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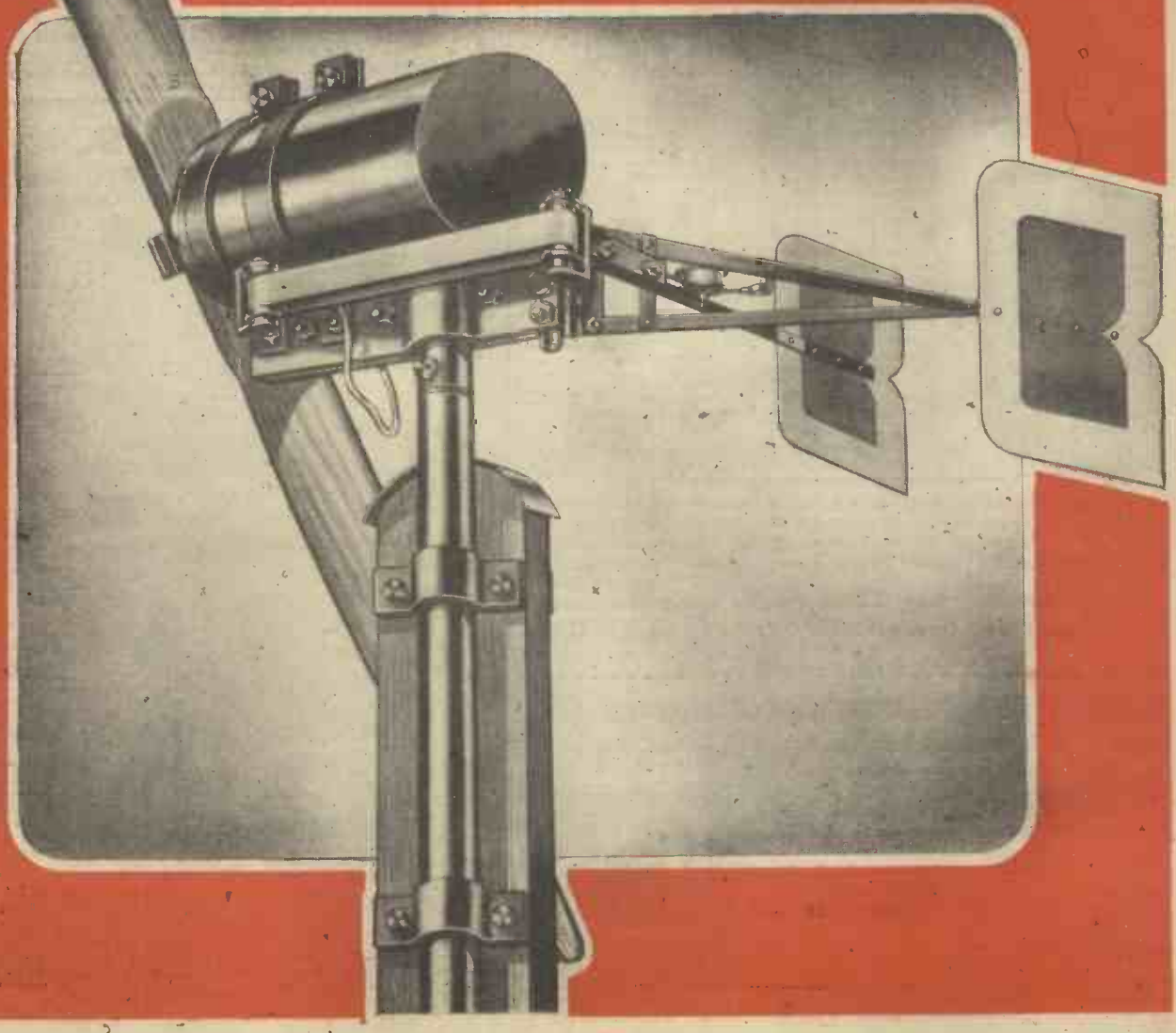

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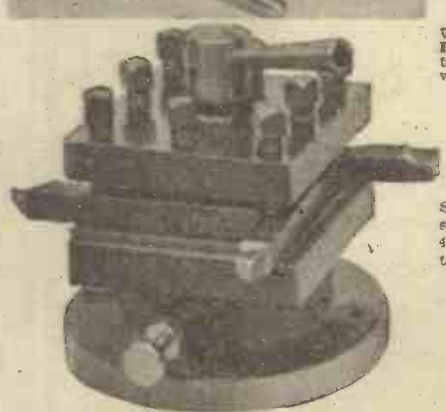

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PRACTICAL MECHANICS

Owing to the paper shortage "The Cyclist," "Practical Motorist," and "Home Movies" are temporarily incorporated.

Editor: F. J. CAMM

VOL. XI. JANUARY, 1944 No. 124

FAIR COMMENT — BY THE EDITOR

Wanted—A Square Deal for Inventors

I WAS interested to receive a copy of a pamphlet entitled "How Inventors Can Aid the War Effort," from the U.S. Department of Commerce. I read this pamphlet with great interest, for, as readers know, I have always held that inventors in this country have been badly treated by Government Departments as well as vested interests. I am not, of course, referring to those stupid "inventors" who imagine they are inventors because they bend a nail in a new way to act as a coat-hook. I am referring to inventors with scientific knowledge, education and practical training who are able to perceive, without harassing manufacturers (and editors!), whether their ideas are practicable. Invention, of course, does not necessarily mean the creation of some mechanism or principle; it also means discovery.

I was interested in this pamphlet for two reasons. It indicates that the inventor has a far better time in America, even during the war, than do inventors in this country. Inventors in Germany were for many years before the war subsidised by the German Government. In America there is the National Inventors' Council, which is a central Governmental Clearing House to which can be submitted inventions and suggestions that might prove valuable to the war effort. It was created in August, 1940, by the Secretary of Commerce with the full concurrence of the President. The Council membership comprises outstanding American inventors, scientists and industrialists having wide experience in the development and utilisation of invention, and the high professional standing of these men, all of whom serve without compensation, inspires confidence in the ability of the Council to do the job for which it was created. The primary function of this Council is to encourage the American public to submit inventions or inventive ideas of value in the war effort, and promptly to evaluate these inventions by a system of technical committees so that useful ideas may be promptly placed in the hands of the proper military or naval bureaux. A central file of suggested inventions is kept, as it is considered to be of continuing value; if not in war, then in peace. It is noted that in 16 months of operation the Council received over 90,000 communications, of which about 55,000 contained inventions and ideas. A surprisingly large percentage of these have possessed sufficient merit to warrant serious consideration. A number already have been accepted for use by the American Army, Navy, Air Force and other Government Departments.

Stimulating Inventive Effort

THE Council is desirous of stimulating inventive effort on the part of the nation's inventors, scientists, engineers, technicians and mechanics. Experience has shown that useful suggestions are generally made by men having technical training as well as practical experience in one or more of the various branches of science and engineering. It is recognised that valuable ideas may spring from any other source, and therefore careful attention is given to every suggestion submitted. Each of these is acknowledged, classified and referred to one or more staff engineers for careful examination and evaluation. Those appearing meritorious are then referred to the appropriate technical committee chairman for his consideration and report, and when he reports favourably it is referred to the Council as a whole. If the Council affirms the chairman's opinion, the invention is then forwarded to the various Services for their consideration and ultimate adoption if they find it acceptable. In the latter case the Service Department deals directly with the inventor in making the necessary arrangements for the use of the invention. The Council does not consider the question of compensation, or contracts between inventors, and the Army or Navy. This is negotiated by the appropriate Service or authority. The kind of inventions which may be found useful are improvements in devices or methods now in use and new devices or ideas not now known or used, but which may be found useful. Those most likely to be found acceptable are those based on a knowledge of the particular field in which they lie plus some knowledge of the military requirements surrounding their use; and those based on entirely new but sound conceptions which may be so promising that military requirements and strategy can be planned to utilise them. New ideas, however revolutionary, are always welcome, but inventors should guard against the common fault of thinking that merely because their invention is different, it must be better than another device already in use for the same purpose. Military requirements sometimes preclude the use of devices which may give satisfactory laboratory performance.

Most of the items of military equipment have been devised and developed by civilians, and in some cases by those who have had no experience in military affairs. Well-known examples include the aeroplane, the machine-gun, smokeless powder and rifled cannons. Many ideas have been brought to a state of important usefulness through the assistance of the well-equipped engineering bureaux of the Army and Navy.

Hundreds of industrial companies, laboratories, engineering firms and inventors are engaged in the task of developing new products and processes for commercial and industrial use, but many fail to realise the application that these inventions may have to the needs of the armed Services. The military, naval and other establishments of the United States Government have such extended ramifications that almost any new industrial idea is likely to be of some interest to them. The Navy yards and arsenals do work which demands the greatest precision and most modern methods.

For this reason it is suggested that heads of research and development departments of industrial companies, trade associations, engineering firms, or private laboratories review each new industrial discovery from the standpoint of its application to military, naval or other Governmental needs. This, of course, does not apply to work that is being currently done for the military Services, but only to that which would not automatically come to the attention of these branches. Disclosures of such discoveries or inventions should be sent to the National Inventors' Council. They will be given careful consideration for their applicability to the national emergency. The system of committees and liaison officers established by the Council enables this exploratory or evaluation work to be accomplished with thoroughness and dispatch.

There is little encouragement in this country for inventors. The Government has power to commandeer any invention without compensation to the inventor, although as a fact, when the war is over, the inventor can apply for compensation. If he does make out a case this is usually granted, but, owing to the large number of applications received for compensation, it often takes years for the application to be heard.

If it is necessary to encourage inventors in war, which is purely destructive, is it not even more desirable to encourage them in peace? We are longer at peace than we are at war, and the needs of peace are greater than war.

Small Wind-power Plants

Simple Methods of Building Small Wind-power Plants from Scrap Material with the Minimum of Tools

By W. H. SUTHERLAND

WINDCHARGERS are divided into two main classes — geared and directly driven. Geared units are so difficult to build without unusual facilities, and depend to such an extent on the odds and ends of machinery available that no attempt will be made to describe their construction. On the other hand, a directly-driven dynamo must begin to charge below 500 r.p.m. to make use of light winds, so the choice of dynamo is fairly limited.

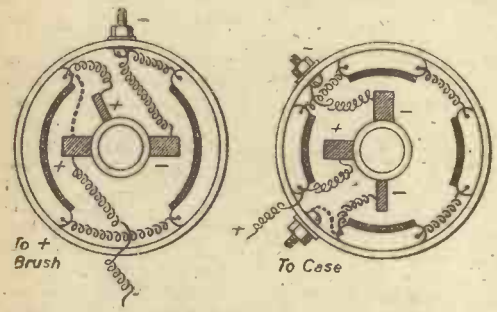


Fig. 1.—Diagrams explaining the removal of third brush from car generators. Dotted lines show new connections.

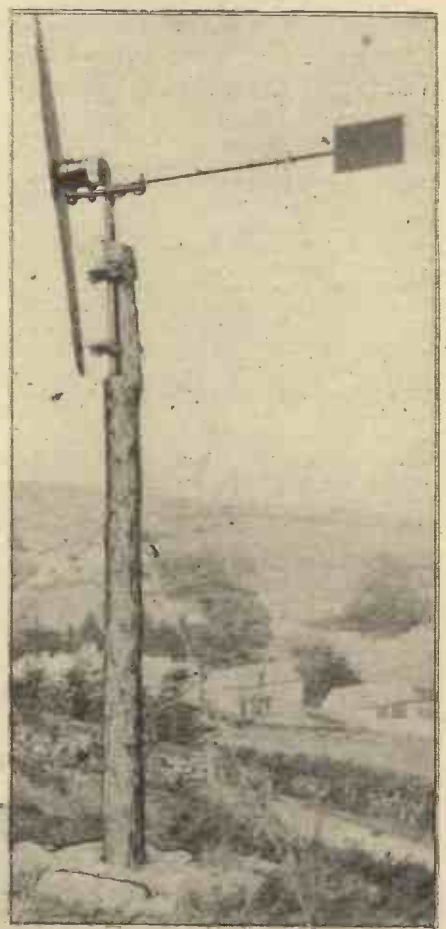
Choosing a Dynamo

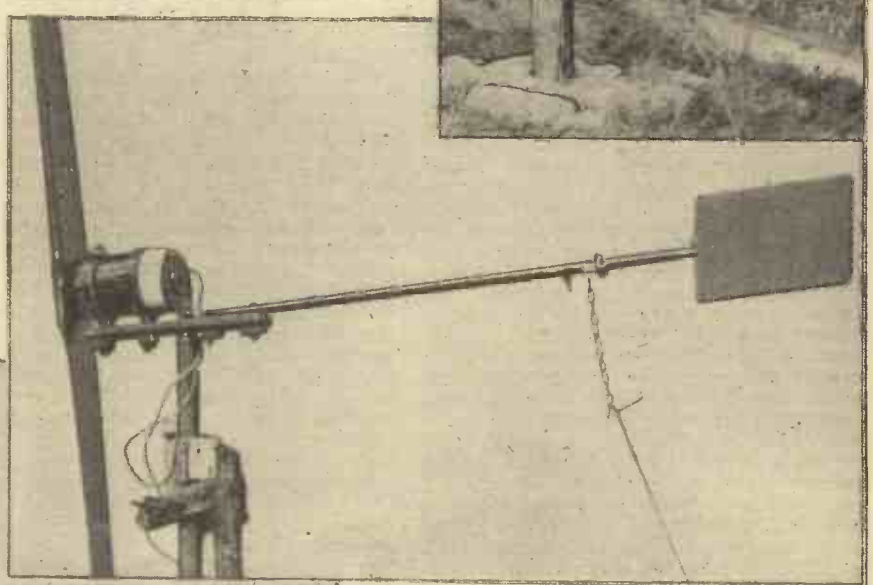
Dynamos off old cars generally have a low charging speed, but are usually built for 6-volt working. A modern 12-volt dynamo does not cut-in before 900 r.p.m., but may be slow enough when used on a 6-volt wind charger. *There are several advantages in using a 12-volt dynamo on a 6-volt circuit.* Such a unit will be charging at currents up to 4 amps in winds that would not cause the same dynamo to cut-in on a 12-volt circuit, and as summer months bring weeks of these light, steady winds, the advantage is obvious. The heating effect in the field-coils is only one quarter as great as it would be at 12 volts, so there is practically no danger of the dynamo burning out. Also, since the magnets get, at most, half of their correct magnetic flux, the current will reach a maximum value at about 15 to 20 amps, and even twice the propeller speed will not cause much increase. This protects both armature and battery cells. Lastly, it is much cheaper to build a 6-volt outfit.

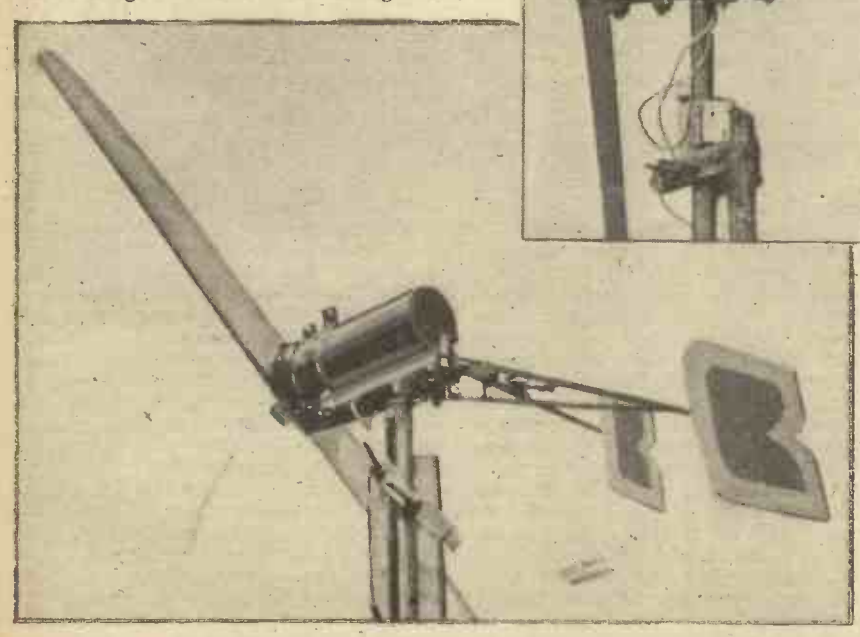
In choosing a dynamo there are certain points to watch that give a rough idea of its value for windcharging. Generally a slow dynamo has a large diameter case rather than a long one. The armature is wound with wire of about 18 S.W.G. for slow charging, while faster ones have a 16 S.W.G. winding. There seems to be little difference in cutting-in speed between 2-pole or 4-pole construction.

To test a dynamo, wind a yard or two of string around the axle and give it a strong, steady pull. A sudden jerk should be felt as the dynamo gathers speed, and after that it should only be possible to rotate it comparatively slowly with the string. After trying several different dynamos it is easy to judge which ones are slow. A fast dynamo will continue to gather speed until the string is nearly off before beginning to generate.

For comparison purposes, remember that the maximum speed possible when turning a dynamo by hand is about 300 r.p.m. Commercial windcharger dynamos will charge at this speed, but no ordinary car dynamo would register more than one volt at 300 r.p.m. The dynamo should light a 12-volt 24-watt bulb easily when turned by string in this manner. See that it has good ball-bearings at each end, and that the







General view of the large model to be described in the next article. Full details for building and winding the dynamo will be given. A Lucas A 900 C or A 800 C dynamo is needed.

(Above) Two views of the 6-volt windcharger described in the text. Built with a Lucas C 45 A type 12.5 dynamo, cutting in about 450 r.p.m. The top illustration shows the windcharger suitably mounted several hundred yards from the house.

backward pressure of the wind on the propeller will not displace the bearings. The commutator should show no sign of a groove where the brushes press. The axle must project far enough from the case, and have sufficient screw-thread to allow for secure fixing of the propeller.

Overhauling the Dynamo

Dismantle the dynamo and remove any oil or carbon dust. If the mica insulation in the commutator grooves is level with the copper surface, cut it down *with a pointed tool.* For windcharger work, the third, or "regulation" brush is removed to lower the cutting-in speed and to reduce wear. This brush is connected directly to one end of the field-coils, and is movable and usually smaller than the other two. Trace the field-coil connections in series through the two or four coils, and find where the end remote from the regulation brush is connected. In a two-pole machine it is usually earthed to the case, but with four-pole construction it will be joined to the main positive brush. Leave it where it is. Remove the other end of the coils from the regulation brush and connect it so that the coils are across the two main brushes. The third brush-holder can then be removed altogether. Fig. 1 makes this procedure clear, the dotted line showing the new connection in each case. Test the dynamo again with string.

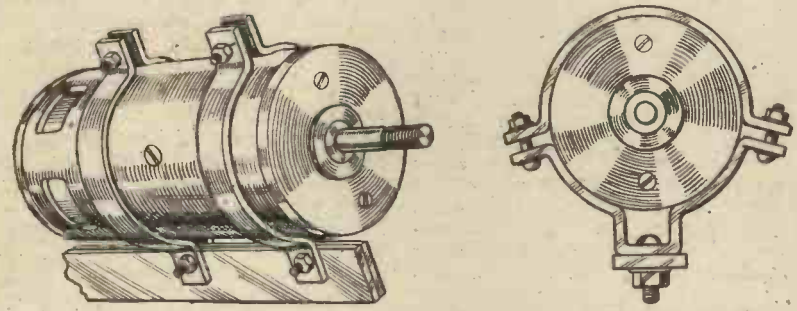


Fig. 3.—Showing methods of attaching dynamo to turntable described, and to a flat bar, as in the model illustrated.

It is useful to know that the direction of rotation of the dynamo is reversed by interchanging the ends of the field-coils, since it may be necessary to do this when changing from chain gearing to cog-wheel gearing. A dynamo which has been idle for long often fails to work because the trace of magnetism necessary to start the field current is absent from the pole-pieces. To remedy this, connect it with correct polarity to a car-battery and allow it to spin as a motor for several minutes. Finally, give the complete dynamo two or three coats of good enamel, after making sure that all screw-holes or other openings are closed to moisture.

Turntable

The turntable is the part of the outfit most likely to cause trouble. The writer has found that complicated fittings, for example, ball-bearings, should be avoided, and that no timber should ever be used in the construction. *The final details depend entirely on the material available,* and general constructional hints are all that can be given in an article like this. A convenient form of turntable consists of two lengths of iron pipe, about 3ft. long and 1½ to 2ins. in diameter. They need not be a very accurate fit, since a little rocking will cause no damage. The outside pipe is blocked by a wooden plug at the bottom to form an oil reservoir, and can be fixed easily to a wooden pole, as shown in the illustration (Fig. 2). The inside pipe is blocked similarly at the top to prevent the entry of rain.

To secure the dynamo to the inside pipe, a cross-arm is needed. This can be made by putting semi-circular depressions in two 15in. lengths of flat iron bar. Pieces of farm-cart wheel-bands are suitable, and any blacksmith will bend them to the required shape. The bars are clamped around the pipe as shown in Fig. 2, using two ¼in. bolts. They should be flat against each other on the long side, but have a clearance of ¼in. on the short side, to allow for tightening. *The long side should be long enough for the particular dynamo used.* The dynamo is fixed to the turntable by a pair of rings, shown in Fig. 3. These are made from any light strips of iron, about 1in. wide and ⅛in. thick. The turntable for the small windcharger shown was made with a solid iron bar instead of the inside pipe. *It is attached to the flat cross-bar carrying the dynamo by means of a large nut and split-pin. It was part of an iron bed, and had about 1½in. of one end threaded.* The tube carrying the tail fin can be attached by small bolts to the short end of the cross-arm. It should consist either of light, circular tubing, or right-angle iron, to prevent vibrations being set up in it. Four feet is a suitable length for a small turntable.

The Tail Fin

The tail fin is made of any strong, light material, and is about 1ft. square. A bigger fin will put unnecessary strain on the dynamo axle when changing direction due to the gyroscopic effect of the propeller. When mounted, the turntable is filled with heavy lubricating oil. *Every constructor will find methods of his own for building a simple turntable, but the points given can form the basis for individual design.* No mention has been made of slip-rings to carry the current from the turntable. During a year's continuous running with the windcharger illustrated, the author had only once to unwind the direct connections going to the dynamo. Heavy rubber-covered leads were used, sufficiently long to loop easily around the turntable pipe should the wind change direction by a complete revolution.

Propeller Design

In spite of the general opinion, a propeller is quite easy to make, and so long as the fundamental principles are adhered to, wide variations of slope and dimensions are possible. I shall give details of two typical types, a very fast one for the small windcharger described, and a more powerful one, not so fast, for rewound or geared dynamos. After one or two attempts, the constructor will get the knack of propeller making, and will be able to introduce alterations. *The first essential is a sound board of uniform thickness, with the grain running along the length.* Douglas fir is the best timber, but well-seasoned ash is a good substitute.

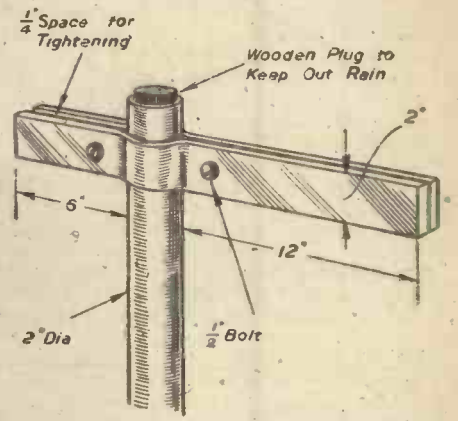


Fig. 2.—Method of making a simple turntable.

For very high speed running, 5ft. 6ins. is a good length, but a 6ft. propeller is a better all-round source of power, and can easily be cut back a few inches if necessary. Both propellers described rotate clockwise. For the fast one, a board 6ft. x 4ins. x ¾in. is needed, but the slower type needs a board 6ft. x 4½ins. x 1in. Find the centre and drill a ¼in. hole for testing the balance by hanging the propeller on a nail in the side of the bench. The propeller should return to the horizontal from any other position, and it is essential that this test be done, and any deviation corrected *after each separate operation* in making the propeller. It is not sufficient to balance the finished propeller by removing some timber at random from the heavier side. Mark the board as shown in Fig. 4, and saw off the shaded portions, cleaning the saw cuts with the plane. Along either trailing edge, mark off from the table the distances shown, measured from the back surface of the board, and join them with a pencil line. To form the driving slope, the front of the propeller must now be planed down so that a flat, smooth surface connects the original edge C D of the board to the pencil line all the way along each blade. The space G F C can best be "scooped" out with a spokeshave, but a

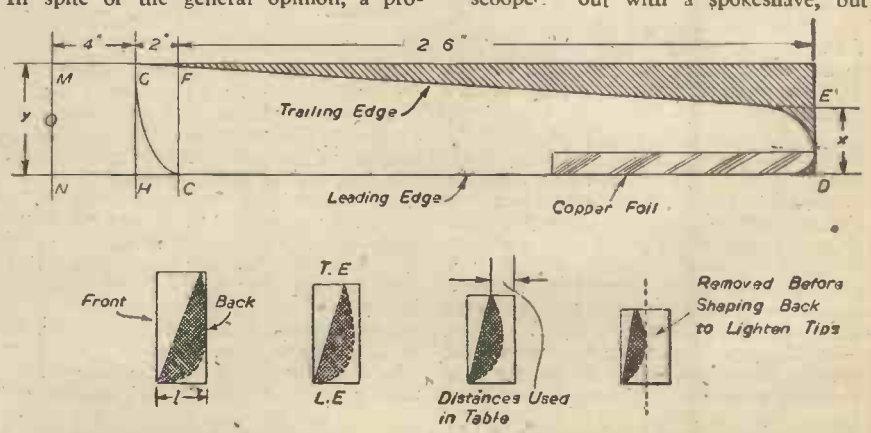


Fig. 4.—Propeller details. Note.—The curve of the leading edge remains the same at each section.
Fast type. $x=3in.$, $y=4in.$, $l=\frac{3}{4}in.$ *Slower type.* $x=3\frac{1}{2}in.$, $y=4\frac{1}{2}in.$, $l=1in.$

small plane will also do. The flatness of the new surface is tested with the edge of a ruler, and should be fairly true all the way along. The cross-section of the board at various points is shown in Fig. 4. This completes the driving slopes of the propeller, and it only remains to shape the back for the lowest possible air-friction. The dotted lines on the cross-section diagrams show the final shape of the back surface, which is planed into a smooth curve with a "blunt" leading edge and decreasing rapidly away to a point along the trailing edge, the maximum thickness of timber being about one-third of the width of the blade from the leading edge at all points. In order to reduce the weight of the outside portions of the propeller, and to maintain the correct proportion between thickness and width, some timber has to be removed from the back before shaping to the streamline section described. Lay the propeller with back uppermost *and put two or three blocks of timber underneath the front face to act as supports, since the driving slopes will not lie flat on the bench.* Plane the board, keeping a flat surface, until it changes from its original thickness at the centre to about half of its thickness at the end of each blade. This will compromise between strength and lightness so that exact details are best decided individually.

The streamline curve illustrated by dotted lines can now be worked on to the back of the blades. Cut the tips of the blades to the shape indicated, and the propeller is ready to be sandpapered. This should be continued, from coarse paper to fine, until the whole propeller has a glass-like surface. Particular attention should be given to the tips of the blade, where the speed is greatest. If a suitable piece of light copper or lead foil is at hand, the leading edge should be protected for the last 12ins. of its length. The foil must be bent to fit the shape of the blade perfectly, extending back about ¼in. on the blade, and fixed by about six small wire staples, passed through tiny holes drilled through the foil and timber, and clenched on alternate sides. This protection is almost a necessity, since the timber comes to pieces along the leading edge after several months working. Give the propeller at least two coats of good outside varnish. If the first coat is not properly hard before the second is added centrifugal force will drive the varnish into ridges underneath the layer formed by the second coat. A week should be enough to dry each coat. Attach the propeller to the dynamo by whatever system is most suitable to the particular type used. *Generally, a ¼in. plate, held on the dynamo axle by the nut that secures the pulley wheel, and attached to the propeller by two ¼in. bolts spaced by about 4ins. is quite sufficient.* Small windchargers seldom need to be shut off to avoid overcharging, but a light rope can be left hanging from the tail to tie the machine perpendicularly to the wind direction, or to unwind the dynamo connections if they should ever become wound around the turntable. It is absolutely necessary that the whole installation be wired with the heaviest possible wire, and on 6-volt circuits there is no need to have covered wires, either outside or inside, provided there is no danger of opposite polarity wires touching. This makes possible the use of 7/22 bare aerial wire, which can be obtained cheaply.

A small unit of the kind described above is only suitable for supplying a few lights in good wind areas, but on account of its simplicity and strong construction, it is practically trouble-free in use. *The dynamo will not begin to charge until there is a strong wind blowing, with the propeller almost invisible. At this point, let me remark that a windcharger propeller is never rotating as fast as it appears to be rotating when viewed from a distance.* Next month the author will describe in detail the complete construction of a larger unit, using a re-wound Lucas A 900 C dynamo. Full winding instructions will be given for this particular type, which is very suitable.

(To be continued.)

VERY FAST TYPE — BOARD DIMENSIONS: 6ft. × 4in. × ¼in. × = 3ins.

Distance from centre of board ...	2	3	4	4½	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Distance from back surface on T.E.	.75	.75	.75	.25	.10	.06	.06	.06	.10	.20	.24	.28	.28	.30	.31	.32	.34	.36
Distance from centre of board ...	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Distance from back surface on T.E.	.39	.40	.41	.41	.41	.42	.42	.44	.50	.55	.57	.58	.59	.60	.60	.61	.62	.62

SLOWER TYPE — BOARD DIMENSIONS: 6ft. × 4½in. × 1in. × = 3½ins.

Distance from centre of board ...	2	3	4	4½	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Distance from back surface on T.E.	1	1	1	.60	.50	.20	.10	.10	.12	.13	.18	.2	.2	.2	.22	.23	.25	.27
Distance from centre of board ...	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Distance from back surface on T.E.	.35	.4	.42	.43	.45	.49	.50	.53	.54	.60	.65	.70	.71	.73	.76	.76	.76	.76

How Many Engines?

The Possibilities of Multi-engined Aircraft.

By NEMO

NOT so very long ago a single-seater machine with more than one motor was quite unheard of, and for multi-engined aircraft the tri-motored layout held the field. Those readers who recall the famous Fokker monoplanes, and their brilliant record in all parts of the world, may stop to wonder why the three-motor layout, one engine in the nose and one slung under each wing, has been abandoned in favour of two or four motor installations, generally mounted on the wings. The only notable surviving tri-motor machines at the present time are the Junkers Ju. 52B, and certain Italian machines, all now admittedly obsolete or obsolescent.

Single Engines

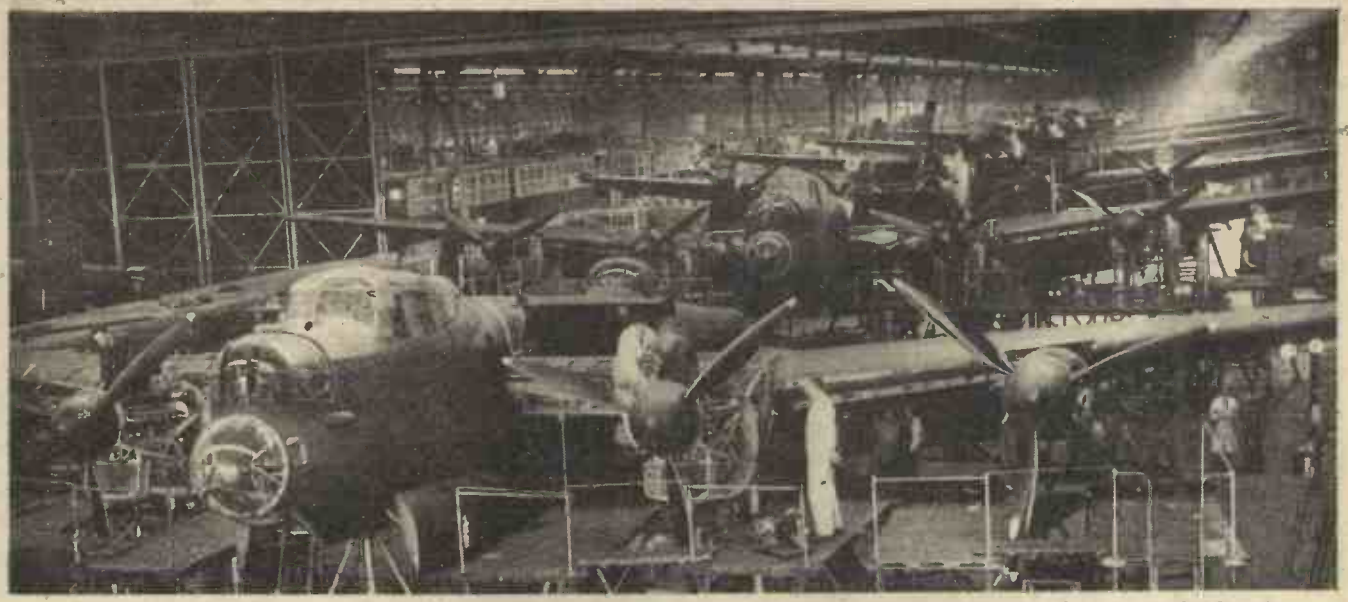
In the early days it was purely a question of the power which could be derived from one engine. Two such engines were not quite enough and so three was the logical choice, although it was soon realised that the centre engine, mounted in the nose of the machine, was less efficient than the other two due to the presence of a fuselage behind it. What actually happens is that the velocity of the slipstream from an airscrew is greater than that of the airspeed of the machine. Thus all components exposed to the slipstream have increased drag (drag being proportional to the square of the velocity of air flowing over the component) and greater drag means less efficiency. From this general description it would appear that the pusher layout with the pusher airscrew, now truly to be termed a propeller, at the rear of the fuselage or engine nacelles, would be the most efficient layout, but this will be dealt with in more detail later.

