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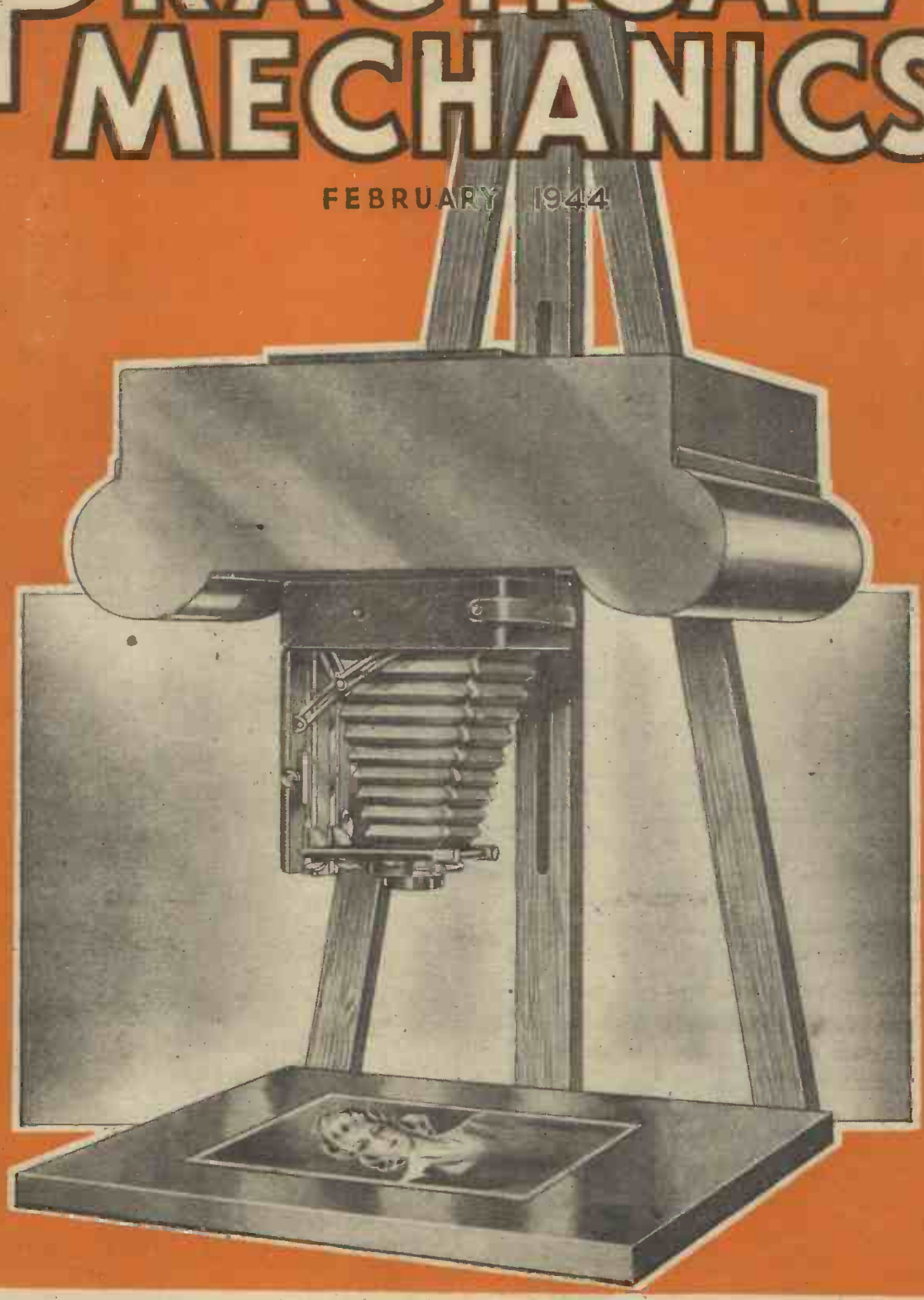

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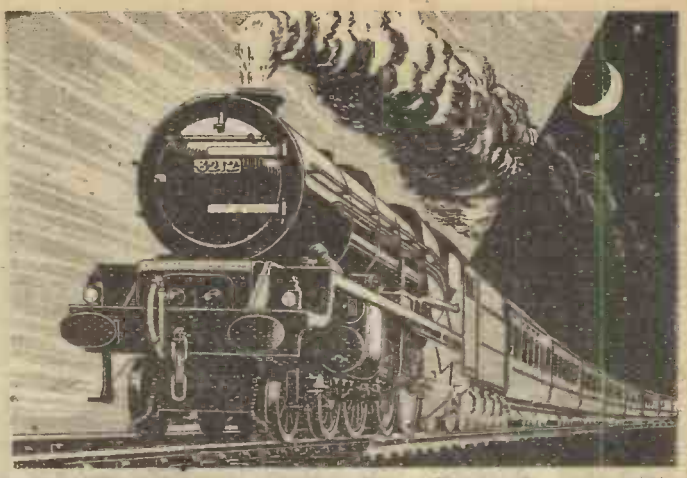

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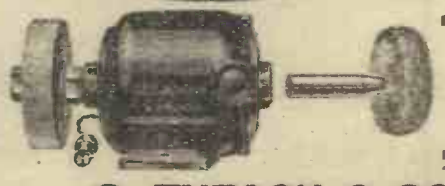

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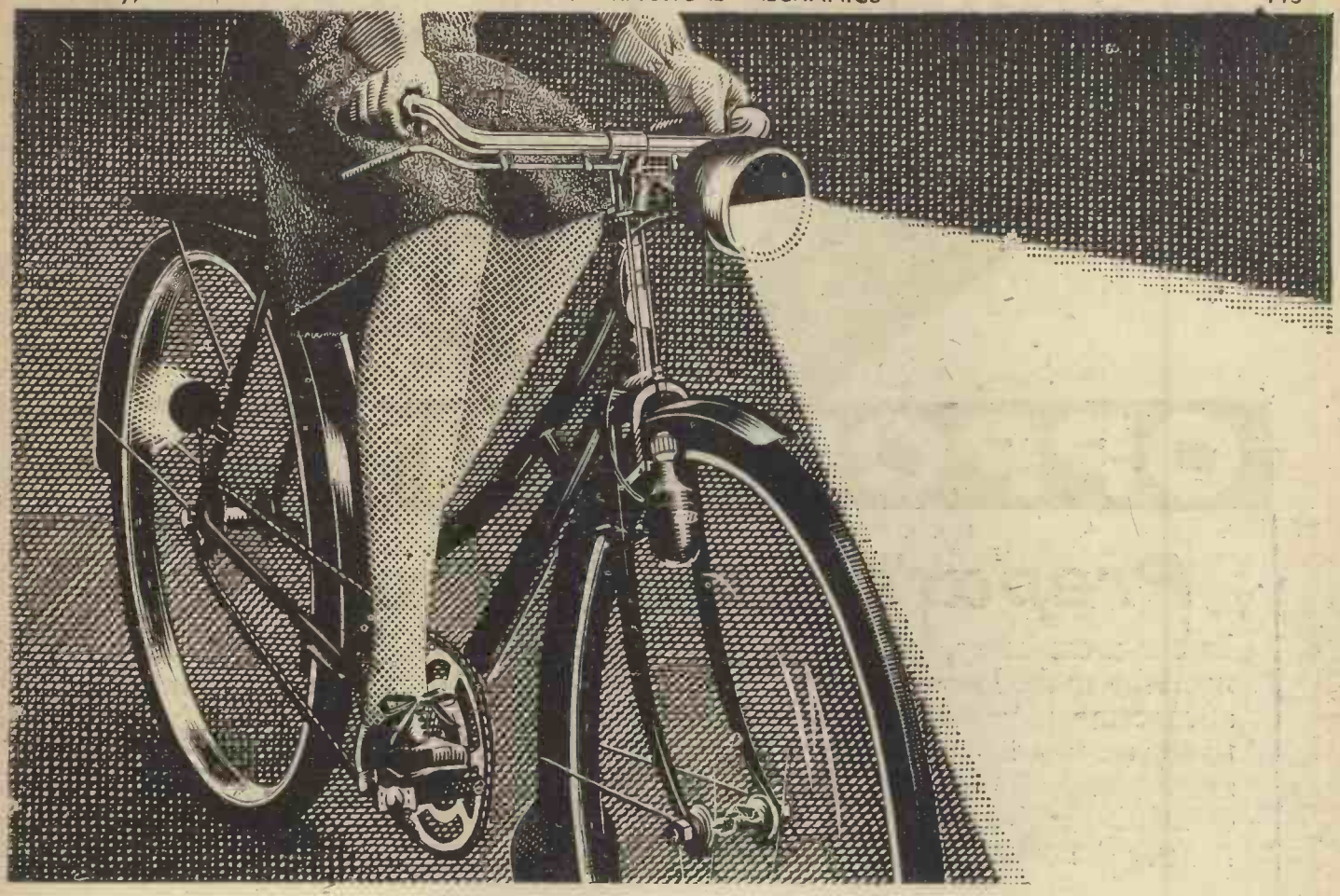

