming a successive series, are rapidly released from

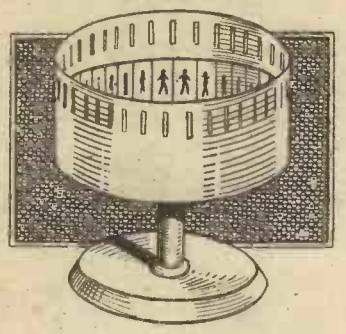


Fig. 30.—Another form of thaumatrope.

contact with the thumb. By persistence of vision the pictures will appear to be moving.

Glass Bowl Illusions

We have all seen the two bands of tin mounted on an Archimedean screw, which

Fig. 37.—A novel rocking motion device in which the horse travels forward and appears to vault.

are rotated by a bobbin, giving the illusion of monster bubbles. These are illustrated in Fig. 34, while Fig. 35 shows an elaboration of the idea where a small goldfish is added to give the illusion of a fish swimming in a bowl.

Rocking Motion Novelties

Quite a number of these devices can be devised by following the schemes indicated in Figs. 36 to 42. In Fig. 36 it will be seen that the grotesque animal has spindles passed through its fore and hind legs, and these spindles are mounted eccentrically in the wheels. When the toy is pushed along, the animal will appear to be galloping. Fig. 37 shows an improvement on the toy rocking-horse idea. A horse is mounted on a little carriage running on a rocking track; the horse is thus capable of the dual motions of rocking, and, apparently, galloping forward. Fig. 38 is a development of this idea. By pushing on the back of the device the horse is made to appear to gallop. In Figs. 39 and

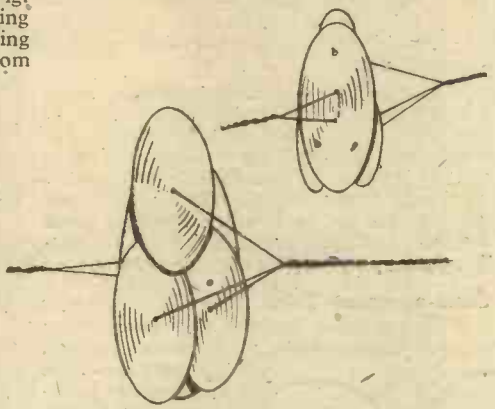


Fig. 32.—A more complicated application of the buzzer principle in which three or more discs are used.

40 is shown, in two positions, a jockey mounted on a racehorse. It will be seen that the legs are mounted on wire cranks. By pulling the cord attached to the jockey's head, action is imparted to the figure. Figs. 41 and 42 show the elements of the galloping ass. The hindquarters of the animal are hinged and the action of pulling on the cord attached to the hat supplies the motion.

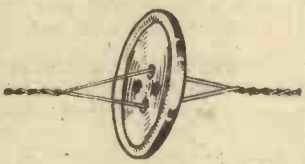


Fig. 31.—A simple whistling buzzer. Motion is imparted by twirling the two strings.

Walking Figures

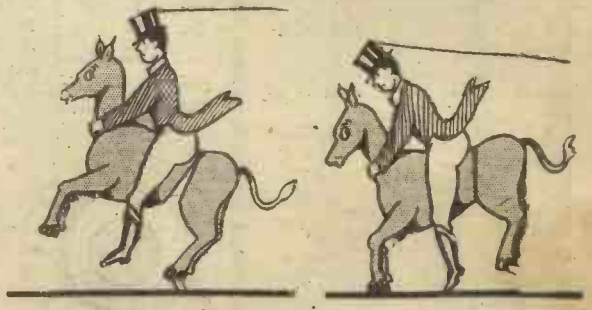
One system of making a walking doll is shown in Fig. 43, where a series of feet are mounted concentrically round a pivoted drum secreted inside the skirt of the doll. When the doll is pushed along by means of the handle, the action of walking is well simulated. Typical walking toys operated by means of inclined planes are described later.

Fig. 36.—A leaping dog novelty. The spindles pass through the wheels eccentrically.

Cranked Wheel Toys

Figs. 44 and 45 are typical examples of toys having cranked axles; the crank is usually connected to some part or parts of the figure so that when the toy is pulled along, motion is imparted to it. This idea lends itself to infinite variations.

Figs. 39 and 40.—By pulling on the cord passed through a wire staple in the jockey's head, a galloping motion is given to the horse.



Figs. 41 and 42.—The galloping ass, the hindquarters of which are hinged. The action of pulling on the cord attached to the hat supplies the motion.

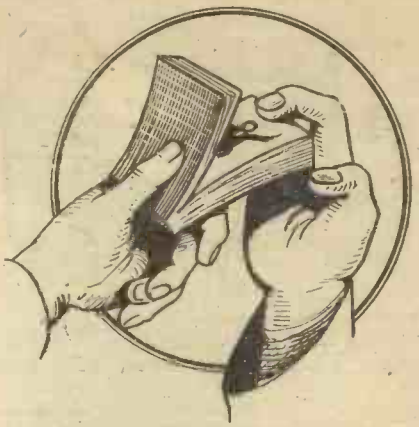


Fig. 33.—A metamorphosis. In this device a series of related movements are drawn on each leaf of the book, and when these are flicked rapidly past the finger, continuous or "moving" pictures are obtained.

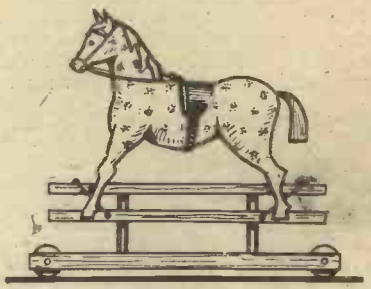


Fig. 38.—A development of the idea sketched in Fig. 37.

Fig. 34.—"Bubbles" are formed when the loops are spun by means of the Archimedean bobbin.

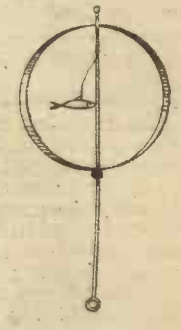


Fig. 35.—"The fish-in-bowl" novelty. Here persistence of vision, when the ring is revolved, provides the illusion of a fish swimming in a bowl of water.

Fig. 43.—A simple idea for making a walking doll. When the doll is pushed along by means of the handle, the action of walking is imitated.

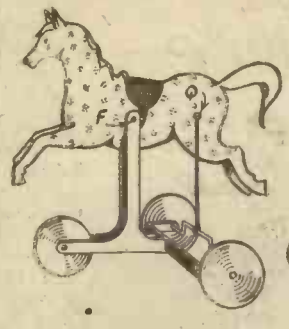


Fig. 44.—A typical example of a cranked-axle toy.

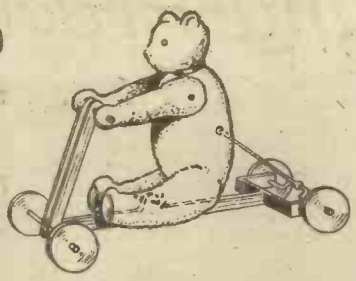


Fig. 45.—This toy is similar to Fig. 44. The bear is pushed backwards and forwards by the cranked axle.

The Use of Springs in Soft Toys

Some attractive soft toys can be made by substituting for the usual rigid jointed arms and legs spiral springs of the form indicated in Fig. 46. Piano wire should be used for the springs, because this provides the maximum amount of springiness, and will return to form after being stretched or distorted.

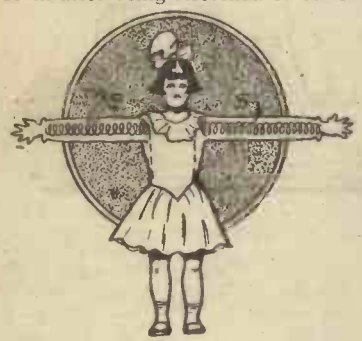


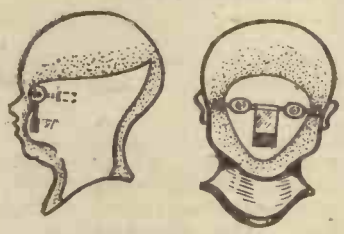
Fig. 46.—Soft toys can be improved by substituting spiral springs for the rigid-jointed arms and legs.

Eye Movements for Soft Toys

Those readers who wish to make soft toys, such as dolls and teddy-bears, which close their eyes, should suspend small lead weights to the eyes themselves, as shown in Fig. 47. It will be obvious that when the doll is in a recumbent position the effect of the weight will partly rotate the eye (suspended on suitable pivots); the eyelid is, of course, fixed to that part of the eye which is normally out of sight. Fig. 48 is a further detail of the scheme.

Squeaking Toys

The usual method adopted with crying dolls and squeaking animals is shown in Figs. 49 and 50. It will be seen that small bellows placed inside the toy have a lead weight attached to an arm. When the doll or toy is held upright the weight will naturally hang vertically, but when the toy is placed in a recumbent position the lead weight will collapse the bellows, thus forcing the air in it out through a small opening, in the mouth of which is a whistle-like device which emits the squeak.



Figs. 47 and 48.—Dolls' eyes can be made to open and shut by weighting them with lead.

Sand-operated Toys

A very popular model is that in which an acrobat performs upon a trapeze (see Fig. 51), but there is a scope for ingenuity in devising other models for which are given two suggestions, namely, the water-mill and the man at the grindstone (see Fig. 52).

The Mechanism

The mechanism is very simple, as will be seen from Fig. 53. A neatly fashioned box of thin wood is the first essential. It may measure 12in. × 9in., with a depth of 2½in.

A sheet of glass will be required to close in the front. This may be secured at the edges with passe-partout strip. When finished, the whole thing must be sand-tight.

Fig. 54 shows the box in sectional view. A narrow fillet is fixed round the inside, at about the middle of its depth, to carry the sheet of stout card on which the background is painted, and in which the forward pivot of the wheel works.

The Sand Reservoir

Referring to Fig. 53 it will be seen that the sand reservoir is made from a strip of cardboard, and that this strip is continued downwards to make the channel through which the reservoir is refilled when empty by turning the box round anti-clockwise. This piece of card must have a width exactly equal to that of the space between the back of the box and the cardboard background, so that when the latter is glued in place, a glue joint may be made also between it and the reservoir.

A small hole must be made in the centre of the angle that forms the bottom of the reservoir to allow of a fine stream of sand to fall upon the wheel.

After piercing, the hole should be made clean with a hot wire, or it may have fitted in it a short length of small diameter brass tube.

The Sand-wheel

Fig. 55 shows how the wheel is constructed from cardboard. The left-hand view is as it would appear with one face removed. In the centre is a wooden disc to afford a good fixing for the wire shaft.

The right-hand view shows the bearings and the collars on the shaft to prevent lateral movement. A small brass plate is let into the wooden back, drilled to take the end of the shaft.

A small amount of lateral play may be allowed to guard against jamming. As to the figures, these should be copied on to stout Bristol board and cut out neatly. They may then be coloured to taste.

Fig. 49.—Squeaking toys can be made by placing a small bellows weighted with lead inside them.

Fig. 50.—Details of the bellows placed inside squeaking dolls.

The Figures

The acrobat, used in Fig. 51, is shown in Fig. 56, and it consists of five pieces

Fig. 51.—The acrobats.

Fig. 53.—The sand reservoir.

Fig. 54.—A sectional view of the box for holding the sand.

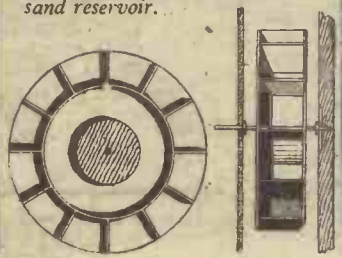


Fig. 55.—The sand wheel.

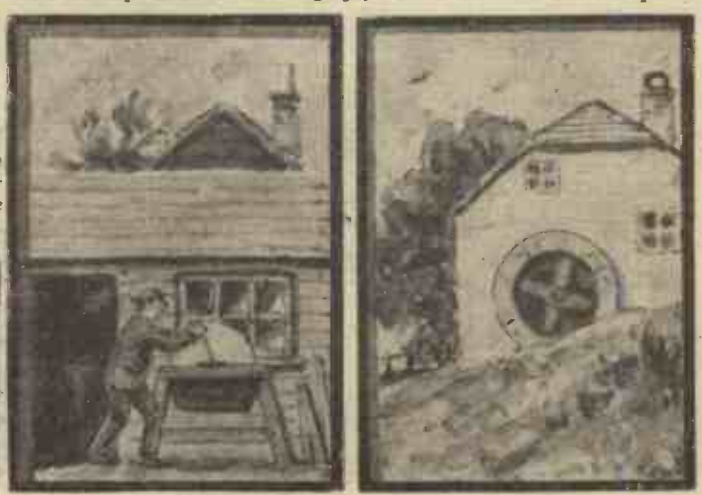


Fig. 52.—The grindstone and (right) the water-wheel.

—the trunk and four limbs. The joints are made with sewing cotton knotted on each side. As the hands have to be separated, a short tube should be made by rolling pasted paper around a piece of the same wire as that used for the shaft. This tube may be ⅜in. long. After the figure has been jointed, insert the tube between the hands, pass a wire through them and tube, glue the ends of the tube, and force all together. When dry the wire may be removed. When mounted on its shaft there will be sufficient friction to hold the figure securely to it.

For the stationary figure the same outline may be used, but reversed, rearranging the arms and legs. When drawn as it has to appear, the figure may be cut out in one piece. It should be fixed with small wooden blocks, so as to stand about midway between the background and the glass.

A round notch (see A, Fig. 56) should be cut in the instep of one foot of the movable figure. This hitches on to the trapeze from time to time, and varies the figure's revolutions.

The man (Fig. 57) also should consist of five separate pieces—the trunk, the right arm, the left arm (in two pieces), and the two legs (in one piece), the joint being at the hips.

The right hand connects with the crank of the grindstone, and the left hand is fixed at a point where a tool would be held. In this case the shaft must be long enough to admit of its fore end being bent to form the grindstone crank handle. The man's feet may have a strip of ground attached, as shown in Fig. 52. The running of the sand wheel must be tested, in all cases, before the background is glued in place, as, unless quite free, it may jam with a grain of sand.

Fig. 56 (left). —The Acrobat.

Fig. 57.—How to make the figure for the Grindstone Model.

The Water-wheel and Grindstone

The water-wheel, which, it should be noted, is undershot, and the grindstone must both rotate clockwise, so that in arranging the internal mechanism the sand-wheel must be set more to the left than shown in Fig. 53, to allow the stream of sand to impinge on its right-hand side.

Build up the water-wheel from cardboard with floats complete, and set forward that part of the foreground that comes in front of it, to allow the necessary space for the wheel. Before closing in, fill the reservoir with clean silver sand that has been passed through fine wire gauze or muslin to exclude all large particles.

If the outside of the box be covered with Rexine, the material may be brought forward at the front and turned over to secure the glass.

(To be continued.)

Sidelights on Searchlights

Notes on the Many Purposes for which They may be Used

By A. M. COLBRIDGE

TO-DAY everyone accepts searchlights as a matter of everyday (or should it be every-night?) fact, but few realise that they may be used for other purposes than the spotting of enemy aircraft and assisting the defence guns by illuminating their targets. They may have watched one searchlight "pass on" a raider to another and another as the aircraft progresses from one area to another—but have they wondered why an aircraft always appears white in the beam?

Colouring for Night-flying Aircraft

Several years ago extensive experiments were carried out with a view to finding the optimum colouring for operational night-flying aircraft. It was readily appreciated that a light coloured 'plane—all military aircraft of that period were of aluminium colour—might well show up to disadvantage, and finally dark green was chosen as the best tone for practical invisibility for night flying. Thus the night bombers of that period—the Heyfords, Virginias, Faireys, etc.—were all coloured dark green. The British national markings, red, white and blue roundels, were modified and the white ring omitted, a practice which has continued to this day, but is not general for all positions on the aircraft.