Systems of Mounting

Realising the inherent inefficiency of the orthodox tri-motor layout many designers adopted different systems of mounting the engine. The most obvious solution, still keeping to the tractor arrangement (i.e., with the airscrew in front) was to raise all the engines clear of obstructions suitably mounted on struts. Examples of this are seen in the Short Calcutta and Saro Windover, to name but two. The engines are then set in line abreast with only the tail unit under the influence of the slipstream. This, obviously, was not the ideal solution, the struts themselves contributing a large amount of excess drag. The next step was to raise the wing above the fuselage and set the engines in line in the wing, as in the Supermarine Air Yacht of 1932 or, a more modern example, the Dornier Do. 24. Both of these machines are flying-boats, and thus this form of engine mounting not only grouped the engines in an efficient manner, but also raised the airscrews clear of spray. Spray thrown back on to revolving airscrews is harmful, pitting or otherwise damaging the blades and shortening their useful life.

A third class of tri-motor designs is deserving of mention, if only on account of its quite unorthodox appearance. In this the two outboard engines are mounted under or between the wings in the normal manner, but the third engine, instead of being mounted in the nose is mounted above, or on the upper wing. In this country we had the Airspeed Ferry, which did much useful work with certain air circuses, and in America the Ford 14-A.

However, the tri-motor layout has nearly died out and apart from the notorious Junkers Ju. 52, which is reckoned "easy meat" to the modern fighter, the Italians are about the only country which has persisted in such designs. Indeed the Savoia Marchetti S.M. 82 Canguru, a normal tri-motor, low-wing monoplane, holds a number of weight-carrying and distance records, outstanding amongst which is a flight of 8,037.97 miles in 56½ hours in a closed circuit in 1939. But in general the tri-motor layout has almost disappeared.



View of the assembly line in one of the Ministry of Aircraft Production factories, showing four-engined Lancaster bombers in various stages of completion.

With the greater power output available from single engines it has been found that two engines of, say, 900 h.p. each gave a better performance than three engines of 600 h.p. each, although the total h.p. is the same. Experiments were performed on a number of aircraft during the early 1930's to test such assumptions, flying one particular type with one, two and three engines of the same *total* power. In all cases it was found that two engines gave the better performance and thus the twin-engined layout approaches more nearly the ideal.

Four-engined Layout

With the recent increase in size of heavy bombers, and in spite of the increased power of single power units, the four-engined layout has become standardised. America was one of the first countries to take this step, a Boeing B-299, the direct ancestor of the Boeing Fortress, being first flown in 1935. Now in this country we have, of course, the Avro Lancaster, Handley Page Halifax, Short Stirling and Short Sunderland, in addition to several American types.

In spite of the outstanding performance the fact remains that all of these four-engined machines would be more efficient and have a better performance if fitted with only two engines, of the same total h.p. In point of fact, the Halifax and Lancaster were originally designed as twin-motor bombers around the Rolls-Royce Vulture engine. This engine failed to come up to expectations and has been abandoned, and hence, since no suitable substitute was available in quantity, both of the types concerned were fitted with four Rolls-Royce Merlins. The total h.p. of four Merlins exceeds that of two Vultures of the original design layout, and thus performance does not suffer. However, two Sabre engines of 2,400 h.p. each, replacing the four Merlins, would probably give an increase in performance.

The reason for this is not hard to find. In the first place, additional engines mean more weight, more accessories and, naturally, more cowlings and nacelles to spoil the aerodynamic form. Thus both drag and weight are increased, so performance naturally suffers. This is not always true, for it may be possible to use four engines of, say, 500 h.p. each which weigh less than two engines of 1,000 h.p. each, but the greater number of auxiliary fittings and decrease in aerodynamic efficiency is still to be countered.

Thus at the moment it would seem that aircraft design for large multi-engined machines has got ahead of engine design, but this is really only a case of *production*. Aircraft design waits upon engine design, as it has always done in military aircraft (and a large number of civil types), but there are a number of 2,000 h.p. and over engines going into production, which figure will probably be still further increased in the near future.

Double-engined Nacelles

In the meantime certain designers have looked for other solutions. The Heinkel He. 177, one of Germany's latest four-engined bombers, is, from external appearances, a twin-engined machine, with a nacelle slung under each wing. Actually each nacelle houses two motors, each pair of motors being geared to a single four-bladed airscrew. In this manner four engines are employed in an aerodynamically efficient manner, although the question of weight of complication of gearing still arises.

The other example is the Dornier Do. 26, which has four motors arranged in two nacelles. Each nacelle thus contains two motors, but each motor drives its own airscrew. Thus there is one airscrew at the end of the two nacelles, two pushers and two tractors. This again is a compromise, but also affords an illustration of the greater efficiency of the pusher layout. With front tractor airscrews stopped and pusher airscrews driving the top speed is greater than that with pusher airscrews stopped and tractor airscrews driving. In other words, the pusher layout is more efficient, i.e., has less drag.

Readers may remember the American Bell Airacuda introduced some years ago, which is a fairly orthodox machine with twin motors in nacelles attached to the wings, with the exception that the airscrews are behind the wing (i.e. pusher) and not in front. This arrangement has been proven to give greater aerodynamic efficiency, but here arrives a big difficulty which apparently has been overlooked on such designs. Owing to the position of the airscrews it is practically impossible for any of the crew in front of them, i.e., in the nose of the machine, to bale out without hitting the airscrews and being cut to pieces. It may be argued that on the Airacuda design provision might be made for an escape hatch in the fuselage aft of the airscrew discs, but for other similar designs, such as the Fokker D 23 push-pull single-seater fighter and certain projected designs, such a solution is not possible.

Hence, in spite of the proven increase in efficiency, it would appear that the application of the pusher layout is somewhat limited, unless it is possible to ensure the air-crew a reasonable chance of baling out clear of the airscrews.

That greater size means more power needed to maintain flight is easily understood, and also that greater power means better performance, but within a short time 10,000 h.p. or more should readily be available from four engines and so, except for outstanding developments in design, there should be little need to include more than four engines on a large machine.

Multi-engined Machines

However, for various reasons aircraft firms will build bigger and bigger machines and so undoubtedly there will be six-engined machines; there are actually a number at the moment of writing, such as the Blohm and Voss Bv. 122, and even eight-engined machines. Six- and eight-engined machines have been built and flown successfully long before the present war, and the Dornier Do. X had 12. Several of this design were built, three for Italy, but in spite of a total of 7,200 h.p. from its 12 engines, it was under-powered. The multiplicity of engines was primarily due to lack of suitable high-powered engines at the time, hence a large number were used to give the required total h.p. To-day the four engines of the Short Stirling deliver nearly the same power as the 12 of the Do. X (6,400 h.p.), and if it had been possible to fit these to the Do. X they would probably have given a better performance on account of reduction in drag and weight.

To talk of the future of multi-engined machines it would appear that with the ever-increasing size it will be possible to house the engines completely within the wings, and this will approach the ideal. On such an arrangement the airscrews, either pusher or tractor, will be driven by extension shafts, and the only notable extrusions will be the necessary cooling radiators, etc. Apart from consideration of weight and structural design the question of duplicity of engines will then be simplified.

Airship Development

The Possibilities of the Use of Airships in the Post-war Years

By T. E. G. BOWDEN

The R-100 at the mooring mast in Montreal, after her remarkable trip from England in 1930.

THE question as to whether airships will be utilised in the future is interesting, and quite a good case can be made out for their use. Freight which is not of a compact form may be delivered by airship at lower speeds than is possible by heavier-than-air machines, but at the same time three or four times faster than normal land or sea transport. Prior to the present conflict, due to several catastrophes, the airship looked as though it was becoming extinct, but a review of its development, advantages and disadvantages follows.

Development

Very shortly after the first successful free balloon flights had been made several inventors began to tackle the problem of controlling the direction of flight so that planned journeys could be made. Although balloons have flown hundreds of miles and ascended to the stratosphere, they are always at the mercy of the wind.

A steam engine enabled the first airship to fly under its own power in 1852, but very little success was achieved until the latter part of the nineteenth century, when the internal-combustion engine was developed. The first important step was the change from the spherical form of the balloon to a more streamlined form, which enabled the resistance to be lowered and the control to be improved.

It was soon found that as the size of airships was increased, difficulty in maintaining the shape of the gas container was experienced. This type, known as the non-rigid airship, was nothing more or less than an ordinary balloon with a passenger basket and engine hung from cables attached to the fabric. Due to the variation in the pressure of the gas caused by the heat from the sun or the release of gas for manœuvring purposes, the envelope may sag or otherwise lose its shape. Also, if the pressure becomes too high the fabric may split and allow the gas to escape. This danger occurs when the airship rises, owing to the reduction of the air-pressure causing the container to expand and tend to burst.

Non-rigid Airship

Various methods of overcoming some of the difficulties described in the previous paragraph encountered in the non-rigid type of airship have been developed. In order to maintain the nose profile, wooden or metal stiffeners may be incorporated at this portion and prevent the air pushing the fabric inwards, thus maintaining a good entry.

To prevent the pressure inside the container rising to a dangerous figure as the airship gains altitude, valves are fitted which allow the excess gas to escape. Unfortunately, when the airship descends the volume of the gas will decrease and cause the envelope to collapse. To counter this last disadvantage balloonets (small air bags) are fitted inside the envelope. By filling these containers with air, the correct profile is maintained.

The use of these air bags during ascent prevents waste of hydrogen, as the air may be allowed to escape and make room for the expanding gas containers. Fig. 1 illustrates the general outline of a typical non-rigid airship. During the last war (1914-18) this type of airship was used extensively for patrol work over the sea, and the Americans are using them for anti-U-boat flights in the present conflict. The speed of these airships is approximately 50 m.p.h. and the capacity 60,000 cu. ft., giving a useful lift of half a ton.

A development of the non-rigid airship was the type designed by the Astra-Torres Co. Instead of having the usual circular cross-section (Fig. 2), a trefoil section was used giving three lobes. Internal fabric diaphragms were fitted to maintain this shape, and holes cut, so that in effect there was only one gas container. By adopting this design the necessary rigging for the attachment of the car and engine was allowed to be partly inside the envelope due to the load distribution obtained in this type. By doing this the drag was considerably reduced, although the constructional difficulties were increased.

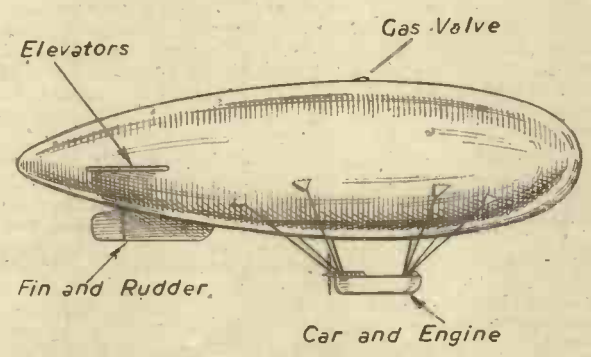


Fig. 1.—Non-rigid airship.

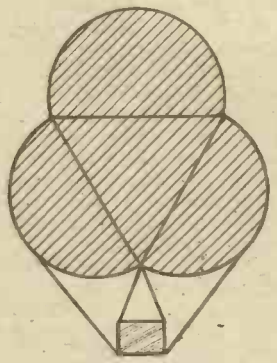


Fig. 2.—Trefoil section airship.

These airships were very successful, and, when powered by two 240 h.p. engines, flew at almost 60 m.p.h., with a duration of 24 hours. The capacity of these patrol airships varied from 100,000 cu. ft. to approximately 400,000 cu. ft. They are ideal for coastal patrol work, provided that they are not likely to encounter opposition from enemy aircraft, as their envelopes are extremely vulnerable. On the other hand, their ability to remain stationary is an immense advantage when searching for submarines.

The materials utilised for the envelopes have not changed from those used in the early days. Doped fabric, with layers of rubber between them, have proved satisfactory. For manœuvring purposes, fins, rudders, tailplanes and elevators have been standard fittings, and function in a similar manner to those used on heavier-than-air aircraft.

In 1925 several non-rigid airships were constructed in the United States for commercial purposes and achieved considerable success. One of the first of these passenger airships remained in operation for six years. The capacity was 112,000 cu. ft. and length 14oft. The U.S. Army Air Corps flew non-rigid airships with several interesting features. To allow for a landing on the surface of the sea the passenger car was shaped in the form of a boat, and walkways were provided so that the engines could be maintained in flight. A small observation car was carried, capable of being lowered from the main car by means of a cable and an auxiliary motor. An extremely interesting innovation was the introduction of a method whereby water could be picked up during flight for ballasting purposes.

Semi-rigid Airship

As the size of airships became greater, the need for some form of stiffening became more apparent and led to the introduction of the semi-rigid design of airship. The main feature of this type is a girder which extends from the nose to the tail. A typical keel girder is illustrated in Fig. 3. By this means the profile may be retained more easily and also the pressure required in the gas container may be reduced, thus avoiding straining the fabric.

Two Frenchmen, Pierre and Paul Lebaudey, constructed one of the first semi-rigid airships but it was not a very great success. The disadvantage was due to the

amount of resistance caused by the stiffening members, which were external. The speed was, as a result, not very great and also, due to the lack of knowledge of the forces acting on the structure, the flexibility was excessive.

The Italians developed a more successful semi-rigid type by enclosing the keel inside the main envelope, thus reducing the resistance. At the same time the passenger car was attached close to the keel and by this means a fairly satisfactory streamlined shape was obtained.

One of the largest semi-rigid airships to be constructed was the Roma (Italian) with a capacity of one and a quarter million cubic feet. The length was 410ft., speed 70 m.p.h., and the lifting force approximately 40 tons. This airship was designed for ocean travel, but after being sold to America was unfortunately destroyed by fire.

The hydrogen in this type may be carried either in separate containers or in one large gas bag separated into several sections by fabric diaphragms. An extremely successful airship, the Nore, had 10 gas compartments with a total capacity of almost 700,000 cu. ft. This airship flew vast distances over the Polar regions in all climatic conditions.

A nose cap attached to the keel helped to maintain a good nose profile.

Rigid Airships

From the semi-rigid design of airship, the next step was the rigid type illustrated in Fig. 4, and developed mainly by the German, Count Zeppelin. In this type a metal framework is installed which carries all the loads, thus making an extremely stiff and strong structure. Transverse frames built from light alloy are connected to each other by means of a series of girders running from the nose to the tail. Additional wire bracing is fitted and a layer of fabric spread over the frames. The outer envelope need not be gas-tight as its main function is to provide the correct profile.

A typical successful rigid airship was the Hindenburg with a capacity of 7,000,000 cu. ft. of gas. Four 1,000 h.p. diesel engines were fitted and gave a maximum speed of over 80 m.p.h. Accommodation for 50 passengers was provided.

Special precautions are necessary on this type in order to prevent an accumulation of an explosive mixture of hydrogen and air in the space between the gas container and the outer envelope. Scoops are generally fitted which ventilate this space by means of jets of air.

Valves are fitted at the top of the gas containers which enable the gas to be released when required. To prevent excessive pressure occurring, safety valves are also fitted which operate automatically when a certain pressure is exceeded.

To enable the altitude of the airship to be varied, apart from operating the usual elevator controls, water ballast is carried, with means of jettisoning in order to reduce the weight and therefore to cause the airship to rise. An important problem is the increase of lift due to the consumption of fuel, etc.

The U.S. Army dirigible RS-1, soaring over Washington after a flight from Langley Field, Virginia, several years ago.

Various methods to overcome this difficulty have been tried out and one solution is to condense the water in the engine exhausts instead of discharging it to waste. An interesting method was the one used by the Graf Zeppelin. Instead of using normal liquid fuel, a gaseous fuel was used which possessed a density approximately the same as that of the normal atmosphere. Consequently, the consumption of fuel did not affect the lifting properties of the airship.

All-metal Airship

A departure from the usual airship design was the introduction of an all-metal airship. The problem of covering the framework with a thin metal skin required a great deal of experimenting and research work before success was achieved. Originally, in America, a skin of duraluminium 0.008in. thick was suggested, but difficulty was experienced, due to corrosion.

After several years experimenting, a satisfactory material called Alclad was developed. It consists of ordinary dural with a thin layer of aluminium on both faces to protect it against corrosion. This material is used to-day in the manufacture of many aircraft whose duties entail flight over the sea. In 1929 the all-metal airship was constructed at Detroit in America with an Alclad skin 0.0095in. thick.

The capacity of this airship, known as the ZMC2, was 200,000 cu. ft., and the profile was maintained by means of the usual longitudinal girders and transverse circular frames. The skin was riveted together and almost 4,000,000 rivets were required in the construction. A special tool was developed to fit these rivets which were formed from wire approximately 1/32in. thick.

Gas

Two alternative gases are used to provide the lift in airship design. The most commonly used is hydrogen, which is the lightest gas known. Unfortunately, it has the grave disadvantage of being extremely inflammable, which offsets its advantages as regards lifting properties. Several major disasters have been caused by airships filled with hydrogen becoming ignited and being entirely destroyed by fire.

As an alternative to hydrogen, helium is utilised. This gas is the second lightest gas known, and possesses the advantage of not being inflammable. This last property makes it the ideal gas to use in airships, and the reason why it has not been generally adopted is the fact that it is scarce. America has a monopoly in the supply of helium at the present time, as it has not been found practicable to obtain commercial quantities in any other country.

For future airships hydrogen cannot be used if the element of danger is to be reduced to a minimum, and unless some other gas is discovered, helium, which is considerably more expensive, is the only other alternative. By using a non-inflammable gas, the engines may be mounted inside the hull, as in the case of several American airships.

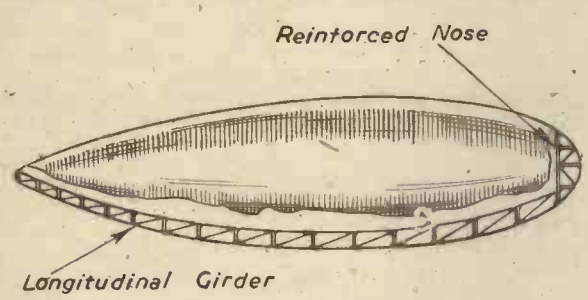


Fig. 3 (Left).— Semi-rigid keel girder.

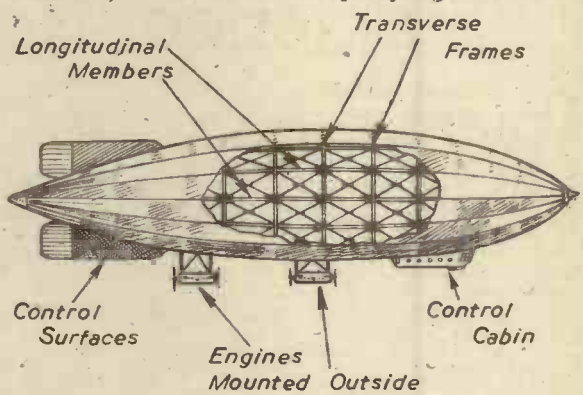


Fig. 4 (Right).— Rigid airship construction.

Ground Handling

One of the difficulties in the operation of large airships is the ground handling and the mooring. Originally airships were housed in hangars and manhandled out when required. This operation was extremely dangerous if the wind happened to be very strong, and a very large number of men were required. The introduction of the mooring mast reduced the risk of damage to the airship and rendered the handling very much more efficient.

A typical mooring mast of the type developed in England is illustrated in Fig. 5. The mast at Cardington, constructed for the R.101 class, was 200ft. high, and

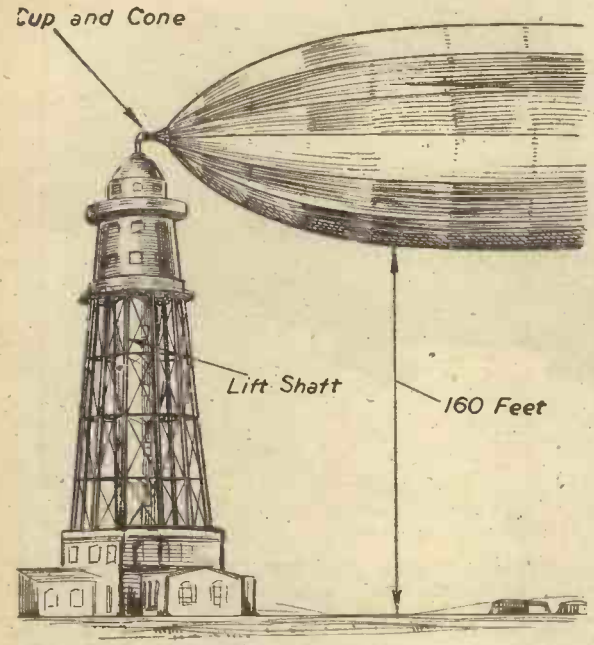


Fig. 5.—View of a mooring mast showing the lift shaft.

enabled airships to moor in bad climatic conditions. A wire from the extreme nose is attached to a wire connected to a winch in the mast, which draws the airship up to the automatic attachment consisting of a spring-loaded cup and cone. Ballast weights are attached to the tail to prevent excessive swinging. A lift runs up the mast, and a gangway is fitted between the platform and the entrance hatch in the nose of the airship.

The smaller type of airship, i.e., the non-rigid design, is usually housed in hangars or picketed to the ground by means of wire cables. In case of an emergency, should an airship require to moor over water, sea anchors may be carried. In addition to the sea anchor, which is of normal design, an inverted cone, holding approximately half a ton of water, is fixed to the line. The function of this cone is to keep the anchor submerged and to damp out any excessive movement. To enable the anchor to be hoisted up, the water is spilt out of the cone by means of a weight, which runs down the line and reverses the cone.

The Americans have favoured a much smaller mooring mast than the English type. The airship, in this case, is almost touching the ground, and the tail is fixed to a trolley which is capable of rotating around a circular track according to the direction of the wind. A disadvantage of this system is the fact that extremely careful piloting is required when approaching the mast. Should there be any vertical air currents, the airship is liable to be dashed against the ground. The advantage is the fact that the airship is very accessible for maintenance, etc.

An ingenious method of reducing the large number of men normally required to take airships in and out of their hangars is as follows. The normal mooring mast is mounted on wheels running on tracks leading inside the hangar. By this means the airship may be drawn out of its hangar quite safely, and when outside, the mast extends and raises it approximately 100 feet. As an alternative to rails, caterpillar tracks may be fitted to the mast, enabling it to be manœuvred into any position.

Future Development

An interesting achievement, with possibilities for the future, is the launching of aeroplanes or gliders from airships. This has already been carried out successfully in the past, and also aeroplanes have flown up to and been picked up by airships. On long-distance flights, say from England to Cape Town non-stop, gliders with mail or passengers could be dropped at points en route, e.g., Cairo, etc.

The possibility of propelling airships by means of jet propulsion is also interesting, as their natural profile makes the fitting of the necessary tube more easy than in the case of normal aeroplanes. The development of a gas as light as hydrogen, without possessing the danger of being inflammable, would also help to bring airships into their own again.

Airships have been neglected in England ever since the R.101 disaster, and America and Germany are the two main countries likely to proceed with the design of post-war airships. The German dirigibles in particular have had an extremely successful career, and unless some altogether new principle is discovered for the propulsion of aircraft there is a distinct possibility that airships will continue to be built and flown in competition with heavier-than-air aircraft.

Science Notes of the Month

New Victory Ships

IT is reported from America that the Henry J. Kaiser companies will henceforth devote their yards to the production of two new types of vessels. The first will be the Victory ship—bigger, faster and better equipped than the Liberty ships, with three decks instead of two. The second will be small cargo vessels, about 5,000 tons, half the size of the Liberty ships. These cargo vessels are designed to go almost anywhere in the South Pacific.

Solving Air-icing Problem

SIR ALAN COBHAM stated in London recently that experts are working on the problem of how to take the heat from an aeroplane engine and transfer it to the various parts of the wings and other parts of the aircraft liable to icing. According to Sir Alan, he felt sure that before long we shall have effective de-icing apparatus.

Balloon "Scaffolding"

A WAREHOUSE with a circular base 100ft. in diameter was recently constructed in Los Angeles by applying cement to a blown-up canvas half-sphere. When everything was dry and firm the canvas was deflated and pulled out through the door. There was left a smooth all-cement building with no girders or columns.

New Mosquito Fighter-Bomber

AN improved version of the de Havilland Mosquito twin-engined fighter-bomber is now in service. The new 'plane carries a 1,000lb. bomb load, and has the full fighter armament of four 20mm. cannon and four .303 machine-guns. The speed of the improved machine is unaffected by the new internal modifications, which represent another stage in the development of the aircraft like the use of wing-tip drop tanks for extra range. Improved Rolls-Royce Merlin engines give the new aircraft higher performance at all altitudes.

Roofing Material from Rags

A CHICAGO firm has perfected a method by which rags and resin can be combined to make a war-emergency building material. Known as "corrugated asphalt siding," the new material replaces corrugated steel sheets. The "siding" consists of two sheets of heavy felt saturated with a resin-bituminous compound, bound together with a high melting-point asphalt adhesive, and then corrugated under high pressure. The finished sheets are stated to be hard, rigid, light in weight, and moisture-proof.

First Stainless Steel Aircraft

THE first large stainless steel 'plane, described as a "twin-engined cargo-carrier of unusual construction," was recently completed at Philadelphia, and passed its tests successfully, according to the U.S. Navy Department, at Washington. At various factories in the United States, Curtiss Wright is beginning to manufacture cargo 'planes for the U.S. Army on a large scale, and military transport aircraft are being built which may be a satisfactory stop-gap for passenger traffic after the war until new types can be put into production.

Rubber from Wild Trees

A PROMISING wartime project is the attempt to tap rubber from the millions of wild trees growing in the vast and steaming jungles of the Amazon basin in South America. The U.S. Government Rubber Development Corporation is reported to be spending about £15,000,000 on the scheme, which may during 1944 produce 23,000 tons of natural rubber from Brazil, Bolivia and Peru.

I.M.E. Exams in Prisoner-of-War Camps

THE Institution of Mechanical Engineers announces that, thanks to arrangements made by the War Organisation of the British Red Cross and the Order of St. John of Jerusalem, no less than 37 candidates recently sat for the Institution's examinations in prisoner-of-war camps in Germany. No fewer than 34, or 92 per cent., passed with an exceptionally high average percentage marking. The results reflect credit both on the candidates and on members of the Institution and others in the camps who organised classes and acted as instructors.

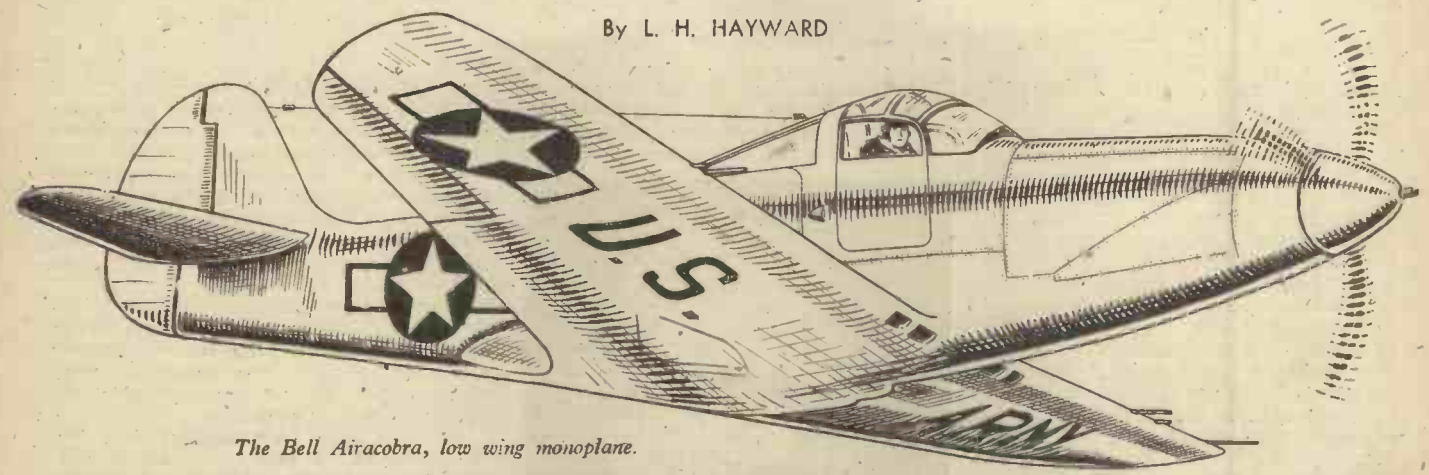
Ocean Air Liners

IT is reported that of nine U.S. trans-ocean air routes proposed for after the war seven will have their terminals in London. The routes were recently considered by the U.S. Civil Aeronautics Board. The Pennsylvania Central Airlines propose to use a series of anchored seadromes, 800 miles apart, between Great Britain and U.S.A.

AIRCRAFT ON ACTIVE SERVICE

4.—The Bell Airacobra

By L. H. HAYWARD



The Bell Airacobra, low wing monoplane.

THE Airacobra single seater fighter, or "Cannon on Wings," to give it the name it has earned by service pilots, is designed and manufactured by the Bell Aircraft Corporation, of Buffalo, New York. The installation of the single Allison V-1710-E4 engine in the fuselage behind the pilot, instead of in the nose, and the tricycle undercarriage place the Airacobra or, as it was formerly called by the British, the Caribou, among the world's unorthodox aircraft. The table below gives the leading particulars of the machines now in service with R.A.F. Fighter Command.

The front portion of the fuselage from the nose to the rear of the engine is built up on two main spars, while the rear portion is of standard monocoque construction. This type of construction enables a light but strong structure to be made, as the loads are mostly taken by the sheet metal skin, strengthened by bulkheads and stringers. The front and rear portions are bolted and riveted together. Access panels are provided for servicing the engine and controls.

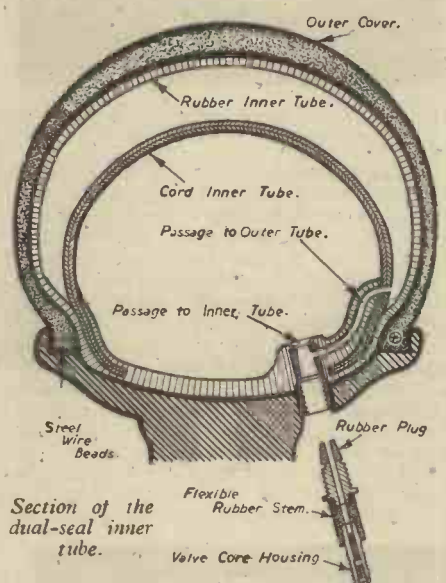
The all metal, full cantilever wings are built up on two main spars, and combine maximum strength and rigidity with minimum weight. The two fuel tanks having a combined capacity of 100 gallons form an integral part of the wings, which also house the retracted main undercarriage wheels.

Metal frames with fabric covering form the movable surfaces of the tailplane and rudder.

The installation of the engine, in the centre section of the fuselage, brought about a favourable weight distribution for fitting a tricycle undercarriage. To assist pilots in landing on rough and strange aerodromes this type of landing gear is fitted, as it enables an aircraft to land in a horizontal, near flying attitude at higher speeds than the conventional type of landing gear. To avoid a crash in the event of the nose wheel being punctured it is fitted with a special non-skid tyre that has a dual-seal inner tube. The tube has two air compartments, the inner compartment is inflated to a low pressure and the outer one to the standard high pressure. If the casing and outer tube are punctured the pressure in the inner section is sufficient to expand the tube and fill out the tyre to the normal size. The undercarriage is electrically operated, but the pilot is provided with an emergency hand-operated lever enabling him to retract or lower the undercarriage wheels and flaps should the electrical system fail.