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PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. XI. FEBRUARY, 1944 No. 125

FAIR COMMENT — BY THE EDITOR

Jet Propulsion

WE are glad that this country has at long last announced to the world the result of our experiments in reaction propulsion, or to give it its popular name "jet propulsion." Too often do we allow other countries to steal our thunder, but in this particular case we got in first. We have, of course, known for many years of the experiments, but we have not been permitted to publish them, although we have dealt with the subject in a general way for the past five years. In fact, we have published more about it than any other periodical. We have always believed that a more direct method of using the calorific power in fuel which is released by combustion could be used in a more effective and a less wasteful way, as well as in a more direct way than through the complicated and loss-producing petrol engine where pistons, cranks, valve gear, pumps, airscrews, superchargers, and oil coolers are necessary, and each of which absorbs power. The efficiency of the average heat engine is probably not much more than 20 per cent. Now the principle of using reaction for propulsion is by no means new.

Hero's Steam Turbine

HERO, of Alexandria, produced his famous reaction steam turbine 50 years or so before the birth of Christ. An illustration of the cylindrical boiler, with four spouts from which the steam escapes, appears in most textbooks on physics. However, the principle has not been used much, except by model makers, and it was not until the German, Fritz Von Opel, experimented with rocket cars in Germany (experiments which ultimately caused his death), that interest in the subject was renewed. From that point hundreds of patents have been taken out, but most of these were in connection with machines intended for astronautical travel.

A few years before the war Caproni, in Italy, produced the Caproni-Campini Monoplane which flew successfully after initial tests at the Forlanini Airport from Milan to Rome, a distance of 168 miles, in November 1941.

With the advent of the jet-propelled machine, communication is likely to be made more rapid, the aircraft gaining with development more and more advantage from high altitude operation, in the stratosphere and troposphere, in economy, and fuel expenditure where air supplied to the jet unit under compression is still of sufficient density to support combustion, and where air resistance is so greatly diminished. The layout of the jet plant leads to snug installation, the compressors and operating motors (which may be exhaust-driven turbines) being sunk deep within the wings, with the addition of an airscrew.

There are certain illusions in connection with jet propulsion which have to be dispelled. The first is the very prevalent one that this form of aircraft obtains its power by virtue of the jet pushing on the air. It does not any more than does a rocket. It is well known that a rocket operates more efficiently in a vacuum than in the air.

We were astonished to hear a speaker in a recent broadcast repeat the fallacy. The blind leading the blind!

Rocket Principle

JET propulsion is the expression used to denote all the various applications of the rocket principle which have been devised up to the present day, since they all depend upon the operation of one and the same national physical law, namely, that of the conservation of momentum. Momentum denotes the amount or quantity of motion in a body, and it is measured by multiplying together the mass of the moving body and its velocity. Everyone knows the well-known formula that $M = mv$. Thus we may imagine two bodies in motion together at different speeds. One is a light body moving at a higher speed, and the second a heavier body moving at a lower speed, yet it would be possible for each to possess the same momentum.

Consider, now, what happens when a cannon is discharged. Before discharge, gun and shell are at rest. After firing, the shell is given a high velocity in a forwards direction and thus it acquires momentum. The cannon, also, acquires exactly the same amount of momentum, but in the opposite direction. Since, however, the mass (or weight) of the cannon is very many times that of the shell, it follows that the actual backwards motion of the former is very small, and is readily absorbable by means of the recoil mechanism with which it is equipped.

Imagine, again, that you are standing on ice with glass-bottomed shoes on your feet, and that you are firing bullets from a particularly heavy rifle, the firing always being in the same direction. Provided, in this instance, that you kept your balance, you would find that gradually you were moving backwards on the ice surface in a more or less perfectly straight line.

Fundamental Law

IN every case the fundamental law is the same, e.g., that when any fluid or body escapes from a vessel the vessel acquires a momentum equal to that of the escaping fluid or body, but in the opposite direction. Hence, the vessel tends to move in a direction opposite to that of the escaping gases or fluid. The idea of propelling sailing vessels by means of backwards projected jets of water can be traced back as far as the year 1729. In 1866 the Admiralty made comparative trials of two vessels. The first, the *Viper*, of 1,180 tons of displacement, was fitted with the screw propeller system. The second, the *Waterwitch*, of 1,161 tons displacement, had a system of jet propulsion on the lines described above. It was found that the propulsive efficiency of the propeller system was far superior to that of the jet system, and in another series of trials, conducted with small boats, which was made nearly 20 years later by Thornycroft, the marine engineer, the same conclusions were reached.

One of the great advantages of jet propulsion for ships and aircraft is that it gives an almost vibrationless means of travel. It is also less noisy, although in the case of aircraft there is an unpleasant whistle similar to that of a boiling kettle. On account of the lack of vibration, it was proposed towards the end of the last war to employ this system of ship propulsion in submarine detecting vessels whose motion through the water would thus be rendered practically noiseless.

Prospects

THIS briefly is a description of experiences to date and an explanation of principle. As details are revealed so shall we publish them. In the meantime the announcement that we are successfully flying for training purposes aircraft of this type is an encouraging sign that England can produce secret weapons, too. Unlike the Germans, we announce it when it is a *fait accompli*. It is not part of our war of nerves to make wild statements about secret weapons which do not eventuate. Here are further opportunities for young men interested in aeronautics to get in at the start of a new science and a new industry, and in a period which has seen so many startling developments—the telephone, the gramophone, aeroplane, wireless, television, the photo-electric cell, the motor-car, and the turbine.

We have set these facts down to give our readers a true impression of jet propulsion, and to correct the erroneous statements which have appeared in the newspapers and been given in broadcast speeches by those who obviously do not understand the subject.

A Printer-Enlarger

A Method of Making Prints from Negatives Made on Sensitised Paper.

By E. R. W. MAY

General view of the printer-enlarger.

THE majority of amateur photographers are probably aware of the fact that sensitised paper may be used as negative material, and realise that, as the paper is, of course, opaque, a special projector is required to produce the final print. The apparatus is really a modified epidiascope, and, in fact, could be used as such if the necessity arose. The printer is very simple to use, and enlargements or reductions are readily obtainable.

Initial Experiments

The writer has made some experiments with an ordinary enlarger by placing a negative on the baseboard, bromide paper in the negative carrier and flooding the baseboard with light from an electric lamp. The prints obtained could only be called "fair," while the method was undoubtedly slow and clumsy. The apparatus described below was then designed; the actual time taken to construct the projector was approximately eight hours.

As will be seen from the illustrations, which were all produced on this projector, the apparatus may be divided into three sections, (1) the camera, (2) the lamphouse, and (3) the stand.

The Camera

The heart of the projector is, of course, the camera attached to the base of the lamphouse. A folding camera is specified to enable different sized prints to be obtained, but a fixed focus printer could easily be made from a simple box-type instrument.

The camera as used in the original printer is a "Premo" folding camera, taking a plate of postcard size, and fitted with a rack and pinion for adjusting the focus. The focal length of the lens is 6½in., with an aperture of f.8.

The removable back (containing the ground glass focusing screen) is attached to the camera body by two spring clips, which provide a ready means of fixing the camera to the lamphouse base. A false back with an aperture of suitable dimensions was made and screwed to the lamphouse base, two pins being provided to engage the spring clips already fixed to the camera body. Thus the camera was readily attached to the printer or detached ready for use as the makers intended.

The illustrations show the camera (Premo), but no difficulty should be experienced in adapting any suitable make of instrument providing a removable back is incorporated in the design.

The Lamphouse

The design of the lamphouse is shown in Fig. 1. The main structure is of ½in. wood, the only metal parts, excepting the electric fittings, screws, etc., are the reflectors around the lamps. Scrap wood from boxes was used and found to be quite serviceable.