It would appear at first that jet black would be the ideal colour for night-flying aircraft, but it was generally found that, whatever the colour, an object in a searchlight beam always showed up white. This is merely because the image seen is simply reflected light from the searchlight itself. The beam, being of terrific intensity, completely blots out any colour of the object and reveals the whole as white.

Non-reflecting Pigment

A year or two ago certain reports appeared in the American technical press throwing an interesting sidelight on this problem. A certain firm specialising in the production of paints and dopes were credited with having found a perfect non-reflection pigment dope of cellulose base, and that it had been employed on night-flying aircraft in this country. If all the properties claimed for it were true it would mean that a 'plane so painted would be almost invisible, even if caught in a searchlight beam. This paint would reflect no light and therefore there would be no object in the beam except, possibly, a darkish patch of indistinguishable form.

Some confirmation of this was forthcoming from a German source, although rather unreliable, which reported that a portion of a crashed British aircraft so painted had been tested by holding it in the beam of powerful car headlamps. At a distance of about 15 metres the painted surface was practically invisible.

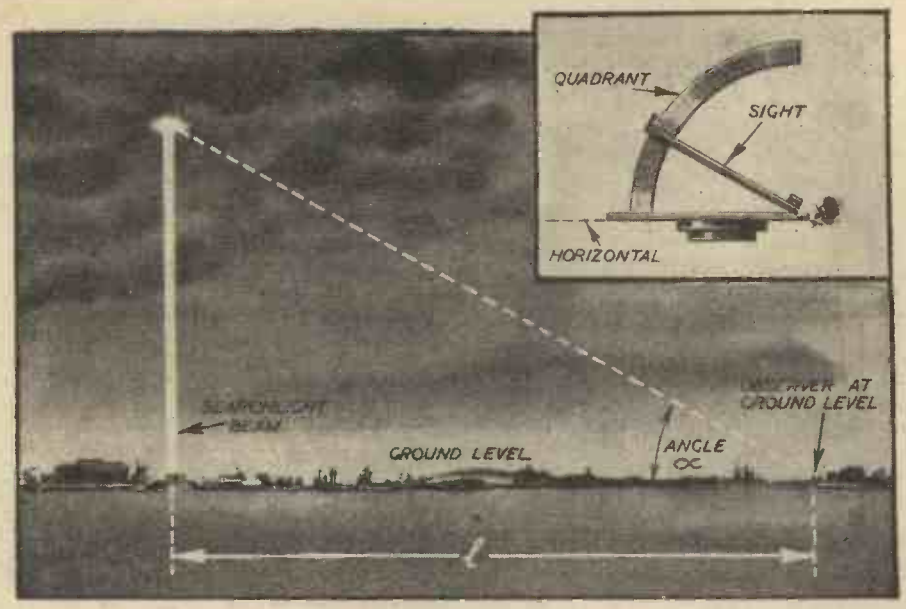
This leads to interesting speculation, but in the absence of further confirmation or comment such reports should be treated with reserve.

Finding Heights of Clouds

Apart from the obvious duty of "illuminating" hostile aircraft as mentioned above, a searchlight may also be employed on cloudy nights to find the height of the cloud base (see illustration on the following page).

The searchlight is set to shine vertically upwards and where the beam strikes the cloud a spot of light is seen on its base. If now from a measured distance from the base of the searchlight a reading is taken of the angle between the horizontal and line of visibility of the spot of light the cloud base-height may be quickly computed. The base length, *l*, should not be too great, otherwise the angle measured will be small and the liability to

How a searchlight beam appears bent when projected at a narrow angle to the ground.



Method of finding the height of clouds by means of a searchlight.

error greater; similarly, if the base length is short the measured angle is large and, again, errors in reading will be introduced.

If the measured distance between the observer and the base of the searchlight is, say, *l*ft., and a is the angle measured by the observer, then the height of the cloud base in feet is given simply by the following equation:

Height of cloud base $= l \tan a$.

Optical Illusions

The following phenomena, in the nature of optical illusions, associated with searchlights may also prove of interest. On a moonlight night an aeroplane flying overhead may be clearly visible to a ground observer, but should a searchlight in the near neighbourhood be switched on (away from the aircraft), the aeroplane, before so clearly seen by the naked eye, now disappears! The solution of this phenomena is similar to that explaining why it is quite possible to see out of a room with muslin or net curtains, but quite impossible to see *in* during the day. It is a question of degree of lightness—the added brightness of the sun shining on the outside of the curtains, or the sudden switching on of the searchlight, reduces the effectiveness of the image (or, rather, its response to the retina), and thus it is impossible to see through the curtain from the outside, or the original image of the aeroplane disappears. It is, of course, still there, but dimmed below that intensity suitable for perception.

"Bent" Searchlight Beam

Then, again, there is the case of the "bent" searchlight beam! When a searchlight beam is near horizontal, i.e., nearly parallel to the horizon, the middle part often appears higher than the two ends, or, in other words, the beam appears to be arched or bent. This is a pure optical illusion, and due mainly to the fact that there is no background to line it up with. If this is done, such as by holding a walking stick parallel to the beam, the illusion disappears.

Why is a searchlight beam visible at all? Well, this is simply because the light generated at the source is reflected off the numerous particles of dust and droplets of water present in the atmosphere. It has been said that the intensity of the beam could be used to measure the degree of purity of the air, leading to the assumption that searchlights in industrial areas would normally appear brighter than those in country areas *on dry nights*.

The persistency of a searchlight beam is another interesting phenomenon. When a beam is shut off the image persists in our minds for a second or so after. This is partly explained by the fact that the carbons of the arc do not "die" immediately, but the effect is heightened by one's own imagination.

Shadows and Fog

Light has many peculiar properties and can play many tricks with the imagination. In foggy weather some particularly amazing phenomena are possible. Shadows may be cast on to the fog, usually very large and distorted in shape, when a solid object is interposed between the source of light and the fog bank. In some cases these shadows may have depth, due to uneven formation of fog banks. In similar manner a searchlight may cast a shadow of an aeroplane in its beam on to a cloud above, although this is generally more clearly defined.

Possibly many readers have been to a cinema on a foggy night. The fog filters into the body of the cinema itself and the projector, transmitting light to the screen in the form of a divergent beam which casts queer shapes on the fog belt. Each little particle of fog reflects light in all directions, lighting up the interior of the cinema and dimming the final image on the screen as if the fog itself was not a sufficient hindrance to vision! The final image is dimmed still more by comparison with the relative brightness of the whole interior.

Coloured Searchlight Beams

Returning once more to searchlights. It has been found possible to transmit beams of light through cloud and fog to a certain extent. The Germans, in particular, have for some time employed beams of coloured light, obtained by the use of red, blue, orange, yellow and green filters. Possibly these coloured beams have a greater penetrating power than white light, but, judging from the variety of the colours employed, the final solution is far from reached. It does not *necessarily* follow that the ground observer will be able to see beyond the cloud, even if the searchlight does penetrate it, but there is quite a possibility that he *will* be able to do so. It actually depends upon a number of rather complex factors, but with further experimental work such a condition may be established in the future.

To be caught in a searchlight beam is a rather terrifying experience for the inexperienced aircrew, particularly the pilot, for the whole of the interior of the aircraft is lit up and the surrounding sky appears perfectly black by comparison (a case of light intensities, again). This effect is obviously the more pronounced the nearer the object to the source of light, but even at relatively great heights such conditions can be somewhat disconcerting.

Evading the Searchlights

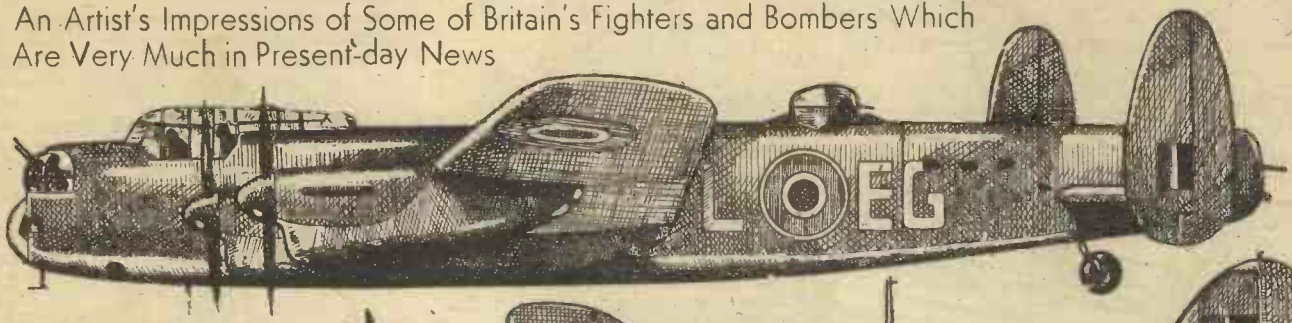
Searchlight evasion is quite an art—the advantage lying with the searchlight in that it is able to sweep a whole arc of the sky in a matter of seconds, and thus, in this sense, is more manœuvrable. The smallness of the object and the presence of cloud are the pilot's weapons.

Above a certain height, however, a searchlight is relatively ineffective, and thus high-flying aircraft are fairly safe from their sphere of action. The maximum effective height is not known, and will vary according to the type of searchlight and the various improvements introduced, but it may be taken at 15,000 feet. Thus, to avoid contact the hostile aircraft would fly above this height, but the searchlight can claim a "half victory" in that it has forced the raider to fly high from where precision bombing is very difficult, if not impossible, except in conditions of exceptional visibility.

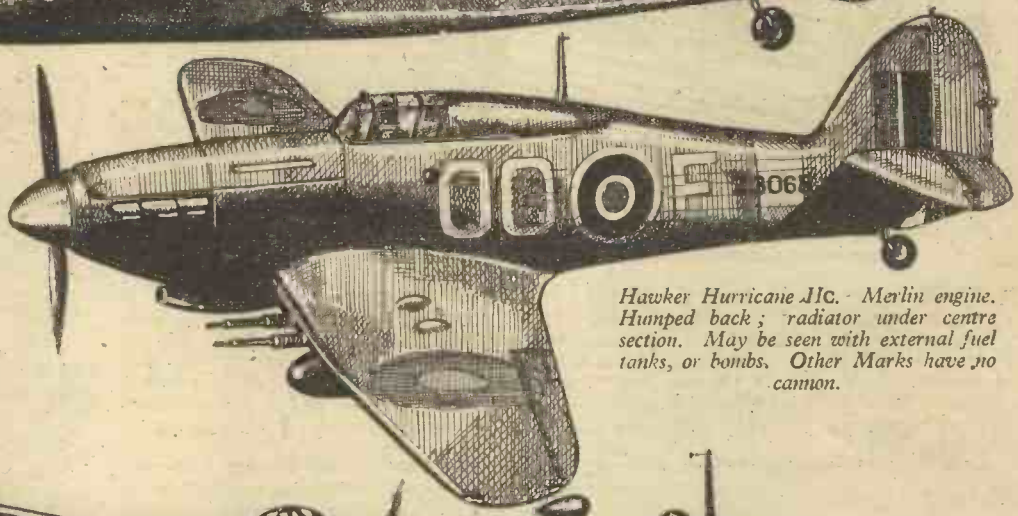
Showing how a beam of light throws an enlarged shadow of an object on a fog bank. The shadow may have depth due to the uneven formation of the fog bank.

Types of British Aircraft

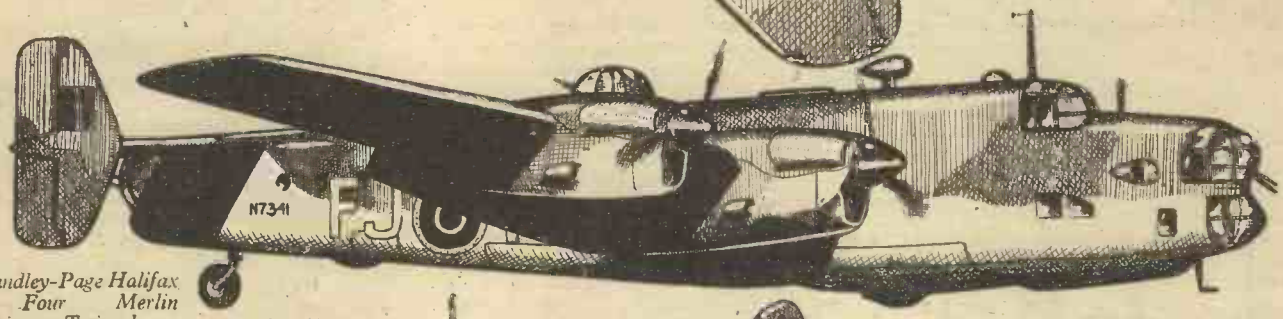
An Artist's Impressions of Some of Britain's Fighters and Bombers Which Are Very Much in Present-day News



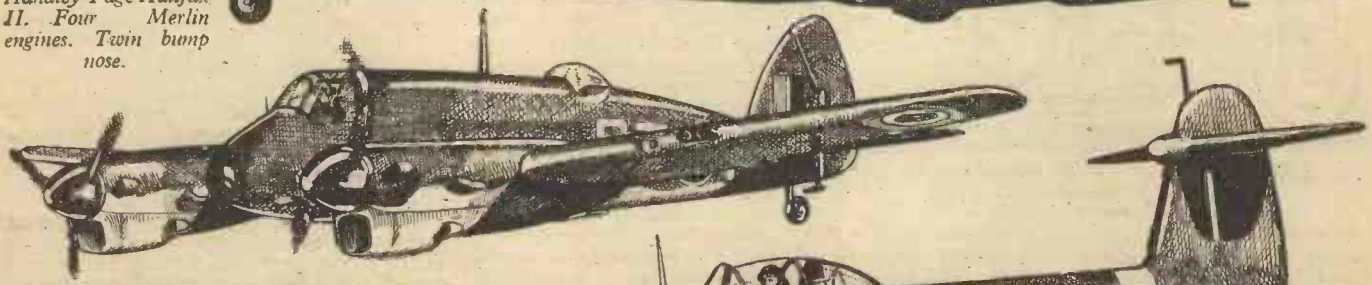
Avro Lancaster I, a four-engined bomber. Underslung Merlin engines four in line: underslung, and projecting well out, with high bosses. Twin outrigged fins and rudders. Span 102 feet, length 69 feet 4 inches. The undercarriage is backwards retracting into inboard nacelles.



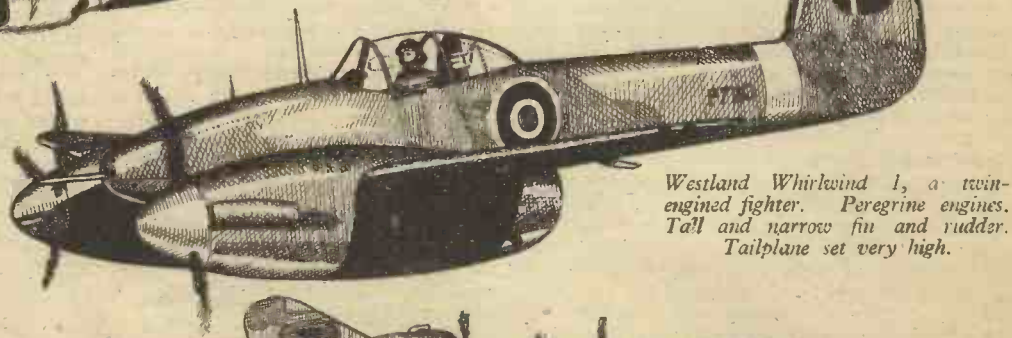
Hawker Hurricane IIc. Merlin engine. Humped back; radiator under centre section. May be seen with external fuel tanks, or bombs. Other Marks have no cannon.