Span	Length	Height	Weight Max. Load	Max. Speed	Motor Type	Motor Power
34ft.	30ft.	9ft.4in.	6,500lb.	400 m.p.h. Approx.	Allison V-1710-E4	1,100 h.p.

One of the main essentials of a modern fighter aircraft is speed, and in turn this demand leads to larger and more powerful engines. The installation of large engines in the nose of an aircraft usually reduces the pilot's visibility. To prevent this the engine is installed in the centre or largest portion of the fuselage, resulting in a streamline nose giving the pilot an excellent view.



Section of the dual-seal inner tube.

The Allison V-1710-E4, 12 cylinder, liquid cooled engine is rated at 880 h.p. at 2,600 r.p.m. at sea level and 1,150 h.p. at 3,000 r.p.m. at 12,000 ft. The drive from the engine to the reduction gear unit situated immediately behind the airscrew is by means of an 8ft. long, 2½in. diameter propeller shaft, housed in a casing passing between the legs of the pilot.

Ducts in the leading edge of the wings lead cooling air to the engine coolant radiator located under the engine in the centre section of the fuselage, and the warm air is exhausted through an automatically operated flap in the fuselage. The engine air intake is situated behind the pilot's cockpit on the top of the fuselage.

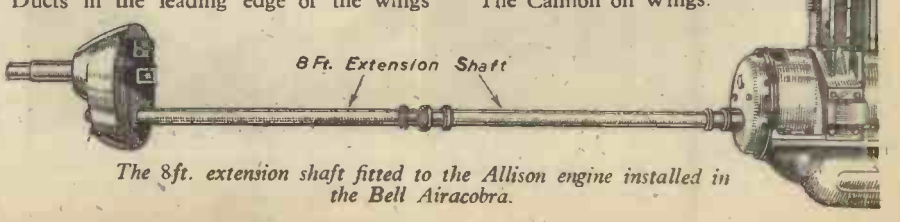
Fuel consumption of the engine is approximately 40 gallons per hour at the maximum cruising speed of 300 m.p.h.

The British version of the Airacobra is armed with one 20mm. cannon firing through the airscrew shaft, two 0.50in. calibre machine guns in the fuselage, firing through the airscrew blades, and four 0.30in. calibre machine guns in the wings. In the American version the 20mm. cannon is exchanged for a 37mm. cannon. The nose of the fuselage is utilised for housing the two central machine guns and cannon, and in addition the retracted nose wheel. The guns are all aimed through a single reflector sight and they are arranged so that their fire is concentrated at a fixed distance. All guns can be fired simultaneously, or alternatively, they can be selected to fire individually.

Electrically-heated clothing and oxygen equipment for the pilot are provided for high altitude operation. A specially designed crash arch protects the pilot's body in the event of a crash landing, and a bullet-proof windscreen protects him from enemy bullets. The normal range is approximately 750 miles, and this is found to be ample for most combat flights.

The Airacobra is one of the very few aircraft that can claim the distinction of having a span of almost the same length as the fuselage. The prototype machine made its first appearance towards the end of 1938, and since then very large numbers have been put in service by the R.A.F. Fighter Command and the United States Army Air Corps. Due to the location of the engine near the aircraft centre of gravity, a much larger degree of manœuvrability is obtained.

One of the most unorthodox aircraft in the world, with a speed approaching 375 m.p.h., it certainly deserves the name "The Cannon on Wings."



The 8ft. extension shaft fitted to the Allison engine installed in the Bell Airacobra.

Penicillin, the New Germ Killer

Chemistry's Latest Contribution to the Battle Against Bacteria

NOT all bacteria or germs are harmful to human life. On the contrary, quite a number of these microscopic living entities are definitely beneficial to our health and well-being. Nevertheless, the relatively few species of antagonistic germs —the "pathogenic bacteria," as they are called—which war against human and animal health and even life itself can, given favourable conditions, become extremely potent, speedy and deadly in their capabilities.

In olden times before the introduction of chloroform and other anæsthetics, it was not so much an actual surgical operation which was so greatly dreaded both by patient and surgeon alike as the onset of the fearsome and frequently fatal gangrene or mortification of the bodily tissues after the operation.

It was not, indeed, until after the middle of the last century that the true nature of surgical gangrene began to dawn upon scientific minds. That great French genius and medical pioneer, Louis Pasteur, had shown that many diseases and bodily conditions are due to the activities of tiny cellular or plant-like parasitical bodies, nowadays popularly called "germs," and in consequence of this realisation it became apparent that one of the obvious ways of dealing with these microscopic foes would be to apply to them some chemical substance which would not only destroy them but which would also prevent their regrowth.

From such considerations arose gradually the present-day practical science of "chemotherapy," the science, as we may define it, of disease treatment by chemical means. Chemotherapy, in our days, has developed into a highly complex, albeit ultra-fascinating and many-branched department of organic chemistry, of which, in this necessarily brief survey of the subject, we can only deal with one small portion, to wit, that concerning the discovery and development of chemical aids to germ destruction.

The First Antiseptic

It was Lord Lister, one of the more famous of British surgeons, who in 1867 first introduced as aids to surgical operations substances which he termed "antiseptics," that is, substances which inhibit or prevent the development of sepsis or mortification of the bodily tissues caused through germ action.

Lister tried to use carbolic acid, which was the pioneer antiseptic, but although the carbolic acid killed the unwanted germs it

Lord Lister, English surgeon and pioneer of antiseptics and germ-killers.

also acted detrimentally upon the patients' wounds and tissues, for it functioned as a poison to the living cells of the flesh as well as to the pathogenic bacteria. Carbolic acid, creosote and guaiacol were used in very dilute solutions as antiseptics, and various other synthetic compounds were added to the list of antiseptic substances as time went on. Some of them were more successful than others. But they all had this real disadvantage; they could not be taken internally or injected directly into the blood stream in order to kill germs which had gained a firm hold on some inner organ of the body. You could not, for instance, allow a patient to drink carbolic in order to cure his pneumonia, because if you adopted this course of action, although you might succeed in killing the pneumonia germs you would almost certainly have to attend a coroner's inquest over the death of the patient!

Antiseptics and other chemical germ-killers were all very well in their respective ways at this stage of chemical science, but they were not selective enough in action. They tended to destroy both the living germs and the living cells of the body.

Next came Paul Ehrlich, a German investigator, who, in 1904, discovered that a certain dyestuff, trypan red, possessed the property of killing certain disease organisms called *trypanosomes* which are responsible for certain tropical diseases.

But Paul Ehrlich went further than this. He conceived the idea of chemically synthesising a substance which would be able to act on bodily disease germs as a sort of poisoned arrow, carrying its dose of poison to the germ which it was aimed at and thereafter becoming harmless to the rest of the body.

Ehrlich selected the well-defined *spirilla* or corkscrew-like germs of syphilis for his

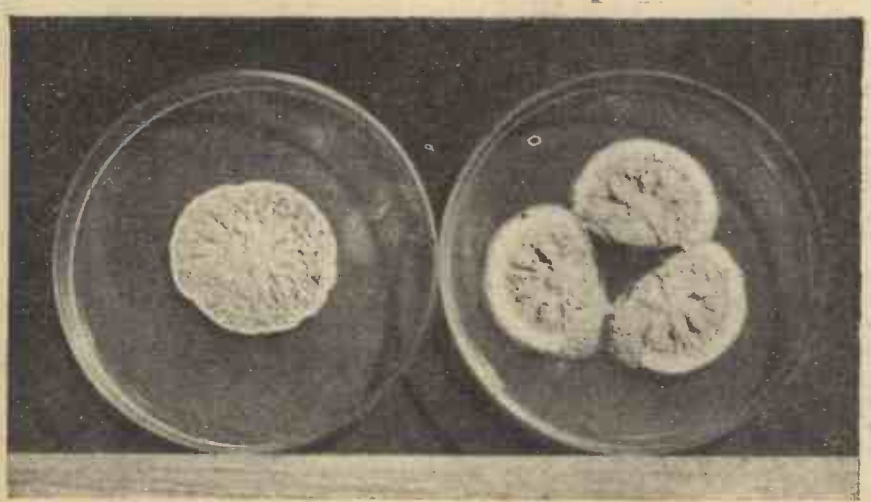
A close-up view of Penicillin mould growing on a gelatine medium. It is from this mould that the new antiseptic, penicillin, is being obtained.

experiments. He built up synthetically in his laboratory compounds which contained arsenic in loose combination. His idea was that if he injected his new selective germ-killers into the blood of patients suffering from syphilis, the chemical would unload its cargo of arsenic on to the *spirilla* of the disease and so cure the patient.

After a good deal of patient experimenting, together with no small amount of failures, Ehrlich succeeded rather spectacularly in his quest. The result was his selective germ-killer which he named "Salvarsan" and which formed the first of a group of arsenical compounds used for similar purposes.

Selective Germ-killer

Salvarsan introduced an entirely new principle into chemical medicine, the principle of the selective antiseptic. During the last war, it was found that several dyestuffs, notably acriflavine, had powerful germ-killing properties, whilst being, at the same time, harmless to the body. Such antiseptics were used in large quantities



Cultures of penicillium patulum of Agar medium.

during the 1914-18 war, and undoubtedly saved many thousands of lives.

Within the last ten years, the work of Ehrlich and other contemporary pioneers has fructified in the new era of antiseptic and germ-killing compounds which is now rapidly dawning upon us.

It is not very long since two new classes of bactericides (germ-killers) were placed on the market. Such drugs are now typified by the substances "Prontosil" and "M. & B. 693." Prontosil is, in reality, a dyestuff. It is predominantly destructive of germs belonging to the group known as the *streptococci*. And because it is this group of germs which is very much concerned in that once-dreaded puerperal fever (the fever of childbirth), prontosil made its name as a saver of many lives.

Then, shortly afterwards, were synthesised the first of the "M. & B." (May and Baker) bactericides, which are, in particular, specific against the deadly *pneumococci*, the germs responsible for pneumonia. Such compounds contain sulphur in organic combination. Hence these substances are chemically known as the "sulphonamides." Many hundreds of them have been synthesised, but only a relatively few are used in ordinary medical practice.

Penicillin

The most recent development in the creation of super-power antiseptics and germ-killers is to be seen in the discovery of the new chemical, *penicillin*, which is now being produced on the commercial scale.

The story of penicillin is an interesting

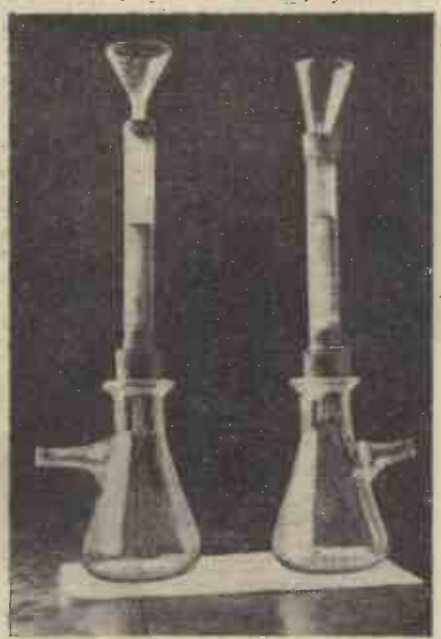
A microscope view of Aspergillus, *the green mould of cheese. From this mould the new antiseptic* fumigatin *is obtained.*

one, not only in view of the rather strange origin of this new compound but, also, because its introduction to medicine opens out further fields of discovery for the enthusiastic and highly skilled chemical worker.

It is a well-known fact that nearly every vegetable material is, under favourable conditions, liable to become attacked by various moulds which grow parasitically upon it. Fruits, cheese, bread, jams, sugar solutions, fabrics, wood and a host of other divers materials will all go mouldy when exposed to the right conditions.

Moulds, of course, are merely forms of plant life which exist upon the nutriment which they abstract from the materials upon which they grow. Given moisture, air, a little light and a suitable medium in or on which to grow, the majority of them flourish exceedingly.

One of the commonest of the everyday moulds has long been given the name of *penicillium* (Latin, *penicillum*, "a brush or a pencil") in allusion to the long, thin, brush-like filaments which it manifests when viewed under the microscope. The various species of *penicillium* moulds are very destructive. It has been estimated, for example, that, in pre-war days, *penicillium* moulds attacking packed fruit accounted for a 2-3 per cent. loss on fruit imports into this country, amounting annually to some millions of cases of fruit. Yet, by a curious



Chromotographic columns of a simple type for laboratory use. They consist of glass cylinders filled with aluminium oxide through which mixed solutions are percolated in order to effect their purification and separation, as in the case of penicillin extracts.

twist of coincidence, it is from this very group of *penicillium* moulds that the most up-to-date and probably the most powerful of all the known bactericides or germ-killers is now being manufactured.

A Product of Mould Growth

The discovery of penicillin, the new bactericide, came about in this way:

In 1929, Professor Alexander Fleming, of St. Mary's Hospital, London, noticed that one of his bacteria culture media refused to grow the germs which he required. He investigated the matter and found that this particular culture-medium had gone slightly mouldy, having become, through an accident, infected with the mould, *penicillium*, one of the common green moulds.

Professor Fleming's curiosity was aroused. He purposely grew a quantity of the *penicillium* mould. Then he inoculated some germ cultures with extracts made from the medium in which the mould had grown. The result was that the germs refused to grow in their various media and that, in some instances, they were actually destroyed.

It became obvious that the extract of the medium in which the *penicillium* mould had been grown contained some substance which exerted a powerful antiseptic effect upon certain types of bacteria. To this mysterious substance the name "penicillin" was given, although its chemical nature was at that time entirely unknown.

Although some investigational work on the chemical products of mould growth had been done previous to Professor Fleming's discovery, surprisingly little was known ten years ago about these products. The Fleming discovery, however, gave a fillip to chemical research in this direction, and a number of investigators got to work without delay. Work on this subject is still proceeding, and even within a few short years, several new compounds derived from the growth of common moulds have been discovered, the majority of which are highly antibacterial in nature.

There is no doubt at the present juncture that penicillin is by far the most powerful of these new bactericides. It has been proved to be an extremely potent antiseptic. A solution containing 1 part of penicillin in 25 million parts of water has a strong bactericidal action. Hence, penicillin is far more powerful than even pure carbolic acid.

The great advantage of penicillin as a germ-killing agent is that its action is quite unaffected by the presence of blood, serum, mucus or pus. Moreover, it is non-poisonous to humans. It can be injected directly into the blood stream without ill effect. Consequently an injection of penicillin given after an individual has received any bodily injury will go far towards completely preventing the appearance of any sepsis or mortification.

In the incubator room showing cultures of the mould, one of the penicillium series, in flasks. Numerous series of moulds are grown for testing for anti-bacterial activity.

That is why penicillin is in such demand among the modern armies as an almost certain life-saver. Apart from this use, however, it is very possible that penicillin or, at least, other compounds of its class, will figure largely in diminishing the future mortality rates of many other civil-life diseases, the various fevers, for instance, to say nothing of the present-day often ineradicable bronchitis and similar chronic complaints.

Laboratory cultures of moulds used for research purposes in the investigation of the new mould-made antiseptics.

Chromotographic Separation

Penicillin has not yet been synthesised or created artificially. Its precise chemical composition is not yet known, and until such details are available its synthesis will remain impossible.

Owing to the fact that penicillin is only produced in small amount by the mould *penicillium* and that it is somewhat liable to become oxidised, this new substance is very difficult to manufacture on the commercial scale. Its manufacture, however, is being tackled in America by dint of extracting mould cultures with a mixture of amyl acetate and water. The mixture is then subjected to the new technique of chromotographic separation, which latter, in its essentials, consists of allowing the mixture to percolate through a column containing some absorbent material such as aluminium oxide. It is found that, by this means, one component of a mixture is absorbed by the aluminium oxide at the top of the column whilst another component will be absorbed and retained lower down. By dissolving out the various "bands" or areas of the chromotographic column with suitable solvents a fairly good separation of complex mixtures can be achieved.

It is, therefore, by this new chromotographic method that all penicillin extracts are purified. No doubt, after the true composition of this remarkable compound is clearly known, it will become possible to manufacture the material in much larger amounts and by far more convenient and speedier methods. At the present, however, penicillin production is one of the most tedious of processes in chemical industry, yet so valuable is this novel material that it is being eagerly sought after by medical science the world over.

Notatin

Another ultra-powerful antibacterial substance has been recently isolated from media in which the mould *penicillium notatum* has been grown. To this new material the name of "Notatin" has been given. Whether notatin is a mixture of penicillin and some other unknown substance, or whether it is a single chemical compound, is not yet known. One thing, however, is certain. Notatin is capable of stopping bacterial growth in dilution as high as one part of notatin in *one billion* parts of water. Notatin seems to be more stable than penicillin, and if it is a pure substance it must also be considerably more powerful in its antibacterial activity than the latter.

Within the last year or two, other mould-grown chemical materials have been brought to light and examined. Without exception these have all shown themselves to be highly bactericidal in properties. Puberulic acid, puberulonic acid, penicillic acid and citrinin are but four of these newly revealed antibacterial compounds. These are not so potent as penicillin itself, but they seem to be much more readily obtained, particularly the compound, citrinin.

The value of these latter substances lies in the fact that the chemical structure of them is now known with some degree of certainty. This being the case, they may in all probability be made to act as "models" upon whose structural design the creation and synthesis of other and more potent antibacterial compounds may be based.

Spinulosin and Fumigatin

Two more interesting "mould compounds" are spinulosin (made from the mould, *penicillium spinulosum*) and fumigatin (derived from *Aspergillus fumigatus*, an entirely different type of mould). Both spinulosin and fumigatin have been successfully analysed and synthesised. Whilst spinulosin is only a relatively weak bactericide, fumigatin has powerful antibacterial properties against the bacteria of anthrax and cholera. As in the case of the previously mentioned substances, both spinulosin and fumigatin will probably function as models for the artificial creation of other compounds of greater potency by future chemical researchers.

The majority of the new antibacterials, when they have been obtained in pure form, have shown themselves to be solid, strongly crystalline substances which are soluble in water and various other liquids. Most of them are colourless, but a few, notably spinulosin and fumigatin, are coloured. Thus, for instance, spinulosin takes the form, when pure, of purplish-brown crystals, whilst fumigatin is maroon coloured.

It is with these new compounds prepared from common moulds that the bactericidal branch of chemotherapy is at present achieving its almost spectacular successes. From comprising the out-of-the-way research subject of a few isolated chemical enthusiasts, mould chemistry has suddenly become a commercial proposition, and is, at the present moment, being prosecuted assiduously in that direction, for, with these strange and peculiar mould-made compounds it seems likely that the ideal of that intrepid pioneer, Paul Ehrlich, may yet be reached and that selective antibacterial substances will be discovered which, whilst being deadly to their own particular strains of germs, will be perfectly innocuous to all forms of human and animal life.

The new technique of injecting harmless germ-killers and antiseptics directly into the blood of a patient in order to overcome the danger of infection from accidental injuries and wounds.

An Aid to Efficiency

A VERY useful and ingenious addition to rapid calculation equipment has just been introduced by W. J. Steel and Co., Ltd., of Bedfont, Middlesex. It is registered as the "Confractor" and is a most compact conversion table of inches to millimetres and vice-versa, covering a range from 1/128 part of an inch to 6 15/16 inches and one to 100 millimetres. The "Confractor" comprises three discs each about 1/32 inch thick made from an almost indestructible plastic material and the discs are fastened together in the centre with a brass eyelet so that they rotate upon each other. A slot is arranged on the left hand side of each outer disc, to reveal the figures boldly printed upon each side of the middle disc and the devised conversion is obtained by simply rotating the disc. The range of conversion data provided is upon the following generous scale:

(*A*) *Inches to Millimetres (to seven decimal places)*

Reading through the slot on one side of the "Confractor" the table groups the conversion in ½, ⅛, 1/16, 1/32 and 1/64 inch stages and at the same time gives the equivalent of the fractions to six places of decimals.

(*B*) *Inches to Millimetres (to seven decimal places)*

Reading through the slot on the opposite side of the "confractor" the odd numerators of 128th parts of an inch are converted to millimetres and the equivalent of the fractions to seven decimal places are also given.

(*C*) *Inches to Millimetres*

Reading on the surface of one outer disc the millimetres equivalents are tabulated to two decimal places from 1 inch in stages of 1/16th inch up to 6 5/16th inch.

(*D*) *Millimetres to Inches*

On the surface of the other outer disc the inch equivalents to five decimal places of one to fifty millimetres is given progressively and then in stages of five up to one hundred millimetres.

The "Confractor" is being distributed solely by the above firm at the reasonable price of 4s. 6d.

Engineer-built Houses of the Future—12

(Continued from page 88, December issue.)

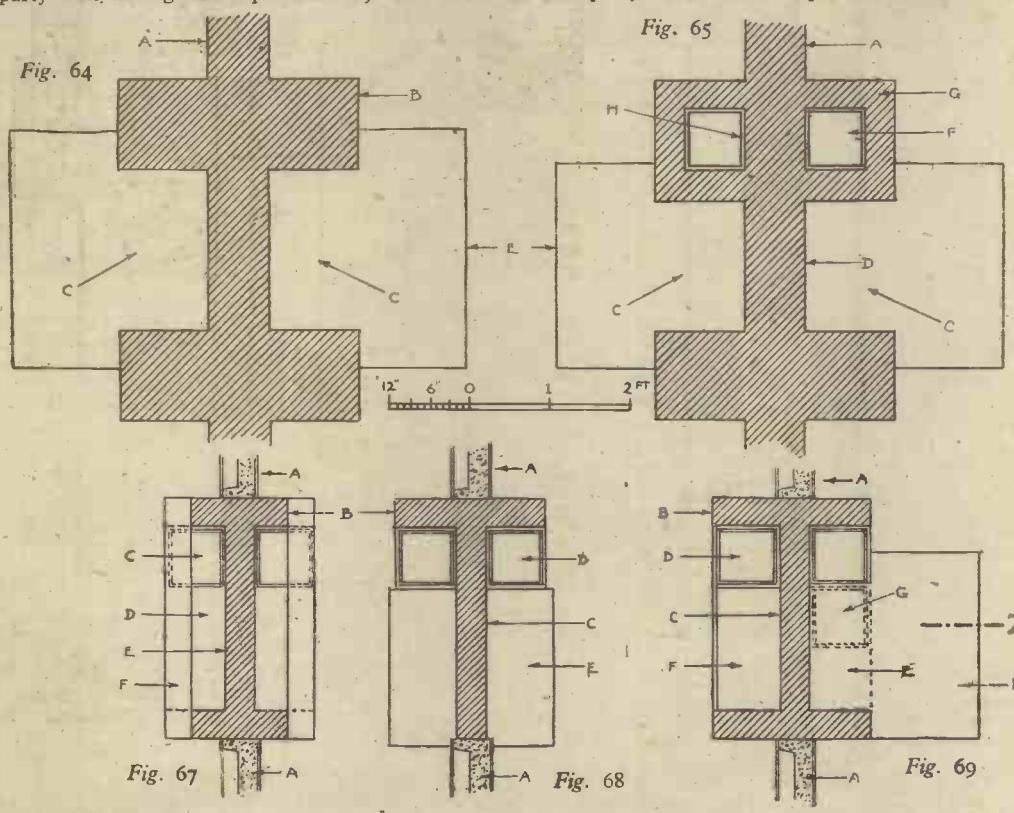
Party Wall Construction—Solid Fuel, Gas and Electric Fires in Pre-built Houses : The Wiles of Jerry Builders

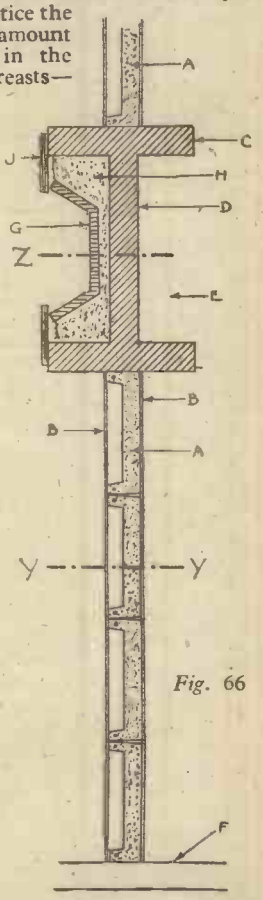
By R. V. BOUGHTON, A.I.Struct.E.

Party Wall and Fireplace Construction

THERE are three rather important differences between party walls, which divide two houses, and external walls: (1) a party wall requires a higher degree of acoustical insulation than an external wall because of the need to prevent all normal sounds from one house being transmitted to the adjoining one; (2) a party wall needs to be more reasonably fire-resistant than an external wall; and (3) although a party wall can be designed to take a good proportion of floor and roof loads, more often than not the majority of such loads are borne by external walls and internal partitions—there is often a temptation to the structural designer to avoid letting floor units bear on party walls unless the method of construction is such as will ensure reasonable immunity of sound transmission to the adjoining house, and fire risks in the case of floors built with timber. A study of the general structure of a pair of semi-detached houses will show (a) that a party wall having no fireplaces in it, and not having any or much lateral support by, say, a first floor being adequately secured to it, can have a very high slenderness ratio between its base and roof level; it is quite probable, in the case of a two-storey house, that the height of the wall will be about 18ft., and if the wall is only 6in. thick, the slenderness ratio will be 18ft. divided by ½ft. equals 36, which is far too great. Therefore it is essential that if adequate lateral support is not provided by the first-floor construction bearing on and being properly connected to a party wall, means must be adopted to ensure a degree of unity between the wall and floor units so that adequate lateral support is provided. If the side of a floor unit is parallel to the length of a party wall, and the unit is rigid, it is only necessary to tie the side of the unit to the wall to make certain that lateral support is provided; and the tying may be done effectually by stout metal clips well screwed to the floor units and bedded and fixed to the party wall units; (b) that a party wall having solid fuel (coal, coke, etc.) fireplaces constructed in conjunction with it; such fireplaces having breasts which project beyond the faces of the party wall will considerably strengthen the wall by strongly buttressing it. Although parts of the party wall between external walls, partitions and fireplaces are not actually buttressed, they are, however, of short length; by this is meant that such parts of the party wall may be considered as partly governed by a horizontal ratio of slenderness based on the distance between the external walls, partitions and fireplaces.

Before considering the construction of party walls and fireplaces of engineer-pre-built houses, I recommend a careful study of traditional methods of brick party wall and fireplace construction as shown by Figs. 64 and 65. Notice the considerable amount of brickwork in the fireplaces and breasts—





Figs. 64 and 65.—Traditional methods of constructing brick party wall and fireplaces, etc. Fig. 64 is ground storey and Fig. 65 is first storey construction. A—Party wall. B—Fireplace jamb. C—Fireplace opening and back hearth. D—9in. thick brick back. E—Front hearth. F—8in. by 8in. flue. G—4½in. thick brickwork. H—Parging.

Fig. 66.—Plan of party wall and fireplace in ground storey of engineer-built house. A—Concrete pre-built party wall units. B—Insulated wall covering or finish. C—4½in. thick brick (or concrete) fireplace jamb. D—4½in. thick brick fireplace back. E—Solid fuel (coal, coke, etc.) fireplace opening. F—External wall. G—Firebrick back. H—Fine concrete. J—Surround.

Fig. 67.—Plan of fireplace just over fireplace opening. A—Party wall. B—Jamb. C—Base of flue. D—Throat to fireplace. E—Fireplace back. F—Concrete lintol.

Fig. 68.—Plan of fireplace at shelf level. A—Party wall. B—Jamb. C—Fireplace back. D—Flue of metal construction with exposed faces lined with metal or other material to suit æsthetic requirements and to make the exposed faces as flat heat radiators. E—Shelf.

Fig. 69.—Plan of fireplace in first storey. A—Party wall. B—Jamb. C—Fireplace back. D—Flue as before described from ground storey fire. E—Solid flue fireplace opening. As this opening is comparatively small and suitable for a small fire, it may be used for a gas fire. F—Upper part of fireplace opening joined to suit type of fire used. G—Flue over. H—Front hearth.

the width and projection into the rooms—and, if the sizes of concrete bases and stacks in and above roof are borne in mind, it may be evident that this traditional, heavy and really wasteful method of construction can be superseded by much better, lighter and more economical (if all direct and indirect advantages are analysed) methods of design and construction. I am aware of the essentials which govern fire-resistance, upward draughts, and other vital codes of practice of fireplace, etc., design, but I am also aware that all these essentials can be met by adoption of better methods—many new, at least as far as this country is concerned, but which in some cases accord to general principles which have been used successfully in other countries.

Fig. 66 depicts part of the length of a party wall between two houses and a ground storey fireplace for solid fuel. It is interesting to note the great difference in the amount of brickwork—or it may be concrete work—in the two methods of construction shown by Figs. 64 and 66.

Pre-built Party Wall Construction

There is a school of thought which advocates traditional methods of construction for party walls of pre-built houses—viz., the use of brickwork. The reasons advanced are that brickwork is fire-resisting, it allows for the comparatively easy construction of fireplaces, etc., and, if well built, is a reasonable insulator against sound. These reasons have a good foundation of common sense; but against them modernists offer the following contributions on behalf of the betterment of building: (1) that concrete, and reinforced concrete, may be comparatively thin compared with brickwork and therefore save space, weight, and, what is by no means unimportant, an appreciable reduction in base and foundation work; (2) that concrete, and reinforced concrete, can be pre-built (brickwork cannot), and (3) they can be combined with sound insulating sheet material to ensure a thin wall being satisfactorily fire-resistant, proof against normal noises, and can be covered with any of the various classes of wall boards.

Figs. 66 and 70 show the use of 18in.-wide reinforced concrete units covered with insulating material and wall boards. The

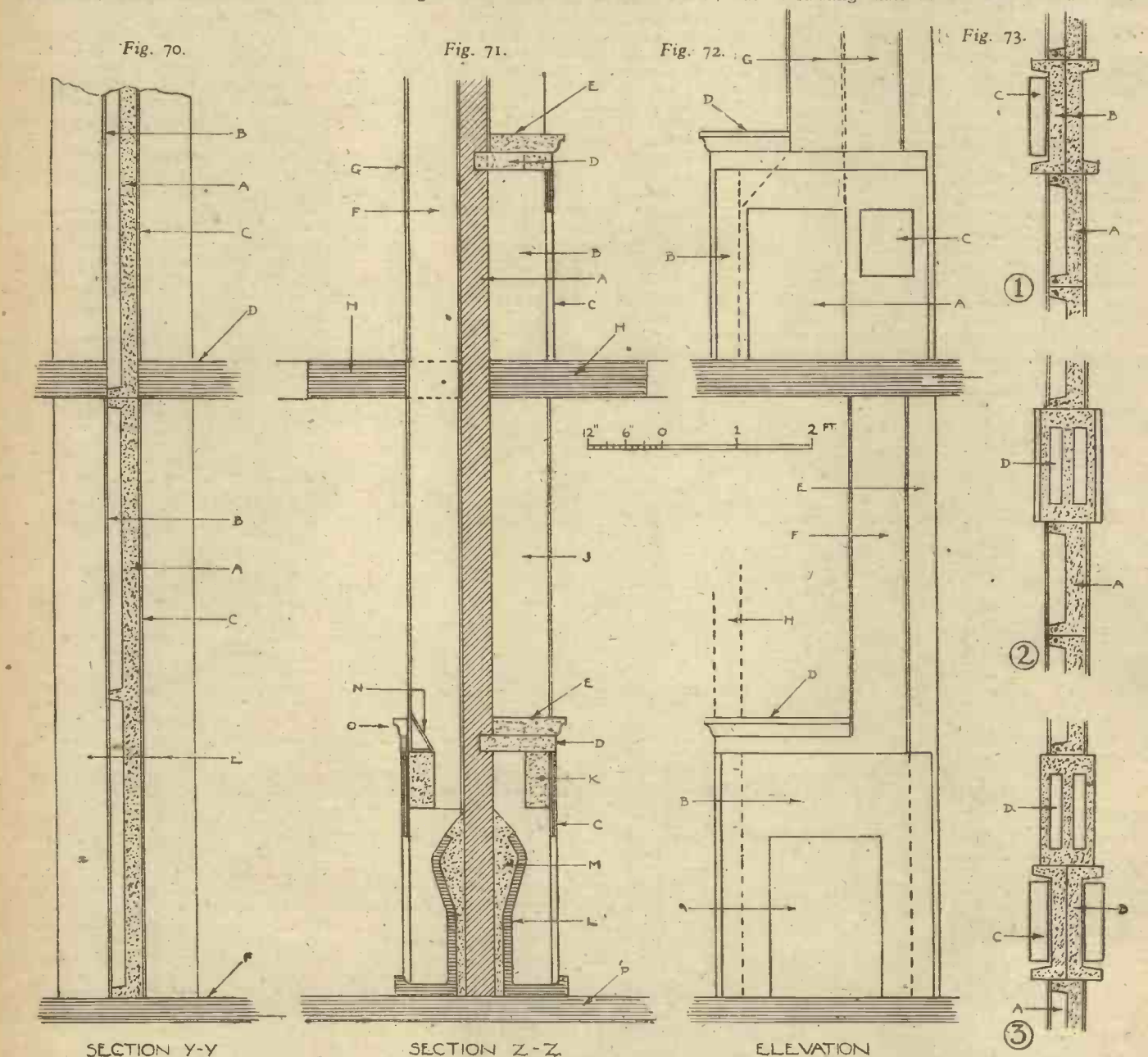


Fig. 70.—Section through party wall shown by Fig. 66. A—Concrete pre-built party wall units. B—Insulated wall covering or finish with hollow space behind. C—Insulated wall covering or finish applied to solid part of concrete units. D—First floor. E—Side of fireplace. F—Ground floor.
Fig. 71.—Section through fireplaces and chimney breast shown in plan by Figs. 66 and 69. A—Fireplace back. B—Fireplace opening. C—Surround. D—Structural concrete slab over opening with aperture to take metal throat of flue. E—Concrete (or other material) shelf. F—Metal flue and radiator as before described. G—Face of flue. H—First floor and hearth. J—Side of flue. K—Concrete lintol. L—Firebrick back. M—Fine concrete filling. N—Flue shaped to form throat over fireplace opening. O—Shelf in distance. P—Ground floor.
Fig. 72.—Elevation of fireplaces and space-saving flue and breast construction. A—Fireplace openings. B—Tiled or sheet material surround to opening. C—Electric fire. D—Shelf. E—Brick (or concrete) jamb. This may be omitted if desired and is not required for any superstructure. F—Face of flue. G—Twin flues. H—A brick jamb can be built here if desired for any structural purpose.
Fig. 73.—Plans of party wall with gas fire openings and flues. 1—Ground floor level. 2—Gas fire flues in ground storey. 3—First floor level. A—Pre-built party wall units. B—Gas fire openings. C—Gas fire. D—Flue blocks.

design allows that the first floor will provide adequate lateral support to the party wall at first-floor level, and, even if there was no fireplace construction, structural stability will be ensured. Another method is to include a beam at first-floor level running in the direction of the length of the party wall, such beam making the effective height of the wall units about 8ft., and if they are 6in. thick the slenderness ratio would be 16, which is quite good. If the party wall contains fireplaces, they form excellent buttresses and also bearings for any beams used in the party wall. There are, of course, several types of party wall units which may be used in lieu of those shown, and according to structural requirements they may have their lengths either horizontal or vertical.