The general dimensions should be adhered to, the only variable being the distance (A), which will alter with different lenses.

For finding the dimension (A), that is, the distance from negative to back of camera, the following method is simple and accurate.

First of all find the focal length of the lens. If the focal length is not engraved on the lens mount, it may be found with sufficient accuracy by sighting the camera on a distant object, e.g., a chimney or church spire, and focusing the image on a ground glass plate. The distance from the ground glass plate to the centre of the lens is the required focal length. A ground glass plate may be made very easily by scouring a suitable piece of glass with motor-car valve grinding paste applied with a piece of wood or cork.

If we make the distance (A) sufficient (with bellows extended) to enable a print of the same size as the negative to be obtained, that is, a magnification of one, the apparatus will then be correct for any reasonable magnification, adjustments being made by moving the printer up or down its stand and focusing by adjusting the lens along its runway.

The following formula will give the total distance negative to lens for any required magnification or reduction.

A bromide paper negative.

Let f. = focal length of lens.
m = magnification required.
x = total distance from negative to lens.
Then x = f

Now take the camera and fully extend the bellows. Measure the distance from negative to lens and call this distance y.

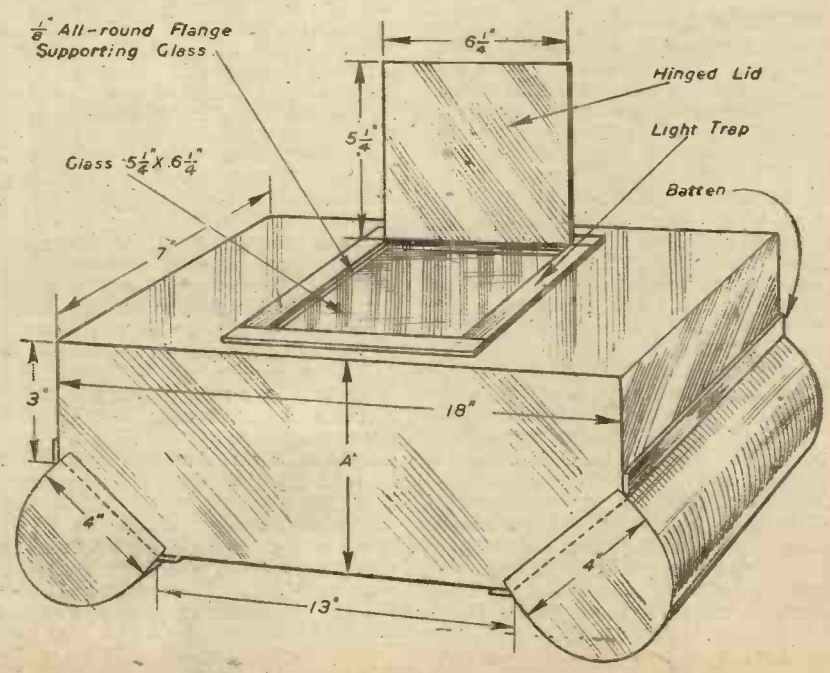


Fig. 1.— Isometric diagram of the lamphouse.

If we now subtract y from x we get the distance (A).

For the (Premo) camera f = 6.5in., y = 7in. Therefore, applying the above formula, (A) = 6in., with a magnification of one.

To attach the lamphouse to the stand two coachbolts are used and fixed with wing-nuts.

The metal reflectors are cut from suitable size tins, and should be made long enough

A print made from a paper negative.

to allow for fixing by nailing battens along the edges as indicated in Fig. 1. Metal end-caps are then soldered to the reflectors and screwed to the woodwork, care being taken not to forget the necessary holes for the lamp-holders.

To make the negative holder, cut a hole 5in. x 6in. in the top of the lamphouse. The holder must be made light tight as follows:

About ¼in. from the edges of the hole already cut, a wooden frame is screwed down and a glass panel 5¼in. x 6¼in. slipped inside. A lid must then be made to fit inside the frame. This lid is hinged to the back of the frame and a simple catch fitted to enable the lid to flatten the negative against the glass panel. It is essential that the lid itself should not reflect any light, and the inside is covered with cloth and painted dull black. To prevent light escaping from the various joints in the woodwork all such joints should be sealed by sticking on cloth or thick paper. The lamphouse is then painted dull black, both inside and out, excepting, of course, the inner surfaces of the metal reflectors.

The dimensions given for the negative holder have proved satisfactory, but the constructor may alter them to suit the size and thickness of the glass available, always bearing in mind that a small portion of each end of the glass window is not fully illuminated by both lamps. This is illustrated in Fig. 2. This defect is not serious and may be overcome by bevelling the edges, but is hardly worth the trouble involved.

The Stand

As will be seen from the general view of the apparatus, the stand is simple in design, the actual size being determined by the degree of magnification required. Once again a simple formula is available to find the distance "camera lens to baseboard."

As in the previous formula, let f = focal length of lens and m = magnification.

Then the distance "lens to baseboard" = f + mf.

Thus for a magnification of two with a focal length of 6.5in., the "Premo" lens required to be 19.5in. from the baseboard. The original stand was made 30in. high to allow for the height of the lamphouse and

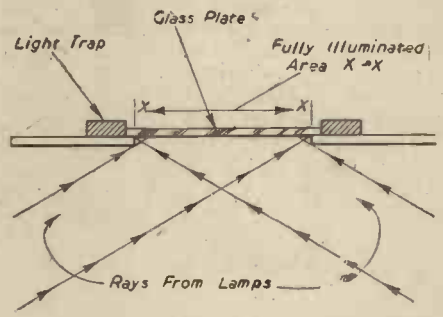


Fig. 2.—How the negative is illuminated by the two lamps.

A paper negative of the complete apparatus.

camera, but may be designed to cover any desired range.

Method of Use

Fit two 75-watt lamps in the lampholders by inserting them through the hole made for the negative holder. Placing a piece of newspaper in the negative holder, adjust the height of the printer and focus on a piece of plain paper on the baseboard until an image of the desired size is obtained. A negative could be used for focusing, but it will be found that printed matter is easier to focus sharply.

If, due to dampness in the wood, the glass window is found to "steam up," remove the glass and leave the lamps burning for about ten minutes before attempting to use the apparatus.

More powerful lamps may be fitted, in which case light-tight ventilators should be attached to top and bottom of both the metal reflectors.

Using bromide paper, it has been found that the exposure required for a print of same size as the negative is approximately one minute, but with more powerful lamps the exposure time would naturally be reduced.

Raising the "Normandie"

THE U.S.S. *Lafayette*, formerly the French luxury liner *Normandie*, was transferred by the U.S. Maritime Commission to the Navy Department on December 24th, 1941, for conversion and operation as a troop transport. The *Normandie* was the largest liner afloat, with a gross tonnage of 79,280. She was 1,029ft. long and of 119½ft. beam. Conversion of the ship was begun at Pier 88, North River, New York, and was nearing completion when a spark from a workman's cutting torch set fire to a bale of kapok-filled life jackets. In a few minutes the flames roared through the grand lounge of the ship, fed by rolls of carpet, decorative trim and fine furnishings. A strong north-west wind fanned the flames. This was on February 9th, 1942. At 2.45 a.m., February 10th, the big ship capsized from the weight of water poured into her. On May 1st, 1942, a committee appointed to recommend a course of action on the *Lafayette* recommended that the ship be raised. The Navy's supervisor of salvage, Captain W. A. Sullivan, was ordered to proceed with the job—one of the greatest salvage undertakings in maritime history. The Navy assembled a corps of divers and went to work to seal up the hull of the great ship and prepare her for the job of righting to an even keel. An estimated 100,000 tons of water had to be pumped out with 93 pumps, countless tons of mud also had to be removed. The illustration shows the giant liner on its side after being raised.