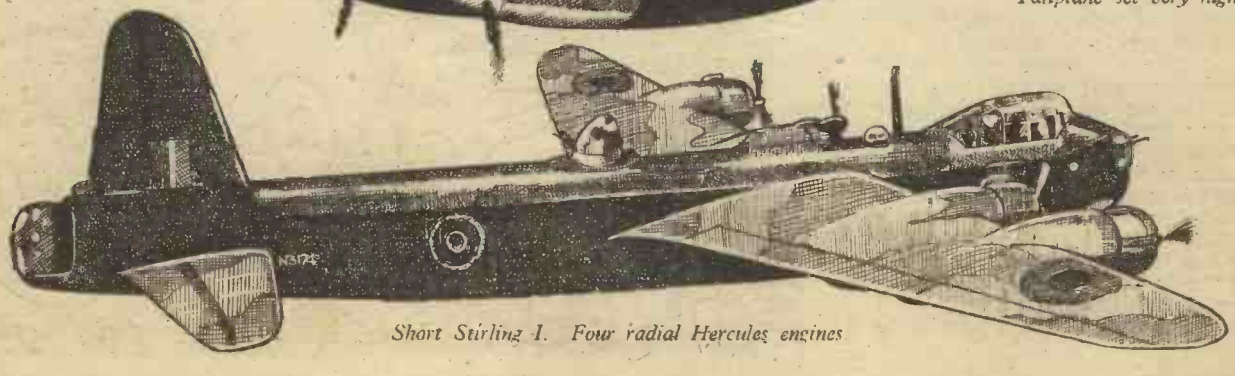
Handley-Page Halifax II. Four Merlin engines. Twin bump nose.



Bristol Beaufighter II. Two Hercules engines. Low short stub nose, and curve-pointed fin and rudder.



Westland Whirlwind I, a twin-engined fighter. Peregrine engines. Tall and narrow fin and rudder. Tailplane set very high.



Short Stirling I. Four radial Hercules engines

Overhauling a Lawn Mower

Cleaning and Maintenance

By "HANDYMAN"

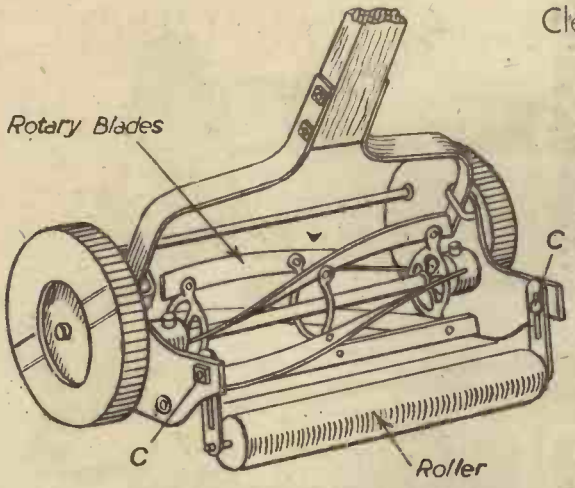


Fig. 4.—Rear view of a side-wheel mower showing the rotary blades and roller.

AFTER being stowed away during the winter months a lawn mower usually requires overhauling and cleaning before it is used again. The cutting blades and under-plate may have become rusted, especially if these parts were not well greased when the mower was put away at the end of the autumn.

One method of removing the rust is to well soak a piece of rag in paraffin, place it on the rusty parts, and leave for a few hours. Then well rub the parts with the rag, which should be sufficient to remove the rust, but if any still remains, rub the affected parts with fine emery paper. After this, wipe over the parts with an oily rag.

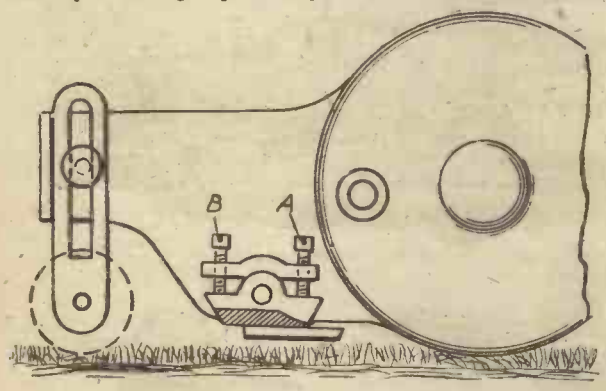


Fig. 1.—Part of one of the side frames showing the fixed cutting plate and adjusting screws.

Cleaning the Parts

If the internal working parts of the mower have not been cleaned for a season or two, the mower should be partly dismantled by removing one of the side wheels, as in Fig. 2. The internal teeth of the wheel will probably be clogged with small grass cuttings, and fine earth, which should be removed with the aid of a pointed implement, such as a long nail. After clearing out all the sediment from between the teeth, brush out the spaces with a stiff brush.

Next, remove the ratchet-pinion, D, and well clean this inside and out. Remove the sliding ratchet pawl from the shaft, and after cleaning this, replace it, and give a liberal application of thick machine oil. Also well lubricate the inside of the ratchet-pinion and side wheel before replacing them. Treat the other side wheel and internal parts in the same way.

Adjustment of Under-plate

In order to get the best results from a mower the rotary cutting blades must be properly fixed in relation to the under-plate, which must be adjusted so that it barely touches the blades the whole way along its length. If set too tightly, the machine will run heavily, and cause unnecessary wear on the cutting blades.

If the sides of a mower are examined it will be found that the under-plate is attached to a cast-iron member which is carried in trunnion bearings, and that the whole unit can be tilted by means of two screws (see Fig. 1). By adjusting these screws carefully the under-plate can be reset in relation to the cutting blades. If it is found necessary to bring the cutting edge of the under-plate slightly nearer to the rotary blades, slacken screw A on each side very slightly, and screw down screw B hard (on both sides). When adjusted correctly, the cutting blades should spin freely.

Sharpening the Cutting Blades

After a mower has been in use for two or more seasons it will generally be found that the cutting edges of the rotary blades and under-plate have become blunted, and will require resharpening. The best method is, of course, to have this work done by the local ironmongers' stores. A good makeshift method is to use one of the small sharpening tools which can be purchased at most hardware stores. This tool simply consists of a piece of carborundum stone mounted in a wooden holder, and in use it is placed over the edge of a cutting blade and worked to and fro, applying pressure all the time. It is rather a tiring job to treat all the cutting edges of the blades in this way, but with a little patience the cutting qualities of the mower can be considerably improved by this method.

Another method for resharpening, or re-grinding the cutting edges of the blades is known as lapping, using a paste of fine emery powder and oil. First remove the side wheels by taking out the split pins, and then remove the small ratchet sprocket-wheels, change the right-hand one over to the left-hand side, and vice versa, and then replace the side wheels. The blades will now revolve in the reverse direction, as indicated in Fig. 3. Smear some of the paste along the top of the under-plate, as at E, and then adjust the under-plate so that the blades scrape over the surface as they revolve.

If the machine is now pushed about, the blades in rubbing over the under-plate with the emery paste between will be reground to a correct cutting edge again. When the blades appear to have been lapped sufficiently, return the sprockets to their correct sides, and wipe off any remaining emery paste. After well oiling the mower will be ready for use again.

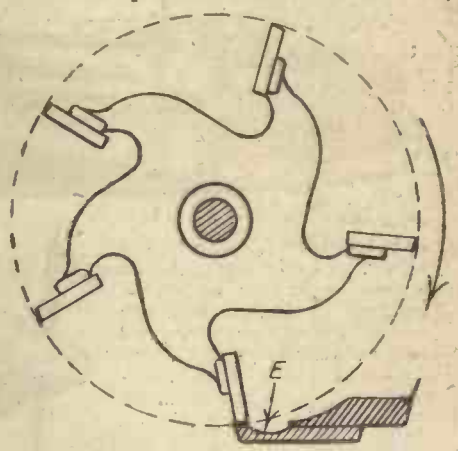


Fig. 3.—Illustrating a method of "lapping" the rotary blades.

Adjustment of Rear Roller

The purpose of the rear roller (see Fig. 4) is to regulate the height of the grass cut. When the roller is raised to its fullest extent a close cut will be obtained, but for cutting long grass the roller should be lowered as far as possible. The position of the roller is adjusted by loosening the nuts and bolts, C, C, on the side frames.

Maintenance

A mower, like any other machine, requires proper attention if it is to give efficient service. It is important that all the working parts, including the axle bearings of the side wheels, the bearings of the rotary cylinder, and the front roller axle, are frequently oiled; at least once every time the mower is used.

Before oiling, make sure that the oil-holes are not clogged with earth and small pieces of grass cuttings. It is a good plan to clear out the oil-holes occasionally with a piece of pointed iron wire.

Carefully examine the surface of a lawn before mowing, and remove stones, twigs, or any other similar objects, as these are liable to damage the cutting edges of the rotary blades. Any loose soil, such as worm casts, should be raked flat, and rolled before mowing a lawn, as the grit contained in the earth tends to blunt the cutting edges.

Finally, check over all nuts and bolts with a spanner to ensure that they are properly tightened up.

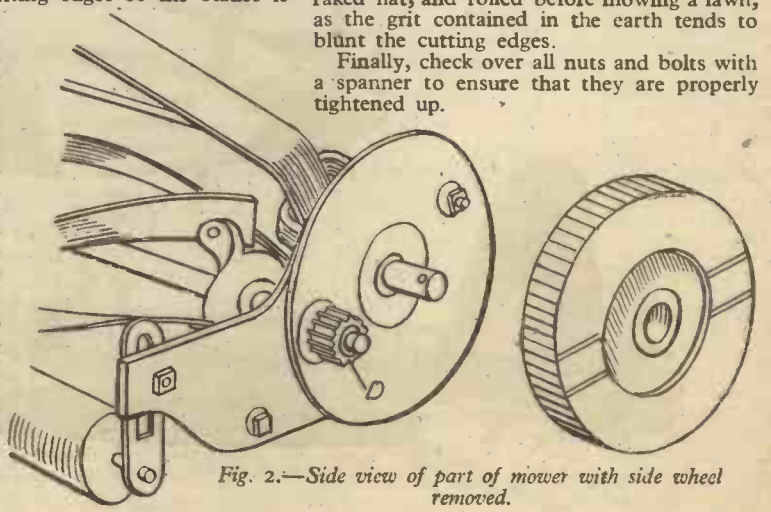


Fig. 2.—Side view of part of mower with side wheel removed.

THE WORLD OF MODELS

By "MOTILUS"

Hints on Waterline Model Ship Construction; A Model Sideboard

A skilled craftsman working on a waterline model of an American warship.

A waterline model of an "I." Class Destroyer, photographed on a sheet of glass.

PROBABLY there is no hobby so popular to-day as model aircraft construction among both the young, who are always keen on many things, and those of riper years, who have to firewatch and get tired of playing darts and dominoes and look for something more constructive to do.

The appeal of model aircraft may be partly due to the fact that there are more sets of parts available; but the pastime that has always appealed to me has been that of water-line models of ships, whether they be of the Merchant Navy or of the world's fighting fleets.

Here again there are numbers of sources available for drawings and sets of parts, including small sheets of instructions and drawings of warships issued, free of charge, by the National Savings Committee of Westminster, London, in connection with the War Savings Campaign.

In view of this increased interest lately in the building of model ships, the Editor has asked me to give a few main hints in this article, based on waterline model construction, not dealing with any specific ship, but useful to all those who are interested in the craft.

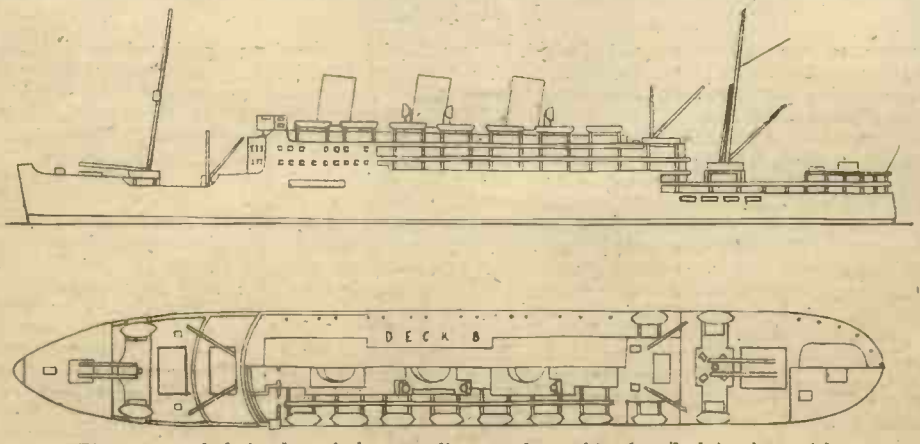
Useful Instruction Sheet

In connection with this I feel I cannot do better than recommend an excellent sheet of instructions and hints on the construction of waterline ship models issued as a large blueprint by Mr. C. Swift, of Ainsdale, Liverpool, and obtainable, price 3s. 6d., post paid, from Bassett-Lowke, Ltd., head office, Northampton, or from their London or Manchester branches.

Reproduced herewith are two of the sketches from this sheet, which also includes "close-ups" on the construction of ventilators, lifeboats, funnels, davits and windows, and indicates the isometric details of the model, the drilling of deck cards, and the assembling of a complicated piece of modelling like the bridge.

Mr. Swift mentions the advantage of waterline ship modelling in that the materials are so inexpensively purchased, and aims in his description at interesting a much wider field of hobbyists in waterline modelling. He shows clearly by his sketches that his model is "standardised," eliminating all unnecessary detail and emphasising only the general lines. All fittings are constructed to a standard system, which can be adapted to any vessel it is desired to construct.

Having collected the data for the ship you decide to model, you draw detailed elevation and plan (as the two sketches reproduced herewith), and now to the materials.



Elevation and deck plan of the waterline merchant ship described in the article.

Constructional Details

The hull should be of hardwood, a close grained timber like birch, sycamore or lime, the decks of medium Bristol board, and lifeboats, winches, small deck houses, etc., of boxwood or white holly. Fine florist's wire is used for the davits, derricks and Samson's posts, and I advise a matt finish paint as giving the best final effect.

The hull is of wood up to the first Bristol board deck, which is cut to the sheer required, and is maintained on each deck by deck houses of book board.

Attention is now turned to the profile cards, which are clearly drawn out as a sketch and show windows, port and starboard lights, etc. These carefully cut profile cards are glued in position on the hull, and having completed the rebate, the various decks should be cut (using the hull as a template), and painted white.

Superstructures

Using a fine awl, the holes for the davits are made, the decks being carefully placed in position, after which it is time to paint the profiles, which are securely glued into the rebates and trimmed off flush with the waterline. The bows and stern are then painted, and when dry, the waterline.

The intermediate deck houses are cut from thick book board and temporary wire stanchions are placed through the holes in the decks to ensure correct alignment.

It is recommended to paint the davit wire with oil paint, which is more satisfactory than poster paint, and the davits do not

require gluing in as the natural tension set up at each deck will retain them in position.

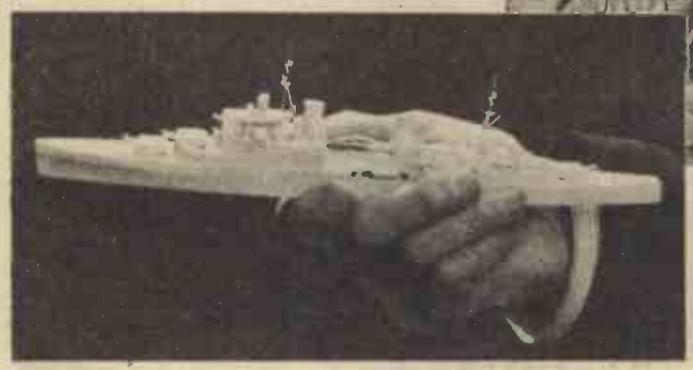
The navigation bridge details are outlined clearly in a drawing, and this finished piece of work is glued to the hull, the next item being the funnels. These are also clearly shown in various stages of construction in one of the drawings, and are glued in position after they have been painted.

The lifeboats are ingeniously carved from strips of hardwood with the aid of a penknife, and are all painted before lightly gluing on to the davits. When in position they are painted buff on top to represent canvas coverings.

The ventilators, too, are of hardwood cut, painted and lastly glued in position.

Each mast, with its derricks, is constructed as a unit, and there is generally a deck house at the foot which forms a foundation. The main mast is made of needles, the nest, cross-trees and gaff are soldered on, and the unit painted. Before mounting the unit, the hatches of Bristol board should be cut and glued in position after painting. Light buff is the most suitable colour to use.