Solid Fuel Fireplace Construction

We have become too accustomed to orthodox or traditional methods of structural and æsthetical design of fireplaces, and I am a strong believer that the public are only too willing to accept any modern methods which can be proved to be better than those which our ancestors gave us. The public are becoming used to electric and gas fires; but it is generally accepted that they really do like one or two coal or solid fuel fires in a house, and, consequently, it is advisable that designers of pre-built houses be prepared to cater for this liking.

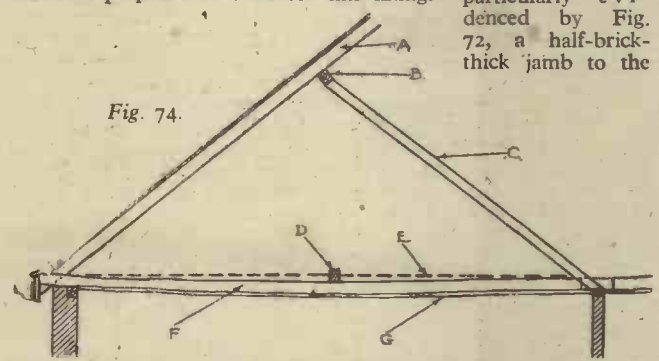


Fig. 74.

But, in such catering, it is just to conclude that much saner methods than those which have prevailed for hundreds of years can now be adopted in view of what modern science has taught, is teaching, and will teach us. A very high percentage of the heat of an ordinary coal or coke fire goes up the chimney and is completely lost—completely lost and wasted, unless it can be argued that a little heat is given off from a flue which passes through a wall of a room. Subject to ensuring sufficient draught up a flue, and prevention of down-draught, it is practicable to utilise much of the heat which goes up a flue for heating specially and simply constructed panels adjacent to the actual flue, or, in other words, not to use thick brickwork for surrounding a flue, but, instead, to use metal in the form of a flat radiator. This method of flue construction is in principle shown by Figs. 67 to 69 and 71 to 72. It will be noticed that the structural design eliminates all forms of construction used merely to give what may be termed æsthetical balance and symmetry. In my view space should be of utilitarian value, and I suggest that the space to the left of the flue constructioan as Fig. 72 is much more useful for shelves, etc., than if it is blocked in with a useless mass of construction simply for the purpose of providing what some consider "good appearance."

In connection with the general principles of fireplace construction which I advocate, a few points of interest and importance may be now considered. The use of brickwork does mean "wet-construction" on site, which pre-building principles endeavour to avoid as much as possible; but in this respect it should be granted that "wet-construction," if it is for the betterment of building, should not be discarded. If the designs are studied it will be apparent that very little brickwork is incorporated: there is no heavy work, and no wasteful foundations, because the lightness of the construction makes it practicable to build the brickwork directly on the concrete floor or on a very simple and small concrete base; most of the brickwork can be built without scaffolding, and that above "first scaffold height"—5ft.—can be built off trestles. Although I have shown by the various illustrations, and which is particularly evidenced by Fig. 72, a half-brick-thick jamb to the side of the flue, extending the full storey height, this jamb can be omitted. But it must be realised that such jambs are sometimes necessary to assist in supporting the fireplace work in the storey above if there is no solid foundation, such as a concrete floor, to provide support. Cast iron or sheet metal flue pipes are a practical proposition, and they can be treated so as to radiate heat or be insulated against heat when adjacent to inflammable material. Initially, they may be rather costly; but against this cost must be set many direct and indirect savings, such as reduction in brickwork and other traditional structural work, and heat-conserving powers. If all these considerations are analysed in a financial light, it will be found that the advocated modern methods will be cheaper than the old heavy type of brick fireplace construction depicted by Figs. 64 and 65.

I have for a good reason not shown how the fireplace construction may terminate at roof level in various ways; these depend on the type of roof.

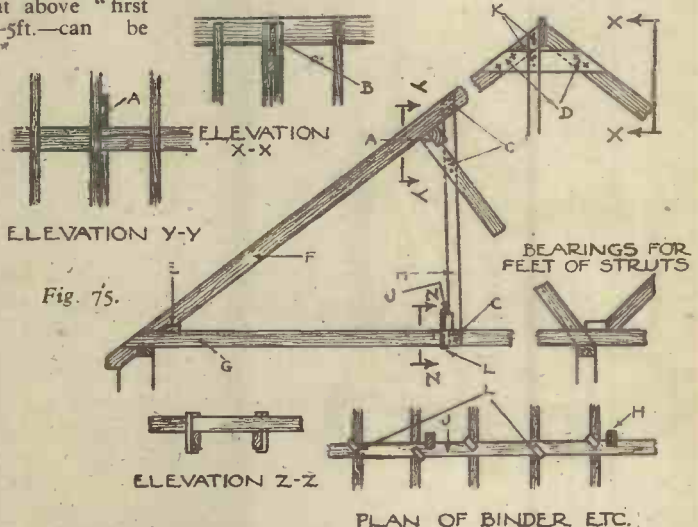


Fig. 75.

Fig. 74.—Part section of a typical jerry-built roof. A—Common rafters. B—Purlin. C—Strut usually of ill-considered size, shape, etc. D—"Binder," viz., a length of 3in. or 4in. by 2in. timber laid across top of weak ceiling joists, the binder and joists being nailed together. The object of this form of construction is to prevent the ceiling joists twisting, to assist in distributing any point loads over several joists, and does little to prevent the 4in. by 2in. ceiling joists, which usually span twice the distance they should, sagging and cracking the plastered ceiling. F—4in. by 2in. ceiling joists. G—Plastered ceiling.

Fig. 75.—How a house roof should be constructed (engineer pre-building allows for entirely different methods of construction). A—Purlin. B—Packing. C—Nailed joint—2 nails each side. D—½in. bolts. E—3in. by 2in. tension plate which being birdsmouthed with common rafters and notched into ceiling joists, provides strong resistance to thrust of rafters and pull of joists. F—Common rafters subject to compression and bending stresses. G—Ceiling joists which may be of small size, such as 3in., 3½in. or 4in. by 2in., depending on their span between binder and other ceiling joists sagging. J—Binder in plan. K—Nailed joist. L—W.I. straps which form a joint between ceiling joists and binder, which is as strong as the members they connect.

N.B.—This method of construction is intended to conform with the good L.C.C. by-laws for timber construction which are followed by many local authorities outside London area. These by-laws require ceiling joists to be of about the same size as floor joists for domestic buildings.

Gas and Electric Fires

Gas fires require small flues to carry off the fumes, and Fig. 73 shows how these may be incorporated in party walls, and very similarly in external walls. Manifestly, the type of construction provides practically no buttressing effect to walls.

The Wiles of Jerry Builders

Fig. 74 shows a typical part section through a timber house roof—a type of construction which can be seen in many hundreds of thousands of roofs to houses. In fairness to jerry builders, I must state that unless they have a knowledge equal to that of a first-year student of elementary building construction they are not entirely to blame for constructing house roofs which generally foul the most elementary canons of decent construction and the laws of mechanics of structures. An examination of the timber members of a vast majority of the roofs over houses will provide evidence that rafters and purlins usually conform to by-law requirements, and struts, which are exceedingly important members, and are not adequately regulated as to size by the pre-1939 by-laws, are usually of wrong design. Joints, which should be at least as strong as the members which they connect, are not strong enough, and often ill-constructed. Ceiling joists, usually 4in. x 2in., span ridiculously too long spans and consequently deflect and cause plastered ceilings to crack and look like an inverted undulated country scene; and that such weak ceiling joists are supposed to be strengthened by "binders," which are bits of timber placed across the top of, and nailed to, the ceiling joists, which are viewed by structural engineers with the same contempt as a modern mother does the use of binders—a few yards of super-wide tape into which a baby is enveloped on the rolling-pin method.

The construction of many roofs over jerry-built houses is really appalling—good and valuable material mostly wasted, as far as strength is concerned, by designing and constructing without knowledge of even the elementary laws of construction.

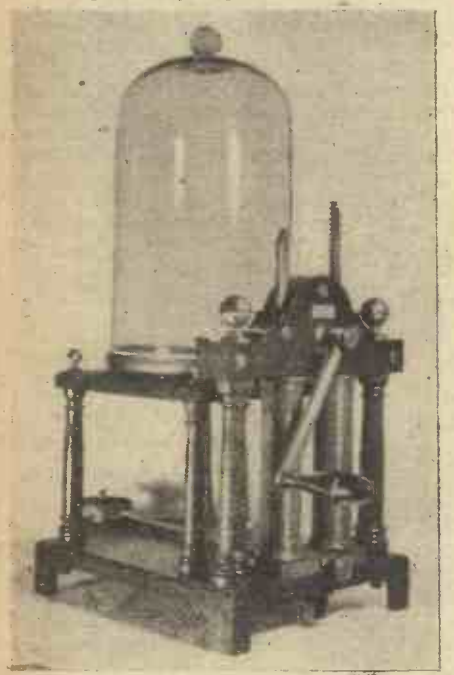
(To be continued)

The Story of Chemical Discovery

The Chemistry of Combustion

Underlying Features of Fire and Flame

THE circumstances under which fire and flame, those twin chemical phenomena, were first brought to the notice of mankind have many times been speculated upon. The truth is, of course, that we have no idea of how man first became practically acquainted with the uses



An early double-cylinder air-pump, such as was used for pioneer experiments on the nature of combustion.

of fire. Such an acquaintance may have been consequent upon a lightning storm, a volcanic eruption, the natural heat of the sun's rays, frictional effects, or even upon some untoward incident of spontaneous combustion. All we know is that mankind made practical use of fire and combustion at a very early period of its history, and, without any doubt, man's continued usage of fire and flame underlies a very great proportion of his truly remarkable command over Nature.

Fire and flame are inherently chemical processes and chemical effects. Yet they were known and made use of for unknown thousands of years before their real nature first dawned upon human reason. Putting aside the ancient pseudo-scientific philosophers who at times speculated wildly and almost fantastically on the nature of fire and flame, the first man to put on record a reasonable observation concerning combustion was that great and many-sided Italian genius, Leonardo da Vinci, who, towards the end of the sixteenth century, noted down in his writings the fact that air is necessary for the maintenance of the flame of a burning candle. Our English philosopher, Robert Boyle, one of the first members of the English Royal Society, noticed, in 1661, that a flame would go out for "want of air." He performed several experiments with his newly-devised air pumps by means of which he gradually pumped out the air from a glass vessel containing a burning candle. Invariably the flame of the candle was extinguished after a certain proportion of the air had been withdrawn from the vessel.

Robert Boyle definitely proved that air is necessary for flame and combustion. Also, a most significant suggestion was thrown out by his brilliant contemporary, the curious, crotchety Dr. Robert Hooke, first secretary of the Royal Society in Charles II's time. Hooke threw out the idea that ordinary air contains a substance "which is like, if not identical with, that which is fixed in saltpetre."

Lightning has been credited with being the first fire-giver to mankind. This photograph of a single lightning flash was taken on a summer's night in Manchester.

We know nowadays how accurate old Robert Hooke was, for air contains oxygen, and so does saltpetre (potassium nitrate), a fact which enables the latter to play its well-known part in the production of gunpowder, and other highly combustible and explosive mixtures.

Mayow's Experiment

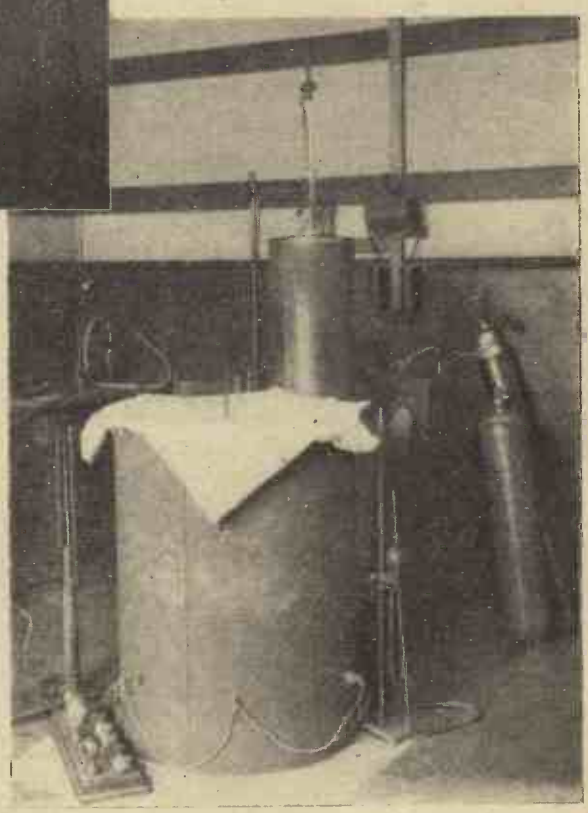
Then, about the year 1674, came John Mayow, an English physician, who devised an experiment in which a candle was burned in a confined space over water. After a time the candle flame went out and the water-level rose in the enclosing vessel. Although the candle-flame had been extinguished, some gas remained in the enclosing vessel or jar. Hence, Mayow concluded that air contains two substances or "particles," as he termed them, the "nitro-aerial particles" which were withdrawn from the air during the burning of the candle and the ordinary "aerial particles" which had nothing to do with the burning and which were left behind in the jar.

Mayow showed, also, that a similar effect happened when, instead of a burning candle, a live mouse was confined in a jar of air standing over water. The water gradually rose in the vessel and eventually the mouse died, proving thereby that during its breathing it had abstracted from the enclosed volume of air the same active principle which the burning candle had made use of.

John Mayow was on the very brink of the true and rational explanation of flame and combustion. For all that, he missed such an explanation of the revealed facts, mainly because the chemical science of his day was so extremely immature and fragmentary.

In the eighteenth century, the experiments of Mayow became forgotten. The "phlogiston" theory of heat and combustion arose and held the day for many years until it was finally vanquished by the discovery of oxygen and the recognition of its true part in the phenomenon of combustion.

The phlogiston theory has previously been described in this series of articles. For the benefit of the new reader, however, it may be stated briefly that "phlogiston" (from



An electrical apparatus for determining the precise ignition temperatures of gases and vapours. The gas is stored in the small gasholder shown in the foreground. It is then allowed to flow into the tall cylindrical electric furnace behind the gasholder, in which chamber the temperature of its ignition is electrically recorded. (Prof. H. B. Dixon's apparatus—University of Manchester.)

A modern reproduction of Mahow's experiment on the burning of a candle in an enclosed space above water.

the Greek, *phlogisteo*, "I set on fire") was considered to be a very mysterious, imponderable, invisible and even a weightless substance which was a constituent of all combustible materials. When a combustible substance was burned, its stock of phlogiston escaped from it, either wholly or in part. Fire, flame and combustion, therefore, were merely phenomena connected with the escape of this remarkably tenuous and, indeed, truly fantastic substance or principle, "phlogiston."

"Last of the Phlogistonists"

Right through the not inconsiderable chemical development of the eighteenth century, the phlogiston theory of fire and combustion held the field. Even the Rev. Joseph Priestley, the Yorkshire dissenting cleric who discovered the gas which we nowadays call "oxygen," fanatically clung to and defended the phlogiston theory to the very end of his life, a fact which has gained for this worthy individual the somewhat dubious title of "the last of the phlogistonists."

It was the great Antoine Lavoisier (1743-94), the politician-chemist who was executed during the French Revolution, who founded our modern theory of combustion. This he did merely by replacing "phlogiston," by oxygen. In consequence of the careful work of Lavoisier and others, chemists came to realise that oxygen, the ever-present constituent of the air, is the universal supporter of both animal life and combustion. When a substance burns it abstracts oxygen from the air. When an animal breathes, it does the same thing. Burning and breathing are merely two different aspects of the same thing; they are both oxygen-using processes.

How near had old John Mayow been to the truth nearly a century before Priestley, Lavoisier and their contemporary workers were ever thought of!

Lavoisier founded our present-day knowledge of fire, flame and combustion, but he did not live long enough to delve into any great semblance of detail concerning them. He merely demonstrated the chemical nature of fire and combustion. The explanation of the actual "mechanism" of these chemical processes was to come at a considerably later date.

Burning is Oxidation

We know nowadays that when a substance burns, its atoms (or a portion of them) enter into chemical union with the atoms of oxygen in the surrounding air, forming an invisible gas which at once escapes from the sphere of the burning. Burning, therefore, is merely a species of oxidation. So, too, is animal breathing, the rusting of iron

The miner's lamp, an indispensable aid to coal-mining. It is based on the simple principle illustrated in the diagrams given below.

and the tarnishing of many other metals.

Clearly, however, something more than mere contact of the oxygen atoms and the combustible material is usually necessary to start the burning. We may stand a candle in a jar of oxygen for ever and a day, but, under normal circumstances, the candle will never take fire of itself. The truth is that, normally, before the groups of atoms which are susceptible of combustion changes can be made to take part in a process of combustion they have to be, as it were, "activated." This activation is usually brought about merely by raising their temperatures. When a body undergoes a temperature-rise the movement of its constituent particles or atoms increases. When this atomic movement becomes sufficiently intense, the oxygen atoms and the atoms of the combustible substance attract one another. They enter into a chemical union, this process usually being carried out with so great a degree of violence that the atomic and molecular movements become manifest to us by their production of light and heat.

Without going into elaborate detail over this matter, we may now state one very clearly observed fact. It is this: Before any combustible material can undergo the process of burning, it must first of all be heated up to a certain minimum temperature, which temperature is now known as the *ignition point* of that material. The ignition point once reached, combustion or burning proceeds continuously and automatically so long as the necessary supplies of oxygen are available.

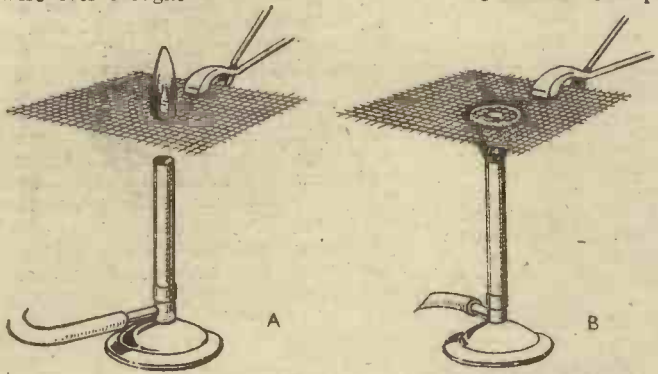
Ignition Point and Flash Point

Great care should be taken to distinguish the term *ignition point* from the expression "flash-point," which latter is very much used in industrial circles in connection with the properties of liquid fuels and oils. The "flash point" of an oil is the temperature at which it begins to give off an inflammable vapour, whereas the *ignition point* is the temperature to which that vapour must be heated (locally) for its combustion to be initiated. Careful reflection will show that there is a vast difference between these two terms. Flash points are usually relatively low; ignition points or ignition temperatures are normally high, being well above the 500 degrees centigrade mark.

A few materials, however, have abnormally low ignition temperatures, notably that evil-smelling liquid known as "carbon disulphide," the vapour of which requires to be locally heated to only a temperature of about 95 degrees centigrade (below the temperature of boiling water) for it to ignite and to burn continuously.

Once a substance has been raised in temperature to its ignition point, the heat of its ensuing combustion enables successive amounts of the substance to attain the necessary ignition temperature, and thus the combustion process becomes automatic.

The process of burning at once stops when we cool down the burning substance below its ignition temperature. A well-known laboratory experiment clearly demonstrates this fact. If a piece of wire gauze is held about half an inch above a bunsen burner from which gas is issuing, and if a light is applied *above* the gauze, it will be



The principle on which the miner's safety lamp is based. Sketch A depicts the flame of a bunsen burner igniting above the wire gauze. At B the flame is shown burning below the gauze; in both instances the cooling effect of the gauze prevents the upward or downward spread of the flame.

"Electrical flame"—a photograph of the flame of white-hot, glowing carbon vapour existing between the carbon electrodes of a high-power arc lamp.

found that the gas will burn above the gauze but not below it. This effect is due to the cooling influence of the gauze on the gas, for the wire gauze conducts away heat so rapidly that the issuing gas below the gauze is not able to attain its ignition temperature. Only after the wire gauze has become red hot does the gas stream below the gauze take fire in consequence of its then being heated up to its ignition point.

Again, if a cool piece of wire gauze is brought down on to the flame of a bunsen burner, the gauze at once extinguishes the flame above it. Nevertheless, the gas passes through the gauze, as can be proved by igniting it above the gauze by means of a match.

The Miner's Lamp

This cooling power of a wire gauze in forcing down the temperature of a burning gas below its ignition point and thereby extinguishing the flame was brought into valued use by both Sir Humphrey Davy, the chemist, and by George Stephenson, the engineer, in the production of miners' lamps. In these lamps, the burning wick is surrounded with a wire gauze cage. Although any combustible gas, such as the "fire-damp" of the mines, can pass into this cage and can actually burn *within* the cage, the flame of its burning cannot pass outside the wire gauze and so ignite the gas in the surrounding atmosphere. By this simple means, the "safety lamp" at once established its position of industrial importance at the beginning of the last century.

The difference between burning and rusting is merely one of degree and not of kind. Burning and rusting, as we have previously seen, are both processes of oxidation. Burning is a rapid oxidation. Rusting is a slow oxidation. It is possible, however, to have what we might term a "rapid rusting," for if iron is heated to a white heat and plunged into a jar of oxygen, the metal will actually take fire and burn with a dazzling white light, producing a compound of iron and oxygen—iron oxide. It is true that the black iron oxide produced by the oxygen-burning of iron is not precisely the same as the red oxide produced by the slow rusting of the metal. Nevertheless, the two principles are identical, the rusting and the burning being merely processes of oxygen-combination, or, "oxidation," as it is now called in modern chemical parlance.

Flame and fire are due to rapid combustion. The rusting of iron and the tarnishing of many metals are caused by slow combustion. Certain oils, such as turpentine and linseed oil, very slowly absorb oxygen from the air (particularly under the influence of traces of materials known as "driers") and become solid. Here again is a species of slow oxidation which we are everyday acquainted with, since it is on this characteristic property of turpentine and other oils that the properties of the older types of paints are based.

Spontaneous Combustion

In some circumstances, oxidation may proceed slowly at first. But, given certain conditions, the heat of the oxidation may not be dissipated adequately. Consequently, the produced heat will tend to accumulate in the combustible or oxidisable mass of material. As a result of this, the material will heat up still more. Its rate of oxidation will increase. This increased oxidation will raise the temperature of the mass still higher, and having once started, the sequence of effects will be continued until the combustible material will be raised in local temperature to its ignition point. Once this temperature has been reached, the material will at once break out into open fire or flame. It will be said to have "self-ignited."

Such is the explanation of the mysterious cases of spontaneous combustion which we all have heard of from time to time. There is nothing inherently perplexing in spontaneous combustion, although cases of this phenomenon usually occur under mysterious circumstances. Oxidation processes due to mould and mildew attack in hay and hayricks are quite capable of leading up to eventual spontaneous combustion. Such, too, are the well-known heating effects of manure heaps and of other chemically active masses of material. Remember, always, therefore, that spontaneous combustion is merely a matter of a mass of material having had its temperature raised locally above its ignition point by one cause or another, and any profound mystery enshrouding such a conflagration will at once vanish.

The Significance of Breathing

Our bodies, as we have noted, are activated by a combustion process just as much as a steam or an internal-combustion engine is. When air is inhaled into the lungs, the oxygen of the air passes through the thin walls and tissues of the lungs into the mass of blood vessels situated therein, and it immediately forms a loosely-held union with the hæmoglobin, or the colouring-matter of the blood. The resulting oxy-hæmoglobin is bright red in colour. It flows to all parts of the body and its oxygen load is utilised in oxidising or burning up the lactic acid and various other waste products which are formed by the cells, tissues and muscles. Carbon dioxide gas and water are produced in this oxidisation process. The former is conveyed back to the lungs loosely combined with the hæmoglobin: It is then given up and exchanged for fresh oxygen. Hence, we breathe in oxygen and breathe out carbon dioxide, the product of the continual combustion or oxidation which is taking place in our bodies.

Probes and Problems

Some Mental Nuts for You to Crack

(*Solutions are given on page* 135.)

A Poser from Muggins

"You fancy yourself as a mathematician," said my friend Muggins to me the other day. "Here is a little problem for you. I have just spent ten shillings on cigars, buying some at 3d. each, some at 7d., and some at a shilling. How many did I buy of each kind?"

"I can't tell you," I replied, "unless you give me some further information."

"Well," said Muggins, "here is another hint for you. The total number of cigars I bought is equal to half the number of years in your age. Now can you answer the question,"

"No," I told him. "I still can't."

How old am I?

Brides and Their Brothers

"We had a quadruple wedding at our church yesterday," said Albert Hill. "Each one of the brides was the sister of one of the grooms.

"My wife's brother married Susan, and her brother married Miss Gill," he went on. "Mary's brother married my sister. Constance is Mrs. Gill now; and Mrs. Dill's maiden name was Quill."

"It all sounds very complicated," I said.

"Possibly," replied Albert. "But on the strength of what I've told you, you ought to know Clara's married name."

What is it?

A Mathematical Certainty

Here is a little puzzle that may serve as a tribute to our Russian Allies. We are all confident that the SOVIET FORCES spell VICTORY. The problem, therefore, is to substitute figures for letters in the following sum in addition. (Naturally, the same letter always represents the same number.)

SOVIET
FORCES
———
VICTORY
———

League Football

In our local football league Aytown, Beetown, Ceetown and Deetown competed, finishing in that order. Each team played each of the others once, and points were awarded on the basis of 2 for a win and 1 for a draw. If points were equal, position was to be decided on goal average.

Curiously enough, each individual game produced the same total number of goals, although no team made the same score against any two opponents.

Aytown won all their games, with the exception of a draw against Beetown. Ceetown beat Deetown by 4 goals, the latter team failing to score.

It is required to construct the entire league table.

A Geography Lesson

"How many places are there in the world," said Binks Minor, "all the same distance apart?"

"Millions," promptly replied Perkins.

Tomkins scratched his head a little doubtfully. "I don't quite see what you mean," he said. "I suppose you could have dozens of places, each a mile away from the next one."

"Yes," answered Binks, "but the first needn't be a mile away from the last. I mean, supposing London is the same distance from New York as it is from Moscow ——"

"It isn't," put in Tomkins.

"All right, clever. I only said supposing. Then if New York were the same distance from Moscow, that would be three of them. I wonder, could you have more than three?"

"No," said Tomkins.

"Nonsense," said Perkins. "You could have thousands of them."

What is, in fact, the largest number of places that can be found in the world all at the same distance from each other? And, for the benefit of those who like a more difficult problem, what would that distance be? (The diameter of the earth may be taken as roughly 7,920 miles.)

(*To be continued.*)

Vacuum-cleaner Maintenance

How to Carry Out Simple Repairs.

By E. S. BROWN

THERE are few domestic appliances that are appreciated as much as the vacuum cleaner. In these days the purchase of a new cleaner is practically impossible through the wartime restriction of manufacture. Therefore it behoves the possessor of one to spend a little time and patience on it, if he or she desires to obtain the maximum life and service.

Although the general principle of operation is the same, most modern cleaners have evolved into two types. One pattern has an external dust-bag suspended from the handle, whilst the other has the dust-bag enclosed in a cylindrical container.

Special attachments enable one to clean upholstery, heavy curtains, etc. The external-bag machine, however, employs a rather more powerful motor, which results in a stronger suction. It can also be run for longer intervals without emptying the bag, due to its larger capacity.

An impellor, or motor-driven fan, constitutes the main feature in both, and is operated at high speed for creating a vacuum. The air rushes through the material that is being cleaned to fill the vacuum, carrying with it dust and dirt particles, etc. Eventually it reaches the dust-bag, where the air disperses through the fine mesh, leaving the dust, etc., behind.

Some external-bag machines have as an additional feature an agitator, which in principle is a revolving brush driven by the motor through a simple transmission system, mostly by an endless rubber belt.

Inspecting the Motor

From time to time it will be necessary to inspect the motor. In the cylindrical models, remove the air exit cover. In the external-bag type it will only be necessary to remove the top cover to expose the motor.

The motor runs on ball-bearings, which are usually packed during manufacture with a special grease, which runs for extremely long periods without attention, thus obviating frequent lubrication of a rather inaccessible point.

The commutator should next be carefully examined for any accumulation of carbon dust from the brushes in its segment gaps. If such is the case, sharpen a match to a point and carefully remove the dust from between the gaps.

After long use it is to be expected that the commutator will be discoloured and dirty, and in this state is electrically inefficient. To remedy this defect, hold a piece of very fine glasspaper against the commutator with one hand and turn the armature with the other, until it is perfectly clean.

Now replace the glasspaper with a piece of clean rag, moistened with petrol or methylated spirit. Be careful not to over-wet the rag with the spirit, as it is a strong solvent of shellac, which is often used for insulating purposes in the armature. Revolve the armature, changing frequently to clean portions of the rag, until it comes away unsoiled.

To inspect the brushes, remove first the retaining plug positioned at the extreme end of the brush post or guide. A small coil spring will now be seen. Gently pulling upon this will remove the brush from its housing. (Fig. 1.)

It is very rare for the brushes to require attention. Points that should be observed are that they are free from cracks, in which case, of course, renewals will be necessary.

Switch Trouble

With some cleaners the switch is a continual source of trouble. Undoubtedly the wisest procedure to adopt is to leave the switch permanently on, and operate the cleaner by removing or replacing the connecting plug.

Sometimes, however, the trouble is simply caused through the breaking of the small

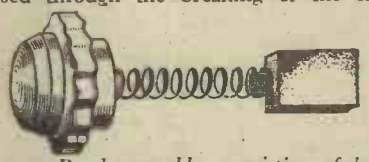
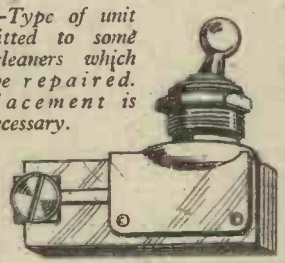


Fig. 1.—Brush assembly, consisting of brush, spring and plug.