The "Volkswagen"

Particulars of the German Light Aid Detachment Vehicle, Which is Based on the German People's Car

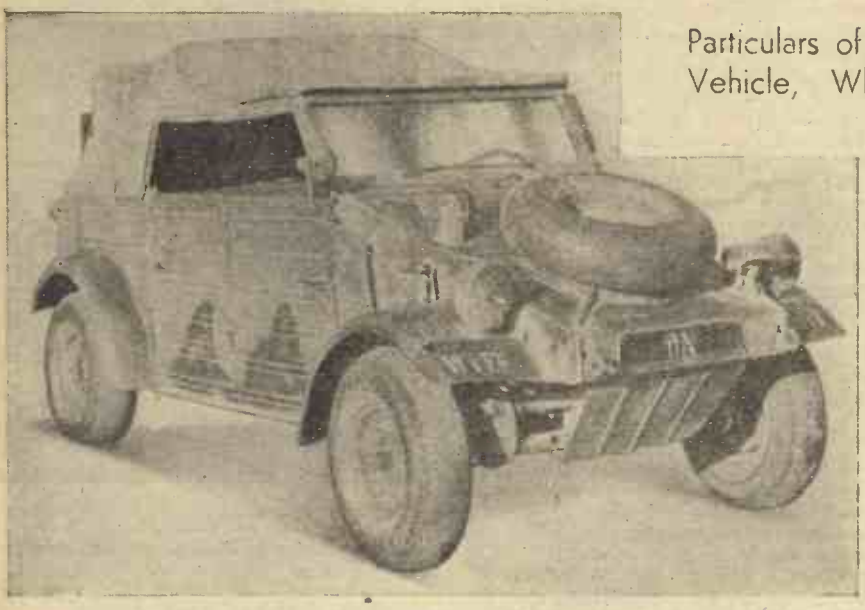


Fig. 1.—Three-quarter front view of the complete vehicle.

Independent wheel suspension is provided for all wheels, torsion bars being used. The front torsion bars are of unusual and ingenious design to obtain soft springing in a compact form. The front suspension, complete with the steering unit, shock absorbers and track rod system, forms a very compact assembly unit.

The speedometer drive is housed neatly within one of the stub axles.

Extensive use is made of aluminium and magnesium base alloys, and a very good finish imparted to the die castings.

Plain carbon steels are used in preference to alloy steels, except in special cases such as valves, etc. Nickel has not been used for the manufacture of any of the parts, and copper has been added to the cast-iron component in order to produce a similar effect to nickel. The hardening elements used in the steels are manganese, chromium and molybdenum.

IN January, 1943, a German light aid detachment vehicle (Volkswagen) was received by Humber, Limited, who were instructed to make a complete examination and prepare a technical report. The vehicle was captured in the Middle East and it was ascertained that it was originally fitted with a gas welding kit for dealing with repairs to military vehicles.

The vehicle under examination is based on the Volkswagen (German People's Car) and from the available descriptive matter the military version differs in the following respects.

The peacetime saloon body is replaced by an entirely new open-type tourer body which has obviously been designed to suit its military rôle.

Hub reduction gears have been added, and special type equipment and wheels are also used.

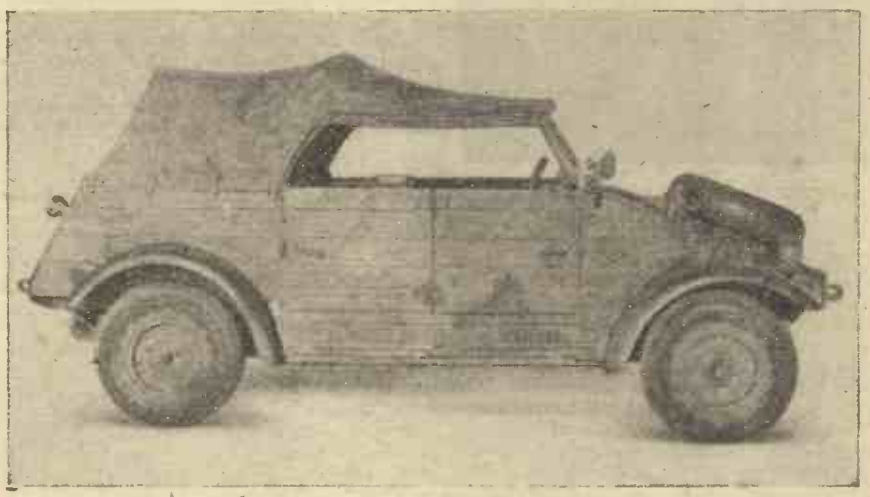


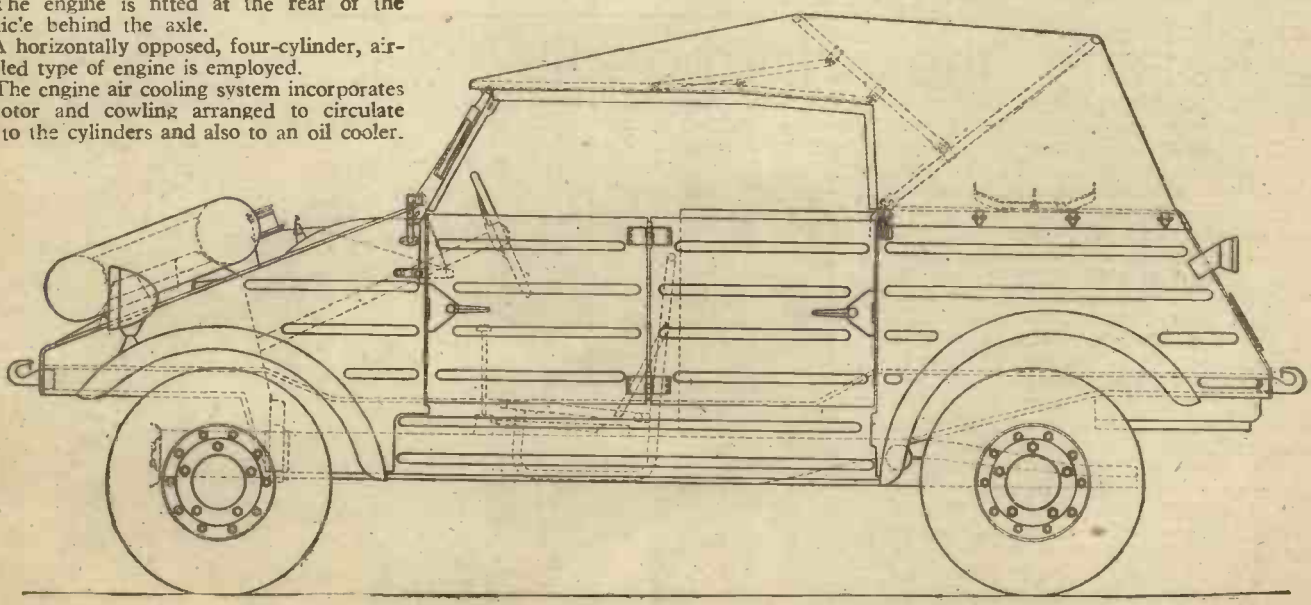
Fig. 2.—Side view.

Features of Noteworthy Interest

The engine is fitted at the rear of the vehicle behind the axle.

A horizontally opposed, four-cylinder, air-cooled type of engine is employed.

The engine air cooling system incorporates a rotor and cowling arranged to circulate air to the cylinders and also to an oil cooler.



Side elevation of the body.

A special dog-type gear engagement is incorporated in the gearbox, using steel rods in grooves. The design of differential is ingenious, having only a partial slip, thus obviating wheel spin and therefore very suitable for cross country and muddy conditions. This is patented under German Pat. Spec. No. 639876, and British Pat. Spec. No. 431020, both patents taken out by Gottfried Weidmann.

Hub reduction gearing is used to obtain a lower overall ratio by a simple conversion of the original design of Volkswagen, and this also gives the increased ground clearance required for traversing across country.

Chassis consists of a light gauge pressed steel underframe; this is arranged in a "back-bone" construction and also provides the floor. A comparatively strong chassis, especially torsionally.

The location of the rear suspension swing arms or struts above the axle enables a cheap and light form of strut to be used according to claims stated in Patent No. 544748 F. Porsche. Ground clearance is also increased by raising the torsion bar relatively.

The body was of open tourer type fitted with a collapsible fabric hood and provided with a steel trunk designed to carry the welding plant. It is thought that a study of the sections and methods of construction described in the report will be valuable.

Fig. 3.—Three-quarter rear view.

In order to ascertain full particulars of the design, technical data, weights and dimensions, the vehicle was dismantled and assembly drawings, together with a detailed description of the design and construction, prepared. The illustrations, Figs. 1, 2, 3 and 4, were taken on receipt of the vehicle, and show its general appearance when it arrived at the Humber works.

From the condition of the vehicle as received for examination it was apparent that it had covered a considerable mileage—unfortunately the speedometer was not functioning and the exact mileage could not therefore be verified.