Putting the fine details on a waterline model destroyer. The lady in the background helps with the less difficult details.



Model of H.M.S. "Nigeria" held in the hand.

With the mast or masts in position the model is then complete, with the exception of general retouching of paintwork.

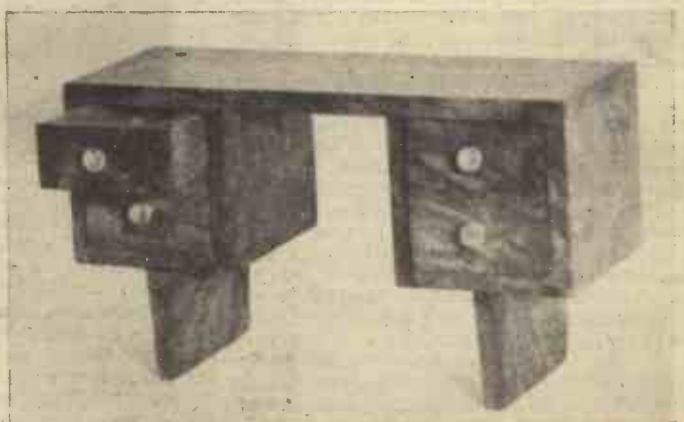
Mr. Swift suggests that the model will show to best advantage in a delicate case and mounted on a plinth. A strip of celluloid over the painted blue surface will give a translucent effect.

This is only a short précis of the excellent blueprint of sketches and instructions, which I advise anyone interested in simplified model waterline ship construction to obtain.

Apart from the interest in waterline models by the general public and those who love the sea, we must not forget the important part these little models are playing in the war effort, for training purposes, for instruction in details and also for identification in operations by the Coastal Command, submarines, captains of ships, and various other ways that have been referred to from time to time in the popular press.

Model Sideboard

Thinking of good craftsmanship, I recently saw another example of model furniture from the hands of Miss Judith Hughes, the lady cabinet-maker of Tavistock, who has been mentioned before in these pages. This time she has made a beautiful little model of a modernised sideboard, scale 1in. to the foot, and carried out in a beautifully figured walnut, with rosewood knobs for the drawers, which, incidentally, all open. In the illustration you will notice the model is supported on two legs only. This may seem a little strange to those who are used to seeing four legs for every rectangular article, but the idea is to prevent the delicate legs of small model furniture being broken off by the young owner.



A one-inch-to-the-foot model in walnut of a modernist piece of furniture for a post-war dolls' house.

Testing a Focal-plane Shutter

By M. HEDLEY

SOME time ago I wrote to the query department of PRACTICAL MECHANICS and asked for a method of testing a camera focal-plane shutter. I was advised to try the stock method of spinning a wheel with a white spot on it. I tried this method, which was not successful, but the problem still intrigued me. I had not, and still have no knowledge of the method adopted by the makers but assume that they will be stroboscopic. Having a camera by a reliable maker, I was more interested in the method than the accuracy of my shutter, and I finally devised a method which satisfied me although I have not constructed the apparatus.

Disc and Flash Lamp

My method was to rotate a disc at known angular velocity by means of a synchronous motor. The disc operates a connecting rod, one end of which is constrained to move along parallel guides. To this end is fixed an illuminated flash-lamp bulb. The camera is focused on the bulb in the centre of the focusing screen so that its range of travel is fully contained on the plate. A plate is then exposed on time, so that a complete black line would result on the developed plate. On the same plate, however, by means of the rise and fall front or tilting the camera in the vertical plane, other exposures are made at different shutter speeds, so that the developed plate will contain one complete line on the middle of the plate and shorter lines in various other positions. In some positions the flash-lamp bulb may have returned on its own path, but the varying density of the black line will show where the light was cut off. A circle is then drawn on the plate with the complete black line as a diameter, and the shorter lines projected on to the circumference. Knowing the angular velocity of the wheel, the period during which the shutter is open can then be ascertained. The speed of the wheel would be so regulated as to produce lines of reasonable length.

Alternative Method

Since satisfying myself on this point I have just come across a very simple and effective method. Remove the lens from the camera and in a dark room place a neon lamp in front of the camera-lens aperture and expose a plate. The developed plate will show a series of dark horizontal lines due to the frequency of the alternating current. By the simple expedient of counting the bands and knowing the frequency of the alternating current the shutter speed can be determined.

Our Busy Inventors

By "Dynamo"

Button Stick

"SPIT and polish" is still a feature of military life, and to prevent soiling the uniform when its buttons are being cleaned there is used what is known as a button stick.

The customary form of button stick consists of a plate of rigid material having a hole sufficiently large to take the head of the button. And there is a slot for the ring.

It appears that with this type of button stick difficulty is experienced in preventing fingers from touching the material of the garment, and also in holding the button firmly while it is being polished. In addition, a portion of the material remains uncovered by the aforementioned slot.

To overcome these drawbacks is the aim of an invention for which a patent in this country has been applied. According to this device, the button stick consists of two blades of metal, or any non-flexible material, movable on a pin. These blades, not being in the same plane, when closed, will overlap, and each blade has a slot which is broad enough to take the largest size of button ring in common use. The depth of the slot allows an overlap when the ring of the button is gripped by the blades.

In order that the thumb and finger may be inserted, holes may be cut in the blades at the end opposite to the button end. Finger grips, such as semi-circular slots, may be provided between the button end and the movable pin.

The inventor has not overlooked badges and buckles. Rectangular slots and suitable holes may be cut in the blades for dealing with these articles.

A spring, which may be a rubber band, is fastened to the blades in order to assist their separation, when the cleaning and polishing have been completed.

Fire Hose Protector

IN case of fire when hoses like huge boa constrictors cross the highway they are liable to be damaged by passing vehicles. It is true that traffic may be stopped or diverted, but, in the event of a town being raided and fires in various parts breaking out, a considerable number of hoses would be laid in the streets through which additional fire engines and ambulances would be likely to pass.

An inventor has contrived an improved device with the object of providing a simple and effective method whereby hoses can be easily protected against injury.

His invention consists of a ramp enabling vehicles to surmount these obstructions on the road. It comprises at least one longitudinal bridge member practically of U-shape. This is adapted to be placed over the hose and there are a number of triangular ramp members at each side, having detachable connections between them and the bridge member, and also between adjacent ramp members at the same side.

As a consequence, the various members of which the ramp is built are detachably connected against relative movement of the hose lengthwise and transversely.

Training Target for Airmen

TO train fighter pilots and air gunners is the object of a new device, which is the subject of an application to the British Patent Office.

One previous invention of this kind has a carriage supporting a miniature aeroplane which runs on an overhead track furnished with a number of junction points. The aeroplane is carried at the end of an arm designed to be raised and lowered on a girder, depending from the carriage. Attached to this arm is a lamp for illuminating the aeroplane.

The new invention is an apparatus which has a model aircraft, or equivalent target, actuated by a number of reversible motors intended to carry out movements resembling those of an aircraft in flight. The device differs from its predecessors, owing to the fact that the model aeroplane is carried by a turntable arrangement mounted on a carriage running on rails, slides, etc., so as to enable the model aircraft to be turned about a vertical axis.

Welders at work on an M4 tank, on a positioner, in the welding shop of an American manufacturer. The M4 makes a new advance in American production of heavy-armoured equipment.

Comfort for Drivers

WHEN the driver of a vehicle indicates the course he intends to pursue, he puts out his hand. To enable him to make this sign without opening the window is the aim of a device which has been submitted to the British Patent Office.

An aperture is made in the window, preferably at or near one of the bottom corners. This is of a size sufficient to allow the passage of the driver's arm. It has a sliding shutter which can be rapidly and easily opened and closed. When closed it is quite secure and, if preferred, it may be made to lock automatically.

This invention will reduce the exposure of the driver to a minimum of cold air.

Mobile Hangar

AN improved hangar has been designed with the chief object of providing an aeroplane shed which is light in weight, collapsible yet strong, easy to transport and erect, and not conspicuous from the air.

This hangar, which has a practically circular rigid roof, is built up by pre-formed parts.

The components include a main outer ring girder and radial rafters. Both the girder and the rafters consist of a number of parts which are detachably connected.

The hangar possesses supporting columns which hold the roof at the desired height. And the roof is detachably connected to the columns.

The whole arrangement apparently can be erected and pulled down with the speed of a circus tent.

Light-weight Box

THE ideal box is light in weight, strong, durable and unaffected by damp and climate. An inventor has achieved these characteristics in a box which he has conceived.

To produce this article he superimposes on one another a series of paper or fabric sheets, or a combination of both, which have been impregnated with a substance such as synthetic resin. This becomes viscid and then hard through being subjected to heat. The sheets are folded to the desired shape and are bent over integral flap portions, so that the latter overlap portions of the wall of the box. The construction is of such a nature that, at every edge where adjacent walls meet, a flap extension of one wall passes around this edge to overlap an adjacent wall.

The article thus formed is submitted to pressure between complementary elements of a correspondingly shaped mould heated to the required temperature.

The resulting box should thoroughly protect its contents and last for a considerable time.

QUERIES and ENQUIRIES

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

Glue Moulds

I WOULD be grateful if you would inform me what mixture is needed to make glue moulds for casting plaster figures, etc. I have tried ordinary glue but it does not hold together. Also, how are the rubber moulds made, and the mixture of rubber needed ?—What treatment is needed in order to use plaster moulds for casting metal ? —B. Webb (Totton, Hants).

YOU can make glue moulds for the purpose you require by dissolving ordinary glue in hot water and evaporating the solution down to a thick consistency, and then by stirring into the thickened glue about one quarter of its weight of *dry* whiting or some similar powder. The glue mixture is run, still hot, into suitable receptacles in which it sets hard to the shape of the required mould. Finally, after completing setting, the glue mould thus prepared is immersed in a bath made up by diluting 1 part of commercial formalin solution with 15 to 20 parts of water. The moulds should be immersed in this solution for about 15 minutes, after which they will be hard and completely insoluble even in hot water. The moulds thus prepared should be lubricated with a little Vaseline or other grease.

Rubber moulds are usually made by vulcanising a "mix" of raw rubber, "filler" (such as whiting, etc.), shellac and pigment (if required) in a specially devised vulcanising press. The flexibility of the resultant moulds is governed to a great extent by the degree and duration of the vulcanising treatment. From your point of view, we think it will be impossible to produce such moulds owing to the scarcity of rubber and the high cost of a vulcanising press. A flexible mould can be prepared by dissolving two parts of glue in one part of water and one part of glycerine, but, here again, you will find it almost impossible to procure glycerine for such a purpose.

You can, up to a certain extent, toughen plaster of paris moulds for metal casting by mixing with the dry plaster of paris about 4 or 5 per cent. of its weight of powdered dextrine, gum arabic or glue. A small amount (say 2½ per cent.) of finely powdered asbestos added to the plaster of paris will also toughen it up and improve its resistance to fracture. If, for any reason, you desire to slow down the setting of the plaster of paris mixture, add to it a pinch or two of citric acid. If the setting time of the plaster of paris is to be accelerated, add a little alum to the water.

Small Water Softener

I WISH to construct a small water softener for household use. Could you please give me information on the materials necessary, details of construction and the salts to be used ? Also, if and where they are obtainable ?—A. Bolton (Greenford).

THERE are many different systems of water softening, and it is a very difficult task for the ordinary amateur to make a satisfactory softener on a small scale. However, if you desire to attempt the job, you may start your experiments by obtaining an iron cylinder about two feet long and four inches diameter. This has an exit pipe at the bottom and an entrance pipe at the top. The cylinder is loosely filled with a material known as "artificial zeolite." All that it is necessary to do is to trickle the water slowly through this column of zeolite. After a time, the zeolite begins to lose its water-softening power, and when this effect takes place, the material can be "regenerated" by filtering a solution of common salt through it, afterwards swilling away all traces of the salt solution by means of clean, soft water. You may, at the present time, have the very greatest difficulty in obtaining a supply of artificial zeolite. However, for this material, we should advise you to write to Sofnol Limited, Greenwich, London, S.E.10, stating your requirements, and inquiring whether the firm can assist you in regard to materials. Sofnol, Ltd., publish a very interesting book on water softening which, no doubt, you will find useful.

Distant-reading Thermometer

WILL you please give me some information regarding a suitable medium with which to fill a distant-reading thermometer ?

Is the principle of these and of the capsules for thermostatic control based on coefficient of expansion or upon vapour pressure ? Indication of a promising "brew" to work over a range 30-120 C., using a Bourdon gauge to indicate, would oblige.—G. A. Cary Lynch (Standish).

DISTANT-READING thermometers are of many varying types from the high-temperature variety which utilises the expansion of mercury in a narrow steel tube, to the delicate instruments operating upon the vapour pressure of ether.

Since you propose to use a Bourdon gauge, we are inclined to think that a vapour-pressure device would suit your needs, and we would suggest an ether-alcohol mixture containing about 20 per cent. of ethyl alcohol. The alcohol used must be as pure as possible. For very delicate work, the "absolute" variety is essential, but it is possible to get quite good results with ordinary pharmaceutical rectified spirits. In place of the ether-alcohol mixture, pure acetone may be tried.

Messrs. Towers, Laboratory Furnishers, of Widnes, make (or used to make) a good thermometric thermostat control which utilises a column of pure toluene expanding against mercury in a capillary tube ? If this would be of use for your purpose, we imagine that such an instrument might still be procurable from Messrs. Towers. No doubt, also, Messrs. Negretti and Zambra, Holborn Viaduct, London, E.C.1, would be able to suggest other suitable thermometric fluid for your purpose.

Former for Electric Heater

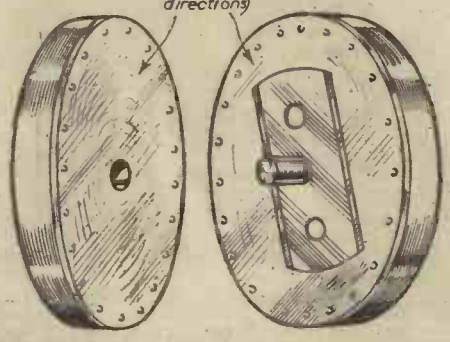
CAN you tell me the materials to use to make an electric fire element holder—that is, the asbestos part on which the element is wound ? I have some asbestos and plaster of paris, which I believe these parts consist of, but I have no idea what else is mixed with them or the method of making same.—F. J. Lawrence (Chingford).

ASBESTOS and plaster of paris are quite unsuitable materials for making the formers employed for electric heaters, as they would disintegrate almost at once when in use. A special fireclay is used, such as aluminous porcelain, or sillimanite, moulded under great pressure and fired for a considerable time in a kiln, and their manufacture is beyond the ability of amateur construction. They can, however, be obtained at quite a reasonable outlay from the Morgan Crucible Co., Ltd., Battersea Church Road, London, S.W.11, or from Lionel Robinson, Ltd., 2/4, Staple Inn, Holborn, W.C.

Honing Device for Razor Blades

I AM interested in the honing (mechanical) of razor blades, and understand that there are some devices which claim to do this work effectively.

Could you give me any details of such a hone, as I would like to make one ?—G. C. Greaves (Birmingham).



A simple honing device for safety-razor blades.

SEVERAL forms of razor-blade sharpening devices are marketed, the majority of these comprising plane or concave glass or leather mating surfaces. The yo-yo type is illustrated.

The manufacturers of Rolls Razors use a plane surface of proprietary material and a special mechanism which reverses the blade after traversal by hand. To reveal a little-known trick of the trade, the following method is suggested. Use two plane surfaces of marble which have been lapped together with liberal lubrication by water, until the surfaces are highly polished. Still using plenty of water, insert the blade and re-hone. Always allow a blade to remain idle and age-harden as long as is practicable before re-honing. Oil stones are not to be recommended.