Fig. 2.—Type of unit switch fitted to some vacuum-cleaners which cannot be repaired. A replacement is necessary.



coil spring which actuates the snap mechanism. If a similar spring can be obtained, it can be quite easily fixed. One end of the spring should be fixed on to the locating pin, then compressed so that upon release the other end locates itself on the tumbler pin. (Fig. 2.)

As the cleaner's dust-removing properties depend upon good suction, particular attention should be occasionally given to see that the various connections between the machine, hose and accessories are airtight. If a leak is suspected, a smear of soap before assembly will in most cases effect a cure.

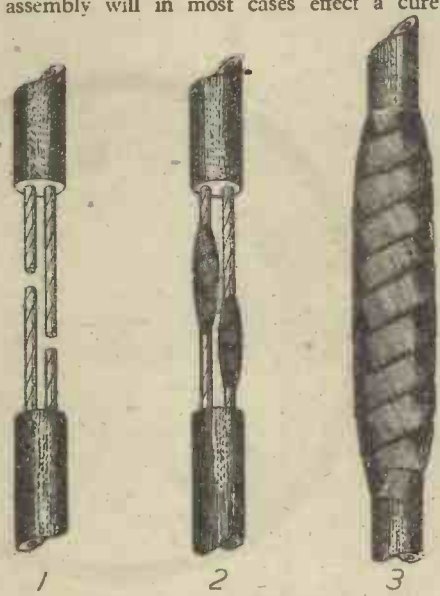


Fig. 3.—Various stages in lead repair. 1. Lead cut, and wires divided in various lengths. 2. Wires joined and insulated. 3. Repair completed.

See also that the end cover fitting on to the cleaner beds down firmly and evenly on to the rubber ring, and that the holding-down clips work satisfactory.

Defective Leads

With a cleaner that has seen much service a somewhat obscure defect sometimes occurs. This asserts itself by the cleaner mysteriously cutting off and on during use. The trouble can usually be traced to the lead carrying the current to the machine having an internal fracture.

With current switched on, carefully bend the lead in alternate directions along its entire length. At one point the movements of the lead will connect and disconnect the current to the cleaner.

It is, of course, far more satisfactory to replace a defective lead with a new one, but in these days such a procedure cannot always be adopted. Therefore, if through necessity or otherwise, it is decided to retain the old lead, a satisfactory repair can be easily carried out.

Incise the lead in two at the point of fracture and, for about 3in. along each length, remove the outer covering to expose the insulated wire beneath. The wires should next be cut into two varying lengths. (See Fig. 3.) Remove sufficient insulation to allow for joining, and preferably solder the respective ends together. Next wind insulating tape very firmly around each join and finish by applying further insulating tape around the entire repair, taking care to provide a good overlap on the severed ends of the lead.

Germs breed prolifically in dust and dirt. A worth-while tip is to slightly moisten a small sponge with a disinfectant, one of the pine oil varieties are very pleasant, and place inside the dust-bag.

Storing

Take particular care where the cleaner is stored. At all costs avoid storing in a damp atmosphere.

The ideal storing conditions should be a place that is well ventilated, dry and cool. The cylindrical model should be stored on end with the motor end undermost.

Dust-bag Repairs

With normal usage the dust-bag should last many years. Should, however, a slight tear occur as the result of an accident, immediate steps should be taken to effect a repair.

The tear should be carefully drawn together with carpet thread, then, after cleaning the surrounding parts, apply some rubber solution liberally on both sides. Two patches of thin calico will now be required. They should be cut to allow at least ½in. overlap all around the tear. Rubber solution should now be applied to the patches, this being well rubbed into the material with the forefinger.

Allow a reasonable time for the solution to thoroughly dry on the parts to be repaired, then apply a second application. When the prepared surfaces are again dry, affix the patches to the tear, one inside, the other out. Press outwards from the middle of the patches, and then firmly fix in place; apply a fairly hot domestic iron to them, maintaining as heavy pressure as possible. After about a minute the repair will be completed.

A Perpetual Calendar

An Easily-made Calendar Which Quickly Gives the Days of the Month for Any Year from 1925 to 1980

BY following the simple instructions here given anyone can make an extremely useful calendar, which, by the simple process of setting the month against the year, will show the correct calendar for that month; it additionally gives the back years as far as 1925, which are sometimes most useful, and goes ahead as far as 1980, which is long enough for most of us to care to think about. The completed calendar is shown in Fig. 1.

The chief parts for making the calendar consist of the "basic circle," shown in Fig. 2, and the calendar front, Fig. 3. To enable readers to easily make up this useful unit we have had the two chief parts printed on tinted card to a slightly larger scale than the illustrations Figs. 2 and 3. By this means it is a simple matter to cut out the parts and assemble them as described below.

Having cut out the "basic circle" save the outside portion, which should be stuck down to another piece of cardboard and then trimmed down to the circle a little larger than the "basic circle" still showing on the card. Now cut out the shaded slits in Fig. 2. Bevel off the $\frac{1}{8}$in. strip round the openings thus cut out, starting with a razor blade, or sharp penknife, and finishing with glass-paper. Whiten over the bevelled edges with ivory-white colour, and cut out the thumb hole shown on the right edge of Fig. 2, and a similar one on a piece of cardboard which will be the backing board. This should measure $5\frac{1}{2}$in. × $4\frac{1}{8}$in.

Readers may obtain the two parts of the calendar in this larger size, printed in two colours on stiff board for 1s. 6d., post paid, from the publishers, George Newnes, Ltd., Tower House, Southampton St., Strand, W.C.2

To assemble, drive a flat-headed nail through the centre hole of the calendar portion (Fig. 2) and through the centre of the circular piece (Fig. 3). Place the parts in position and drive the nail on through the centre hole of the backing board (Fig. 4). Smear glue on the meeting surfaces, press into position, and make all secure with some small fretwork pins along the edges. Glue on at the back a suitably shaped piece of cardboard for a leg, held from going too far back with a piece of tape of a suitable length (Fig. 5). Secure the ends of the tape with glue and cover them over with strips of passe-partout binding tape to make doubly sure.

Having cut a piece of glass to the required size, cut out the semi-circular thumb-hole with a glass cutter and finish the edge smooth with a small carborundum wheel. Finally, bind the complete assembly with passe-partout tape, as shown in Fig. 1.

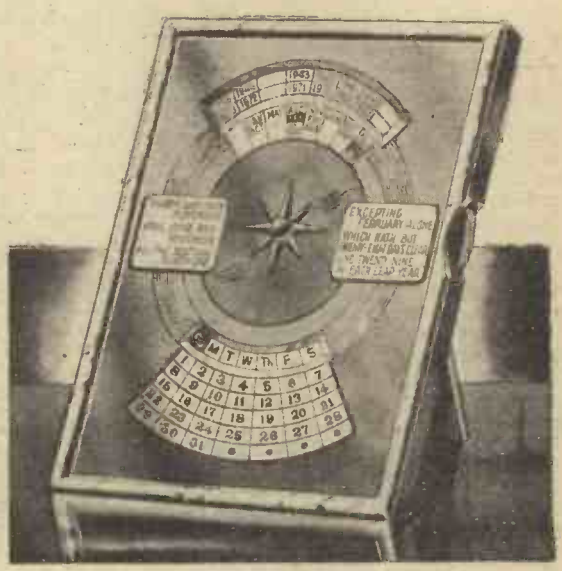


Fig. 1.—The finished calendar and stand.

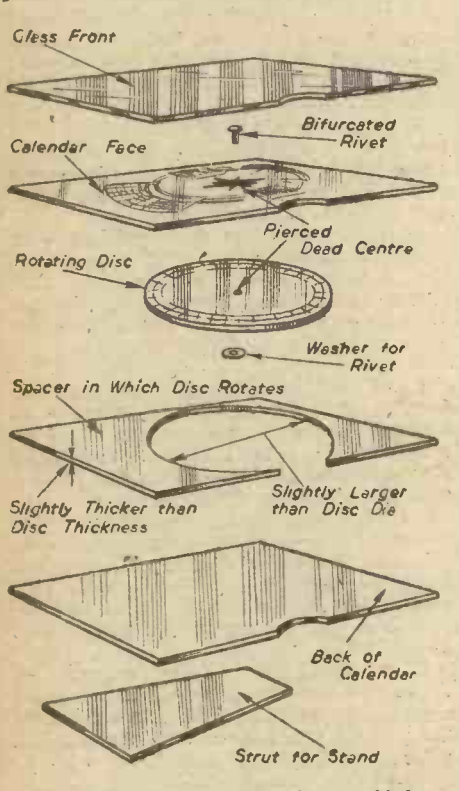


Fig. 4.—How the parts are assembled.

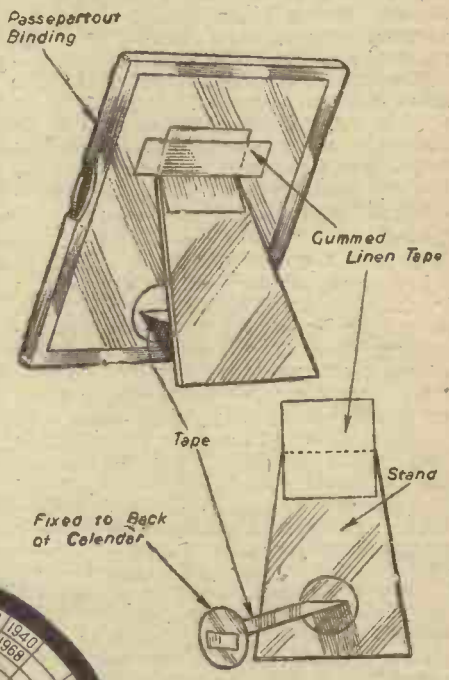


Fig. 5.—Method of fixing the supporting leg.

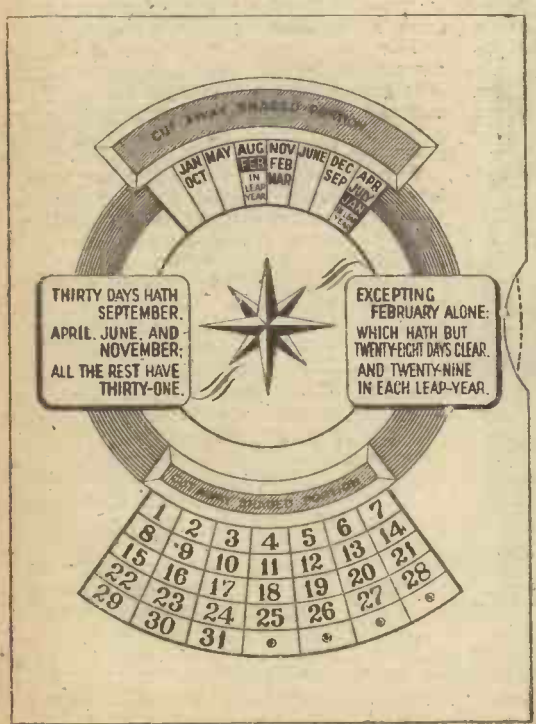


Fig. 2 (left).—The calendar front.

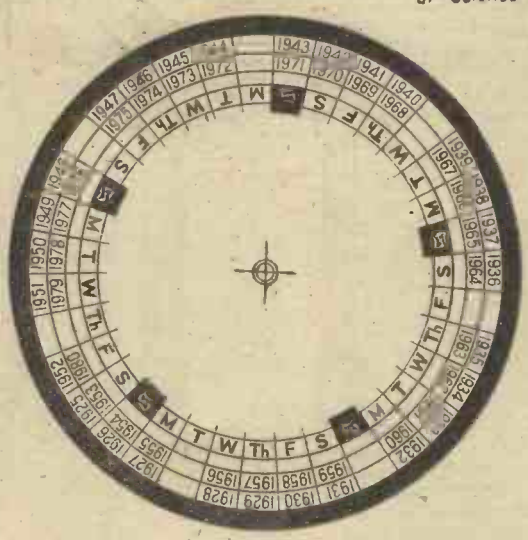


Fig. 3 (above).—The "basic circle."

Inventions of Interest

By "Dynamo"

Floating Runway

THE future of flying after the war will no doubt be characterised by remarkable developments. We shall not be able literally to build castles in the air as stations for aeroplanes, but one does not need to be a prophet to foretell that runways which float on the sea will be a feature of aerial navigation.

In connection with this prospect it is interesting to note that the subject of a current application to the British Patent Office is a structure of the nature of a raft which has been designed as a floating runway for starting and landing aeroplanes.

The device includes a hinged extending platform supported by hinged extending arms floated by a series of rectangular floats between the arms under the platform. There are also two half-cylinder floats at the ends of the platform.

Distress Signal

THE shipwrecked mariner on a raft has been known to improvise a signal of distress in the shape of his fluttering shirt. This crude method has now been far surpassed by an improved visual signal whereby a light on a lifeboat or other craft may be displayed to solicit aid "for those in peril on the sea."

The invention comprises a rotatable lamp having an aperture for emitting a beam of light. This aperture has a shutter which can be moved between screening and non-screening positions. There is an actuator for the shutter mounted on the lamp

Gear is provided operable by motive power supplied by a spring motor which is wound by a key.

Buoyant Rope

THERE has been applied for in this country a patent for a rope which will float on sea or fresh water for a considerable time.

The inventor of this buoyant rope points out that when cotton and other fibres are made up into rope by stranding, plaiting or braiding the resulting rope may have an apparent specific gravity less than one. But if left in contact with water it will absorb the water more or less rapidly and the interstices will be filled with the liquid. As a consequence the apparent specific gravity will be raised to a value greater than one.

The new device consists of a flexible rope formed of fibres rendered water-repellent by means of a wax or fat or both applied as an emulsion. It has an apparent specific gravity of less than one and it is stated to be capable of floating on water for more than one day.

Handy Handle

AT the present time there is a most annoying scarcity of teacups. As a result, even chipped china is at a premium and crocks are not necessarily consigned to the dustbin.

We have not yet attained to the philosophy of Diogenes, who, when he saw a boy drinking out of his hand, threw away his cup. Therefore it behoves us to adopt any method which will enable us with the minimum of inconvenience to imbibe "the cups that cheer but not inebriate.".

It has hitherto been proposed to furnish a handle which can be attached to cups and like receptacles. In the case of one such proposal the handle has been secured in position by means of a hand which encloses and is drawn tightly round the receptacle. According to another idea, the handle at one end is in the form of a resilient hook adapted to fit over the rim of the vessel and to bear against the inner and outer face while the other end bears against the outer face.

A recent invention has for its aim the fixing of a handle to cups made without the usual handle and known as utility or austerity cups,

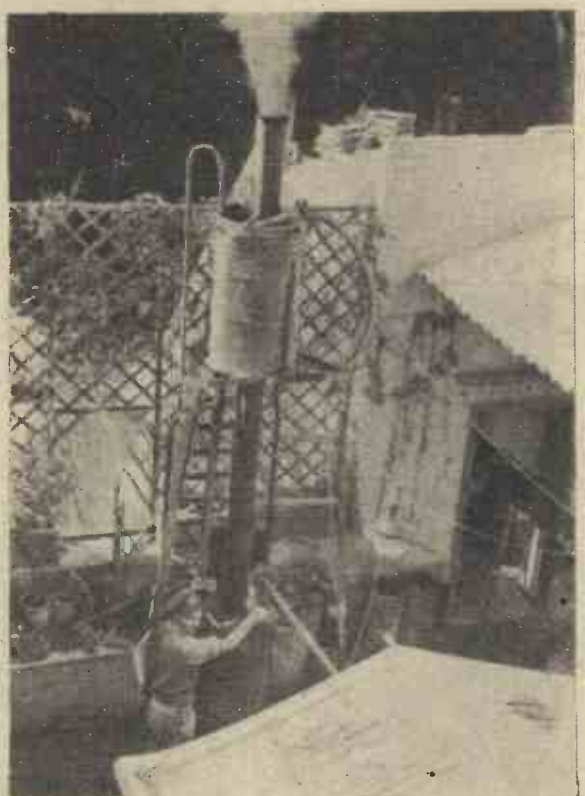
and also to cups with handles broken off, tumblers, etc.

According to this invention a handle is provided with a shoulder or abutment to engage with the rim of the vessel and thereby prevents the handle slipping down. And there is a band which encircles the vessel and secures the handle.

The two ends of the band may be connected to a pin in a slot in the handle, the tightening of the band being effected by adjustment of the pin in the slot.

The handle may carry a screw which, when rotated, will bear on the vessel and thereby force the foot of the handle therefrom and tighten the band.

To enable the vessel to be thoroughly cleaned the handle is removable.



This Heath Robinson contraption provides the hot water (under pressure) for a welcome shower for Allied airmen on an Italian airfield.

Helmet Attachment

IT is frequently necessary to attach various articles, such as camouflage devices and nets, to military helmets and gas curtains to the helmets of civil defence workers.

Hitherto the attachment of gas curtains to civil defence helmets, even by an experienced person, takes a considerable time, and this happens at a juncture when speed is of very great importance. Consequently, it appears that, contrary to regulations, it is often the practice for civil defence personnel to have their gas curtains permanently attached to their helmets. This practice, however, has the disadvantage that the edge of the curtain becomes worn through, rendering the curtain useless for protection.

There has recently been submitted to the British Patent Office a simple device by means of which an article may be practically instantaneously attached to or detached from a helmet even by an inexperienced person.

An additional object of the inventor has been to furnish, in combination with the above device, an improved form of gas curtain which may be folded compactly and carried in the gas mask haversack or other receptacle. At the same time when adjusted over the helmet, it leaves no part of the face exposed to liquid gas.

Anti-gas Balaclava

THE quick helmet attachment in question comprises a portion adapted to fit over the central part of the crown of the helmet. There is a resilient strip having at its extremities clips intended to fit over the brim of the helmet. And an arrangement is provided for securing the device to the particular article which is to be attached to the helmet.

As regards the improved gas curtain, this comprises what may be described as a large-size Balaclava helmet formed to extend over the shoulders of the wearer.

The curtain is made of gas-proof material such as oilskin. Open in the front, it has fastening means such as snap or sliding quick-fasteners, so that any desired degree of closing may be obtained. A draw cord is supplied for closing the curtain tightly about the gas mask.

To attach the curtain all that is necessary is to place the open curtain over the helmet, so that the centre piece recess formed by an annular pad engages the helmet bolt head. Then the two eyes of attachment means are caught and they are drawn downwards until the clips are beyond the helmet brim. The clips are then drawn up into engagement with the brim. The front of the curtain can be closed to suit the convenience of the wearer.

THE WORLD OF MODELS

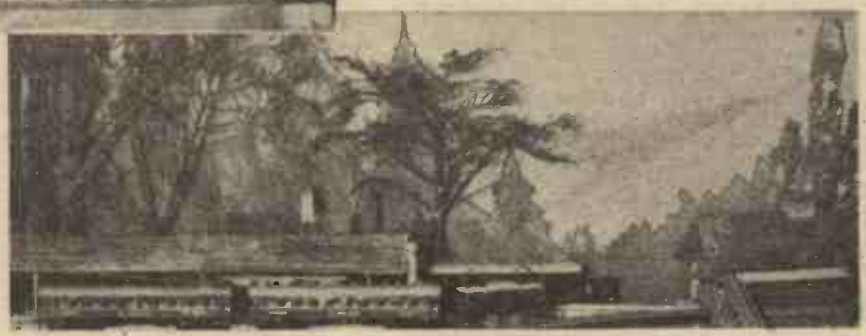
Some Realistic Model Railway Layouts

By "MOTILUS"

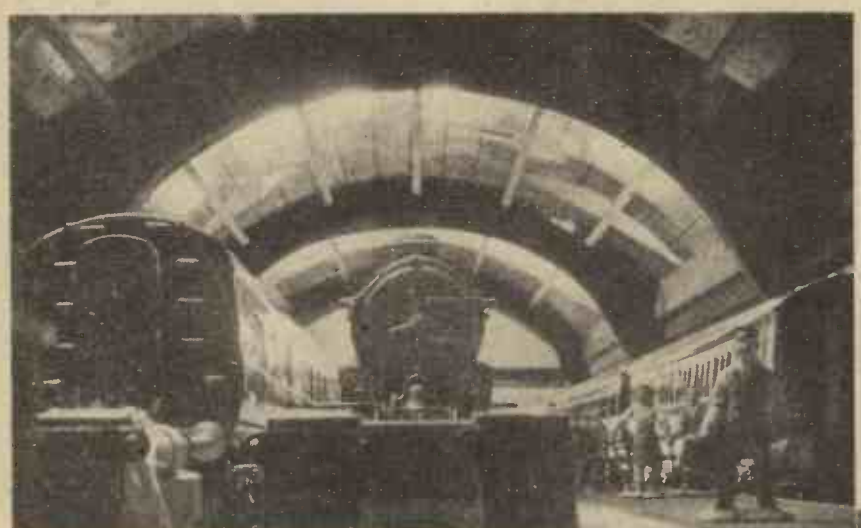
Scene on the Sankey model railway—a small harbour on an inland canal with boat alongside the quay, a picturesque windmill and a mixed traffic train by the quay.

IT hardly seems "cricket" to write about model railways when there are so many keen to have them, but owing to war conditions they can obtain no equipment except second-hand through a private source, for the Government at present forbids the sale by dealers of finished models containing more than 10 per cent. metal, unless these have some historic value.

But those who have model railways still find them a great relaxation from their war effort, besides the "younger generation" who have grown from "little boys" to model enthusiasts during the war years. These "lucky people" can continue to improve their layouts by individual effort with any material available, and in looking through my post-bag I have come across a few examples which show that work is still proceeding.



Another scene on the Sankey model railway—an Apline type scene with its distant view of pine trees, a chalet and a small rustic wayside station.



An unusual camera shot of the inside of a model railway station, taken on Mr. Gilbert Thomas's gauge "O" railway.

Sankey Model Railway

Firstly, there is our friend, Mr. H. M. Sankey, whose work has been featured in previous issues, especially in connection with the modelling material "Pyruma."

Here are two photographs of sections of his son's railway, which is continually being developed. The first shows a small harbour on an inland canal with boat alongside the quay, a picturesque windmill in the foreground and a mixed train alongside the quay.

The second illustration is of an Alpine character with its distant view of pine trees, a chalet, and a small rustic wayside station with electric locomotive drawing two Mitropa dining cars, evidently bringing imaginary passengers for an imaginary holiday—at least until peace breaks out!

And Mr. Sankey deserves his relaxation. His wife works on munitions, which means him rising at six a.m. to see to breakfast before he departs for his own work, which is also helping the war effort.

Photographing Model Railway Stations

A friend has asked me about photographing views of model railway stations. This is not an easy matter unless you have a short focus lens as used in conjunction with 35 mm. cameras, which gives great depth of focus, and enables you to get close to the job.

Here is a photograph taken with such a camera of Mr. Gilbert Thomas's gauge "O" railway when it was in the London area. It shows the inside of a terminus station with a G.W.R. King George V locomotive alongside the platform. Did you notice the famous brass bell on the buffer beam, which is a souvenir of the real engine's visit to the New World? It was sent across the Atlantic in 1927, and represented Great Britain at the Fair of the Iron Horse in Baltimore.

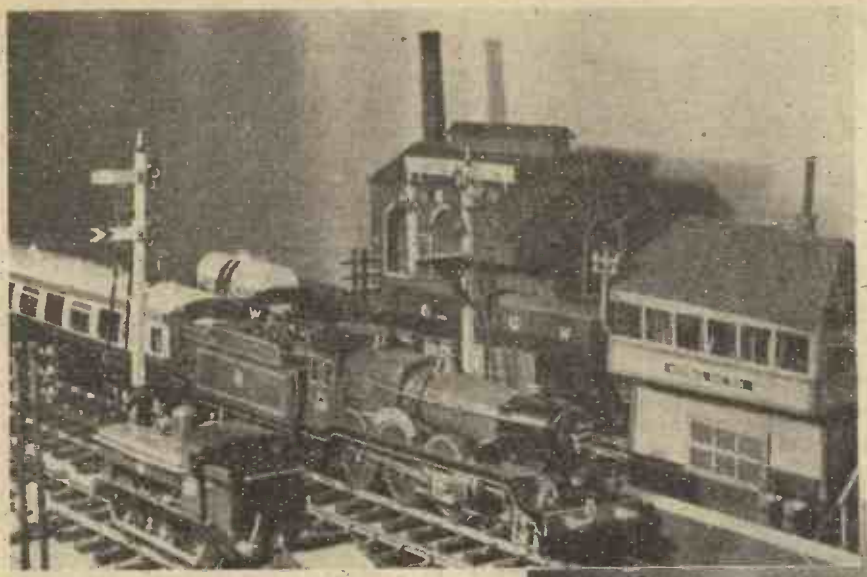
A Model Terminus Station

This photograph—from another angle—of a terminus station is taken by R. Wisbey, of Burton-on-Trent, and is a view of his Nottingham railway which took about two and a half years of his leisure time to build.

"All the tools I had when I built my layout," he writes, "were a pair of pliers, a small screwdriver, a 2-inch vice, two small files, a hammer, and soldering iron."

The buildings were made of plywood, compressed cardboard, building papers, and Cellophane material. The complete length of track is approximately 65 yards (in this there are four cross-overs, three facing and

Terminus station on the model railway of Mr. R. Wisbey, of Burton-on-Trent.



The "O" gauge model railway of Mr. Cecil A. Moore, of Leicester.

one trailing, one set of points facing and three trailing), and it was constructed by Mr. Wisbey from Bassett-Lowke steel and brass rails with cast slide-on chairs laid on sleepers and fastened down on a plywood base.

The railway was driven by electricity supplied through a converter, and this would work three trains with ease. In wartime days, however, Mr. Wisbey had to fall back on batteries, and have them recharged at intervals. In the track circuit he has made quite a few switches to isolate sections to work in conjunction with the signals. The locomotives he possesses are the L.M.S.R. Princess Elizabeth with new type tender, 2—6—0 L.N.E.R. Mogul, two L.M.S.R. 4—4—0 Compounds, and an 0—6—0 tender goods L.N.E.R. locomotive, also eight L.M.S.R. bogie coaches (including one mail van), and two L.N.E.R. bogie coaches.

As to goods rolling stock, he has ten ready-made vehicles, and made the other eighteen four-wheeled goods wagons from bought parts.

His main through station is 6ft. 6in. long, and there are four platforms complete with all details. There are up and down main through lines, and a slow through line on the inside oval layout. There is also a trailing crossover in the station.

Items which add to the interest of his layout, and which any handyman can make for his railway, are a petrol storage depot, a tunnel, engine shed, and the careful detail he has achieved with the stations.

A Gauge "O" Layout

Mr. Cecil A. Moore, of Leicester, has sent me pictures of his railway, which, he informs me, he prepared for a cine film he was hoping to make, but "owing to the war"—how often have we heard that phrase—and the difficulty in obtaining film stock, the idea had to be abandoned.

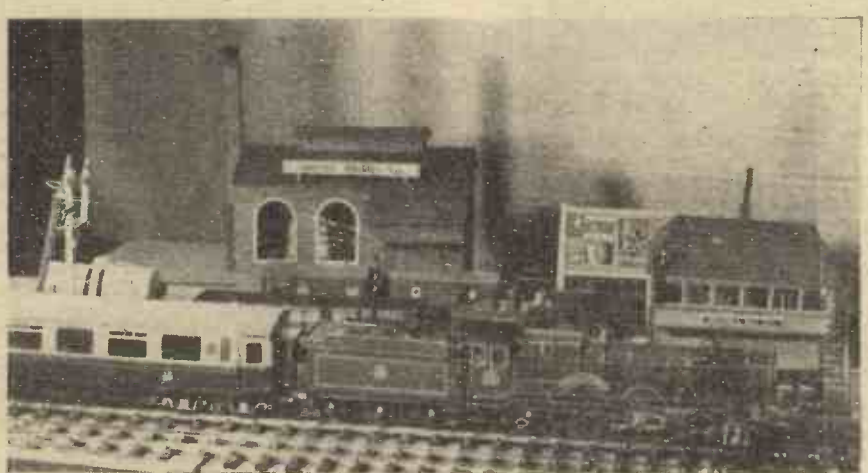
The layout is gauge "O," and he tells me some of the components are not what they seem For instance, the small 0—6—0 tank locomotive is a mere dummy, made mostly from wood, and is used for effect rather than work. All the rolling stock is made with wood tops, and axle boxes and B-L wheels, buffers, and couplings, mounted on wooden chassis. The wood tops have thin card strips glued on to the faces to give a tongued and grooved effect. All the windows are glazed with celastoid, the interiors being of Cellophane. The painting, lining, and lettering are by hand.

Another view of the gauge "O" model railway.

The locomotive power is clockwork, and the engine, King James I, is made from blueprints, and from various photos of G.W.R King class locos.

The track is B-L scale model permanent way in 2ft. lengths, mounted on $\frac{5}{8}$-inch boards with end battens, which are lipped alternatively to fit exactly into one another and clipped together on the sides with snap clasps. Signal boxes, factory, and various other things are fixed direct on to the $\frac{5}{8}$-inch boards, and brick papers were used extensively throughout. The water tank is made from a paste aluminium container, painted. The signals have been glazed with green and red Cellophane.

The whole effect, as seen in the photographs, is very realistic, and let us hope it will not be long before Mr. Moore is able to carry out his project of a model railway film.



A corner of the model railway, giving a side view of the King James I express locomotive.

Rationed Electricity

THIS is the age of rationing. A method of controlling the consumption of electric current is the subject of an application to the British Patent Office.

The inventor points out that there are frequent occasions when an electricity supply undertaking wishes to limit its maximum output. For example, it may be desired to reduce the range between the peak loads and the mean loads in a daily cycle, or to effect a scheme of current rationing in wartime. Also it may be required to deal with sudden increases of load on particular circuits on the occasion of a fog or some other exceptional occurrence.

The object of the invention in question is to limit each consumer to a predetermined variable maximum load continuously or at regular intervals, or at any intervals determined by circumstances at the time. And this is done in such a way as to allow of the consumer adjusting his circuits to that maximum, except in the special cases when a complete cessation of supply is necessary.

The proposed method of controlling the maximum consumption of current fed to a circuit from supply mains consists in providing in that circuit a load-responsive circuit-breaker whose maximum capacity may be caused by the normally supplied current to pass through successive identical periods of variation, and in varying the capacity by means of such current.

Masters of Mechanics—92

General Shrapnel

The Inventor of the Shrapnel Shell

IT is said that Sir Hiram Maxim, pioneer of the machine gun, used, at times, rather pensively to claim that his invention had been responsible for more men being deprived of a natural death than any other single device, invention or creation in the world's history.

Probably Maxim was right in his assertion. Nevertheless, Lieutenant-General Henry Shrapnel, who lived and experimented in the stormy days of the great Napoleon's rise to power, and the Duke of Wellington's Continental exploits, was a close runner-up of Maxim's in respect of the invention of a mechanical means of bringing about the violent and abrupt cessation of human life in wartime.

The name "Shrapnel" is far better known than that of the early nineteenth-century military inventor who then owned it. Posterity has forgotten the man, but it still clings tenaciously to the seemingly indispensable principle of his death-dealing invention. Indeed, had there been no such things as War Office personal records, we moderns would have known very little in detail about the career of the man Shrapnel, for the greater part of his inventive work was necessarily secret and, as an individual, he was seldom, if ever, within the public gaze.

Wiltshire Born

There is quite a common yet totally erroneous notion that Shrapnel, the originator of the famous projectile bearing his name, was a foreigner, and even that he was a German. As a matter of fact, Henry Shrapnel was a Wiltshireman, having been born at Bradford-on-Avon, in that county, on June 3rd, 1761. Few particulars concerning Henry Shrapnel's earliest years are available. We only become away of his career in detail when, on July 9th, 1779, at the age of 18, he was gazetted a 2nd lieutenant in the Royal Artillery, in which capacity he was drafted off to Newfoundland in the year following. In 1781 he was promoted to the rank of 1st lieutenant, and he was returned to England in 1784.

He studied ordnance in all its aspects, and after he was returned to England by his superiors he commenced in a small way to work out one or two of his own ideas in the way of ordnance projectiles. These experiments were conducted by him mainly in his leisure hours, and entirely at his own expense. Exactly how Shrapnel commenced his experiments is not known. Nevertheless, they must have been important and significant experiments, for they culminated in the production of the shrapnel shell.

Gunpowder Bombs

The type of military projectile named after Henry Shrapnel consists, in principle, of a metal container or shell having within it a large number of bullets which are released by the bursting of the shell and which then travel forwards with a high velocity. Henry Shrapnel was, perhaps, by no means the first originator of the basic idea which materialised in the shell named after him. There are records of canisters of gunpowder, so-called bombs, which burst under the influence of a crude type of fuse and which scattered around them various odds and ends of metal fragments and the like.