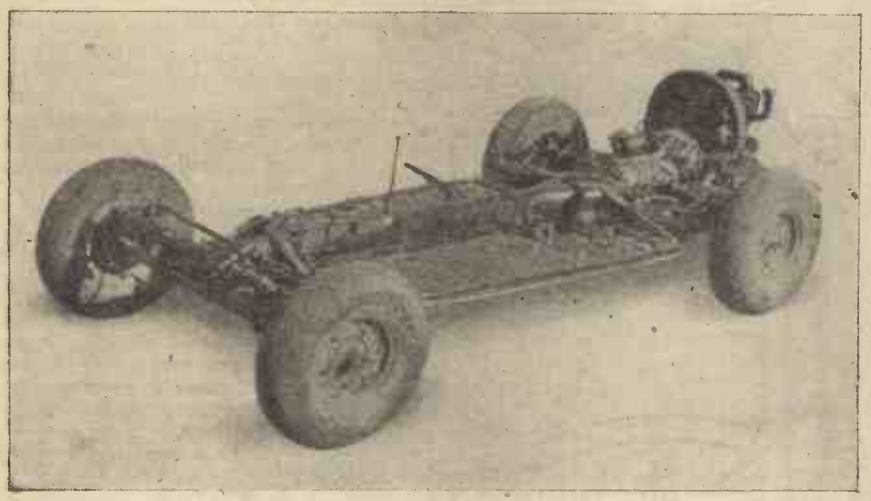


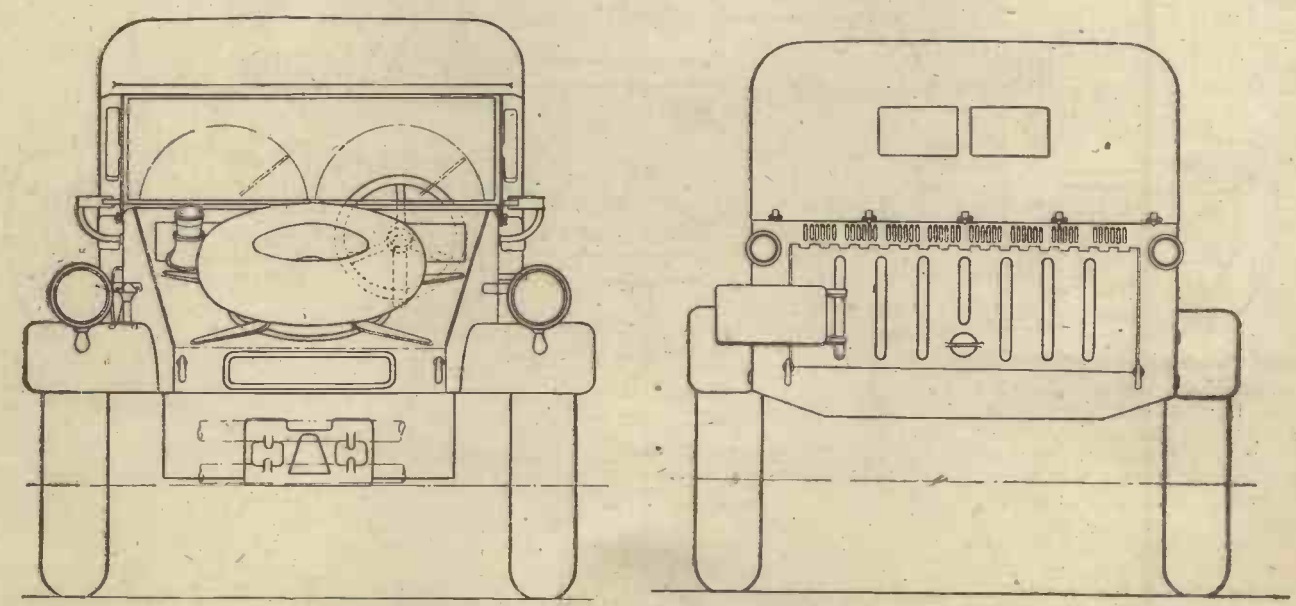
Fig. 4.—The chassis.

General Observations

The following general observations are made by Humber Engineering, and should be treated purely as their views.

The design is particularly interesting because it is quite uninfluenced by any previous traditions, and it is doubtful if the question of whether the public would or would not like a car with an air-cooled engine positioned at the rear, was considered by the designer. This model has departed almost entirely from the conventional motor-car, and features of interest have already been referred to above.

In spite of the assumed freedom of the designer and the unconventional vehicle produced, little or no special advantage has been obtained in production cost, neither does it appear that any improvement in performance or weight compared with the



Front and rear views of the body.

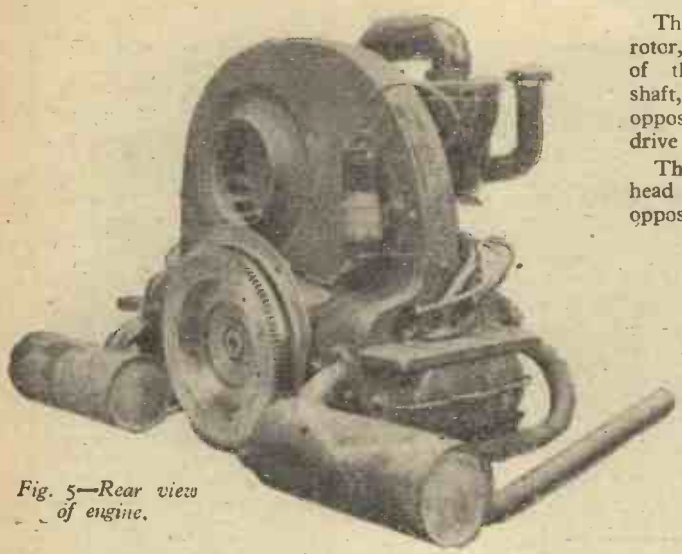


Fig. 5—Rear view of engine.

more conventional type of vehicle known in this country has been achieved.

So far as materials are concerned, no signs of the use of any ingeniously applied materials have been found; in other words, the material specification is, with few exceptions, very parallel with what is already well known in this country. The use of plastics is not apparent. The tyres are, however, manufactured from synthetic rubber.

A study of the engine indicated that the unit was, in certain details, most inefficient. The design of the inlet manifold makes it clear that the designer did not intend the unit to produce power proportionate to its capacity, and from a study of both the design and condition of the crank bearings it is very doubtful whether it was even capable of giving reliable service had it produced a performance commensurate with its size.

Looking at the general picture, we do not consider that the design represents any special brilliance apart from certain of the detail points, and it is suggested that it is not to be regarded as an example of first-class modern design to be copied by the British industry.

The blower consists of a rotor, mounted on one end of the dynamo armature shaft, which is driven at the opposite end by a "V" belt drive from the crankshaft.

The engine is of the overhead valve, horizontally opposed four-cylinder type, consisting of two banks, each bank having two cylinders which are separately cast and interchangeable. Detachable cylinder heads of aluminium silicon alloy are fitted; these are cast in pairs and located in the cylinders by means of spigots formed on the latter. Both these are secured to the crankcase by long studs, screwed direct into the crankcase, the cylinder head joint being formed between the top face of the cylinder spigot and the head. Bronze alloy valve seat inserts, phosphor bronze valve guides, and steel sparking plug inserts are employed.