Poster Paints

I WOULD be extremely obliged if you can give me some information on the following matter. I wish to manufacture small quantities of water poster paint suitable for brush and spray gun. I have tried mixing equal parts of zinc oxide, kaolin and chalk with varying quantities of gum arabic, tragacanth and casco glue, using aniline dyes (water soluble) to colour, and while all of these give a paint of sorts, none is entirely satisfactory. The poster paint I used to purchase (now apparently unobtainable) gave a thin, fine texture coat of good covering power, and did not leave patchy brush marks.—W. H. Trevett (Erith).

THERE are, in the main, two general types of poster paints, viz., those made with gum-dextrine solutions and those incorporating casein solutions. Since you will doubtless require to experiment with both these varieties, we append below formulæ of each type. The formulæ are actual manufacturing ones, which will have to be reduced for small experimental purposes.

Casein Paints

These all require a casein "vehicle" made up as follows :

Sodium caseinate	1¼lb.
Bentonite (or other form of china clay)	1oz.
Sodium fluoride	½oz.
Phenol	½oz.

White Paint

Vehicle	17lb.
Lithopone	13lb.
Titanium oxide	2lb.
Barytes (white)	14lb.
Ultramarine blue	½oz.
Water to	2½gals.

Yellow Paint

Vehicle	18¼lb.
Chrome yellow	6lb.
Barytes (white)	8lb.
Water to	2½gals.

Gum-dextrine Water Paints

These require the following three solutions to be made up :

Gum Arabic Solution

Dissolve 125lb. gum arabic in 50 gals. water. After complete solution, add 1 quart formalin.

Dextrine Solution

Dissolve 200lb. best white dextrine in 50 gals. water. After complete solution, add 1 quart formalin.

Starch Solution

Dissolve 50lb. starch in 50 gals. water. After complete solution, add 1 quart formalin.

From the above solutions, the gum-dextrine water paints are made up on the following lines :

White Paint

Dextrine solution	3 gals.
Gum arabic solution	4 gals.
Starch solution	2 gals.
Sugar syrup	4 gals.
Titanium oxide	300lb.
Lithopone	200lb.
Water to make	50 gals.

Add 1 quart of formalin to finished paint.

Red Paint

Gum arabic solution	4 gals.
Dextrine solution	2 gals.
Starch solution	4 gals.
Sugar syrup	1 gal.
Whiting	50lb.
Blanc fixe	50lb.
Pigment	120lb.

Note : In these formulæ the use of sugar syrup is to impart a good gloss to the paint when dry. It can be omitted if desired, in which case the dextrine proportion should be increased. If, however, too much dextrine is used, the paint surface will crack.

You should be able to obtain books on the subject of water-paint production from Messrs. W. and G. Foyle, of Charing Cross Road, W.C.2.

Sun-ray Lamp

I HAVE constructed a carbon-arc sun-ray lamp using one solid carbon ⅜in. diameter and one iron-cored carbon ½in. diameter. The resistance I am using is a 750 watt radiator bar and the voltage used is 230 volts, A.C.

Can you tell me if this arrangement is suitable for sun-ray treatment? If so, do you think the arrangement will give off an appreciable amount of ultra-violet rays?—H. R. Dowson (Colne, Lancs).

AS the amount of ultra-violet rays produced by the carbon arc is directly proportional to the amount of current used, you would obtain very feeble results from the arrangement you propose, embodying a 750 watt radiator bar in series, with the arc on 230 volts alternating current. Usually such lamps are intended for a consumption of about 30 amperes, either on A.C. or D.C., but if a mercury vapour lamp is employed about 200 volts and 3 amperes would be sufficient. The tungsten arc is another form more economical of current than the carbon arc, but requires a direct current circuit for operation, and if yours is an A.C. supply a rectifier or motor-generator would be necessary to convert the A.C. to D.C. The current consumption with a tungsten arc is approximately 5 amperes. Write the General Electric Co., Ltd., Magnet House, Kingsway, W.C.2, for their lists of artificial sunlight apparatus.

Electric Welding Plant

IS it possible for me to make up a small portable electric welding set, using either batteries or generator and some type of coil?—R. Calver (Essex).

ASSUMING you require to weld metal up to, say, ¼in. mild steel plate, using electrodes 3/32in. diameter, this would require about 70 volts to break down the scale and initiate the arc, and about 75 amps. at 25 volts to maintain the arc, plus an extra 5 volts to cover the voltage drop in the leads to the welding electrodes. The best way to obtain this is to use a special welding dynamo having a high voltage drop on load. A machine giving 75 volts on open circuit and 30 volts on a current of 75 amperes would be ideal. This dynamo would have a full load output of 30 volts × 75 amps, that is 2,250 watts or 2.25 kW. The dynamo would probably have an efficiency of about 75 per cent., so that the power required to drive it (expressed in electrical units) would be 2,250 ÷ 0.75 = 3,000 watts. One h.p. corresponds to 746 watts, so that the h.p. required to drive the dynamo when delivering a welding current of 75 amps is 4 h.p. Since the machine is to be portable it is probable that a petrol or oil engine would be most convenient for driving. At the same welding voltage of 30 volts total, the h.p. required to drive a dynamo would be practically proportional to the welding current required.

Steel-blue Finish for Brass

COULD you tell me of any chemical treatment for putting a "steely blue" finish on brass objects, similar to that on rifles, etc.? Also, is there a reasonable economical method for chromium plating or silver plating brass by electrolysis?

Will you please inform me of the firms from which the chemicals for the above questions may be obtained?—G. Downes-Rose (Derby).

YOU can obtain a steely blue coloration on brass by making use of the following solution: Copper carbonate, 1lb.; ammonia, 1 quart; water, 3 quarts.

Mix the copper carbonate and ammonia first, and then add the water. Some of the copper carbonate must remain in excess in the mixture. Use this bath at a temperature of 175 deg. F. and immerse the metal to be coloured in it until the desired colour is obtained—usually from half to one hour. Finally, rinse the metal well and dry it carefully.

The following bath is simpler, but it gives a rather lighter blue:

Photographer's "hypo," 8oz.; lead acetate ("sugar of lead"), 4oz.; water, 1 gallon.

Use this bath boiling, and immerse the metal parts in it for some minutes until the required blue coloration is obtained. Finally, well wash and dry.

The brasswork must, on all occasions, be scrupulously well cleaned and degreased before the chemical coloration treatment is begun.

There are hundreds of different formulæ for silver and chromium plating. Since we do not know your exact requirements in this connection, we would advise you to get into touch with a firm of electro-plating material suppliers, who will be able to supply you with plating salts ready made up and in small quantities. You will find this method much more satisfactory than endeavouring to make up your own solutions in these days of short supplies. Such firms are: Messrs. W. Canning and Co., Ltd., Great Hampton Street, Birmingham, 18; Messrs. R. Cruickshank, Ltd., Camden Street, Birmingham; Chromium Portable Plater Sales Co., Ltd., 169-173, Hampstead Road, London, N.W.1.

You should be able to obtain the chemicals for the brass coloration from any of the firms of multiple chemists.

Armature Winding

I HAVE a vacuum cleaner motor, the armature of which I wish to rewind. Will you please give me a diagram of connections?

The armature has 12 slots and commutator 36 bars. I have wound quite a number of machines with two bars per slot but the three bars per slot have puzzled me. The machine is 250v. 50~.—J. Sinclair (Tillicoultry).

WHEN the commutator has more bars than there are slots in the core of the armature the coils have to be grouped in twos or threes for convenience in assembly, and wound with the appropriate number of tapping points looped out at equal intervals. The invariable rule is that there shall be as many armature coils as there are commutator bars, so that with a 12-slot armature and 36-part commutator there must be three coils grouped as one in each armature slot. In practice these are former-wound and taped up as in Fig. 1, with loops taken out at appropriate intervals, each loop comprising an equal number of turns, but the wire is not cut as the sections already form the junction from one coil to the next. After taping up the appearance of the coil is similar to Fig. 1, and its actual internal connections are given in Fig. 2, assuming only one turn per coil to avoid confusing the figure.

Wimshurst Machine

I HAVE constructed a Wimshurst electrical machine, as follows:

Two ebonite plates 12in. diameter, 24 strips on each plate.

What would be the maximum voltage, and number of revs. to produce same? Also, what size should be the discharging terminals?—R. Hancock (Swindon).

ABOUT 90 revolutions per minute of the driving gear, speeded up three to one on the plate spindles, is the highest safe speed advisable for 12in. plates. The spark length between discharging knobs is determined by many conditions other than the voltage, such as the state of the surrounding air, whether dry or humid, and the barometric pressure. From plates of the size stated a 1in. to 1½in. spark would be considered excellent. The size of the discharging knobs on the electrodes might be ½in. and 1½in. respectively.

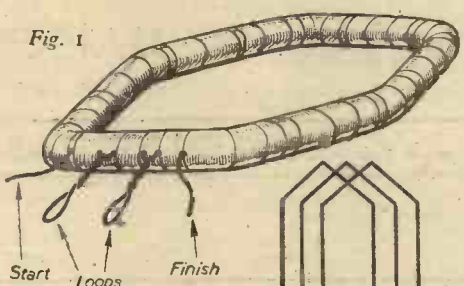


Fig. 1

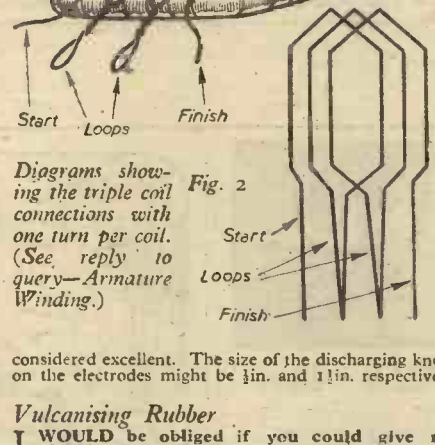


Fig. 2

Diagrams showing the triple coil connections with one turn per coil. (See reply to query—Armature Winding.)

Vulcanising Rubber

I WOULD be obliged if you could give me details of a simple method of vulcanising rubber, also of the chemicals required. I have heard that it is possible to dissolve the rubber in a solution of sulphur chloride in carbon tetrachloride, but have so far been unable to obtain any carbon tetrachloride.—J. Malham (Grove Park, S.E.12).

THE vulcanisation of rubber is not an easy process, and there is no really simple or reliable mode of accomplishing it on the small scale.

In general, rubber can be vulcanised by means of sulphur, or with certain compounds of sulphur, such as sulphur monochloride.

Sulphur alone is seldom used in vulcanisation in consequence of its uncertainty of action, its slowness and, also, in view of the high temperature needed for its action. In place of sulphur for modern vulcanisation processes, organic sulphur compounds are used, and these are accompanied by certain complex compounds known as "accelerators", which speed up the vulcanisation process. Usually, these accelerators require, also, the use of zinc oxide for their functioning.

In your own instance, you do not state what type of rubber you wish to vulcanise and to what degree of vulcanisation you wish to take it. We think, however, you would find sulphur monochloride to be the best vulcanisation agent for your purpose. Sulphur monochloride is a yellow, evil-smelling, corrosive liquid which is soluble in carbon tetrachloride or in carbon disulphide. Your best plan is to dissolve about 10 parts of the sulphur monochloride in 90 parts of carbon tetrachloride or carbon disulphide and to plunge the rubber article into this solution for about a minute and a half. It is then placed in a warm oven for the solvent to evaporate, and finally it is washed in a dilute solution of soda in water, rinsed and dried.

The extent of vulcanisation is mainly governed in the above instance by the strength of the sulphur monochloride solution and the time of immersion of the rubber article in it. With certain types of rubbers, this process is quite satisfactory, but we do not guarantee that it will work with all varieties of rubber. It will not work with any synthetic rubbers.

Sulphur monochloride is a product of Imperial Chemical Industries, Ltd., Millbank, London, S.W.1, but we do not think you will be able to obtain it in small quantities from this source. Your best plan is to purchase it (along with carbon tetrachloride or carbon disulphide) from a firm of laboratory chemical suppliers such as Messrs. F. E. Becker & Co., 17-29, Hatton Wall, London, E.C.1, or Messrs. A. Gallenkamp & Co., Ltd., 17-29, Sun Street, and 1-3, Clifton Street, Finsbury Square, London, E.C.2.

Rewinding a Vacuum Cleaner Motor

I HAVE an "unwound" electric vacuum cleaner motor, and wish to use same for a small emery wheel drive. I shall be pleased if you would inform me as to the windings suitable for 230-volt single-phase 50~.—J. Hargreaves (Preston).

THE motor you have in an unwound condition can be wound suitably for driving a small grinding wheel, but will have to be series connected in order to operate on A.C. This means that the speed will be variable with the load, and unless you attach a fan or some automatic means of preventing excessive speed when running light there is a possibility of bursting the emery wheel or damaging the armature windings. Without artificial ventilation, such as present in a vacuum cleaner, the power available will be very small in any case, say from 1/16th to 1/20th h.p. at 4,000 r.p.m. The winding recommended will be as follows:

Armature—26 coils, grouped two per slot in the 13-slot armature, each coil with 68 turns of No. 36 S.W.G. d.s.c. copper, coil span from slot 1 to slot 7 inclusive, and lap-connected to the 26-part commutator.

Fields—2 coils, each containing 1,000 turns of No. 30 S.W.G. enamel and s.s.c. copper, in series with one another and series connected to the armature.

A 4in. propeller type fan fixed to the shaft extension at one end would restrain the speed from becoming excessive, and at the same time help to keep the motor cool.

Ultra-violet Rays

I HAVE constructed an ultra-violet ray lamp, using a mercury vapour bulb—80 watt—with the outer sheath cut off, and the necessary choke. For a reflector I am using a glass parabolic reflector which is apparently silvered at the rear.

In the first instance, I am not sure whether this reflector is effective for this kind of light, or if it should be painted over with aluminium paint, or, on the other hand, should I use an aluminium reflector? If so, could you supply the address of any firm from which I could purchase one?

I have been using this lamp for a week or two now, and the effect is that it will burn more or less in one spot and not seemingly diffused into one broad beam as I should prefer it, the spot apparently coming from direct radiation from the lamp.—G. C. G. (Birmingham).

THE therapeutic effect of ultra-violet rays depends much upon the wavelength, and exercises distinctly different effects according to the degree of penetration. The spectrum known as the "near" region, including waves from 4,000 to 3,000 Angstrom units are much more penetrating to the human body, whereas the rays in the "far" region of the spectrum ranging between 3,000 and 1,800 Angstrom units have a powerful bactericidal action. More tonic effects can be looked for with the longer wavelengths, while the shorter waves are more used for open wounds, etc. An aluminium polished reflector is to be preferred to silvered glass, and if erythema or burning is experienced in one spot, the remedy is to alter the distance from the reflector to the body so that the focus of the rays is more dispersed. It is possible you may still be able to obtain reflectors and equipment for such apparatus from the General Electric Co., Ltd., Magnet House, Kingsway, W.C.2.

THE Cyclist

Editor: F. J. CAMM

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Phone: Temple Bar 4363
Telegrams: Newnes, Rand, London

Comments of the Month

By F. J. C.

Company Registration

APROPOS our recent explanation of the legal position concerning the conversion of a private cycling club into one of limited liability, there seems to be a misapprehension that the club is limited from the moment of passing the resolution empowering the committee to form the club into a company. The committee has not power to reach this decision on its own; such decision must be taken at an annual general meeting or a special general meeting. Unless the rules are put before the members at such meetings a further general meeting must be held before the papers are filed with the Registrar of Companies. If the rules are changed without the approval of the members the registration can be upset. The rules which govern the club must be sent to the registrar with the application for registration, and these must be approved by the members. The memorandum submitted to the registrar need be signed by only seven members, and so members need to be careful that there is not a *coup d'état*.

Usually when a club becomes a limited liability company (but not always) it is because there has been trouble or trouble is brewing. In an imaginary case seven people could register the company (any seven members, not necessarily committeemen) and become the proprietors of the club, inviting the members to rejoin under the terms imposed by the new rules. It is important therefore for members of clubs which are thinking of making this change to make quite sure that they are kept fully informed of all that is happening and at the meeting which makes the vital decision to see that the old rules are either carried on or modified by general consent.