The first shell devised by Shrapnel was a curious form of hollow sphere which was filled with lead lumps. The thin-walled sphere was burst by a gunpowder charge, which was set off by means of a fuse ignited by the firing of the gun.

Shrapnel experimented with these shells by firing them from both light and heavy cannons, but, as could be expected, they were extremely unreliable in action, their greatest drawback being the extremely crude type of gunpowder fuse which was provided for them.

General Henry Shrapnel, inventor of the famous artillery shell principle.

The military authorities failed to share even a portion of the enthusiasm of the energetic Shrapnel. In order, perhaps, to discourage him or to remove him, as they thought, to a greater sphere of usefulness, they shipped him off to Gibraltar in 1787, and, afterwards, to a succession of military posts in several of the West Indies possessions.

Eventually, however, Shrapnel returned to England, and in the same year (1793), he was raised to the rank of "captain-lieutenant." His next military experience comprised service in the army of the Duke of York in Flanders. He was wounded at the siege of Dunkirk, which took place in the September of 1793, but even in this crisis it is recorded that he had the originality and the clearness of mind to lock the wheels of his gun-carriages so that they could be skidded rapidly over the hard, dry sands, and, also, to light fires, away from the British positions for the purpose of attracting the fire of the enemy, tactics which were entirely novel at that time.

An old-time "Carronade," used for naval warfare in the time of Napoleon.

In 1795, Henry Shrapnel was promoted to the rank of captain. In 1802 he became a brevet-major; then a major in 1803, and a lieutenant-colonel in 1804.

Assistant-Inspector of Artillery

These military promotions seem to have had little influence upon Shrapnel's character, for he delved more and more deeply into his routine of experiments and trials. From spare-time ones, they became, in part, "official" ones. So much so that, in 1804, Shrapnel was firmly established at the Royal Arsenal, Woolwich, as Assistant-Inspector of Artillery, in which post he seized every opportunity to develop the novel type of shell which he had previously invented.

The shrapnel shell appears to have been first used by the British in 1804, during the attack on Surinam, a colony of Guiana, which was originally settled by the Dutch. At first the new shell was not altogether successful. Although its principle was right, its design was wrong, and, mainly through the defects of its fuse, the shell was anything but reliable. Furthermore, the military authorities, ever conservative, like their naval brethren in those days, did not show any great liking for the novel projectile. It was only after the Duke of Wellington had commended the shell in 1808 that Shrapnel's prospects began definitely to brighten. The Duke gave it as his opinion that the details of the shell should not be made public, and that as the inventor, in consequence, would thereby be deprived of a considerable amount of fame and commercial success, he should be properly rewarded "for his ingenuity and the science which he has proved he possesses by the great perfection to which he has brought this invention."

The first shrapnel shells were made at the famous iron foundry at Carron, near Falkirk, Scotland. At that time they were named "spherical case shot." This name remained with them for many years, for it was only in 1852 that the British Army authorities adopted the title of "shrapnel" to distinguish this type of military projectile as a mark of honour and appreciation of the then nine-years-dead inventor.

During the early years of the nineteenth century the Carron Company had a wide reputation for the production of various types of cast ordnance, including, among others, the famous "carronades," iron cannons which gained great fame on the British warships. The workers at the Carron foundry had acquired the technique of producing exactly the right variety of iron which was required for cannon production. That was why, perhaps, the first contract for the manufacture of Henry Shrapnel's new shells was given to the Carron Company instead of to one or other of the Royal Arsenals, and particularly to Woolwich Arsenal, in which many of the earlier shrapnel experiments had been conducted.

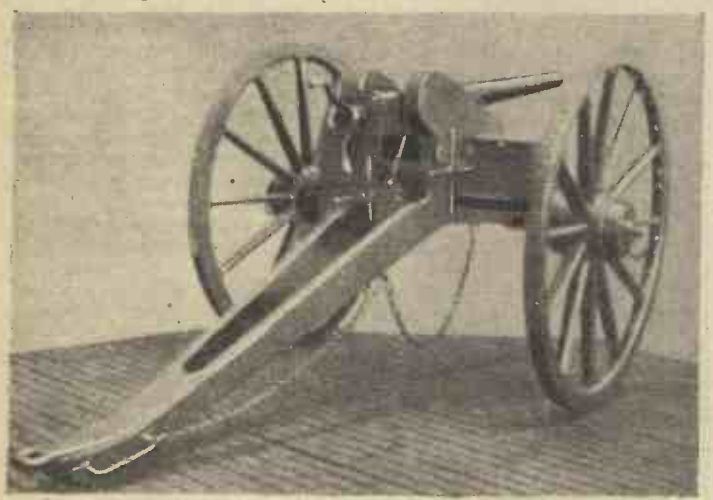
Firing Tests

In the fields around the Carron foundry the early practical firing tests of the shrapnel

shell were carried out under the supervision of Shrapnel himself. Quickly Carron became almost as famous for its production of the new shells as it had done for its manufacture of "carronades" and other pieces of ordnance.

The early shrapnel shells made at Carron ranged in size from 3-pounders for the lightest guns up to 68-pounders. Apparently they were supplied at prices varying from 6d. to 5s. each.

It was during the exploits of Wellington in the Peninsular War that the "spherical case shot," or, in other words, the early shrapnel shell, established its military position. Wellington himself, as we have already seen, went to the trouble of personally recommending the inventor for a reward.



An early light cannon which fired some of the first shrapnel shells.

All the British generals—and the admirals, too — began, one by one, to share Wellington's enthusiasm. It was General Sir William Robe, commander of artillery in the Peninsular War in Spain and Portugal during the years 1808-14, who wrote personally to Henry Shrapnel: "It [*the shell*] is admirable to the whole Army, and its effects dreadful"—rather an involved sort of a testimonial, but, nevertheless, sure in its meaning.

Admirals, with their man-o'-war "carronades," were similarly infected with enthusiasm for the shell. One of them, Sir Sydney Smith, actually wrote to Shrapnel and implored him to expedite the dispatch of the new shells, even if he supplied them at his (the Admiral's) own private expense.

Shrapnel's Reward!

In 1813 the rank of colonel in the Royal Artillery was bestowed on Henry Shrapnel. And in September of that year he formally addressed the Board of Ordnance on the subject of the reward which Wellington had previously mentioned. He pointed out to the Board that he had patiently and painstakingly experimented, partly at his own personal expense and in his own leisure time, and that he had expended his own private funds in pursuance of his trials and experiments to the tune of several thousand pounds.

To which appeal the members of the Board of Ordnance listened courteously. Eventually they promulgated their official reply. It was to the effect that the Board had no funds at its disposal for the reward of merit!

Less than a year afterwards, however, the Treasury granted Shrapnel a pension of £1,200 per annum in addition to any regimental or official pay which he might also receive. That was Henry Shrapnel's financial reward for his services to the British Army. Had he commercialised his invention he might have made millions.

Shrapnel's next Army promotion took place in the year 1819. It was to the rank of major-general, and it was with this rank that he retired from the Army in 1825.

A couple of years later he received, in retirement, the title of Colonel-Commandant of the Royal Artillery, whilst ten years later, in 1837, the year of Queen Victoria's accession, he was given his last military promotion —to the rank of lieutenant-general.

General Shrapnel retired permanently to his residence, Peartree House, Southampton, and it was here that he died on March 13th, 1843.

"Duplex Disappearing Mounting"

The "spherical case shot" shell was by no means the only creative product of Shrapnel's busy military career. During his work at Woolwich he improved the detail construction of several types of mortars and howitzers. He invented a number of novel fuses, and he devised what was referred to as a "duplex disappearing mounting," which latter comprised a special type of gun-mounting which so functioned that the recoil of one gun lowered the latter under cover and at the same time elevated the other gun to the correct firing position, a species of alternating motion thereby being obtained.

Shrapnel further invented a brass tangent slide, and he improved the details of several varieties of rifles and small arms. He is said, also, to have spent a considerable amount of time and energy in compiling sets of artillery range-tables which enabled gunners to compute their ranges with a then unheard-of rapidity and accuracy.

All such inventions have long ago disappeared into the vast limbo of obsolete creations. The name of Henry Shrapnel nowadays lives on in popular memory solely through the survival of his shell.

Solutions to Probes and Problems

(*See page* 128)

A Poser from Muggins

I am 36.

It may be assumed that, since I "fancy myself as a mathematician," I shall not make a mistake in a simple calculation. Since, therefore, I was unable to answer Muggins's question, at least two answers to the problem must be mathematically possible.

The question about the cigars allows of many solutions, but in only two cases will the total number be the same, i.e., 9 at 3d., 3 at 7d., 6 at 1s., total 18; 4 at 3d., 12 at 7d., 2 at 1s., total 18.

In either case my age must be 36.

Brides and their Brothers

Clara's married name is Hill. The complete list is as follows:

Groom	*Bride*
Dill	Susan Quill
Gill	Constance Hill
Hill	Clara Dill
Quill	Mary Gill

A Mathematical Certainty

491063
592864
1083927

League Football

	A	B	C	D	W	D	L	Goals F	A	Pts.
A	x	2—2	4—0	3—1	2	1	0	9	3	5
B	2—2	x	3—1	1—3	1	1	1	6	6	3
C	0—4	1—3	x	4—0	1	0	2	5	7	2
D	1—3	3—1	0—4	x	1	0	2	4	8	2

A Geography Lesson

There can be no more than four places in the world all at the same distance from each other; although there can, of course, be an unlimited number of *sets* of four. They are situated at the four points of a regular tetrahedron enclosed within a sphere.

The best way to visualise it is by imagining inside the earth a pyramid on a triangular base, with the three points of the base and the apex all just touching the surface of the earth.

The distance between the points will be approximately 7,568 miles.

The "Gigant" Transport 'Plane

THE *Militaerische Correspondenz aus Deutschland* publishes an article on what is at the moment the largest aircraft in the world, the German transport 'plane "Gigant."

German transport 'planes have repeatedly played an important part in the fighting in the Mediterranean, and in particular in the military operations which occurred in the course of the evacuation of Sardinia and Corsica. In these a new large transport 'plane of the Luftwaffe came into evidence, namely, the motorised transport 'plane Me. 323, "Gigant," developed by Prof. Messerschmitt. An idea of the size of this aeroplane is given by the following figures: The span of the wings is 55m., the area of the wings is 300qm. and the cargo space 100 cubic ft. The cargo space is so big that all bulky loads which a railway wagon can take can be stowed away. For example, the high load capacity of the "Gigant" makes it possible for 2½-ton lorries or medium-sized tanks or guns, such as the 8.8 cm. A.A. cannon, to be carried. On numerous occasions the "Gigant" has carried no fewer than 130 fully equipped soldiers, as well as 52 barrels each containing 250 litres of fuel; on ambulance work, it can transport 60 wounded men in bunks.

The "Gigant" is constructed of wood and steel, a braced shoulder-wing monoplane (abgestrebter Schulterdecker). Six auxiliary engines enable it to fly under its own power. The undercarriage consists of ten wheels in all and can surmount obstacles on the ground like a caterpillar track.

Making a Success of Your Photography

Winter Photography

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

A Real Winter's Day
H.P. 3 filter. Exp. F8 1/50 with 3 times filter. Developed with Azol. Taken about 11 a.m. in January, 1943.

WHEN we think of winter our minds usually turn to thoughts of snow scenes; generally these are only obtainable in January or February. I once had the pleasure of seeing a large portion of Ben Nevis covered with snow in July, but, unfortunately for me, I had been persuaded to leave my camera at home and to travel light, so as to reach the top of this wonderful "sight-yielding" mountain. I have never quite forgiven the friend who gave me this advice, and now, whenever I go to a new spot of country, whether it be mountains or lakes, my camera is a constant companion. Therefore, when you are off for a ramble in January, or at any other time, have the camera charged. Snow scenes are often made in a night, and to get the real beauty of such it is necessary to get out as soon as you can and while the light is good; certainly before the snow has had time to lose its brilliance.

"Pictorial" Pictures

It is "novelty," I think, which induces amateur photographers to use their cameras on such occasions, for I am convinced that it is possible to waste more films on snow effects than on any other subject; by this I mean that it is seldom one comes across a really good "pictorial" result of a snow scene in England.

What are the most essential features required to make such scenes beautiful? I would put first and foremost sunshine and shadow, for without these you can only expect to get hard contrasts and, in consequence, an absence of the delicate half tones or tone gradations which are of paramount importance, in fact, necessary, when making "pictorial" pictures.

Sun effects on snow are obtainable, but, as already said, it is advisable to get out early before the sun has had the chance of having too much effect on the snow and changing its surface.

The mention of surface brings me to my second essential feature—texture. Newly fallen snow will give you this, especially while the frost continues; its surface is bright, almost alive with sparkles, and the snow generally is soft; it has not had time to settle down in a solid mass, and the sun has not been able to break up the delicate particles or, as it were, the tissue of the flakes.

If, then, you can be sure of securing sunshine and shadow together with texture, by all means take your camera out; but it is as well for you to know beforehand where to go, and to get there before the snow surface has been destroyed by traffic.

Snow Scenes

I have spent many hours in woods and dells, roving round farms and villages in the snow, but I have never succeeded in securing what I consider a successful exhibition result. Some of my best, or what pleases me most, are those taken in some woods one morning after a slight fall of snow. The ground was not completely covered, and parts of the banks and hedges were only sprinkled, the prints revealing a variety of tones, and not just black and white; but even with these sunshine is missing.

You will have gathered from this that snow scenes are probably not very popular in photographic circles; this may be due to the difficulty experienced, but I believe most keen amateurs will go on trying until they have succeeded in getting what they want. Therefore I would advise you to be ready at the right moment. My aim is to get a snow landscape, complete with trees, fields, farmhouse or cottage, and perhaps a lane with a five-barred gate; when I find it I shall make more than one exposure in order to secure the correct picture. The time and stop required must be a matter of careful judgment on the spot at the time; I shall use perhaps F6.3 and 1-100th, also F11 with the same time. It will depend on the amount of white snow around and also the value of the sun. I shall strive to keep every detail sharp, including the surface of the snow. I would also be very careful to correctly develop the film and would use Azol, because it gives soft negatives. I believe with such conditions I could make a good picture on a normal grade of bromide paper, such as Barnet, Gevaert or Ilford.

Frost Pictures

There are, however, other scenes besides snow in winter which we should look for and which are, during these months, more common. If you will take a stroll across your local park or through a country lane one morning after a very hard frost and before the warmth from the sun has had time to remove the traces, you will not fail to be struck with the beauty of the bushes and twigs. These were very commonplace yesterday, but to-day, when they are covered with Nature's very delicate work, they have become pictures. A young beech tree decorated with hoar frost is a lovely sight, so also is a low, straggling bramble bush close to the ground with still many of its last year's leaves. Should you know where to find a tamarisk bush or hedge with its twigs covered with close, fine foliage you should go straight to it before the frost disappears. You may be fortunate to arrive just when the sun is shining on these objects; then is your chance. Set the camera for 1-50th with F8, and make certain the distance scale is correctly adjusted before you shoot.

Many subjects similar to these can be found in your own gardens. Have you ever noticed the beautiful effects of frost on a spider's web? I do not know where the spider goes to in winter, but I have many a time seen the beauties of his work enhanced or revealed by frost, and with more time on my hands I intend trying to record it on a film.

One day during January last year I remember seeing a bush of the thin, fine twig variety, with a mass of tiny globules of water at each point of its foliage; the sun had been on it sufficiently long to disperse the frost. Unfortunately I had exhausted my spool, and therefore could not make a shot, but I know now where to find a picture.

I cannot leave this feature without making reference to the frost pictures which are occasionally to be found on our windows. I remember an old-time professional friend showing me a negative which he had taken of his dining-room window one winter morning over 40 years ago. In those days all plates were slow ones, even the fastest, as compared with our present-day films, and his largest stop was F8. The result was a perfect negative of a beautiful nature study.

Frozen Ponds and Lakes

There is still one other feature of winter which we can at times use in connection with our hobby, and that is ice. We must pass over any detailed description of icicles and their possibilities for picture making, in order to devote a few lines to frozen ponds and lakes. Perhaps you have in your local park a lake or small ornamental water. I hope it has natural banks, and by this I mean not artificial sides made of cement and stonework. Perhaps there are some waterfowl. Have you ever noted what a curious effect is produced when ducks or other fowl are walking on a sheet of ice? You can also get some charming studies around this lake when there has been a slight fall of snow leaving the trees, bushes and banks slightly covered; but wait for that splash of sunlight.

Should the frost continue long enough, skating may be permitted on the lake or river; this should offer you the chance of getting some very different type of pictures. If you have a friend who can skate well, you should try a shot or two in an "action" picture. Use an open stop, if possible F5.6 or F6.3 with a fast film.

Diesel or Petrol?

A Future Problem for Power Engineers

By C. O. LLOYD

WAR conditions have imposed interesting changes on the direction of progress in prime movers. Up to 1939 there were clear signs that the diesel engine was

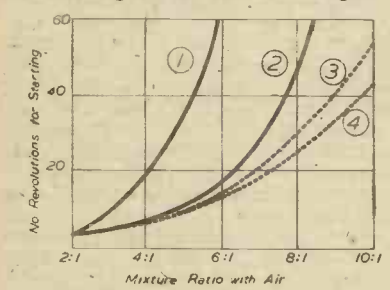


Fig. 1.—Effect of volatility of petrol on starting at different mixture strengths. 1—Commercial petrol, in winter (4 deg. C.); 2—Commercial petrol in summer (20 deg. C.); 3—Benzole-petrol mixture, in winter (4 deg. C.); 4—Benzole-petrol mixture in summer (20 deg. C.).

encroaching on the field of the petrol engine, where the latter had held sole sway, as, for example, in light transport. In the meantime the issues have become more complicated, and where one would have expected progress there has been retrogression, due, no doubt, to the artificial conditions imposed by the war. It is not, however, sufficient to explain away unexpected developments by ascribing them to "artificial" conditions. Many of the new factors imposed on industry of that day by the last war not only remained, but served as a springboard for further developments of an unexpected nature.

To-day, crankless engines, turbine-driven superchargers and jet propulsion are being discussed freely, and the indications are that there is something more than mere discussion in the air. This is an example of what might happen to prime movers in the future, although one must weigh up all relevant information before drawing conclusions. The more spectacular part played by aircraft may mislead one into thinking that the petrol engine has established itself once and for all in that sphere. There is a tendency to overlook the part played by fuel oil on ground mechanical equipment and the steady progress being made, while the changes in industry are perhaps more permanent and significant.

Petrol and Fuel Oil Compared

There are, of course, the well-known differences between fuel oil and petrol as a source of power. The fire hazard of the

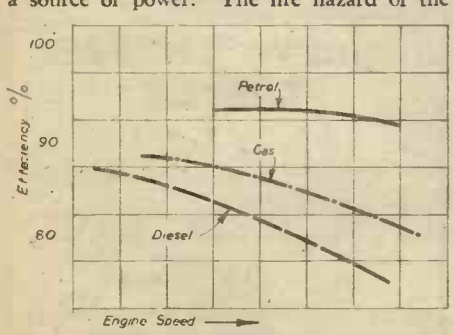


Fig. 5.—Mechanical efficiency of petrol, diesel and gas engine compared. (Judge.)

former is less, against which can be set the better flexibility of petrol. Then, again, a diesel engine is usually more expensive than a petrol engine, but offers the advantages of lower fuel costs and greater robustness. Indeed, one can draw up a list of the characteristic advantages and disadvantages of petrol and fuel oil, and still be divided on the opinion as to the better source of power. The ultimate criterion depends on the purpose for which the engine is required. For large stationary units there can be little doubt that the oil engine is the correct choice, but the lower one descends in the power output scale the more problematical does the question become. The petrol engine has the advantage of lower stressing

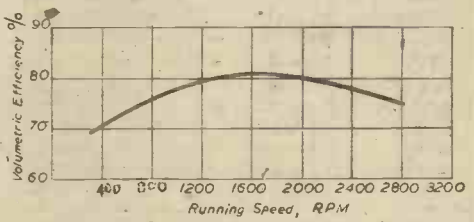


Fig. 2.—Variation of volumetric efficiency of diesel engine with speed. (Ricardo and Glyde.)

and greater simplicity in design, so making it a lighter job and, therefore, more suitable for mobile work where weight is a main consideration. Diesel enthusiasts will maintain that wear and upkeep costs are lower for the diesel, but this is not necessarily so in high-speed diesel engines of lower-power rating, although with careful usage there may be a little in favour of the diesel in the above two respects.

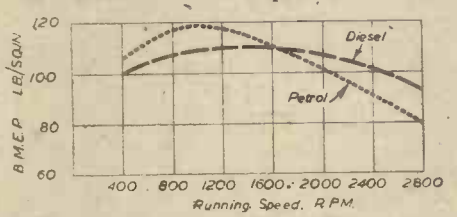


Fig. 3.—Variation of torque for a diesel engine, with engine speed. (Ricardo and Glyde.)

Some Modern Comparisons

The last decade has proved fruitful from the point of view of fundamental and practical research on engine fuels. If one considers that the thermal efficiencies of diesel and petrol engines are similar, and around 30 per cent., one can expect most improvement to come from the fuel itself. This has happened in particular with petrol, improvements in jets, cylinder heads and other parts having perhaps been more in evidence with compression ignition engines as contributing to progress, rather than startling developments in fuel oil. The tendency with the oil engine is to look for methods of using cruder oils rather than to step up the quality of the fuel. On the other hand, every effort has been made to improve petrol, particularly its anti-knock qualities.

Volatility

The ease of starting in an engine is measured by the volatility of the fuel, other things being equal. Thus the lower the boiling point of petrol, the quicker the start, but owing to the widely different nature of the fuels and the engines in which they are

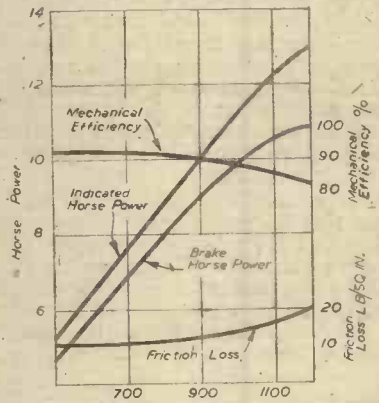


Fig. 4.—Relation between engine speeds, efficiency and power output.

employed it is not possible to compare petrol and fuel oil. W. A. Whatmough showed in 1933 what improvement can be effected in starting by using the right petrol, Fig. 1 being plotted from his data. The influence of air temperature is clearly revealed in the steeper slope of the curves for winter fuels; that is to say, the reduction of volatility of the petrol which accompanies colder weather.

Engine Speed

The larger field for the diesel is that of the low-speed stationary unit, where, unquestionably, this type of prime mover has proved as important a step in industrial progress as the steam engine. There is an optimum speed where the volumetric efficiency is about 80 per cent. Scavenging and attention to details have made for further improvements, but Fig. 2, due to Ricardo and Glyde, illustrates this aspect well. With volumetric efficiency goes power output, and a comparison on this, between a petrol and diesel engine, has been made by the same two engineers, and is given in Fig. 3. It will be noted that the diesel offers better torque-speed characteristics over a wide range, but between 400 and 1,600 r.p.m. the petrol engine is superior.

Mechanical Efficiency

The practical engineer wants to know what power yield he is going to obtain from an engine for a particular fuel expenditure. One cannot decide from thermal efficiency or factors other than mechanical efficiency, which, in effect, informs the user what power

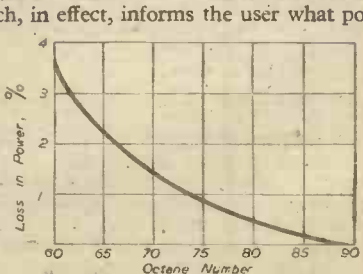


Fig. 6.—Loss in power due to fall in octane rating of a petrol.

return he is getting. This raises a point which in turn means that the suitability or otherwise of a power unit can only be decided with reference to the work for which that unit is required. Fig. 4 emphasises this well, showing as it does the connection between engine speed, power output and mechanical efficiency. The results shown may be said to be typical of all high-speed engines, and closer examination of the B.H.P. curve reveals that there is a tendency, for this particular engine at least, to drop slightly in efficiency above 1,100 r.p.m. The curve for mechanical efficiency is derived by combining the B.H.P. and friction losses.

The importance of running speed is again emphasised by the comparison of mechanical efficiencies between a gas, petrol and diesel engine given in Fig. 5. The steady decline in efficiency with engine speed is apparent with all types, but it is interesting to note the wider speed range of petrol units.

It is evident from what has been said above that no generalisation can be made with regard to the best type of prime mover for a particular job. The availability of fuel has, furthermore, to be considered. For example, if gas is plentiful a gas engine is the obvious choice, provided, of course, its characteristics are suited to the work.

Power Rating and Speed

Industrial experience has largely influenced the progress of certain units, so that it is possible to group diesel and petrol engines thus:

POWER REQUIRED	ENGINE SPEED	TYPE.
1-50 h.p.	Up to 4,000 r.p.m.	Petrol
60-100 h.p.	2,800-3,000 r.p.m.	Petrol or High Speed Diesel
100-200 h.p.	2,400-2,500 r.p.m.	Petrol or High Speed Diesel
300 h.p. upwards	Low Speed Diesels or Gas Engines	—

Fuels

Many investigations have been made into the behaviour of fuels in the cylinder of an engine. Theory combined with practice, in which the physicist, engineer and chemist have collaborated, has served to unravel many of the mysteries of combustion. X-rays, spectrographs, cathode ray tubes are only some of the instruments employed in this research work, which has made considerable progress in the last ten years. An exact record, for example, of the development of the combustion wave front in a cylinder has been made; detonation has been examined, and, above all, this knowledge applied to practical ends, so that fuels are not only better but cheaper, excluding war influences.

Fuels have been graded in knock rating, or their lack of tendency to deteriorate at higher compression ratios. This is important, inasmuch as higher compression ratios mean greater power output and efficiency. This fact has been so evident with designers of petrol engines that such units are now operating at compressions near the lower values for diesel engines, owing to high octane fuel.

Incidentally, a petrol is usually rated with reference to octane, while diesel fuel is measured in terms of cetene, which is also a liquid hydrocarbon. In the past few years more attention has been paid to the cetene number of fuel oils, a significant point. The influence of octane number on the power loss from a petrol engine has been recorded by L. E. Hebl and T. B. Rendel (J.S.A.E., May, 1939) as in Fig. 6. The diesel picture is brought up to date by the Report of the Diesel Fuels Division of the Co-operative Fuel Research Committee of the United States (J.S.A.E., February, 1941), in which it is stated that a high cetene value improves starting, idling and the power yield on light loads, while this factor is also considered to give maximum piston ring life before sticking.

The war has interrupted much development and research to find a better diesel and petrol engine for general use. It has also served to give progress an abnormal twist, so that one should not take present trends too literally. The point at issue would seem to be whether smaller diesels can cover the field requirement of the petrol and whether there is room for larger petrol engines where medium diesels are now employed.

Letters from Readers

RUNNING CARS ON "CALOR" GAS

SIR,—With reference to the reply to Mr. S. T. Jones, of Leominster, in Queries and Enquiries of the August issue of PRACTICAL MECHANICS.

The running of cars on "Calor" gas, and other propane and butane mixtures, is no novelty. In 1940 it was possible to have a complete installation for the sum of £12. This including the mounting of the gas cylinder, fitting of a flap valve to the carburetter intake, and a tap system. The supplier being Carbuettors, Limited, Grange Road, Willesden Green, London, N.W.10.

Calor gas liquefies at 22lb. per sq. inch. It is supplied to the carburettor, via a reducing valve, at a pressure of ½lb. Performance on Calor gas is almost equal to that of petrol. Starting, acceleration, and climbing power all being good.

Running costs rather higher than petrol. A cylinder being sufficient for approximately 150 miles on a 10 h.p. car. The cost for a recharge, in 1940, being 16s. Advantages over petrol are: Freedom from detonation (no pinking) and absence of oil dilution.

Everything appears all right, but, of course, there is a snag. The suppliers of propane/butane mixtures were not willing to supply gas for motor vehicle propulsion. But if you can obtain the gas, it is the best alternative to petrol yet discovered, and it is definitely practical.

A. E. LEECH (West Molesey).

DISSOLVING FILM NEGATIVE

SIR.—In the reply to a Blackpool reader's query in the November issue of PRACTICAL MECHANICS, it is suggested that his difficulty in dissolving portions of an undeveloped film negative in a mixture of amyl acetate and acetone was probably due to his failure to remove the gelatine coating on the film.

This may be so, but it is also possible that the film was of the "non-flam." type (cellulose acetate, I believe). This is certainly not readily soluble in amyl acetate and acetone, but there is one good solvent available, diethylene dioxide (dioxane). Quite a good, thick cement can be made overnight, or even in a shorter period of time, by dissolving small pieces of X-ray or other film in this fluid, which also dissolves ordinary cellulose very readily.

Incidentally, to remove the gelatine coating from used film, particularly if the film has been "fixed" in an acid hypo bath, or has been acid hardened, it is generally necessary to use more than hot water. Even boiling in water sometimes fails to dislodge the obstinate gelatine. But soaking in a hot solution of soda (preferably caustic) for some time usually does the trick. Even if the gelatine is not completely dissolved, it wipes off easily with the fingers, leaving a particularly clear piece of celluloid, which afterwards wants thorough washing in water only.

J. P. NAPPER (Cardiff).

ELECTRICALLY DRIVEN MODEL RAILWAY

SIR,—In a recent issue a correspondent, Mr. J. K. Dixon, asks about a method of electrically driving an 8in. gauge railway.

For four years I have been running a 10in. gauge line by a method which may be of interest. An A.C. motor on the house supply, ½ h.p. in my case, drives a 12-volt motor-car dynamo, 950 r.p.m. is fast enough, This supplies current at 25-35 volts, 8-10 amps. to a six-volt small car dynamo reconnected with the field coils in parallel as a series motor. This is fitted to a "tram" meant to carry two children at a time, but capable of more, at 4 m.p.h. on a sticky track.

A motor-car cut-out must be wired in to reduce the dynamo voltage on open circuit by a series resistance.

The merit of this system is that all the components are easy to obtain, and no rewinding of motors or dynamos is needed, while an accumulator charging outfit is thrown in for the price of an additional cut-out from an old car.

R. B. T. HALL-CRAGGS (Hale).

ELECTRON MICROSCOPE

SIR,—I was very interested to note in the October issue of PRACTICAL MECHANICS (p. 33) that Mr. R. S. Trowell, of Newport, Isle of Wight, proposes to build an electron microscope.

The following references may be of use to him: *Journal of Biological Chemistry*, 1942, *146*, 25; *British Medical Journal*, 1942, *2*, 728. There have also been some papers in recent issues of the *Journal of Bacteriology*. He should be able to consult these journals in the British Museum, or possibly in the local Public Library.

I am quite willing to obtain any further information from the published literature he may require.

J. O. DAWSON (West Bridgford).

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.

Speeds for Turning

WILL you please answer the following questions :

At what speed should a 3½in. lathe travel for turning 4in. round cast iron, 1in. round mild steel, ½in. round brass.

I tried turning the cast iron and the tool simply turned up at the attempt, yet it turned the mild steed. So I wondered if I had too many r.p.m. on the lathe, which is driven by a ¼ h.p. motor at 1,450 r.p.m.—J. C. Jobson (Grimsby).

THE speeds for the sizes specified are, using high-speed steel tools :

4in. cast iron, 50 r.p.m. roughing, 70 finishing.
1in. mild steel, 190 r.p.m. roughing, 400 finishing.
½in. brass, 1,000 r.p.m. roughing, 1,500 finishing.

The reason for the tool turning up is that it is too keen. The top rake for cast iron should be only about half that for mild steel.

Element Holders for Electric Fires

I AM anxious to experiment in making "clay" element plates or holders that are used in electric fires and boiling rings, on which the wire element is wound. Could you tell me what the constituents of this "clay" are : in what proportion they should be mixed, and how they should be made up ? I would also be glad if you could tell me where I could purchase the necessary materials and if there is a commercially made product which would answer my requirements ? —R. Drohan (Kilkenny).

THE electric elements to which you refer are merely unglazed porcelain, prepared from a mixture of suitable China clays. To make such elements, you require a muffle furnace capable of attaining a high temperature. Given this, the elements are moulded from a mixture of 100 parts China clay and 10 parts limestone, together with about 1 part soda ash, after which they are baked for several hours at a nearly white heat.

We imagine that you will not find it possible to carry out such a process; however, these electrical "porcelain formers" can usually be obtained from any large supplier of electrical fittings.