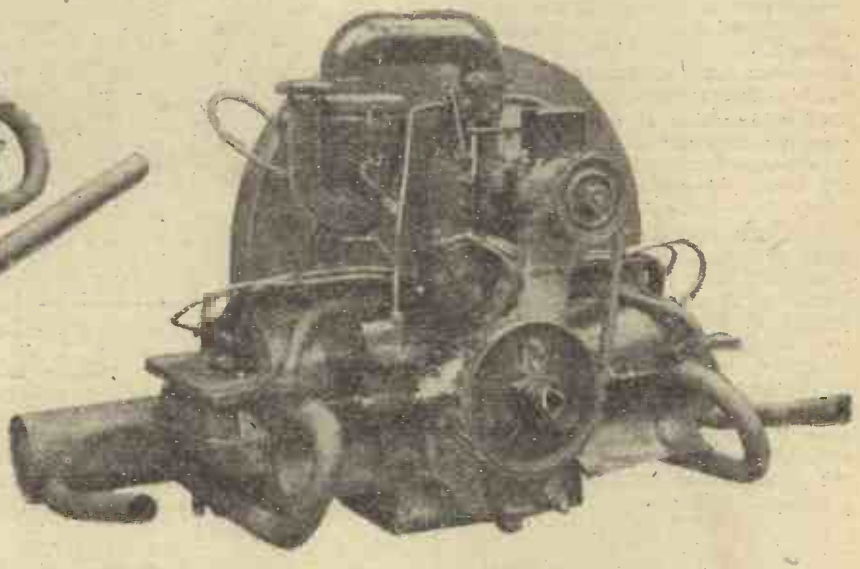
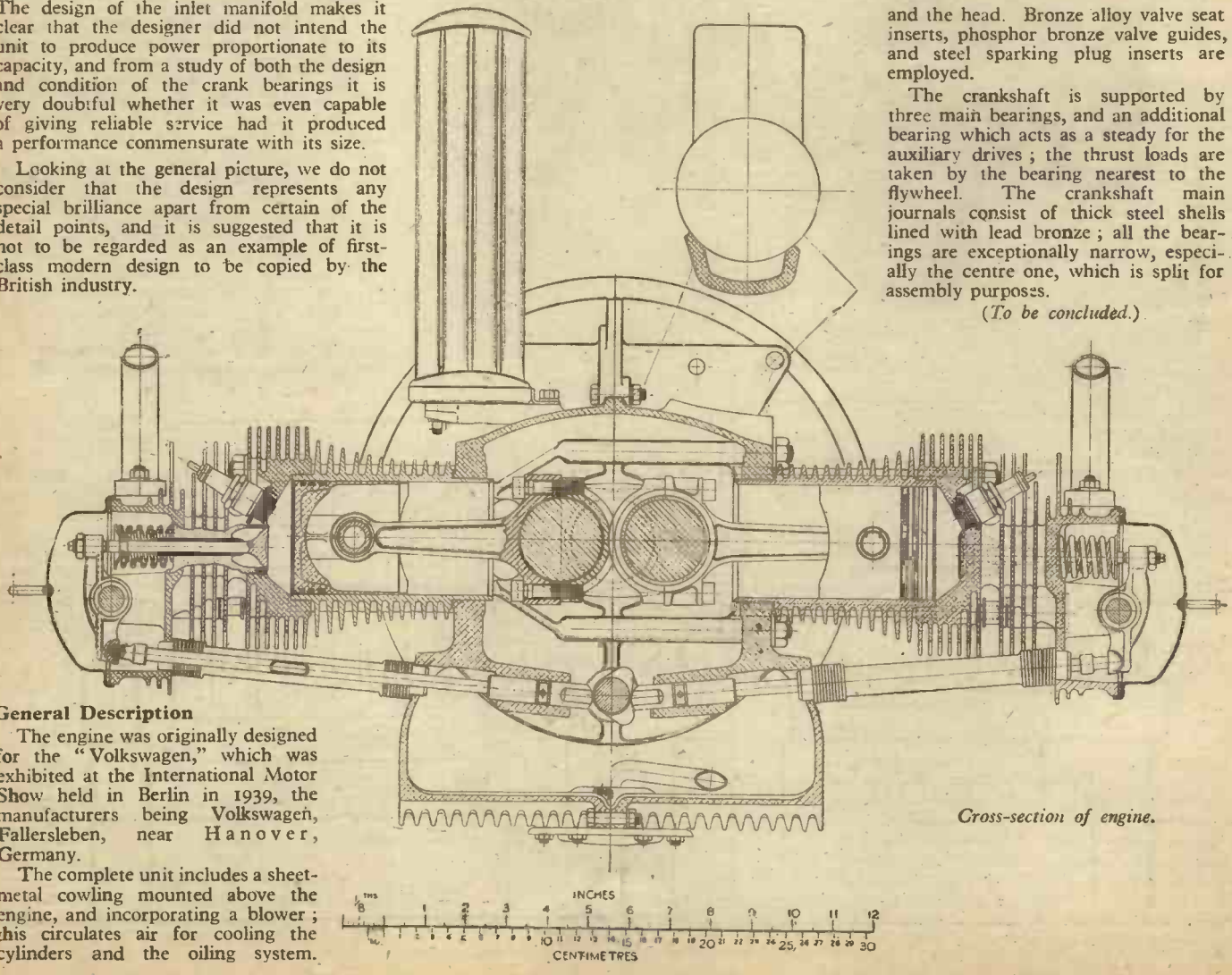


Fig. 6.—Front view of engine.

The crankshaft is supported by three main bearings, and an additional bearing which acts as a steady for the auxiliary drives; the thrust loads are taken by the bearing nearest to the flywheel. The crankshaft main journals consist of thick steel shells lined with lead bronze; all the bearings are exceptionally narrow, especially the centre one, which is split for assembly purposes.

(To be concluded.)



Cross-section of engine.

General Description

The engine was originally designed for the "Volkswagen," which was exhibited at the International Motor Show held in Berlin in 1939, the manufacturers being Volkswagen, Fallersleben, near Hanover, Germany.

The complete unit includes a sheet-metal cowling mounted above the engine, and incorporating a blower; this circulates air for cooling the cylinders and the oiling system.

Small Wind-power Plants—2

Rewinding the Dynamo Armature.

By W. H. SUTHERLAND

(*Continued from page 114, January issue.*)

THIS month we describe the process of rewinding a dynamo to make it suitable for windcharger conditions. No special experience or skill is needed—only unlimited patience! The work is well within the scope of most radio amateurs.

The dynamo used has several type numbers, depending on the year in which it was made. Some of these are: A 900 R, A 900 T, A 900 C, A 800 C, etc., and any of them will serve the purpose. It is better known as a "Morris dyno-starter," and is chosen for several reasons. It was used on many old cars, and since it does not charge until 1,500 r.p.m in its original form, and is therefore of little use to anybody, there should be no difficulty in obtaining one. What is more important, it has the large diameter armature necessary for slow speed working and easy winding. Choose one with good commutator and bearings.

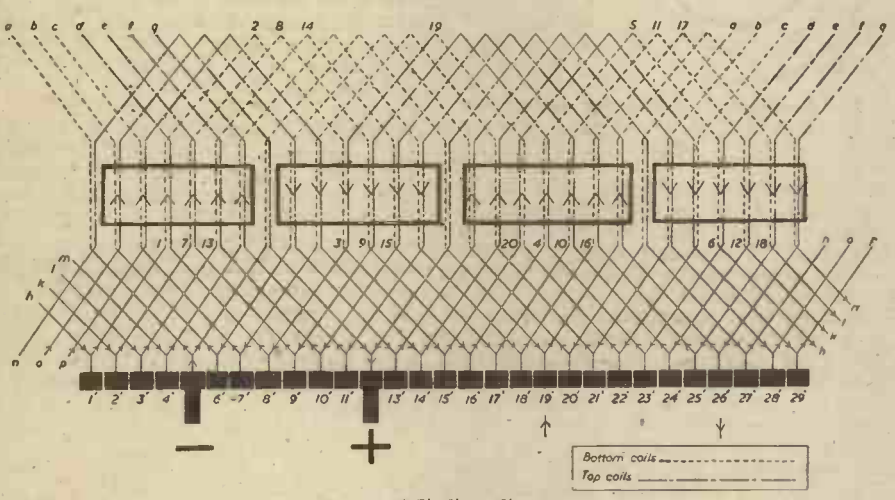


Fig. 1.—Winding diagram.

Winding the Armature

Remove the wire from the armature, pulling off one turn at a time. If the insulation on the sides of the armature slots is well preserved, take care not to damage it. Otherwise remove it all. The fibre discs at each end of the core are essential, and should not be damaged. Clean the connecting slots on the commutator segments now, while there is room to manipulate a small nail-file, so that good soldered joints can be made later.

In the finished wave-wound armature each slot will carry two coils of wire, a bottom and a top one. The more turns in these coils the slower the charging speed, but a compromise is necessary between wire diameter and current-carrying capacity. For 6-volt work, the minimum number of turns per slot is 18—nine in each coil—and 18 S.W.G. enamel or S.C.C. will fill the slot under these conditions. This wire has a listed safe current of 7 amps., but since the current is generated in two parallel paths meeting at the brushes, the maximum armature current would be about 15 amps. Under windcharger conditions, and with the cooling system described, this winding will work up to 20 amps. It cuts in at 6 volts at about 400 r.p.m, and in practice needs no governing, since the current reaches "saturation" at about 18 amps., and does not increase much more. It is a good example of "heavy-duty" winding, and is particularly suitable for use with the minimum of skilled attention in windy districts.