The British League of Racing Cyclists

THE London League of Racing Cyclists, which is a section of the British League of Racing Cyclists, at a recent meeting planned a list of events for the present season. Their first mass-start race, for which police sanction and promise of co-operation have been obtained, is to be held in May. Although the N.C.U. centres have largely decided against mass-start racing on the open road, a complete referendum of all of the clubs adherent to the N.C.U. has not yet been obtained. Certainly a high percentage of the N.C.U. centres have voted negatively. The new movement, however, is not daunted by this negation, and equally proves that a large number of cyclists do want this form of race. One club has solved the difficulty by dividing itself into two parts, one for mass-start, and the other to operate in the ordinary way. The Ealing C.C. remains adamant and has refused to reaffiliate to the National bodies. In the meantime, the London League of Racing Cyclists have planned a programme of 32 road events and hill climbs, including a league road and time trial championship, three open road races, three "50s," six "25s," one "100," three team time trials, four circuit events, a tandem "30," a hardrider's event, two hill climbs, two ladies' "10s," and two ladies' "25s." The league will also promote several track meetings. Several prominent cyclists are associated with the league.

Salvage—An Appeal to Cyclists

THE Directorate of Salvage and Recovery makes a special appeal to cyclists. It says:

"That empty oil tin, for instance, should be squashed flat, together with any other tins you may find, and put out for salvage. It will go to the blast furnaces to be melted down, and can be made into anything from a machine-gun belt to a marine engine. If you have some old nuts or bolts, don't despise them because they are so small. Put them in one of the tins and let them go the same way. The country needs every scrap of metal it can get.

"If you have an old, worn tyre or a split inner tube, it will make a most valuable contribution, for the rubber situation is serious, and the demand for "reclaim" to mix with new rubber for making bomber tyres is almost insatiable.

"Even old puncture patches or valve-caps have their value, and so have odd lengths of hose. Your scraps can be incorporated in the making of collapsible dinghies, life-saving jackets, or barrage-balloons, as well as tyres, or they may help to provide gas or oxygen masks for airmen, surgical equipment, or fire-hose.

"But there will still be other things useful for salvage when you clean out your shed. What about old maps or itineraries, bills, or old newspapers? Pulped and processed, they will make shell containers, cartridge wads, demolition cartons for Commandos, essential parts for mines and bombs, or trench mortar carriers.

"Old rags—and what shed will not contain some fit only for salvage?—are badly wanted. According to their quality, they may become uniforms, engine wipers, paper for maps and charts, or cotton wool for surgical dressing."

"65"!

ON February 16th of this year the National Cyclists' Union celebrated its 65th birthday. In those years it has done a great amount for cyclists and cycling. The Inaugural Meeting was held at the Guildhall Tavern, London, on February 16th, 1878, when the first rules were drafted. One of the earliest problems it had to tackle were the provisions of the Highways Act. The N.C.U. was originally founded under the title of the Bicycle Union, and the amendment to the Highways Act which it opposed was designed to prevent cyclists from using the highway. In those years a cyclist was considered a menace. The action of the Bicycle Union secured the rejection of the amendment. The Bicycle Union changed its name to the National Cyclists' Union in 1883. It has a good record of services energetically and cheerfully rendered. Naturally it has been criticised and feeling at times has run high, both for it and against it. It has weathered the storms, and will continue to experience them. To-day it is wrestling with the controversial mass-start problems. Time must show whether its policy is right. The present attitude of the Union is that if changes are necessary they are prepared to make them, but they require the authority of their adherent clubs before such changes are made.

Veterans' Time Trial Association

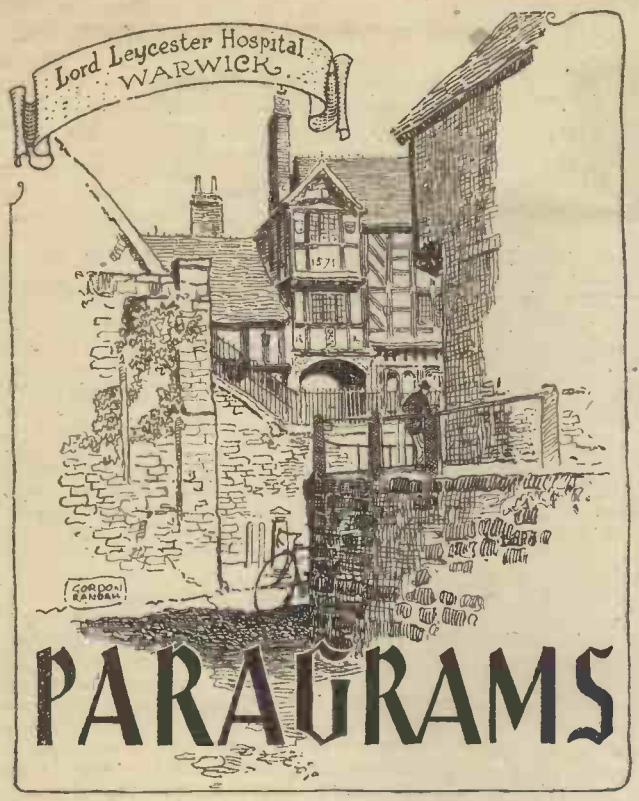
THE Veterans' Time Trial Association has been formed. It solicits membership from all the over 40's who still desire to race against those of their own generation, but at the reduced pace which many find a corollary to the forties. But why veterans? We thought men in the forties were middle aged.

Waste Paper—Urgent

DESPITE the efforts made by all sections of the community, there is a weekly deficit of several thousands of tons of waste paper for war needs; 100,000 tons are urgently needed to meet the immediate demand of war factories, to supply packaging for food, medical supplies, etc., and for other essential purposes. With the much reduced amount of paper being put into current circulation, inevitably the day-to-day collections of waste have suffered. Therefore an intensive effort has to be made to dig out the accumulations of business houses, manufacturing concerns, professions, institutions, etc.

Although much has already been done in this direction, it is estimated that there are still hundreds of thousands of tons to be obtained from these sources.

Every business and manufacturing concern is urged to appoint a member of its staff as salvage officer for the shop, store, factory or office. With the backing of the management he should make himself responsible for the effective collection of every scrap of current waste. Of greater importance, he should explore every possible opportunity of turning out all the old and mainly obsolete records—old correspondence, files, ledgers and other account books, guard books, out-of-date reference books and trade catalogues, old invoices, receipts and cheques, copy estimates, sales graphs, blueprints, etc. Each journal will know what each industry, trade or profession is likely to have. It should be the salvage officer's job to determine, in consultation when necessary with his management, not so much what can be sent to salvage as what it is essential to retain—everything else should be sent to salvage. Business waste is of high quality for paper-making and should go to waste paper merchants so as to ensure efficient sorting and grading. Should there not be a local waste paper merchant, readers should get into touch with the Waste Paper Recovery Association, 154, Fleet Street, London, E.C.4, who will be pleased to help them.



PARAGRAMS

Vice-President Dies in Africa

LIEUT.-COL. THE HON. SOMERSET MAXWELL, enthusiastic vice-president of King's Lynn C.C., has died of wounds in Africa. He was a keen rider.

News of Wally Thain

AFTER serving with the *Ark Royal* on her many adveutures, Wally Thain, Portsmouth North End C.C., is now on another aircraft carrier.

"Smiler" Vaughan Safe

REPORTED missing from air operations early in November, "Smiler" Jack Vaughan, Midland C. and A.C., is known to be a prisoner of war.

"Bert" Houghton in R.A.F.

APPRECIATED vice-president of Twickenham C.C. and former joint holder of several National tandem-tricycle records, "Bert" Houghton is now in the R.A.F. Last year he covered no fewer than 14,737 miles.

Walsall Trophy

THE family of the late Cpl. D. J. Kinsella, a keen time-trialist and tourist and secretary of the Walsall C. and A.C., have presented the club with a trophy to perpetuate his memory. The Corporal was killed in action while serving in the Middle East.

News of Geoff Outhwaite

WELL-known member of a Bradford Cyclists' Club. Geoff Outhwaite, who left this country some years ago to take up a post in Shanghai, is now known to be safe. He left the city in the last boat, and is now making up for restricted cycling activities.

Ridley C.C. Loss

OFFICIAL confirmation is to hand that George Forster, former secretary of the Ridley C.C., has been killed in action. He was an air gunner.

Norwood Paragon Distinction

THREE members of the Norwood Paragon C.C.—all of whom are also keen bicycle-poloists—have been decorated for bravery.

Twickenham's Jubilee

TWICKENHAM C.C. celebrates its Diamond Jubilee this year. The latest club member to join the Forces is J. G. Witcombe, club champion, and a rider who showed outstanding promise. More than 80 per cent. of the club's pre-war members are in the Forces.

H. N. Petty Missing

FORMER secretary and captain of the Anerley B.C., Leading Radio Mechanic H. N. Petty is missing as the result of enemy activity at sea.

What's In a Name?

IN the Harrow and Wembley area there has been formed a cycling club with the name of "Roadster Cycling Club." Officials state that the title in no way indicates the type of machine used but that the name means "sensible road user."

Clubman's Exploit

LEN GUNN, member of South-western Section of the N.C.U., was one of three lance-corporals who captured 300 Italians. He was recognised by members in a Press photograph—a copy of which has been secured for the club's archives.

Club Casualties

FORMER Essex grass track champion, Jack Ivory, Southend and City Wheelers, has been killed in action. Another member of his club, Claud Hutton, is reported missing. News is to hand that Albert Gainsworthy, Gainsford Wheelers, has been killed in action while serving with the Royal Navy.

Cycling Film "Stars"

A FILM, now near completion, "Shorts and Saddles," features members of West Heath Cycling Club of Birmingham.

Manchester Wheelers' Jubilee

MANCHESTER Wheelers are considering a special programme of events by which to celebrate their Diamond Jubilee.

St. Christopher C.C. Loss

THE Leeds St. Christopher's Cycling Club are mourning the death of yet another of their stalwarts: Sergeant-Pilot P. F. Nettleton, former time trials secretary of the club.

A New Tricycle Club

ALTHOUGH the members state that it is in no way formed in opposition to the Tricycle Association, a new three-wheeler club (which is open to women—the T.A. is not) has been launched in the Midlands under the title of the National Tricycle Club.

Resignation of Louis Ewing

LOUIS EWING—of "Fullers of Girtford"—has resigned the secretaryship of the Poly C.C. His business now takes him into the country.

Killed in the Middle East

BY the death on active service in the Middle East of Sergeant-Observer R. Almond, R.A.F.V.R., Rotherham Wheelers have lost their second member in the war.

King's Lynn Activities

AMONG members of the King's Lynn C.C. serving overseas is Lieut. William Pryor—holder of the club 25-mile record—who is in North Africa, and Battery Sergeant-Major J. H. McLaren, who is in the Middle East.

Farewell Party to Pyramid Star

A FAREWELL party was given to H. L. Johnson, Pyramid Road Club star rider, prior to joining the Fleet Air Arm. He is to train as a pilot.

Cyclist Messengers

SOUTHAMPTON Wheelers have been asked by the local Fire Force Commander to form a cyclists' messenger service in the city for use in the event of other means of communication breaking down.

African Casualties

TWO members of Southampton Wheelers, both of whom were serving in the Hampshire Regiment, have been posted missing following operations in North Africa. They are Captain F. Prince and Pte. J. Pullen. The last-named was a prominent track rider.

Plymouth's Invitation

AN open invitation to serving men in the Plymouth area to take part in club fixtures is given by the Plymouth Corinthian C.C., whose secretary is Mr. B. Saunter, 26, Rosslyn Park Road, Plymouth. Thirty-four of the club's members are serving.

Clubman Honoured

SIGNALMAN THOMAS HIGGINBOTHAM, member of Yorkshire Clarion C.C., has been awarded the Polish medal "Krzyz Walecznych," the equivalent to our Distinguished Service Medal.

Club Re-formed

THE Crest C.C., of Ilford, Essex, has been re-formed.

Dealer Gives Armour

A LINCOLNSHIRE cycle dealer has given a suit of armour as scrap to the Ministry of Works.

Bicycles at Stalingrad

THE Russians collected many bicycles amongst the booty lost by the Germans at Stalingrad.

Death of Pioneer Cyclist

THE death has occurred in Edinburgh of a pioneer cyclist, Robert S. Kennedy, at the age of 65.

Cyclists Paid £360

DURING 1942 the Scottish Y.H.A. collected a total of £360 from cycle storage charges at its hostels.

Cycling at Malta

AIR Force personnel at Malta is making use of bicycles for travelling between billets and airfields.

Old to New

THE East Suffolk Education Committee is having 300 bicycles made from usable parts of old machines.

Chambers Consul

TOMMIE CHAMBERS, famous Scottish mile-eater and ex-racing man, is the new Cyclists' Touring Club Chief Consul for Wigtownshire.

Parish Pump Going

SAXMUNDHAM'S parish pump, which has been called a convenient cycle stand in the past, is to be removed as scrap metal.

Bicycles at £250 Each

BRITISH bicycles are costing the equivalent of £250 each in Chengtu, in Free China, states a Church of Scotland minister out there.

New West Coast Route?

COUNTIES in the north-western part of England are pressing for a new west coast road to link Lancashire, Cumberland and Westmorland.

Rubber from Papua

THE rubber plantations of Papua are working again following the release of native labourers who have been helping the Allied Forces against the Japanese.

Clarion Easter Meet

THE National Clarion C.C. is holding its 48th annual Easter meet at York this year. The annual conference, a social-dance, and other items are in the programme.

Next year's meet will be held in the Club's Jubilee Year.

Seen by the tourist: the Redeswire stone at the summit of Carter Bar, on the boundary between England and Scotland.

Around the Wheelworld

By ICARUS

"Spring Sunshine." Wool Lane, Midhurst, Sussex.

S.R.R.A. Annual Lunch

THERE was a pre-war quality about the S.R.R.A. annual lunch, which was held at the Railway Hotel, Purley, on Sunday, February 14th, with the president, J. Dudley Daymond, in the chair. It was, indeed, an all-star performance. This association was founded in the same year as the Purley Railway Station was built, in 1899. The function was an extremely jolly and good-natured affair, and among those present were Ransom Morford, A. Shillito, E. V. Mills, C. F. Davey, H. C. Scotto, S. Amey, H. Kingsmell, Arthur Whinnett (hon. sec.), E. Coles-Webb, F. H. Grubb, H. Beurl, F. Armstrong, Harry Paul, George Lawrie, A. H. Bentley, Rex Coley, W. J. Mills, H. H. England, W. J. Pett and J. H. Wallace. Arthur Shillito, in an extempore speech, proposed the toast of The Association, and paid tribute to the work it had done, and Arthur Whinnett, in response, dealt with the history of the S.R.R.A. from its beginning. He dealt at some length with the year 1928, which he said was the most exciting year of the association. No less than 16 successful attempts on records were made that year. The toast of The Record Breakers was proposed by H. H. Bartlett, with replies from Davey, Grubb and Morford. The toast of The Visitors and Press was proposed by J. Dudley Daymond, who expressed delight that the editors of the cycling papers, W. J. Mills, H. H. England, F. J. Camm and R. B. Coley, had made it their pleasant duty to be present. W. J. Mills, in a witty speech, H. H. England and F. J. Camm replied on behalf of the Press. The latter made the point that whilst the S.R.R.A. had been considered as a local association, it was in reality a national association, in that it governed from a national point of view records made on the southern roads. Mr. A. H. Bentley proposed the toast of The Chairman with brevity but sincerity, based upon a long association with him. Musical honours were accorded the chairman, who suitably replied. It was, indeed, a most pleasant function.

Save Rubber

THE National Committee on Cycling have issued the following statement:

"Cyclists can use their bicycle pumps to save hundreds of tons of rubber.

"In peace-time well over one thousand tons of it went to the making of bicycle tyres every year; so bicycles in Britain must be carrying two or three thousand tons of rubber round their rims to-day.

"Thousands of these bicycles are being ridden on tyres which are under-inflated; and under-inflated tyres waste rubber. They have only half the life of tyres properly blown up.