Rubber Latex

I HAVE recently been experimenting with latex liquid rubber on shoes for re-soling. I have used carbon, sulphur plastic, etc., with it for a "filling" material but with no success.

Can you tell me how to crepe the rubber and make it stick to the old soles, or give me an alternate filling medium as used in car tyres ?—G. Armitage (Selby).

YOU will find it a very difficult job to make rubber soles unless you possess a good knowledge of rubber technology. It is not possible to make such articles merely with the aid of rubber latex, since if any attempt is made merely to "fill" the latex, the latter at once coagulates and loses its characteristic properties. The best "filling" agent for rubber latex is ordinary Portland cement. This gives a rubbery sort of concrete, but such a product is more or less brittle and is, of course, entirely unsuitable for adaptation to footwear requirements.

The following is a typical formula for the making of a rubber suitable for soles. Like all these rubber "mixes," however, it has to be cured for a definite time under steam pressure. Hence its use will necessitate some steam pressure apparatus in which the mixture can be exposed to steam for the requisite time :

Sheet rubber (or dried latex)	.. ..	5 parts.
Scrap rubber powder	.. ..	54 ,,
Dried clay (fine)	.. ..	30 ,,
Zinc oxide	.. ..	1½ ,,
Red iron oxide	.. ..	4 ,,
Diphenylguaniline	.. ..	½ ,,
Sulphur	.. ..	2 ,,

Cure for seven minutes at a steam pressure of 60lbs. sq. in.

For sticking rubber to old soles, use a thick solution of rubber in naphtha. A very small amount (½ per cent.) of bitumen dissolved in the same solution increases the tackiness of the mixture.

It is, however, absolutely impossible for an amateur to produce a processed rubber similar to that employed in the making of car tyres, since not only are these rubbers "cured" at high steam pressures, but also the majority of them are of more or less secret compositions.

Insulating Medium for Refrigerator

I AM making a domestic refrigerator, and shall be glad to have your opinion as to which is the best insulating medium. I was contemplating using granulated and slab cork, but a few tests carried out proved unsatisfactory.—L. Walker (Mill Hill).

YOU do not indicate exactly what type of domestic refrigerator you are making, nor do you give us any indication of its size. We presume, however, that your refrigerator is of the "ice box" type. For such a purpose we see no reason why granulated cork (not slab or compressed cork) should not prove perfectly satisfactory.

Alternative non-conducting materials are asbestos fibre, kapok, hair and dried seaweed.

We suggest that you employ as a heat-insulating material a mixture of granulated cork and coarse fibre asbestos. These materials can be obtained from the under-mentioned suppliers, but we do not think kapok, hair or seaweed are available at the present time.

Cork suppliers : Messrs. Henry Bucknall and Sons, Ltd., 90, Fenchurch Street, London, E.C.3.

Asbestos suppliers : Bell's Asbestos and Engineering Supplies, Ltd., Slough, Bucks; Turner Brothers Asbestos Co., Ltd., Rochdale.

Ammonia : Chemical Action on Metals

(1) CAN you tell me the reason why pure ammonia has a chemical action against copper, brass and solder, turning the liquid blue ?

(2) Is there any acid or liquid that I could mix with it so as not to affect the strength of the ammonia ?—K. A. Varey (York).

(1) IT is impossible for us to tell you exactly why ammonia attacks copper, brass and other metals. You might as well demand to know precisely why oxygen combines with some metals at red heat and nitrogen does not. However, the reason for the blue solution formed when ammonia attacks brass, copper and copper-containing alloys is to be seen in the fact that all chemical solutions containing copper are blue or bluish-green in colour, and that ammonia, through a complex chemical mechanism, forms such solutions when it attacks copper. These blue solutions consist for the most part of solutions of copper hydroxide combined with the ammonium radical, but they are always of varying composition.

(2) There is no acid or liquid which you could mix with ammonia to prevent its attacking copper. Indeed, if you did mix an acid with ammonia the latter would immediately be neutralised with great violence by the ammonia. There is no liquid known which would have the effect you seek.

Preserving Worm-eaten Wood : Nitrogen Iodide

(1) IS there any method of preserving worm-eaten wood ? The insect is a small, white, soft grub similar to the maggot found in cheese. I wish to kill it in plywood panels indoors, in which it has already bored many holes. I think it might be the larva of the Death Watch beetle, especially as I heard a faint ticking noise in another room over a year ago. It was like the ticking of a watch, but stopped and started at about 30 second intervals. Is creosoting the backs of the panels, or painting them with lysol, or a solution of copper sulphate, any use ? Our house is entirely built of wood, and the outside and roof are creosoted regularly.

(2) Also, can you tell me the cheapest method of preparing nitrogen iodide ?—A. Andrew (Larbert).

(1) THE worm holes which you describe are undoubtedly made by the Death Watch beetle, although it is somewhat unusual for this beetle to attack plywood on account of the bonding agents present between the layers of wood.

The complete eradication of the Death Watch beetle is not an easy matter. It calls for much determination and patience, and, also, a clear knowledge of the habits of the beetle and its larva. The beetle emerges from the wood between April and July of the year. After mating, it lays its eggs in tiny crevices in the wood. The eggs hatch out in August, and the young larvæ immediately penetrate into the wood. They remain active in the wood for usually two years, that is to say, until the next Spring but one subsequent to their hatching. About March of that year the larvæ tunnel to about ¼in. or ⅓in. from the surface of the wood. Here they form chrysalises, and, after a week or two turn into the adult beetles, which soon after eat their way out of the wood, forming the characteristic circular holes. These again lay eggs on other portions of woodwork, and since the beetles are able to fly the damage is readily spread about.

Your best plan for dealing with the problem is to wait until the March of next year. Then apply hot creosote liberally to the woodwork, and subsequently keep up weekly applications of hot paraffin or naphtha every fortnight until the end of July. This treatment will kill all beetles on or before emerging, and it will prevent any egg-laying. The same treatment should be applied in the following year at approximately the same period in order to make sure of a complete cure.

It is vitally necessary to apply the above liquids as hot as possible in order to ensure their efficient penetration of the wood.

You will, of course, remember that you cannot paint over creosoted surfaces. Hence, if the wood has to be varnished or finished in any way do not use creosote, but employ naphtha instead.

One pound of ortho-dichlorbenzene and 1lb. of zinc naphthenate dissolved in a gallon of naphtha makes an excellent solution to eradicating Death Watch beetle, provided it is applied at the above times of the year. These materials may be obtained from Messrs. A. Boake, Roberts & Co., Ltd., Stratford, London, E.15. Such a solution is non-staining, and may be safely applied even to furniture.

Water solutions of copper sulphate, etc. are usually of little use for the above wood treatment, because they do not effectively penetrate the wood.

(2) Since nitrogen iodide is a very highly dangerous substance to produce, we feel that we must ask you to excuse us from giving the details of its making. Doubtless, however, you might be able to get such details from any advanced textbook of inorganic chemistry.

Copper-Plating Solution

CAN you please help me with the following queries :

What are the proportions for a copper electro-plating solution ? What are suitable current densities per sq. in. of deposit collecting area, and solution temperatures for (a) copper-plating, and (b) nickel-plating ?

Can a copper body 3/32in. thick be successfully built up on a thin metal foil by means of electro-plating ?—W. Moughtin (Billericay).

A SIMPLE and effective copper-plating solution is made up as follows : Copper sulphate, 1½–2lb. sulphuric acid, 4–6 ozs.; water, 1 gallon.

This bath is best operated at normal temperatures, or at a temperature slightly above this, say, at 25 deg. C. It is best worked with a current density of 25–30 amperes per sq. ft. of deposit area.

A small amount (say, ½ per cent.) of glue or gelatine added to the bath sometimes results in a better and a brighter deposit being obtained. Sometimes, also, a trace of photographers' "hypo" (sodium thiosulphate), is added to the bath for this purpose.

The following is an effective nickel-plating bath : Nickel ammonium sulphate, 12 ozs.; water, 1 gallon.

This bath is operated at normal temperatures and with a current density of 4 amps. per sq. ft. Its rate of deposition is slow, but the deposited metal is very hard and fine-textured.

You can build up a copper body on a metal foil by using the above copper bath. In such an instance it would be preferable to increase the acid content of the bath, to raise the current density, and also to agitate the solution continuously during the plating.

Space Rockets

I AM interested in the development of the liquid fuel rocket, and hope to carry out some experiments in my workshop.

Can you answer the following queries on the subject ?

(1) Of what material are the combustion chambers constructed ?

(2) The fuel which I believe consists of liquid oxygen and hydrogen discharged from separate jets has to be mixed in certain proportions—can you tell me what these are, and also if the fuels

ignite on contact with each other, or if they are started burning by some other means ?

(3) How can I calculate the lift provided by a given combustion chamber and expansion nozzle ?

(4) Can you recommend any books on the subject of Astronautics, and also give the address of British Interplanetary Society.—R. W. Boggio (Walton-on-Thames).

(1 and 2) Very few so-called space rockets have ever been actually constructed. Those which have been made experimentally have had cases of light steel or of aluminium, the combustion chambers being made of either of these metals, usually the former.

It has usually been proposed to propel such rockets by means of successive charges of a suitable rocket powder of the gunpowder type. At times, however, it has also been proposed to employ liquid air (or oxygen) as a propellent merely by the rapid gasification of these liquids and their consequent expansion. Liquid hydrogen has not been used, although it has been suggested as a means of increasing a rocket's energy of flight.

(3) You cannot calculate the life which would be given to a rocket merely from a consideration of the dimensions of its combustion chamber and expansion nozzle. The entire design, dimensions and weight of the rocket profoundly modify its "lift" and until all these factors have been taken into consideration, any calculation of the nature you require is more or less out of the question.

(4) The entire subject of interplanetary communication is very nebulous at the present moment. The British Interplanetary Society has, we believe, disbanded (at least temporarily), and there are no practical formulæ relating to the design of rockets on the lines you require. A few books on the proposed interplanetary travel have been published, the more serious and thoughtful ones in America. If you will write to Messrs. W. & G. Foyle, Ltd., Booksellers, Charing Cross Road, London, W.C.2, they will, we think, be pleased to give you the titles and prices of any such books which may still be available. They will also advise you if they happen to have any second-hand books on this subject in stock. You should also refer to your local Librarian and inquire as to whether any such volumes can be procured on your behalf.

Cerium

CAN you give me any information about cerium and, if possible, the details of manufacture and where obtainable.—F. Rodgers (Bolton).

FOR a detailed description of cerium, its properties and production, we must refer you to an up-to-date chemical work such as J. W. Mellor's "Comprehensive Textbook of Inorganic Chemistry," a copy of which, we think, is in the Bolton Library, and which is certain to be in the Manchester Reference Library.

Within the space of a short reply, it is only possible for us to give you a very brief indication of the nature of cerium.

Cerium is a greyish, hard metal which is soluble in acids but which remains substantially unoxidised when exposed to air. It alloys readily with iron. It is a pyrophoric, that is to say, a spark-producing metal, and it is on account of this fact that it is now being produced for war purposes. Cerium alloy forms the "flints" of petrol lighters, and other spark-producing devices.

The pyrophoric nature of cerium and its alloys was first discovered by Dr. Carl Auer, Baron von Welsbach, of Berlin.

Cerium nowadays is derived from rare-metal earths. From these, a complex alloy known as "mischmetal" is produced, this being derived from rare earths which were once a by-product of the gas-mantle industry. The earths are converted into chlorides by treatment with hydrochloric acid. Then they are mixed with calcium chloride and electrolysed. In this manner, the alloy, "mischmetal" is produced. It contains 50 per cent. of cerium. For pyrophoric purposes, this alloy is further alloyed with iron and then cast into small rods or other convenient formations.

For the preparation of pure cerium, chemical and/or electrolytical methods can be used, but these are all very tedious and complex, and for their detailed description, we must refer you to a standard work of reference, such as the above-mentioned book.

Cleaning Used Oil

I UNDERSTAND it is possible to make up a composition to clean used lubricating oil. Is this correct, and if so, what are the chemicals, and where can they be purchased ?—R. T. Calver (Gt. Holland).

APART from the process of chemical refining, which involves treating the oil with strong acids and alkalis, and subsequent distillation, there is no satisfactory method of cleaning oil merely by treating it with a "composition."

The best way to purify used oil to some extent is to filter it through a "rough" filter, such as a piece of muslin or similar coarse-weave fabric, and, afterwards, to allow the filtered oil to percolate through activated charcoal or through activated alumina. After percolation through either of these materials, the oil should be fit for use again.

The charcoal or alumina is purchased in the form of coarse grains, and it is packed loosely into a cylinder such as a 1lb. coffee tin provided with suitable exit holes at its base. The oil is allowed to seep through this, the whole apparatus being kept fairly warm in order that the oil may not be too viscous. Naturally, the whole operation is a slow one, but, in most instances, this is no disadvantage.

It is doubtful whether you will be able to procure activated charcoal at the present time, but activated alumina (aluminium oxide) is still obtainable from Messrs. Peter Spence & Co., Ltd., Widnes. It can be obtained in varying grades of fineness.

Magnetic Coils

WOULD you please let me know the formula for magnetism, both A.C. and D.C. current ? By that, I mean, for a given core area of an electro-magnet, and voltage, current, gauge of wire taken into consideration. How many turns of wire will be needed to bring the electro-magnet up to its maximum efficiency ?—F. Scholfield (Rotherham).

IT is not possible to give a simple formula for magnetic coils as there are many factors to be taken into consideration in individual cases, and designers spend a considerable amount of time in arriving at the most efficient coils for various purposes.

With D.C. coils, for example, the permeability of the iron core governs the number of ampere turns required to create a magnetic field of a given strength. The permeability varies with different types of iron and also is not a constant factor as it varies with the magnetic flux density in the iron. For some purposes it may be best to use a small core which is well saturated with magnetism so that the permeability is low and a relatively large number of ampere turns are required, rather than use a large core at low magnetic density and high permeability which requires a relatively small number of ampere turns. With good quality of iron it is usual to work at about 13,000 lines of magnetic force per sq. cm. Above this density, with good quality iron, the permeability falls fairly rapidly.

Having decided on the magnetic density to be adopted and knowing the total field strength required, it is a simple matter to calculate the cross-sectional area of core required. Magnetisation curves then give the number of ampere turns needed to create the required magnetic density per unit length of iron circuit so that the total ampere turns can be calculated. If there is an air gap in the iron circuit the number of ampere turns required to pass the magnetism across the gap may be as high as 13,000 times that necessary for a similar length of iron circuit. If the iron circuit is of non-uniform cross-section the ampere turns for each section having different magnetic density will be calculated separately and totalled up.

On a shunt coil which is fed from a constant voltage supply the required ampere turns will be provided by a large number of turns of small gauge wire of high total resistance so that a small current will be required. If the coil is a series coil carrying a high current the current may be a fixed quantity so that the number of turns will also be fixed.

In the case of A.C. current the calculations become more involved owing to the losses set up by eddy current in the iron resulting from the changing magnetic flux, and the fact that the current through the coil is controlled by its reactance as well as its resistance; the reactance will depend on the magnetic flux linked with the turns and upon the frequency of the supply. The querist is advised to study one or two books which deal with the subject of electro-magnetism in detail.

Car Starter as A.C. Motor

I HAVE a 12-volt car starter motor which I wish to convert to a 250-volt A.C. motor to drive a sewing machine. The motor would require to develop 1/25 h.p. The armature is 2¾in. long, 2¼in. diameter, with 21 slots in. 7/16 deep and 3/32 in. wide. There are four poles and four copper brushes. Could you please inform me how to wind the armature, and field coils, etc. ?—T. McGhie (Scotstoun).

THE type of starter-motor you describe is not altogether suitable for use as a high-voltage mains motor, as the thicker insulation required in armature slots and on field poles leaves very little room for active conductors. Carbon brushes of Link A grade also should be substituted for copper brushes. Since the power output required for sewing machine drives is so small, you may possibly obtain what you require by re-winding as follows: Armature, 21 coils, each containing 85 turns of No. 35 s.w.g. d.s.c. copper, coil span from slot 1 to slot 5 inclusive, wave-connected to 21-part commutator; fields, four coils, each with 600 turns of No. 29 s.w.g. d.s.c. copper connected in series with armature, interconnected to give alternate north and south polarity. The thickness of insulation should not be less than 15 mil. empire cloth or leatheroid.

Curing Rabbit Skins

I HAVE heard that there is a simple method of curing air-dried rabbit skins. Can you give me details of this process ? Will a skin dressed or cured by this method remain pliable, or will it stiffen after a time ?—D. Barlow (Walsall).

IN order to cure a rabbit skin, first of all scrape the inner side of the skin with a blunt knife in order to remove every trace of flesh and loose tissue. It is convenient to do this by stretching the skin, fur side down, over a baluster rail or some similar curved object.

Then dissolve 4 parts common alum and 1 part common salt in 8 to 10 parts of water. Immerse the skin in this solution for about 48 hours. In order to ascertain whether the skin has been soaked long enough, squeeze the liquid from it and then double the skin up with the skin side outwards in order to make a sharp crease. If the latter shows white and clean, the soaking has been completed.

After the skin's immersion in the salt-alum bath, rinse it well and then rub over it a paste made of flour and water or oatmeal and water. Work the paste well into the skin, and then wash it all off.

The skin should now be stretched on a board and allowed to dry slowly in the air. The skin will dry hard, but it can be softened by constant rubbing and kneading between the fingers, this action serving to induce permanent pliability. If desired, a very small amount of neatsfoot oil may be rubbed into the skin to soften it. However, if this is overdone the skin will become tacky and the oil will spoil the fur.

"Flash" Paper

CAN you please tell me of a substance that, when chemically treated, will produce a brilliant flash when ignited by an ordinary 1.5 volt gaslighter element ? I have thought of the "Flash-paper" usually found in indoor fireworks but am not certain of the formula. I believe it is nitric acid and sulphuric acid.—A. F. Wyer (Kidderminster).

THE type of "flash paper" which you desire can be made in the following way:

Mix 4 volumes of concentrated sulphuric acid with 1 volume of strong nitric acid. Pour the sulphuric acid into the nitric acid and not vice versa. After the mixed acids have cooled, immerse in them a number of ordinary cigarette papers or paper strips of similar thickness. Allow these papers to remain immersed for three days. Then remove them and wash them most thoroughly for at least two hours in running water, in order to remove every possible trace of the acid.

The papers should now be allowed to dry slowly in the air. The cellulose of which the paper is composed will, by this process, have been changed into cellulose hexa-nitrate, or gun-cotton. As such, it will burn away almost instantly with a flash when ignited with a hot wire, such as you mention, or with a lighted cigarette end.

You should bear in mind the fact that these papers are not without danger. Cellulose hexa-nitrate (gun-cotton) when struck, can explode very violently. Hence, it is always highly advisable to retain these papers in a damped condition and to dry them in the air just before they are required for use.

Plating Formulæ: "Pickling"

CAN you give me any information on the following subjects. What are the formulæ for :—

(1) Nickel and copper plating and polishing ?

(2) What quantity of caustic soda is needed to a gallon of water for a soda dip ? Does the solution have to boil, and how long does one leave the articles in to clean ?

(3) When articles are pickled in a solution of acids, how long are they left in ?

(4) I have a glass tank 12in. x 8in. x 12in. with two nickel anodes, one at each end, and I find that the article being plated gets burnt. Is it because the object being plated is too small, or are the anodes too near the object ?—R. H. Brett (Broomfield).

(1) The following are well-tried nickel and copper plating formulæ:

Nickel Plating.	
Nickel ammonium sulphate ..	8oz.
Nickel sulphate	4oz.
Boric acid	2oz.
Common salt	2oz.
Water	1 gallon.

Operate the above bath at 80 deg. F. Use a current of 6-8 amperes per square foot of surface to be plated, and a voltage of 2-2½ nickel anode.

Copper Plating	
Copper sulphate cryst.	28oz.
Conc. sulphuric acid	3-5oz.
Water	1 gallon.

Operate the above at 75 deg. C. Use a current of 10-15 amperes per square foot of surface to be plated, and a voltage of 3-12. If the solution is continually stirred or agitated, a higher amperage can be used for quicker results, if desired, but in most instances this is not necessary. Use anode of rolled copper.

(2) The strength of the soda dip to which you refer depends entirely upon the class of work for which you intend to use it. Ordinarily speaking, 1lb. of commercial caustic soda (sodium hydroxide) to the gallon of water makes a very effective solution for cleaning and degreasing. Such a solution can be used either hot or cold, it being naturally more potent in the hot condition. The time of immersion of the article in the soda dip is, again, entirely dependent upon (a) the strength of the dip, and (b) the extent to which the article in question requires cleaning or degreasing. On an average, 5 or 10 minutes' immersion should suffice.

(3) To some extent, this question is answered in the above reply. The duration of "pickling" in an acid or mixture of acids is entirely dependent upon the nature of the acids, their strength, their temperature, and the extent to which "pickling" is required. Owing to these variable factors, it is really impossible for us to state any definite duration of pickling, for the particular reason that we do not know the exact class of work to which you refer.

(4) Your nickel plating work may be "burnt" for several reasons, which only you yourself can ascertain by means of experiment. The reason for the "burning" may be: (a) Incorrect composition of electrolyte; (b) Too high a temperature; (c) Too heavy a current; (d) Anode(s) being placed too near the object.

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Phone: Temple Bar 4363
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Comments of the Month By F. J. C.

The Three Tailors of Tooley Street

WHEN Canning was Prime Minister there were three tailors who held a meeting in Tooley Street for the redress of popular grievances or what they conceived to be popular grievances. They were, of course, their own personal grievances, and they addressed a petition to the House of Commons beginning: "*We, the people of England, demand. . . .*" **The N.C.U., the R.T.T.C. and the C.T.C. find themselves to-day in a position analogous to the three tailors of Tooley Street, over the question of massed start racing. On other cycling policy they resemble the Tooley Street tailors in that they do not speak for the majority of cyclists, either.**

We have dealt with this matter at some length in previous issues, and we are determined to pursue the matter until justice has been done. **We are quite convinced that this joint announcement would not have been issued without promptings from some of the bodies concerned, and so that our readers may form an accurate opinion on the matter it is necessary for us to recount certain history.**

When the National Cyclists' Union and the Cyclists' Touring Club were formed over 20 years before the close of the last century, the fastest vehicles on the road were horse-drawn. It was natural that the owners of such vehicles, as well as the coach-building industry, should oppose the development of cycling, for cyclists were faster than horse-drawn vehicles. Almost every magistrate owned a landau, a phaeton, a barouche, or a Victoria, and they were extremely severe on any wight hauled before them for the heinous offence of riding a bicycle. One had only in those days to be seen on a bicycle, riding sedately along a country lane free from other traffic, to be charged with "dangerous riding," "riding to the common danger," without consideration for others who were on the road, or "who might reasonably have been expected to be there." **Road racing received the attention of the police, and so did record breaking, and much of it had to be conducted, as it still is to-day, in a hole and corner manner, as if it were something of which one should be ashamed.**

The only body then whose duty it was to control road racing and to homologate attempts at records on the road, paced or unpaced, was the National Cyclists' Union. This body, instead of asking for the relaxation of the campaign of persecution indulged in by the police, as it should have done, took the line of least resistance, and at its annual general meeting in 1888 it tabled and passed the following resolution: "*The National Cyclists' Union, as a public body, desires to discourage road racing, and calls upon the clubs to assist it by refusing to hold races on the roads, and it prohibits any of its officials from officiating or assisting at any road races, and refuses to recognise any record made on the roads, and that this be added to the rules.*"

From that time the N.C.U. has concerned itself chiefly with track racing.

Troubled Waters

FOR over 50 years the N.C.U. has been in troubled waters on questions of cycling policy. It has muddled along and earned the censure of prominent cycling authorities such as George Lacy Hillier, the late John Urry, and the late F. T. Bidlake. The latter withdrew the affiliation of the North Road Cycling Club to the N.C.U. as a result of its attitude towards road racing and record breaking. **Bidlake was a Triton among the minnows.**

When the N.C.U. set its face against all forms of road sport it did not kill it; on the contrary, it thrived, and a few months later (in April, 1888) Mr. A. J. Wilson founded the Road Records Association to homologate records on the road.

Racing on the roads also continued, and was controlled by a number of bodies until, a few years before the war, the Road Time Trials Council was formed by a number of rebels from the old Road Racing Council.

Now the main opposition to massed start racing comes from the N.C.U. and the R.T.T.C., with a faint echo from the president of the R.R.A. who wrongly asserted that the movement was run by a number of "hot-headed youths." He since has admitted that this statement was wrong.

Loose Ends

NOW let us draw together the loose ends. The N.C.U. is affiliated to the Union Cycliste Internationale, **which promotes massed start racing on the Continent, and the N.C.U. issues licences to British riders to take part in those races. Why, therefore, is the N.C.U. opposed to massed start racing in this country (it claims, of course, that it is not) where the roads are no worse, and in some cases much better, than those, for example, used in the Tour de France? And why is it that the R.T.T.C., which would not be in existence but for the attitude of the N.C.U. against road racing, now supports the N.C.U.?** A reference to the files of *Bicycling News*, which was the first cycling journal, will show that the N.C.U. has made a muddle of nearly everything which it has handled. In a leading article in that paper (September 17th, 1895), the late John Urry, in giving advice to clubs, wrote: "Above all things educate your members so that they may know how properly to express their feelings on the iniquitous conduct of the N.C.U."

It is humorous to think that the R.T.T.C and the R.R.A., both bodies which have been formed as a result of a breakaway movement, should object to the formation of the B.L.R.C. **Now the time has come when the N.C.U. and the C.T.C. should drop their pretence at representing cycling opinion. Like the three tailors of Tooley Street, an overlapping membership of fewer than 50,000 cannot represent the 10 million cyclists which it is presumed are on the roads. There is room and the time is ripe for the formation of a Cyclists' Association which is really representative of the majority and which takes care to sound the opinions of its members on particular subjects. It is humorous to think that the Cyclists' Touring Club, with its peculiar ideas of democratic principles, is so constituted that resolutions can be passed at its annual general meeting of which no notice need be taken by its council.**

Affiliation

THE National Cyclists' Union accepts affiliation from cycling clubs which exist only to promote time trials, and yet it is itself opposed to time trials. The contortions of this body since its foundation are more reminiscent of a boneless wonder than of a cycling organisation.

In any case, as we have stated before, massed start racing in this country will continue in spite of the nonsense spoken by the N.C.U. about amnesties and proclaimings, and all the other footling legal clap-trap with which it endeavours to surround its autocratic attitude.

Mr. Hepworth, M.P., was asked to have a word with Mr. Morrison on the Home Office announcement. **Mr. Morrison replied to Mr. Hepworth that the joint announcement "was purely a wartime measure."** This statement contradicts that in the joint announcement wherein it is implied that massed start racing is undesirable in war, and that it will be more so in peace. The sponsors of the B.L.R.C. are in somewhat the same position as the Tolpuddle martyrs.

As far as we can see there will be no solution to this controversy unless the N.C.U. itself approaches the properly constituted new body concerned with a form of road sport outside the ambit and therefore the control of the N.C.U.

New R.R.A. Records

RECENT tandem tricycle rides by Messrs. L. E. Copping and J. M. Sloper, of the North Road C.C., were passed as records: 100 miles in 4 hrs. 13 mins. 57 secs.; 50 miles in 1hr. 52 mins. 41 secs.

Take Care of Wartime Cycle Tyres

THERE are over ten million cyclists in this country, which means that there are over twenty million bicycle tyres in use. That amounts to a great deal of rubber so every cyclist must play his part in conserving this rubber to the utmost.

War grade tyres, of course, need extra care, and the best way of servicing them is to keep them inflated hard. So pumps should be used regularly and often to ensure that the share of the nation's precious rubber supplies entrusted to cyclists is not wasted in any way.

PARAGRAMS

A picturesque corner of the little South Down village, Steyning, Sussex.

The Trinity

MRS. G. HARPER, Kingsbury Wheelers C.C., has taken over the duties of hon. social secretary for her club. She is already hon. treasurer and hon. Time Trials secretary, two offices she took over from her husband when he was called up.

Dulwich Paragon in India

STAFF SERGEANT LEN HANDS, Dulwich Paragon, is now serving with the Royal Engineers in India.

Well Spent Leave

EDDIE LAIDLER, Early Birds C.C., made most of a short leave when he spent 14 days awheel tandeming in the Lake District. He has been serving on a submarine for many months.

Club Renamed

CAMBORNE Redruth Premier C.C. has been renamed the West Cornwall Wheelers. Reason: scattered membership. Cliff Hitchins, 23, Knave Go-By, Camborne, Cornwall, is the hon. sec.

In Tanganyika

FORMER hon. secretary of the West Cornwall C.C., Denis Stuart is now in Tanganyika.

Pre-war Star's New Role

PAT McCABE, Glasgow track star of pre-war days is now in the Merchant Navy.

Scottish Riders Meet Abroad

WHILE with the R.A.F. in Calgary, Canada, "King" Ferguson, Glasgow Transport C.C., met Tom McNulty, Glasgow Wheelers, leading road, track and roller rider until he joined the R.A.F. three years ago.

Will Keir's New Service

ASSOCIATION president and well-known Scottish timekeeper, Will Keir, Dundee and Thistle Roads C.C. and Dundee and District T.T.A., has gone to sea with the N.A.A.F.I.

George Owen's Loss

GEORGE OWEN, former English path champion and brilliant Manchester Wheeler rider, lost his home during a raid on the south-east coast.

Manchester Wheeler's Loss

FORMER hon. gen. sec. of the Manchester Wheelers, William Critchley died in a Japanese camp. He was in the R.A.F. and captured over two years ago.

News of Ealing Members

TWO members of the Ealing C.C.—Robert Butler and Leslie Stokes—are prisoners of war in Japanese hands. Sergeant Syd Parker, R.R.A. tricycle record holder, is with the Middle East Forces and has met Lieutenant D. Sargent, former club secretary.

Twice Captured

JIMMY PURVES, Veg. C. and A.C., long-distance pre-war rider, is a prisoner of war in Germany. He was formerly captured in Syria but repatriated after cessation of hostilities.

Merseyside Wheelers Re-form

THE Merseyside Wheelers have re-formed and are again in active operation despite the fact that 20 members are in H.M. Forces.

Yorkshire Road Member's Promotion

K. V. HANCOCK, Yorkshire Road Club, has been promoted to captain.

B. L. Smith's Record

B. L. SMITH, Yorkshire Road Club, has a record of which any rider might well be proud. He competed in 22 time trials during 1943, won many club, semi-open and open events, and rode on the track and on rollers with success.

Portsmouth North End Loss

FOR 20 years a member of the Portsmouth North End C.C., R. G. Foster has died. He was an ardent tourist and had cycled in most of the European countries.

The Barnsley Way

IN six months during 1943 members of the Barnsley C.C. won 24 first-class open events, 13 first team-race awards and 86 handicap awards. In 1942 the club secured no fewer than 153 awards of all kinds.

D. Morrison Decorated

D. MORRISON, Glasgow Wheelers, now serving as a sergeant flight-engineer in the R.A.F., has been decorated with the D.F.M.

From 10,000 to 14!

BATTERY SERGEANT-MAJOR J. H. McLAREN, Kings Lynn C.C., now serving in Egypt, rode 14 miles during 1943! For many years his annual mileage was 10,000.

Y.H.A. Reaches 100,000

A RECORD total of 100,907 in Y.H.A. membership was recently announced. London Region's share of the figure is 27,840.

Track Racing in Oldham?

AT the recent general meeting of the Oldham and District Cyclists' Union a sub-committee was appointed to look into the possibility of promoting track racing in the Oldham district during the coming season.

Four Men in a Week

TO lose four men for the Forces in one week is the "record" of the A.E.C. C.C. The members are W. Hale, S. Page, K. Weeks and G. Hanger. The last named was last year's club champion.

Taylor Again

JACK TAYLOR has again won the West of Scotland Clarion C. and A.C. championship.

Sergt. Wall Missing

SERGEANT E. G. WALL, founder member of the Wings S. and S.C., is posted missing following an operational sortie over enemy-occupied country.

Club Champion

H. J. HUTSON, Bon Amis C.C., has won his club's championship with an average speed of 22.166 over distances of 25, 50 and 100 miles.

To Increase Funds

YORKSHIRE Road Club has sent a suggestion to the local R.T.T.C. Council that a penny levy be made on every entry in open events. They estimate that the Council could obtain £200 a year by this method.

Escaped from Captivity

IVOR SANSUM, ace roadman of Swindon Wheelers, was reported "missing" on his 19th R.A.F. operational flight. That was five months ago. He has returned to this country and reports that in the crash the pilot of the plane was killed and the rear gunner taken prisoner.

Oxford Rider's Decoration

MEMBER of the Oxford City Road Club, Pilot Officer Les King, R.A.F.V.R., has been awarded the D.F.C.