A winding of 21 S.W.G. will carry 10 amps., and is the slowest winding recommended for use on this dynamo. With care, 40 turns of enamelled or S.C.C. 21 S.W.G. can be put in each slot, but 30-36 turns of 20 S.W.G. enamelled wire is a better winding for general use. It is a convenient size of wire to handle, but good governors arranged to operate at 10 amps. are a necessity. It is slow enough for 12-volt working. The choice of wire will depend on individual conditions, but should be between the limits mentioned. Old dynamo field coils provide a useful source of suitable wire. When winding, sit astride a stool with the armature held by the axle in a vice attached to the end of the stool, the commutator pointing away. If new insulation is needed, use strips cut from old "linen-finish" playing-cards.

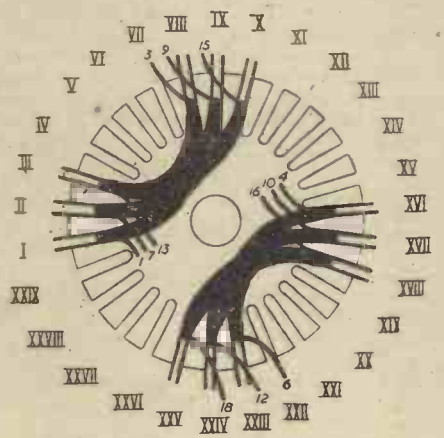


Fig. 2.—Approximate shape and order of winding of first six armature coils, commutator end.

The winding diagram (Fig. 1) explains the whole procedure, but probably is new to many readers. It is really the curved surface of the armature spread on a flat plane. A clockwise armature rotation is represented by a progressive movement of all the coils across the page over the four poles, which remain fixed. The working of the dynamo follows at once from this illustration, since elementary physics tells us that a current is induced in each wire as it moves through the fields, the directions of the currents being shown at any instant by the arrowheads. In each coil only the two sides lying in the armature slots will generate, the other two sides serving only to interconnect the system of generating wires in such a way that the small voltage induced in each wire will add to the total as the circuit is traversed. This is achieved when all arrowheads are pointing the same way as one traces the current from one brush to the other. The only commutator segments with opposing arrows are those under the brushes, 5′ and 12′, showing that these are the only points on the commutator at which there is an accumulation of electricity of appropriate sign to be tapped off by the brushes. Detailed analysis would show that segments 19′ and 26′ also serve as brush points, which is clear in any case from symmetry. It is obvious that the winding is divided into two parallel paths, each carrying half the current flowing in the external circuit. (See Fig. 3.)

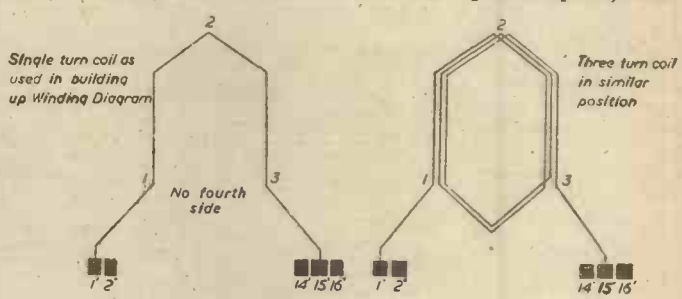


Fig. 3.—Simplified wiring diagram.

Now, select any slot, I (Fig. 2), and fit the card insulation in position. Count to slot VIII and fit another piece of card. Wind on the first coil, 1-2-3, keeping the wire tight and laying each turn as far as possible side by side inside the slots. There is very little room on this armature for packing the idle sides of the coils, so shape these sides to use the space available as economically as possible, the first ones lying well down against the (insulated) axle. For the same reason the author wound the armature in two sections, diametrically opposite. The second coil, 4-5-6, therefore falls into slots XVI and XXIII. Go back next to slots II and IX. It is best to keep to this alternating system rather than to finish one section before starting the other, as it allows easier manipulation of the wires, and helps to break the monotony of the job. A problem of insulation arises here, since the third coil crosses the first at each side almost perpendicularly, and S.C.C. wire is certain to short under such conditions, while enamel is scratched while tightening each turn. After a week of winding with 20 S.W.G.

S.C.C., the author found that all coils except three were shorting to each other at the sides! The only cure is to tape the sides of each coil thoroughly before winding on the next one. This also binds the whole winding together. Even when this is done, continuity tests should be tried from coil to coil and from coil to core after each coil is wound, since faulty insulation would be covered up by succeeding winding if not discovered. A battery and flash-lamp bulb will do the job. To press the wire into the slots, cut several small wooden wedges, and tap the wire down after every few turns. It is a good plan to leave too tight wedges to hold each coil until the next one is put on. In the same way the winding should be compressed at each end by tapping with a hammer and wooden block, so that the whole feels rigid all through the job, with no suggestion of "sponginess." Coil ends are arranged according to any neat system that suggests itself to the constructor, so that beginnings and ends of bottom and top coils can be recognised afterwards. The first seven coils of each section are bottom coils, represented in the winding diagram by broken lines, and all slots except XV are now half full. The next coil, 3-19-20, will fill slot VIII completely, and half-fill slot XV, so that a change (see chain-dotted lines) appears on the winding diagram. All coils after this are top ones, shown by chain-dotted lines. A double strip of card should be tapped into each slot to insulate the two coils, which have the full generator voltage between them, and must be well separated. Proceed exactly as before until the whole armature is wound. The projecting edges of card should be closed into the slots and the whole tapped well down. Binding wires can now be put in position in the two grooves left for the purpose (Fig. 4). The author used brass wire from an old rabbit-snare, putting it on over a double strip of tape with the maximum tension possible with this wire. It is secured by touching with a tinned iron at half a dozen places directly over the iron of the core, to avoid burning the winding.

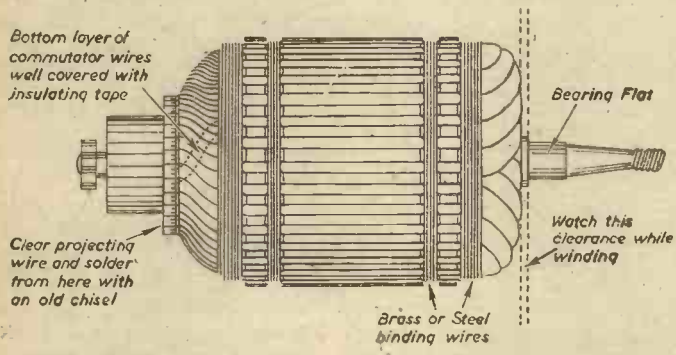


Fig. 4.—Sketch of finished armature illustrating points mentioned in the text.

The commutator connections can now be made, starting with the last coils wound, which can be traced most easily. All connections sloping in one direction to the commutator (dotted lines in Fig. 4) should be secured first. Wires coming from slots separated by the correct period, and showing continuity on a battery-and-bulb test, belong to the same coil. As each coil is located in this way its left-hand end (from the comm. end) is bent back over the armature out of the way, while the right-hand end is taken to the commutator five slots ahead of the one from which the wire emerges and soldered. This is repeated all the way around the armature giving the series of parallel wires of which 1—8', 7—9', 9—16', etc., are examples in the winding diagram. Put a small piece of the heavy wire originally on the armature in each commutator segment to make a foundation for soldering the small wires, as shown in Fig. 5. Better still, leave this piece in position by cutting the wires when unwinding the armature. When these wires are secured, bind over them well with tape from the edge of the commutator up to the edge

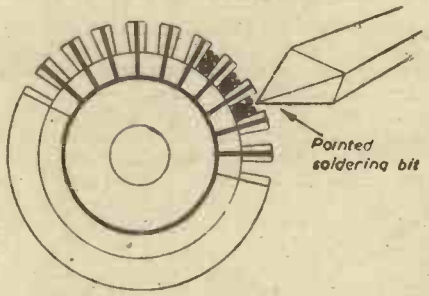


Fig. 5.—Method of soldering commutator by half-filling grooves with pieces of larger wire.

of the armature core, and then lay the remaining wires to their segments *four* places *in the other direction*, so that altogether 15 segments separate the ends of any armature coil. All through this work every wire should be checked with a continuity test, although its beginning and end appear obvious. Once the winding system is understood, this precaution will take very little time. A wrong connection may be very difficult to locate and correct afterwards, and will cause endless trouble. Fill in all the slots well with solder, and cut off projecting wire or solder with a sharp blow from an old chisel. While soldering and finishing, cover the commutator surface with tape to prevent damage and to protect it from flux. Put two more bindings just beyond each side of the iron core, as shown in Fig. 4, and before removing the tape from the commutator give the whole winding a good coat of varnish. In the absence of shellac the author used a tin of outside wood varnish intended for propellers, with quite good results!