"Tyres pumped hard not only save rubber: they give speedier and more enjoyable riding. May we therefore appeal to every cyclist? All hands to the pumps!

"And a flint picked up to-day may cause a puncture to-morrow: so why not look to the covers and pick them clean?"

Solution Tubes

THE tyre manufacturers state that there must be in Great Britain at the moment several million tubes of rubber solution for repairing cycle and motor tyres. As these become empty, would their owners mind taking the trouble to drop the used tubes into the salvage bin at the nearest chemist's?

Toothpaste makers have been kind enough to accept the suggestion of the Tyre Manufacturers' Conference that cyclists and motorists should put solution tubes in the bins for empty toothpaste tubes. All profits on the sale of metal tubes go to the Red Cross and St. John Fund. Without cost to themselves, therefore, contributors of used tubes help the war and the nursing services by one simple act.

Tyres Without Tubes

AN American engineer, John McGay, of Tulsa, has invented a method of sealing tyre casings to wheel rims and inflating them without using inner tubes.

When over 600 car owners of Tulsa had been persuaded to test this invention and had proved it to be successful, the city authorities of Tulsa decided to follow suit, and to-day all city-owned vehicles with drop-centre rims are tubeless. The Douglas Aircraft factory at Tulsa, too, are changing over all their cars and trucks to this new method of tyre inflation.

The principles adopted to adapt existing wheel and tyres are extremely simple. First the rim of the wheel—which, of course, should be drop-centred—is cleaned and smoothed. Then a valve, preferably oversize, is fitted into the regular valve opening and secured with a lock nut and rubber washer. Holes and cracks in the tyre are filled with cold patches or vulcanised and all irregularities sandpapered smooth, especially on the beads. The tyre is then mounted and blown up rapidly and tapped at the same time to ensure that the beads seat themselves evenly.

Once the tyre is inflated, the wheel and tyre are immersed in water for the usual bubble test. Sometimes, in order to seal the smaller cracks, it is necessary to inject a pint or so of liquid cement. It is claimed that once the tyre is made airtight it requires only the usual care. Sounds too good to be practical.

"Wings for Victory"

DUNLOP RUBBER CO., LTD., have invested £150,000 as a contribution to London's Wings for Victory Week which closed last month. It has been allocated among the following boroughs where there are Dunlop offices, warehouses or factories: Westminster, £60,000; Edmonton, £40,000; St. Pancras, £25,000; and Lambeth, Stepney, Greenwich and Finsbury, £6,250 each.

Road Accidents

ROAD deaths in Great Britain in January totalled 589—an average of 19 a day. In addition, 10,403 people were injured, 2,601 of them seriously.

Compared with January of last year, when 681 were killed and 12,770 injured, it was a safer month for all classes of road users except pedal cyclists. The number of cyclists killed was 87, an increase of 16, and there was also a marked rise in the number of cyclists seriously injured.

Of the 370 pedestrians killed, two-thirds lost their lives in the black-out. The total number of black-out deaths among all road users was 335, a reduction of 20 per cent.

Among the daytime accidents were most of the 75 fatalities to child pedestrians and child cyclists. This figure for January has remained almost unchanged for the last three years, and is substantially above the pre-war level.

Past investigations have shown that the victims of these accidents, other than pedal cyclists, are mainly children under eight years of age. The saving of these young lives is a problem which can be solved only by combined efforts on the part of the parents, drivers, and teachers.

All road users are warned against the danger of allowing themselves to be lulled into a false sense of security. Though civilian traffic is lighter, the death rate on the roads is not lower, but higher, than before the war. On the average, at least three more lives were lost on the roads every day in January of this year than in the last January of peace-time.

Broken Milk Bottles

THE Ministry of Food has made an order making it an offence for anyone to misuse or wilfully destroy a milk bottle or to retain it unreasonably. Cyclists have been the chief sufferers from the menace of broken glass, and in these days of rubber shortage it is a serious matter when a tyre is ruined due to the carelessness of those who place milk bottles in a position where they may be easily broken and pieces strewn in the road. This has been a problem for many years, and we hope now that the order has been made that the offenders will be taught a summary lesson in the way of fines.

Stoke Fleming, near Dartmouth. The church contains a very ancient brass (1361), probably the oldest in Devon.

Cyclorama

By H. W. ELEY

Salvage!

IT is strange how sometimes voices from the past seem to proclaim just the words and sentiments which fit our present situation—in this year of destiny 1943. I am thinking of some words spoken by Admiral Blake in 1653, and which have very aptly been used in a recent Dunlop advertisement. This is what the gallant Admiral said so long ago:

"We do very much want paper and canvas for cartridges, also old junk for wads, without which our powder will do us little good."

Now, what about those words as being fitting for a modern, bang up-to-the-minute salvage campaign? Truly there is nothing new under the sun, and I am sure you did not think that the Old Country had its "waste paper drives" away back in 1653!

Post-war Planning

THERE is much talk now about "after-the-war planning," and it is good that we should all be thinking of this vital matter. But I do trust that some of the theorists and expert planners will not be allowed to destroy the *naturalness* of England. We do not want an England devoid of rambling charm; we do not want an England conceived and planned on a drawing-board; we want a free England, with natural beauteous growth, and while we shall be well rid of slums and dirt and disease, we must see to it that we retain the good things which have grown so slowly, and so beautifully, with the years. In fact, we need planners with brains and hearts, and if I ask also for a little sentiment, well, it is sentiment which makes the world tolerable. A standardised England, with each shire looking like its sister, would be horrible.

Dunlop Patches

THERE is no end to the changes brought about by the war in connection with products and packages familiar to us over the years. I have been advised that the familiar Dunlop "Reddi-fix" and "Vulcafix" patches will now be brown—the well-known red tint goes, as in some way or another the new colour meets war-time requirements better. There is, of course, no change in quality.

Rubber Shortage

THE Ministry of Supply has launched a new advertising campaign about the rubber shortage, and some strong and vigorous advertisements are appearing in the technical papers. There is no doubt about it, rubber is almost our No. 1 war material, for, as we all know, this war is a "war on wheels"—and not a 'plane could take the skies without tyres. And not a tank could forge ahead in the desert lands of Africa without tyres. So it is up to all of us to save rubber, to salvage rubber articles, to take extra care when driving. And don't let us run away with any foolish ideas that the vast raw rubber output of Malaya can be made up from supplies in, say, Brazil or Mexico. Just to show the position: in the year 1938 the combined output of Brazil and Mexico was some 28,000 tons—whilst we used to get about 340,000 tons from Malaya annually!

Signs of Spring

KING WINTER has been kind to us! Not for years can we have had such a mild February; and here is March, giving us sunshine such as we might expect in June! As I write, my eye catches sight of the purple and yellow crocus blooms in the garden—the sun glints them, and the yellow blossoms are like burnished gold. And sheeny-feathered, tawny-billed blackbirds pop in and out of the laurel bushes on the lawn, and somewhere near a hen is cackling proudly, no doubt feeling justifiably proud of her aid on the Food Front. Yes, a genuine spring morning, and while it is the fashion to smile at poets, and treat William Wordsworth with disdain, I feel like reading a sonnet and dancing in a woodland glade to the immemorial pipes of Pan. Spring sunshine—one of the things which even Hitler cannot subdue or conquer or terrorise!

Better Lighting for Cyclists

I EXPECT that the eyes of many cyclists gleamed with joy when they caught sight of that little announcement in the press about better lighting. Mr. Herbert Morrison was, I believe, an ardent cyclist himself at one time, so maybe he thought kindly about the problem; anyway, he announced recently that the top half of the glass of a cycle lamp will be black, as at present, but the inside of the lamp will be painted white. The Home Secretary said "a big improvement." And anything which gives us better lighting will be welcome. There are many folk who believe very sincerely that the black-out regulations are much over-due for drastic revisions, and that much could be done to improve matters without in any way endangering security.

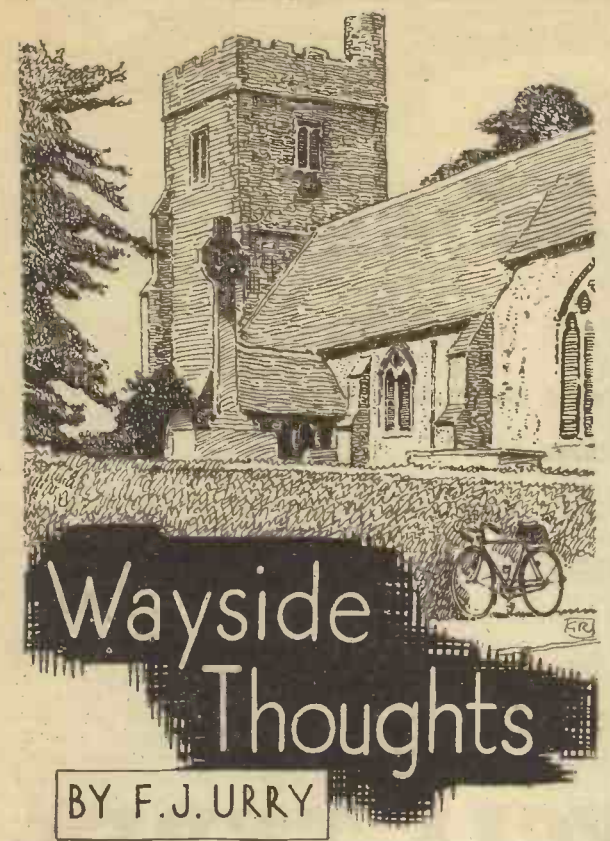
Roadside Cafés

JUST as the old stage-coach brought into being many of our oldest and best roadside inns, so has the long-distance goods-lorry been the cause of the chain of roadside cafés and "shacks" which dot our highways, and provide good and welcome refreshment for those fine fellows who drive through the night, taking precious cargoes from London to Manchester, from Bristol to Birmingham, from Newcastle to Nottingham—and all over the country. They have a hard job. They have to be "tough." And they need pretty constant refreshment—so we have "Joe's Café," the "Jolly Pull-up," and all the other cheerful little places which cater, by means of coffee, tea, and sandwiches, and "fags" for the modern Knights of the Road. Good luck to them all. I noticed recently that a technical paper had started a feature giving a list of all these useful roadside premises, and I thought what a good and helpful feature it might prove to be. These places are a modern development which has not received the publicity or the prominence which it deserves. After the war, the movement will grow, because more and more goods will be carried by road. England's highways will hum with more and more traffic, even if the dreams of the "Air Transport" kings come true! The road is the immemorial thing, the ribbon of trade and activity which will never die. And whenever I see a great lorry, laden with merchandise, rolling along a famous highway, my mind always turns to the days when the beginnings of that road were fashioned by the Romans, the road builders whose work endures, who built straight, and left their undying memorials winding through the shires of England.

Easter Customs

EASTER! And it is as late as it can fall. No space here to enter into all the intricate and extraordinary reasons why Easter Day falls on any given date; it is a matter bound up with the phases of the moon, and mixed with a good many "ecclesiastical ingredients." But I think of past Easters, spent awheel. Of grand little tours in homely country districts, with teas at little cottages—of days when "rationing" was unknown, and one could get a "busting" meal for about one-and-threepence! And the Easter season reminds one of many old customs, some of them still kept up even in these unromantic days.

For instance, there is the "Bread Dole," which is distributed on Easter Day at Ellington, in Huntingdonshire. The ancient ceremony is performed in the village church, and I believe that it is a qualification that each one who receives the "dole" must have slept the previous night in the parish. Then there is the King's "Maundy Money," an ancient charity distributed to a number of widows in Westminster Abbey on the day before Good Friday. It is not generally known that the number of recipients is governed by the age of the King at the time of each annual ceremony.



Wayside Thoughts

BY F. J. URRY

Worth While

EASTER, this year, falls towards the end of April, Shakespeare's month of pied loveliness, and if we get the chance of a few days along he road, I for one, shall take it. Nor shall I be in any hurry to gather swift miles, but rather linger along the way and watch the unfolding beauty of an English spring, with the thought in my mind that, seen on the background of war, it is more precious than ever. I want to stress that point because I have come across people who seem to think there should be no time left in this world of strife to step aside and discover, so gently and so easily, the magnificence of our heritage and all it means to us, and can mean to the folk who come after. A day or two spent among the scented loveliness of an English spring is not merely a rest and recreation —as necessary as meat and drink to the famished—but a thankfulness for things past, and the hope and expectation of things to come. Use Easter like that if you get the chance, and I guarantee you are a better and happier individual for the change. But do for goodness' sake, be fit enough to make your trip, and by that I do not mean you must be at the top of your form, or young and strong and hefty, but just competent to sit on a saddle comfortably and pedal a dozen miles without a rest, and then you have 40 or 50 miles in your legs for a day out, and if you cannot find beauty and a sense of freedom in that range of furlongs, I confess I should be disappointed with you as a cyclist seeking that ultimate bourne of all humanity, a sense of satisfaction. Maybe you cannot wander so widely by reason of family ties; well it does not matter, just limit your journey without invading the sphere of selfishness, for after all that is equally part of the freedom that dominates and adjusts this glorious pastime of cycling.

Make it a Graceful Habit

TO-DAY there must be very many people who have taken to cycling because they have had to if they wish to preserve freedom of travel movement. Among them are folk who resent the necessity, and who while taking advantage of the bicycle's mobility think it a hardship to be "reduced" to such a travel sphere. I have no intention of being critical of such people because they have merely adopted an attitude which has been common enough for many years, possibly because vanity is one of the human failings. But there are other things in life to be vain about besides the ostentation of property; good health for instance, and the ability to play a game with graceful ease and care-free agility.

And that I admit is one of my human failings in reference to cycling. I think I can do these things as well as most people of my years, and I certainly obtain a full measure of satisfaction from the process. Therefore, to those who have recently returned to cycling or taken to this mode of travel as a preservation of their freedom of movement, I would say that this is a manly game, worthy of respect as such, and certainly worthy of achieving a distinction in the method of playing it because of the rewards in health and beauty that lie within its dominion. That is not an exaggeration; it is a fact so easily proven if people would only allow themselves a trifle of time and trouble to resist that innate idleness or carelessness of the slovenly cyclist. I mean what I say: Half the folk who ride bicycles are slovenly—middle-foot pedalling, awkwardly seated, handlebars like plough handles and a swaying, jerking body to overcome the slightest hill. You, to whom this paragraph is addressed, would not dream of walking in such slip-shod fashion. Then let cycling do for you what is has done for thousands like me, presented a simple pleasure in the travel world of incomparable joy.

The Real Test

SOME of you may not believe me when I write in this strain, but then that is because you have not given cycling the same degree of attention in the matter of stylist activity that you give to other games, such as cricket, football, golf or tennis. Cycling is so easily acquired that numerous folk think it is just a question of balance, a trifle of road sense, and foot pressure. Believe me it is much more than that: it is the correct adjustment of the body to the bicycle, or vice versa, the right use of ankles and legs and arms, the nice judgment of speed to conserve effort so that a day's journey shall be pleasurable along every furlong, and, by no means the least of all, the elements that go to make cycling the perfect expression of active travel—the right selection of companionship. To think you can become a happy, care-free rider by the mere possession of the machine is as wrong as is the attitude of a man or maid who imagine they are golfers because they own a few clubs. Actually it is this fact that so many millions of people can ride bicycles that makes the art of cycling so difficult to acquire. Of course you can ride; it is a little difficult to find folk of even my generation who cannot; but how far, and with what pleasure? Cycling, like walking or football, can be very hard and wearing if you treat it always as a means to an end, and not in itself worth while. But give yourself a chance to make it a game in which you are an expert player, and the miles you travel are then invested with a delight, a freedom, and a fascination that knows no compeer. I say this deliberately towards the end of a life which in its leisure hours has played most games and found unalloyed joy in them; but always the background of that leisure has been the wide freedom and the ever varying splendour that has come to me as a result of my wheeling activities.