Sharrow Club Bereaved

JAMES WEAR, well-known member of the Sharrow C.C., and prolific time-trialist for many years, died as the result of an accident when cycling.

Trool as Park!

PLANS are afoot to make Glen Trool into a National Park. Glen Trool has been described as the scenic gem of southern Scotland.

Against By-pass

ST. ASAPH, the small North Wales city, is objecting to the line of a proposed new trunk road, and has suggested an alternative route.

Loch Long, and The Cobbler (2,891 ft.).

Around the Wheelworld

By ICARUS

THE first annual dinner and dance and prize distribution of the West London Road Club was held at the Park Royal Hotel, Western Avenue, on November 20th. Over 150 people were present, and although the club is only about a year old the attendance is an answer to those, especially the effete members of the N.C.U., who still delude themselves into thinking they have killed massed start racing. Mr. Willoughby Garner, the president, was in the chair, with Frank Guy as toastmaster. Clubs represented were Ealing Manor, Sandon, Southern Coureurs, United Doomers, Calleva, Lawrence, Roslyn Ladies, Rickmansworth, Ealing, Leycrest Manor, and several others.

A few of those known to be hostile to massed start racing sent excuses for their non-attendance. Mr. E. Mansfield proposed the toast of the visitors, and Rex Coley replied. The toast of the Press was proposed by Mr. W. S. Summers, and Mr. F. J. Camm, in his reply, dealt with the attitude of the N.C.U. towards massed start racing, and also with the attitudes of the R.T.T.C. and the R.R.A., which two latter bodies were themselves formed as the result of a breakaway movement and are therefore not in a position to criticise the B.L.R.C. He poked fun at the use of the archaic legal terms "amnesty," and "proclaim" which suggested that the N.C.U. was a legal authority.

He advised them to continue with massed start racing, and stated that there would not have been any Home Office announcement had it not been for the attitude of the N.C.U. and the R.T.T.C. He assured them that massed start racing would continue. The evening was as historic as an evening in 1888 when the N.C.U. set its face against road records and road racing—a stab in the back to cycle sport which no one in the cycling movement should be allowed to forget.

Sir Charles Bressey at Roadfarers' Club

FRIDAY, November 12th, was an important occasion to the Roadfarers' Club when they held a dinner at the Waldorf with Sir Charles Bressey as the speaker. His subject was his famous plan for London with which he dealt in detail. He emphasised and underlined the recommendation he made in his report, and received a great ovation at the conclusion, as well as a tribute from the president, Lord Brabazon.

Many famous members were present including Mr. Sydney Camm (designer of the Hurricane, Typhoon, etc.), Mr. G. O. Slade, K.C. (the famous counsel), Mr. C. G. Grey, etc. The next meeting of the Roadfarers' Club takes place on Friday, January 21st, when Mr. H. G. Wells, a Fellow of the Roadfarers' Club and author of the famous cycling novel "The Wheels of Chance," will be present.

N.C.U. Diaries

I HAVE received a copy of the first-class N.C.U. diary which has been carefully prepared to include matter and data of special interest to all cyclists. It also includes 16 pages of maps. It costs 3s. from the N.C.U., 35, Doughty Street, London, W.C.1.

Airman Wins Bicycle

LEADING-AIRCRAFTMAN R. C. HOGG has won the bicycle offered by the British Bicycle Manufacturers' Union for the best slogan on saving cycle tyres: "Use the Pump and Save the Tyres."

Mr. W. C. Dowse, School House, Hedley-on-the-Hill, Stocksfield, Northumberland ("Air and Care Save Wear and Tear"), and Miss Mary Watson, Westbourne Road, Lancaster ("A Pump a Day Keeps the Tyres O.K.") have tied for second place. The second and third prizes of five and three guineas offered by the Tyre Manufacturers' Conference have been divided between them. Their fourth prize of one guinea goes to Mrs. I. W. Bogie, 10, Glebe Gardens, Corstorphine, Edinburgh ("Tyres Looked After Are Tyres Years After").

There were 11,830 slogans sent in. If this is the best slogan, the 11,829 others must have been pretty foul. I can make up better slogans than this all day long. For example:

Give tyres air,
And save repair.

I do not think that Mr. Hogg's slogan will become popular.

At the Roadfarers' Dinner, when Sir Chas. Bressey spoke on his Plan for London. Left to right: C. G. Grey, founder editor of The Aeroplane, *Sydney Camm, C.B.E., F.R.Ae.S., designer of the Hawker machines, including the famous "Hurricane" and "Typhoon" (brother of the editor of this journal), Lord Brabazon of Tara (President), G. O. Slade, K.C., the famous counsel, and E. Coles Webb.*

C.T.C. Reward

THE C.T.C. offers a reward of 10s. to any person securing the conviction of anyone depositing broken glass or any other sharp or dangerous substance on a road. I offer a similar reward to anyone securing a conviction of those caught stealing bicycles, lamps, pumps and other cycling impedimenta! Of course, readers sending me this information and securing these convictions will be expected to spend their own time in the courts and pay their own expenses!

I notice at the foot of the notepaper on which C.T.C. press notices are typewritten the following: "*What do the cyclists say? If you want to know, ring up the C.T.C. News Department.*" I must ring up the C.T.C. News Department and ascertain how they find out what the cyclists say. Should it not be what the C.T.C. *Council* says?

At the Roadfarers' Dinner at the Waldorf on Friday, November 12th, 1943. Sir Chas. Bressey is seen on Lord Brabazon's right in the right hand picture, and Sydney Camm on his left.

Wayside Thoughts

by F. J. URRY

Sheepstor, Dartmoor village.

The User Critic

SOME of my friends having grown old with me are now, in these travel stressed days, bemoaning the fact that they have to "stay put" or incur the consequences of discomfort attached to present-day train or bus travel. Now I feel sorry for those people from whom health has departed, or age prematurely withered their activity, for there is no doubt such are feeling increasingly the burdens of the limitations, and I wish they could be accommodated with private travel facilities, even if only on a small scale. Perhaps they will be in the near future. But really I have little patience with the robust who will only give themselves to cycling in the "five miles at a stretch" method, and then complain that cycling is hard work. Of course it is if the individual will make no attempt to become a cyclist, sits on the saddle like a sack of flour, doesn't know what gear he is pushing and muffles himself up as if for an arctic exploration. Such people—and there are many—are no credit to the pastime; they merely deride it, and endeavour to reduce it to ridicule. They are not usually open to any kind of persuasion, and consider themselves a cut above "paddling their own canoe," which incidentally is surely the manly as well as the healthiest method of travel. Now I have every desire to make the public cycle-minded, to propagate this grand game which I believe to be pre-eminent in the pleasure travel sphere, and will do anything reasonable to help people to enjoy cycling; but I just have no use for the type portrayed, the lazy people who want to buy their leisure—which I interpret as sheer idleness—with the least possible muscular energy. Cycling is not for such as they; but one day when thickened veins and pulsing heart overtakes them, they will be sorry about it.

Spares and Care

THE industry is to-day very much alive to the need for a much greater supply of replacements, and recently approached the supply departments with a view to improving the position, particularly in reference to pedals, spokes, bells, and inflators. How successful they will be remains to be seen. It is true that the repairer is wasting a lot of time these days searching for replacements, time that could be far more profitably spent in servicing machines and quickly returning them to usefulness. The repair and replacement material is simply not available in many cases, and thousands of bicycles must be immobilized as a result, and thousands more are ridden to ruination for want of what used to be a very simple replacement. It is a desperate business which the industry is trying its best to cure; but unfortunately many disappointed people are blaming the dealer and the trade for neglecting their interests. That such is not the case I can vouch for; the trade is really worried over the lack of supplies, for it knows better than most people how much the bicycle counts in the transport system of the country. One thing you and I can and should do is to care for our property, to oil and adjust it more assiduously than ever, because it is true that the main reason for breakdown is the neglect of the simple attention a bicycle needs. If these things were regularly attended to, I believe a considerable percentage of the repair problem would be solved, and the saving in labour expense and worry would be enormous. But how difficult it is to bring this simple fact home to the average rider; that loose crank, that squeaking pedal, that maladjusted gear or slack bearing; they will all lead to trouble in due time, and then the worry will start, whereas a few minutes' attention now and then will cancel out half our transport troubles.

Go Out—Keep Fit

WINTER riding is so jolly, comfortable and companionable that I sometimes wonder if it is not more enjoyable than the summer solstice, when the very length of the days occasionally tempt us to long journeys and we are apt to arrive home a trifle weary. I say winter cycling is comfortable because when darkness falls I am generally within an hour of home on a road I know well, so that the blackout seldom worries me. And it is companionable for the simple reason that most regular riders know the haunts of their friends and can usually find them ensconced by an ingle-nook tasting the tea or enjoying country fare which is so often a change from the set round of rationed food. For the knowledgeable cyclist knows where the fat pig lives and usually discovers the date of his demise—and acts accordingly. At least I do. To step into a brisk air soon after breakfast and ride say fifteen miles to a well-known meeting place, puts you in form for a cup of tea and whatever may be going in the cake line; and ten miles farther there will be lunch waiting for you at some cottage or hostel still in fairly full working order, and a couple of merry talkative hours flash by with little enough time left to make a third call for tea on the circuit home, leaving a bare ten miles to finish a day's easy riding. But how fit and satisfied such a round keeps you, filling your eyes with the winter scene which invariably ends with a glorious sunset. Sometimes it is wet, yet even such days have their charm and adventure, containing that spirit of waywardness that is the very essence of cycling. The man who "sticks in" because of the weather is surely admitting elemental defeat of that first law of the animal, to go out and forage. Some day, when normality in food supplies returns to the land, I will find me a merry companion and we will go a long tour to the Western Highlands in mid-winter, and I know it will be good. I have wanted to do it for years, but have always been afraid to pledge summer holidays to such a venture. But after the war is over, perhaps—indeed I hope—that the younger generation will take the helm and grant me leave to widen my wanderings.

Good Reasons

I WAS talking to a relative of mine the other day expounding the theory that my riding had resulted in the preservation of easy activity and the usual rude health I enjoy. This younger man happens to be a doctor with—in normal times—a wide practice, but at the moment fulfilling duties in the army. Like most medical men the use of a car has become second nature to him, and the only exercise he gets beyond running up and down stairs is an occasional game of golf. "Well," he said, "you may be right, but it would be a very unpopular thing for a medical man to recommend cycling as a cure for most of the ailments humanity is heir to. Certainly you are a decent specimen of your own belief, and it seems to me, fully justified in saying the deep breathing cycling engenders, and the smooth exercise of most of the muscles, have made and keep you fit and well at sixty-four. But you mustn't expect me to become enamoured of such methods to save humanity from its own folly. By all means carry on with the good work, for it is good work, and if finally we have to shoot you to end the story, don't blame us, but your jolly old cycling habits." That idea is, of course, the licence of relationship; but at least it is something to get a frank opinion that cycling is a fine thing to practise, not merely for the youngsters, but for the "growing elderly," who automatically think a trifle more of their health and the best way to preserve it. That I can work and walk and ride—particularly ride—gives me great satisfaction in acquiring and preserving the power to do these things; but all that joy is magnified amid the undiluted pleasure I obtain from looking on a fair countryside any odd hour, and trickling the round of friends when the desire for a chat and exchange of opinion moves me. To think I am free in my comings and goings is fine, but to discover in the processes of exercising such freedoms the depth of mental pleasure such changes reach, is just something that cannot be transferred to words, it goes beyond explanation.

A Thing to Remember

AFTER this war is over I predict a great future for the four-speed gear, either of the hub or derailleur types. I have been riding these combinations since 1939 and have had every chance of comparing them with the two and three speed gears I still have in service. I say this because I consider I am just an ordinary average cyclist, and frankly admit when the four-speed became available, did not realise it would be any great improvement on the previous combinations. Well, I was wrong, for it is, and the reason is chiefly due to the range of ratios that seem to me to be just sufficient in changing dimensions to give a wonderfully level use of all the gears over a give and take road, or under the conditions of windy and stormy weather, for or against. This matter is worth keeping in mind when the time comes for you to order that superb new bicycle you have been talking about.

Club Notes

Tudhope Wins

JACK TUDHOPE, Crawick Whs., won the Scottish Invitation "25" with a time of 1 hr. 4 mins. 23 secs.

Promotion

STANLEY SADLER, well-known Newcastle club-man, is now a Captain in the R.A.S.C. in the Middle East.

Douglas Rollers

THE Douglas C.C. is promoting an open roller contest on January 8th.

Death of Wren President

FLIGHT-LIEUTENANT G. W. WARNES, R.A.F.V.R., formerly president of the Wren Wheelers, has died in Johannesburg, South Africa, following a long illness.

D.F.C. for Clubman

PILOT OFFICER BEN ROOKE, formerly secretary and club champion of the Luton Arrow C.C., has been decorated with the D.F.C.

"Twelves" Again

NO open "twelves" have been promoted in Scotland since 1939, but riders are urging that they should be revived in 1944.

Joined Yorkshire Roads

MR. AND MRS. ALF. MARTIN, South Yorkshire speed stars, have joined the Yorkshire Road Club.

In Air Arm

RICHARD CAMPBELL, son of John Campbell, championship secretary of the Scottish Amateur C.A., has joined the Fleet Air Arm.

Taylor Wins

JACK TAYLOR, West of Scotland, has again won the road championship of the National Clarion C. and A.C.

Tax Dropped

THE 5s. bicycle tax which the Nazis imposed on the Dutch has been dropped.

Most Popular Hostel

THE most popular youth hostel in Scotland during 1943 was that at Edinburgh, with a total of 8,762 visitors.

Cycling Chamberlain

GLASGOW'S new City Chamberlain, Mr. George B. Esslemont, is a keen cyclist.

No Pumps

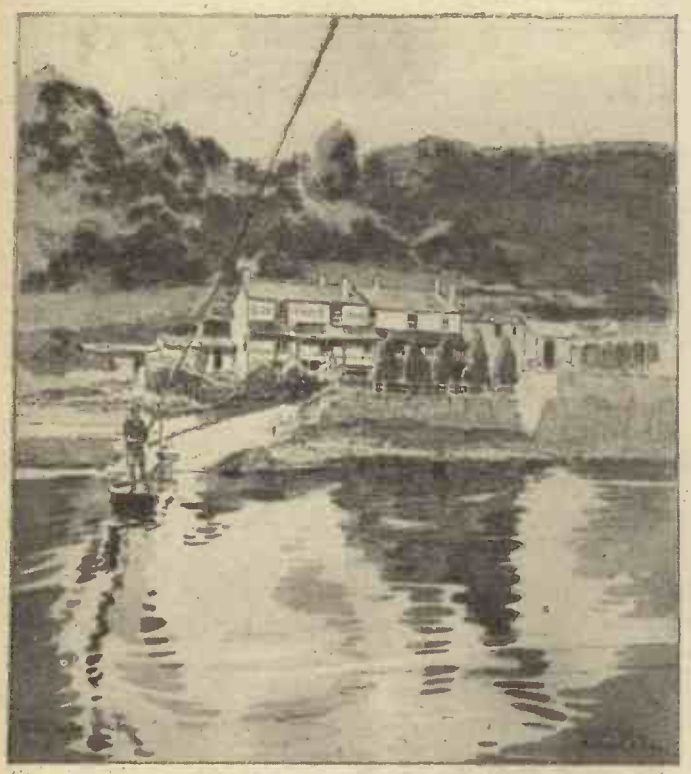
CYCLE inflators are reported to be so short that even the military cannot get supplies.

Clarion Brochure

THE National Clarion C.C. is to issue a brochure to celebrate its jubilee this year.

CYCLORAMA

By H. W. ELEY



The Olde Ferrie Inne, Symonds Yat.

London Dairy Farm

THERE have been many books written to emphasise the fact that rural life is still to be enjoyed quite near to London, and I have myself enjoyed the shooting of hares on some farmland within the sound, and almost sight, of a Tube station. But it was only recently that I discovered that, *right in London*, there was a dairy farm, with some twelve milking cows, and authentic, country-looking cow-sheds with, over each stall, the particular cow's name inscribed, just as one may see it at Daisy Dell Farm, in the heart of the countryside. Where is it? Why, in Swedenborg Square, Cable Street—which, as you may know, is in Dockland! I have read all about it, and one fine day I have promised myself that I will visit this farm in the heart of the Metropolis, and see the "farmers"—Mr. and Mrs. Carson. And I shall take a keen delight in stroking the sleek neck of "Maudie"—one of the well-kept herd.

Children's Tricycles

TO judge from the "smalls" in the advertisements of various provincial papers I have seen lately there is a great demand for children's tricycles, and I gather that big prices are being paid by those lucky enough to find someone with a machine to dispose of. It is all an interesting sidelight on the war, and the acute shortage of certain things. Who would have thought, in the piping days of peace, that when little Johnnie wanted a child's tricycle, it would have been a matter of advertising and offering a "tip-top price"?

Keen Cyclist at 83

TRULY, it is never too old to cycle . . . and I was reminded of the fact quite recently when I was visiting a Derbyshire village where the rector, a grand old fellow, is within a month or so of his eighty-third birthday. And he proudly showed me a *new bicycle* which, after much trouble, he had secured from a dealer in the neighbouring market-town. The old man showed me his new acquisition with a pardonable pride, and made the—to me—astonishing comment, "Yes, it is a good bike; I thought I would get a good machine *that would last!*" There spoke a great-hearted man, and a true cyclist!

"Conkers"

HOW some of the old and simple games of our boyhood days survive and retain their freshness for each generation! This autumn I have spent much of my time in a district rich in fine horse-chestnut trees, and I could not help but notice how popular was the old game of "conkers"—a great favourite in my young days, and one which is still played, apparently, according to the old rules. And what a lot of pleasure it has afforded generations of English schoolboys! First, the gathering of the "conkers"—when the green sheaths have split, and the shiny, tawny nut emerges; then, the boring of the hole through which to thread the string or cord; the tying of the big knot at the end of the string . . . and the cocksure "challenge" to all and sundry! And—just as in the days of yore—the nut which smashes another becomes a "One-er" . . . and is treasured as the victories mount up. I love to see these survivals of a simpler age, and I rejoice that the boys of 1943 are not too sophisticated to enjoy this venerable game of the English town and countryside.

Glories of Derbyshire

I TALKED the other day with a man who had just returned from a little cycle tour in my beloved Derbyshire. He went into ecstasies over Dovedale, and Mill Dale, and all the lovely country around the Derbyshire-Staffordshire border . . . and he knew my villages of Yeaveley, and Rodsley, and Wyaston (where they "dress the wells" at Whitsuntide)—and I told him of the Druidical Circle at Youlgreave, and we chatted about the old "Green Man" at ancient Ashbourne—that historic inn where Doctor Johnson was wont to sit and smoke and sip his ale. A great district, and if it is hilly . . . well, no true cyclist minds a hill! When the war is over, and one can take a real holiday, instead of snatching an odd day from the desk, I shall ride again in Derbyshire, where the gentle Dove winds like a silver ribbon through matchless scenic splendour, reminding one of Izaak Walton and Charles Cotton, and happy hours with rod and line.

Winter Beauty

A RAW, cold, rather dismal December afternoon; and as I write these notes Mother Nature does not seem to have much to offer me should I tramp out along my well-loved lane, which leads to Three Elms Farm. And yet . . . there is beauty in those stark trees; blackbirds hop out from the shrubs along the edge of the sodden lawn, and a robin has been hopping about hopefully for some time around the bed of chrysanthemums. I think I will go out, and, anyway, it will be good to look at Farmer Hodge's young stock and smell the good aroma of the farmyard, and maybe have a word with him about his Black Leghorn pullets which should now be coming into lay. And Rufus—that's the liver spaniel with the limpid eye and faithful heart, wants a run and a blow, anyway. And once outside, what I might have missed! After that shower of rain . . . a rainbow, wondrous and glorious, pledge of all the sunshine to come to gladden hearts and earth. . . .

"Robin Hood" Cycles

CHATTING with my good friend Keller, of the Raleigh Company, I gathered that the "Robin Hood" range of cycles has "gone over" well, and that everyone is very satisfied. The "Robin Hood" now supersedes the "Gazelle," and the appropriateness of the new name is now evident.

Care of Tyres!

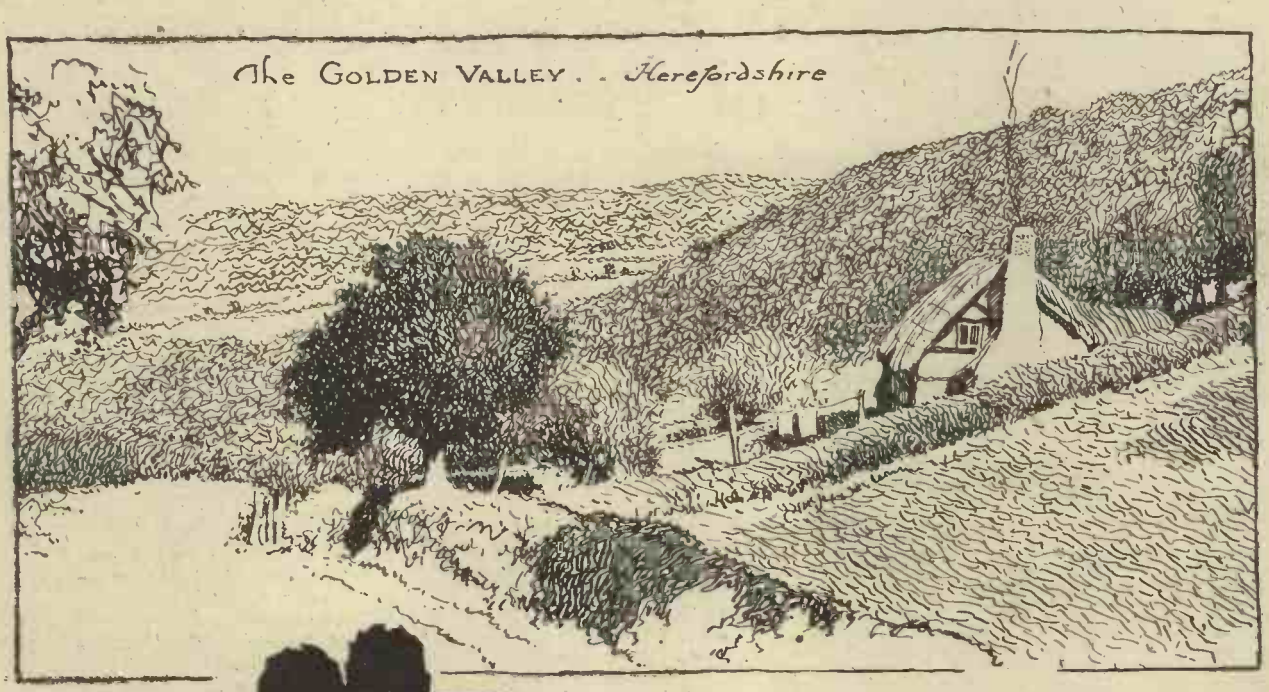
CONTINUE to take great care of your tyres! The very optimistic comments one reads and hears about the development of synthetic rubber are apt to be misleading; the real experts, the men who *know*, say that our rubber problem is by no means solved, and that every user of tyres must try to get the last mile out of them and treat them very carefully. So . . . let us continue to "do our bit" in this direction!

Cycle Inflators

I HAVE heard much lately about the shortage of cycle inflators, and more than one cyclist has pointed out that the urgent advice to riders to "keep their tyres hard" is difficult to follow when one cannot buy a pump. Well, there *is* a shortage, but then there are shortages of many things in these wartime days, and I suppose we must not grumble. It can be stated with confidence that manufacturers, and that hard-working body, Tyre Control, are doing all that is possible to improve the position, but while the shortage lasts it is no bad plan to do as one tyre manufacturer is advocating . . . "Share your pump with a pal."

Post-war Demands

THE recent good news from several war fronts is reflected in the optimistic note which is apparent in much advertising to-day; there is a "looking forward" to the better times of Peace, which is refreshing, and although one does not make any prophecy about the "end of the war," one does feel that it is right and wise to impress upon dealers the fact that good times *are* coming, when demands will be big, and British craftsmanship will be equal to those demands. In the world of cycles, I am sure that we shall find that even during these hard days of war our technical leaders have been busy "evolving"—and they will give the dealer all that he wishes in the way of design and quality when the great day comes.



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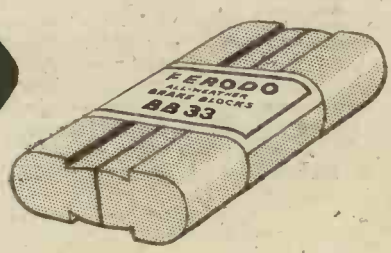

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My Point of View

BY "WAYFARER"

The Pastime's Enemies

CYCLING has a number of climatic enemies, which take their turn at heading the unpopularity poll. I, personally, do not reckon extreme heat or extreme cold among those foes, though certain cyclists are always ready to make use of either excuse for keeping off the road. In the presence of severe ups and downs of weather, the great thing is to dress for the part, and you won't take any harm. No; the enemies I have in mind are heavy head-winds (especially one with a lot of east in it), snow, glazed frost and fog. A cold opposing breeze is not a nice companion on a long ride in winter, though it can be neutralised. Deep snow is a real "buffer-stop." Glazed frost—a rare enough occurrence, thanks be!—renders the maintenance of an upright position very difficult, and generally puts paid to cycling. Fog has a demoralising, but not exactly a demobilising, effect on one's wheeling activities.

There came a Saturday towards the end of November when, had I known what was in store for me, I might—I said "might"—have been tempted to stay at home. During the afternoon the temperature fell. It bit my bare knees, as well as my fingers and toes, and, in the evening, I ran into one of the thickest fogs ever. Down went my pace, and, as usual in such circumstances, it was impossible to ride fast enough to keep warm. So now and again I dismounted and "danced" my way along the road. I subsequently sympathised with a lorry-driver who was using a one-way road in the wrong direction, as well as with a van-man who had invaded the side-walk—because on no fewer than three occasions I found myself at the extreme right-hand side of the highway! Three times, also, I was completely lost—on roads I know as well as the palm of my hand. Early on in this thickness I had tried carrying my lamp on the front fork, but the bracket, unfortunately, is fitted on the right-hand side—in other words, on the wrong side—and all I obtained for my enterprise was the perplexing shadow of the wheel, which was a distinct hindrance to the process of keeping my eye on the grass verge. Having required, in these difficult conditions, 2½ hours to travel a mere 17 miles, I have no hesitation, at the moment, in characterising fog as cycling's No. 1 enemy!

Forbidding Day

AFTER such a clammy experience as this, one might have expected that I would be content to "lie doggo" on the following day. But no! we cyclists—or some of us—are not like that; at any rate, we are not so easily beaten. That Sunday was one of the most forbidding days in my experience. At first it was not raining, but it was a passable imitation. The air was full of moisture, the trees were dripping, and visibility was next-door to nil. Realising that there may come days when the pastime's climatic enemies will keep me at home, I decided to sally forth, in accordance with plan—and right glad I was afterwards. A roundabout ride of 25 miles, mostly inside my cape (for the moistness turned into actual rain), brought me to a well-earned dinner and a roaring fire, plus some pleasant cycling company (for one or two other hardy souls were abroad on that forbidding day), and a journey of a further 23 miles carried me home in time for tea, feeling more than content. Having changed my moist shoes and stockings, I thoroughly enjoyed a quiet evening by the fire, with the memory of "something attempted, something done" in uninviting conditions.

Hill Thrills

NOW let's talk about something warmer! One hot afternoon in the late summer I was just about ready for what the French call "the five o'clock." Nearly at my proposed destination, I discovered a tandem couple, heavily laden as to both selves and steed, who were obviously looking round for an establishment in which to refresh themselves. Inquiry confirmed my suspicion, whereupon I said that, if they cared to ride along the road with me for a mile or so, I would see them right. So we had a pleasant meal in the garden of a tea-house familiar to me, whilst we discussed the Welsh tour upon which the young couple were just embarking. Afterwards my photograph was taken—why, heaven only knows!—and then I put my new friends back on their road, and forgot all about them. But a month later a "snap" arrived, together with a nice chatty letter from the young man. They had enjoyed their 600-mile tour, and his wife had been "thrilled" at seeing mountains for the first time in her life.

The word "thrill" is liable to be over-worked (like "definitely"), but I believe it to be correctly used to describe some of the delights which cycling bestows upon us. It is a thrill to draw mountains into one's sight—especially, perhaps, for the first time. It is a thrill to cycle through the Vale of Llangollen, whether for the first or the 101st time, as it is an eternal thrill to loiter at Capel Curig and look along the Gwryd Valley to Snowdon. It is a thrill to see the Langdale Pikes lift into the picture, or to spot Ben Nevis, or Ben Cruachan, or Schiehallion. It is no less a thrill to draw towards one of the mountains comprising Killarney, on the approach from Mallow, or to see Connemara's mighty uplift from the south side of Galway Bay. And thrill is the word for it when, somewhere on the northern coast of Ireland, you become conscious that the dim etching on the sky-line is Scotland, or when, on the west coast of "the Land o' Cakes," the sprawl of the Outer Hebrides enters the picture.

So I am not at all surprised that the young woman cyclist, whom I met in the heart of England, was thrilled when the great earth masses of the Principality came into her life, in the course of a cycling tour. And there, I think, they will remain for many a day, to provide a precious memory of "things seen."

Prized Luggage

I RECEIVED a letter the other day from a very special touring companion, whose active association with me along the road was fractured some years ago by his departure abroad, first to Paris, then to Prague, then on a sort of roving commission between Iceland and the Canary Islands, and afterwards to Bombay, whence he passed on to Calcutta, where he is now located. The point in his letter which is of special interest to us in this place is that my friend has taken with him, as prized luggage throughout his extensive travels, a number of half-inch cycling maps. One can imagine the joy which accrues to him by virtue of perusal of these pictures of now far-distant country, and the manner in which he is able to transport himself in thought to those areas where he and I used to frolic in days gone by—Cheshire and Shropshire, the New Forest and Devon, Wales and Ireland. With his vivid imagination and excellent memory, he will be able to "fight his battles o'er again," and I am sure that he is able to extract from his prized luggage a fair measure of the old delights which came to him through participation in cycle touring. The pleasure he thus enjoys is for us as well, through the medium of our maps. But active cycling is a condition precedent thereto.

C. J. Fox Hon. Sec. of the British League of Racing Cyclists.

Notes of a Highwayman

By LEONARD ELLIS

The Door of England

PERHAPS I am biased because of a short residence in the town during the last great war, but I have always regarded Dover as a most depressing place. Regarded as a seaside resort it is a dismal failure, as the great stone arms of the harbour not only seem to clasp the whole of Dover within their jealous embrace but they also prevent any wide view of the open sea. In spite of this Dover is a most interesting and romantic town. It has been known as the "key to England" for many centuries, and perhaps an even more apt title would be the "gateway to England." Here at any rate most of the continental traffic enters or leaves; here also is the south-eastern end of one of the country's greatest highways, the Watling Street, that served the country for some 200 miles. There is plenty to interest the tourist and not the least impressive feature is the great old castle standing on the cliffs as if defying invasion. Its story goes back to times before the Roman invasion and it is obvious that it has been added to and strengthened in later centuries. Much of the earlier work was destroyed in comparatively recent times, when it was feared that Napoleon intended to pay us a visit in great strength.

Gateway to Dartmoor

DOVER is not the only place to which one can apply the word "gateway," and I often think that Moretonhampstead in Devon is the real gateway to Dartmoor. The moor has really few approaches, so that any town on its fringe can be so regarded. Moreton always seems to be a delightful place in which to stay a night. Although tiny and with not many attractions, there are some good hotels, and what is more, Dartmoor is within a hop, skip and a jump on the following morning. No tourist, however, will go away without seeing the very fine row of almshouses in the main street, in fact he will be quite unable to miss them, they constitute the most attractive feature of the whole town. They seem oddly out of place in this quiet town with their round-arched, arcaded front, but few will want to pass without taking a photograph. Nearby is the remains of the old village cross and one may also find the successor to an old elm that was known as the Dancing Tree—it is supposed a sort of natural village maypole.

The Almshouses, Moretonhampstead.

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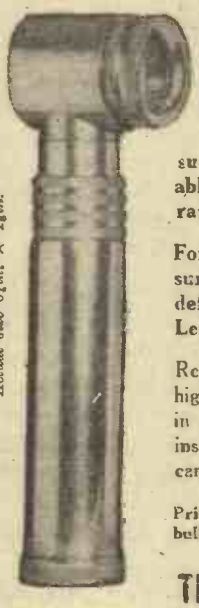

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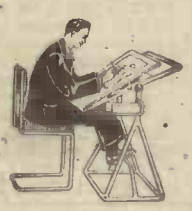

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