Fewer Cycle Makers

THE constant drain of man-power from non-war industries to the services and the munition factories has affected the workers in the cycle trade to such an extent that I gravely doubt if the numbers now engaged in the industry are more than 5,000, and most of them are well beyond military age. Yet the powers-that-be are still seeking to discover how many employees in the cycle trade can be—in their view—more usefully working in munitions. For myself, I have always held the opinion that the making of new machines to replace wastage, and the repair and upkeep of those in being, was as vital to our war needs as the retention of public transport; indeed, that it is public transport at the cheapest possible rate, and the greatest possible convenience. Recently, I understand, the heads of the department investigating the man-power situation working in non-munition making trades held a meeting with the industry, the upshot of which appears to have been that the Union, representing the trade, has been asked to submit proposals with the purpose of still further standardising the wartime machine, and so concentrating conditions that the least available number of employees shall be engaged to produce an agreed output of new machines, and sufficient spares to keep the bicycles now on the road in running order. From what I can gather, it would seem that authority recognises the need for the bicycle and the importance it is playing in transport, and is prepared to leave to the trade the framing of a scheme which will fulfil the need for new machines and the upkeep of old ones, and still release a percentage of cycle-building labour for work on munitions. Provided the labour situation does not reduce the output of bicycles and spares below the needed minimum for the supply of war workers, one has no quarrel with this intention, but if the legitimate demand of the cycling workers is not met, there will surely be trouble, and far more man-power hours lost to munitions than will be added to the war effort if cycle mechanical labour is recklessly withdrawn from the trade.

Standardisation Destroys Interest

THERE is little doubt that wartime bicycles will be more and more restricted in specification, but already they have reached such a point in that matter, so that further standardisation will make little difference. Some makers I have talked with on this subject seem to think that, pre-war, there were far too many models, patterns and fancies; but I am in no mood to agree with that dictum, for is it not true that our polyglot of sizes, and patterns, and types and styles has enabled many thousand bicycles to be put into commission because the manufacturer could substitute, and was not held up for standard stuff? I think so, from the little I know of the problems makers have faced and overcome. Nor should I like to be made to ride a bicycle exactly of the pattern possessed by my neighbour; and that desire to be different, if only by a trifle, is shared by thousands of others. That we must accept standard patterns now that the greatest output is essential and labour and materials are limited, goes without saying; but I should not like to see such a habit spilling over into peacetime. One thing I would ask of the trade is that they keep gearing on the low side—60in. for women and 63in. for men as a maximum —hold to 26×1¾ rims and tyres, and fit a decently comfortable saddle. To me those things are imperative if cycling is to be made easy for the multitude, and that, I take it, should be the first objective of the maker.

The Old Story

LET me end these monthly notes in a pean of praise for the bicycle and all it connotes in the scheme of quiet pleasure and diversity of interest in these war days. I know it is an old story, but it is also a very true one, and if you could read some of my correspondence you would come to realise how much the quiet enjoyment of cycling means to many ordinary people. The cyclist has no pertinent questions to answer as to why he must travel, he is just a law unto himself during his leisure hours, free to come and go as he wills, involving no one in his service, nor interfering with the "lawful occasions" of the community in any way. He and the walker are the only folk left who accord with the restrictions of the times, and are still free to travel, and the favour of wide horizons is certainly with the cyclist. These things are worth cogitating with spring in the air, and the possibility of a short break from work in the offing. To start off from your own doorstep one day with a map in your pocket and the "coloured counties" around you is an adventure of discovery testing your own energy and aptitude to make a holiday out of the simplest elements, and by reason of that very simplicity make it the more enjoyable. There is no exaggeration in that statement: all you need is the bicycle, good health and an easy sense of fitness, some food in your bag and the mentality to travel as the mood of the moment moves you: then the day or the week is your own, the sunshine, the wind and the shower, and the very land through which you travel. That is the spirit of cycle touring, the greatest gift the bicycle can give you, and it is waiting for you to take it amid the glory that is an English spring.

Club Notes

Manchester Change

A. BAMFORTH and K. Redford have changed their club, and will in future ride for the Pyramid Road Club instead of the Altrincham Havens C.C.

Craig in North Africa

"FREDDY" CRAIG, former time trials secretary of the West of Scotland T.T.A. and the Glasgow United C.C., is at present serving in North Africa with the R.A.F.

Morrison—Flight Engineer

DONALD MORRISON, hero of pre-war massed-start events and a member of the 1939 World's Championship team, has now completed 25 operational flights over enemy territory. He is a flight engineer in the R.A.F.

Clydeside's 1943 Programme

THE West of Scotland T.T.A. has approved of a 1943 programme, which includes 11 25's, eight 50's and two 100's.

Greenock Stars Marry

TWO of Greenock's leading cyclists, A. Crichton and Miss N. Montgomery, were recently married. Both did well in pre-war time trials.

Cozens in Scotland

SID COZENS, prominent pre-war trackman, is now serving with a unit of the R.A.F. in a remote corner of Scotland.

Albert Wright in Dieppe

ALBERT WRIGHT, formerly an enthusiastic official of the Cyclists' Touring Club, Manchester D.A., and its Rochdale Section, is now serving with Allied landing craft. He was in the Dieppe raid, as well as the North African landings.

Starting Promptly

THE Scottish Amateur C.A. has informed clubs and associations promoting opens that these must start at the stated times.

Martin Marries

"JOCK" MARTIN, former Douglas C.C. time trialist, regarded as the "veteran" of Scottish competitive cycling, has just married. He is serving in the Army as a sergeant.

New Roller Star

AT the Douglas C.C. roller contest, held near Glasgow, a new star in the person of A. Lindsey, Greenock Wheelers, was prominent. He won the half-mile with 35⅘ secs., but was beaten by a Douglas man, J. Macrae, in the flying quarter.


St Mary the Virgin. Adderbury (Oxon.)
For Strength

My Point of View

BY "WAYFARER"

Does this Follow?

THE Birmingham City Coroner stated last month that "motorists privileged to get petrol nowadays are under a strong obligation to avoid running into people, especially in the black-out." The connection between the two points is not readily discernible, but one presumes that, when petrol restrictions are removed, this irksome obligation to avoid killing or maiming people—"especially in the blackout"—will be set aside. That follows, doesn't it?

Merely Silly

FOLLOWING the "try-on" policy of shifting the onus to the victims of "accidents"—the classic example, of course, is the rear-illumination of cyclists—the East Suffolk Standing Joint Committee have requested the Home Secretary to make it an offence for any pedestrian to go out at night without wearing a white article on his clothing. This is merely silly, and will cause our Suffolk friends to earn the qualification usually (and wrongly) applied to them. But the precious idea is quite in keeping with the present trend of affairs, under which motorists claim a right to go where they cannot see. If magistrates would but apply adequate punishment to those who kill and maim, they would be using the proper remedy for "accidents." The illumination of the victims of careless driving, whether through the medium of "white articles," red lamps, or phosphorescent kippers, is the wrong remedy.

[We cannot agree with these conclusions. Cyclists also "claim the right to go where they cannot see," and so do pedestrians. The fact that they pay for claiming the right does not make the other man wrong.—ED.]

Discovery

IS it possible to take a bicycle through a revolving door, without folding back one or more of the flaps? A fortnight or so ago I would have answered this question in the negative, but I now know better. Having a meeting to attend in the city, my bicycle conveyed me thither (part of my plan of leaving public transport to those who are not so favourably placed), and then I found a revolving door staring me in the face. It was impossible to leave my bicycle in the busy street, if only because, in Birmingham, there are certain people who don't know the difference between *meum* and *tuum*—they would steal the skin off a rice-pudding!—and, as "desperate diseases require desperate remedies," I up-ended the machine, inserted it (and myself) in the compartment, and slowly did the propelling act, with the result that I successfully arrived on the other side of an apparently unsurmountable barrier. At the end of the meeting I repeated the performance in the reverse direction, and rode home, profoundly satisfied with my great discovery, which puts old-man Newton and his apple completely in the shade!

Further Afield

TAKING advantage of a recent full moon, I obtained a deputy for my Sunday duties and resumed temporary indulgence in the week-end habit. Apart from the sheer delight to be obtained from this aspect of cycling, I was desirous of examining traffic conditions beyond the radius to which my wheeling activities are now normally restricted, and of seeing what is happening in the way of prices. My tours last year revealed that cycling holidays were a shade more expensive than in pre-war days—not surprising, is it?—and this particular week-end, which included a tea at the absurd price of 4s., muleted me in 10 per cent. extra on 1939 figures. Which, when you come to think of it, is not unreasonable. At any rate, I was perfectly satisfied.

As to the other point mentioned, I discovered, as was to be expected, that the further I went from populated centres, the greater the freedom from traffic. There were long stretches of road—main road, too—without any other occupant. The Five Mile Drive, on the roof of the Cotswolds, and the "old" Oxford Road, for example, were practically empty. I loitered for some minutes at that point where the latter road intersects the Fosse Way, and not a thing was in sight, to the dismay of an airman, who wanted a lift to a certain camp a few miles away. Broadway and Stratford-on-Avon, usually infested at week-ends with motor traffic, were pleasantly desolate. On the Saturday night I slept in a Gloucestershire cottage which stands plumb on a main road. Normally, it would have been a case of "phut-phut-phut," accompanied by a blaze of lights invading one's bedroom, but the traffic, after dark, was less, if possible, than in the day-time.

What times these are for us, to be sure! Wise is the cyclist who is able and willing to make the most of conditions which none of us will probably ever see again, when once this war is finished. And what a golden opportunity those conditions present to the type of cyclist who is nervous in traffic. There is practically no traffic to be nervous in! One and all, we should take full toll of these halcyon days, which provide us with the traffic conditions of 40-50 years ago, plus perfect roads.

Catering Problems

ANOTHER point which struck me during the week-end may be worthy of mention—the varying attitude of caterers towards the problems confronting them in these war days. Some of our friends "threw in their hand" at the very outset. Others gave the thing a trial before deciding to "pack." A third class is nobly carrying on, despite the difficulties which are imposed upon them in the way of official regulations and interference. At one house where I had tea, the cakes were of pre-war vintage, made with real eggs. At another house, which provided me with a snack, the cakes were in the same class. At the farm where I had dinner on the Sunday, there was no sign of the war, either in the array of food, or in the price charged. Thus, with a bit of luck, and if you "know the ropes," it is possible to fare very well indeed.

Almost Remarkable!

IN the House of Commons, recently, the Colonial Secretary spoke in glowing terms of Malta's successful resistance to Nazi brutality, which latter arises, I gather, out of a superabundance of "kultur." He mentioned, in particular, the Governor and Commander-in-Chief (Lord Gort) "who in a few months became an almost legendary figure, bicycling all over the island with his aide-de-camp pursuing behind." It would have been almost remarkable had the A.D.C. pursued his boss from some other position!

Aiming High

IN a recent month, says *The Times*, 29 per cent. of bus failures in the Glasgow Corporation Transport arose from tyre trouble caused by broken glass. The brainless idiots who think it clever to strew our streets with glass are certainly aiming high.

Notes of a Highwayman

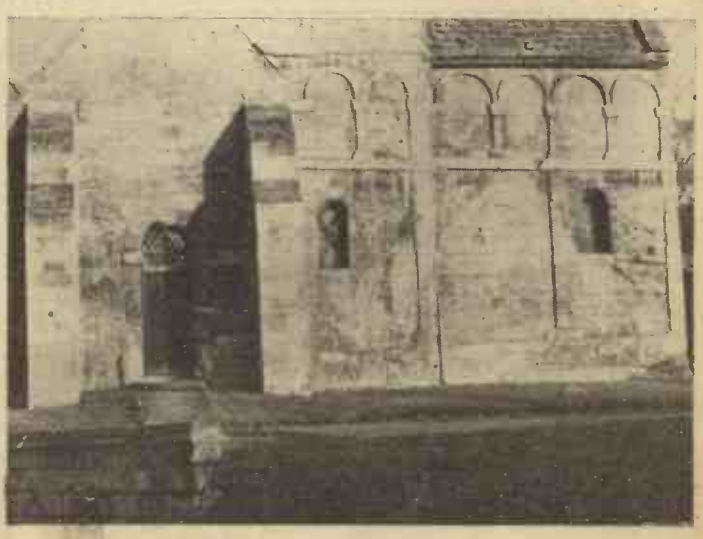
By LEONARD ELLIS

Discoveries Among the Ruins

I SOMETIMES wonder during this wholesale destruction of parts of many of our old towns whether we shall hear of any thrilling "discoveries." By that I mean when the debris is cleared away will anything be unearthed that has lain hidden for centuries? We all know the curious curve of values in old stuff. When a thing is old-fashioned it is probably useless—when it is ancient it becomes priceless. It is easy therefore to understand, and should not cause wonder, why certain gems of architecture have been discovered walled up and neglected. They were probably mercifully covered up when they got old and shabby, and at the time no one realised that by thus preserving them they were storing up treasures for posterity. A well-known example is the wonderful Saxon Chapel now in full view at Bradford-on-Avon. We can assume that long ago it fell into disrepair, became an eyesore before it was "antique," and was so well covered that its very existence was completely forgotten, and not even suspected. Many of the old historians overlook it in their records, proving that they had no knowledge of its existence and presumably no one in Bradford knew what a gem lay hidden. Its discovery was due to the fact that the town of Bradford is built in a saucer or a pudding-basin, with houses rising in terraces all round. Some 80 years ago the Vicar of Bradford was gazing over the roofs of his parishioners' houses, and was struck by something curious—something that looked to him like the roof of a church. Consulting old records he found that 800 years ago nobody knew of such a church. After much bargaining and wire-pulling this gem, the most complete Saxon Church in England, was disentangled from the mass of sordid bricks and mortar that surrounded and choked it. To-day it stands proudly clear for all to see and admire, and there are few who fail to appreciate its beautiful simplicity and its excellent condition after nearly a thousand years of existence. Its swallowing-up had been complete and ignoble. The chancel had become a cottage, the nave was a school. A small house had been built against an outer wall for the schoolmaster, and a factory was built against another wall.

The Other Side of the Picture

There is, of course, the other side to consider. There are places that seem to offer great promise, but after the expenditure of much time, money and energy the explorers turn away sadder and no wiser men. It is possible that Silbury Hill, also in Wiltshire, can be regarded in this category. It is generally agreed that this mound is about 4,000 years old, and that it forms part of a vast but uncomprehended plan embracing Avebury and many other relics in the neighbourhood. The hill is said to cover five acres, and that the circumference at the foot is nearly 1,700ft. It is agreed that the builders were faced with a colossal task, as they had no machinery with which to excavate and only the most primitive tools. No doubt there was purpose in their work; at any rate, the hill stands to-day as a monument to their skill and enterprise, and who knows what else. There have been many theories woven around Silbury, the English pyramid. There have been many attempts to explore the interior and to drag away its secrets, but all the efforts brought little success, and the seekers after knowledge came away with little more than when they started. From the dozen or so shafts from side and top have emerged the skeleton of a man, a piece of timber from the very centre, a Roman coin, and in nearly all cases the bones of deer and oxen. It is supposed that these latter were the picks and shovels of the builders.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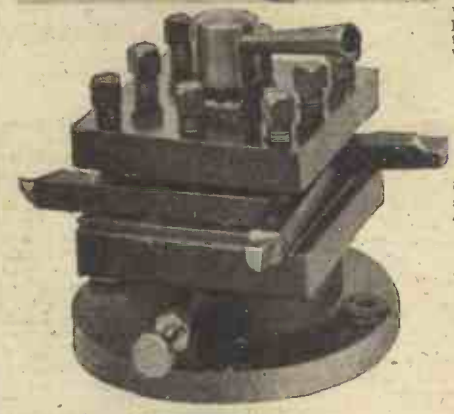

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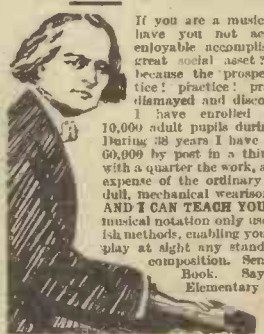

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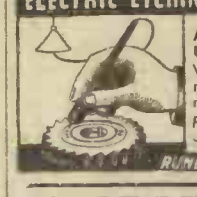

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