Field Coils

Remove the pole-pieces, marking them with white chalk or file cuts so that the excitation field will be maintained. Four new coils are needed, containing about 200 turns each of 18 or 19 S.W.G. wire. A former is necessary for the winding, and is made as shown in Fig. 6. The central wooden block is cut to a size and shape slightly larger than the "neck" of the pole-piece. The two plates can best be of aluminium from an old chassis, with edges well filed to prevent damaging insulation. The system of cuts and grooves allows the coil to be tied by pieces of *cotton-covered* wire, so that the former can be dismantled and removed and the coil bound with tape. Each tying wire is removed as the binding reaches it. The winding should be done as neatly as possible, with good tension, but side-by-side placing is impossible after the first two layers. Wire from old dynamo field coils is satisfactory, if the insulation is sound. The wire used need not be identical on each coil so long as the number of turns is approximately correct. The former described will just hold about 200 turns of 18 S.W.G. enamelled wire when filled to the limit.

The coils are wired in series from the + brush to the − brush, with alternating directions of current flow. If in doubt, check the direction of each coil by means of a small compass needle, a dry cell supplying the magnetising current. If the final connections to the field coils are reversed, the dynamo will cut-in with the wrong direction of rotation, so correct polarity of the field-coil connections may be found by trial and error. As explained last month, any of the suggested windings will generate when the dynamo is turned by hand, "crank-handle" fashion. Move the brush-holders while doing this, a voltmeter indicating the best position. The third brush is, of course, omitted. Some idea of the power developed by the propeller may be got from the force with which the armature resists rotation when one tries to keep the voltage above 5 or 6 volts by hand. Cover the openings in the dynamo case by soldering pieces of tin over them, and give the whole machine at least two coats of good enamel.

(To be continued.)

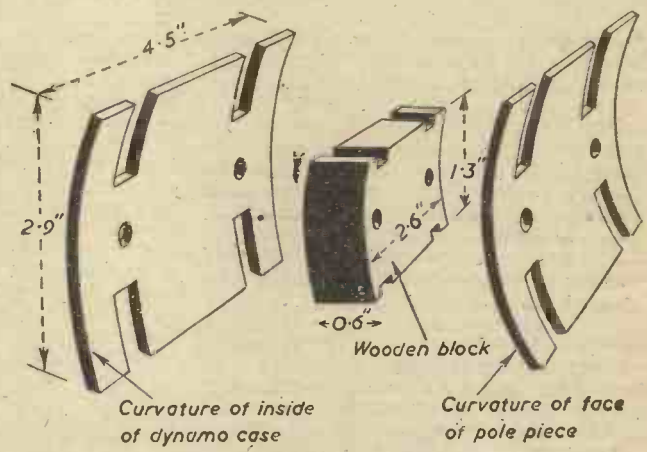


Fig. 6.—Details of former for winding field coils.

Photo-cell Base Connections

IN the article "Sound-on-Film Amplifier Designs," published in our October, 1943 issue, reference was made to the various types of photo-electric cell available, e.g., Cetron CE-1, Osram CMG8 and CMG22, and in Fig. 3 a diagram of the connections, as seen from the underside, was given. It was shown that, with British photo-cells fitted into ordinary valveholders, the cathode is connected to the grid pin (unless from top cap), and the p.e.c. anode to the anode pin of the valveholder.

The author of the article, Mr. D. W. Aldous, informs us that, however, with one type of British photo-cell, namely, the Osram CMG22, the cathode is connected to the right-hand filament pin, and this exception should be noted.

Aircraft Lift-increasing Devices

Various Methods of Increasing the Flying Efficiency of Aircraft

By T. E. G. BOWDEN, Grad.R.Ae.S., M.I.E.T.

IN order to increase the efficiency of aircraft many lift-increasing devices have been developed. Some have proved successful, but the majority, through being too complicated or heavy, have failed to proceed farther than the experimental stage. The ideal method has not yet been discovered, although every country in the world has aircraft research engineers constantly trying out new ideas.

One of the main disadvantages of present-day aircraft is the long take-off run required before the machine becomes airborne. Also, the landing speeds are dangerously high, the average figure for high-powered aircraft being in the neighbourhood of 100 m.p.h. If the take-off and landing runs could be decreased, the efficiency and safety of airline operation would be greatly increased. Landing accidents would be reduced, and the pilot would have less to worry about. At the present time take-offs and landings with certain aircraft call for extreme care, and in some cases the aircraft are hanging on their airscrews when coming in over the aerodrome boundary. These engine-powered landings are not very complementary to the progress made in aircraft design, and should any of the engines cut out, a crash is inevitable unless there is sufficient height in which to recover.

The main feature of any device which is to be fitted to an aircraft is its weight. Even if it should increase the lift by as much as 50 per cent., it is not worth while fitting if the weight of the structure and the necessary operating controls are increased by the same amount.

The lifting properties of various aerofoils may be compared by studying their lift coefficient values at varying angles of incidence. The greater the value of the lift coefficient, the greater the lift exerted by the aerofoil. Alternatively, the speed of flight to maintain the aircraft's weight may be reduced. If the maximum lift coefficient be doubled, the stalling speed (minimum speed of flight) is reduced by approximately 25 per cent. A description of several of the lift-increasing devices that have been used or may be used in the future now follows.

Handley-Page Slot

One of the most successful means of increasing the maximum lift coefficient and delaying the stall is the Handley-Page slot which is illustrated in Fig. 1. On a normal aerofoil, when the stalling angle is approached, the airflow breaks away from the wing-surface and becomes extremely turbulent. This causes the lift to be reduced, and the aircraft is said to be stalled, i.e., the lift is not equal to the weight of the aircraft.

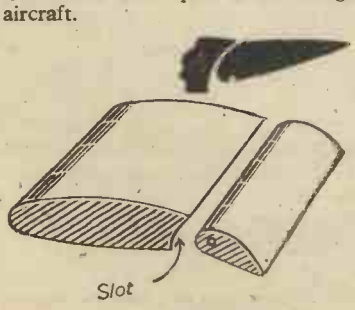


Fig. 4.—Slotted flap.

The fitting of a movable slat in the leading edge enables the airflow to be controlled to a certain degree. In normal flight the slat lies flush with the leading edge and automatically moves outwards when the stalling angle is being approached. The slat is so positioned and hinged that the low air pressure on the wing-top surface pulls the slat into the operating position. The

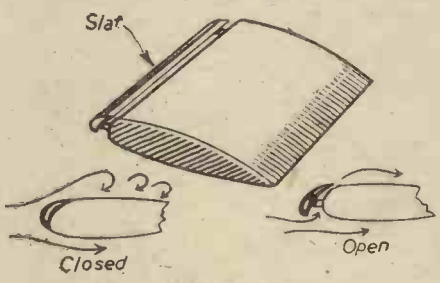


Fig. 1.—Handley-Page slot.

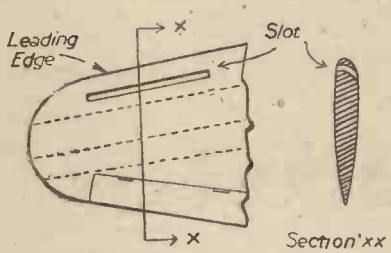


Fig. 2.—Built-in slot.

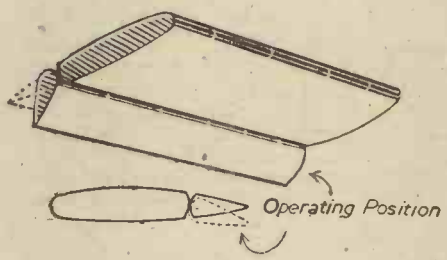


Fig. 3.—Simple flap.

air which would normally have become turbulent is guided along the top surface, and lift is maintained or even increased.

The slot caused by the slat moving forward is generally arranged so that the gap at the rear end is smaller than that at the front opening. This increases the velocity of the air and helps to maintain a streamline flow.

Several disadvantages are incurred by fitting slots, and the question as to whether they are worth while depends upon the type of aircraft. Unless they are very accurately made, the nose profile of the wing is upset and consequently the efficiency of the wing is reduced. The leading edge is the most important portion of the wing, and it is essential that the correct profile be maintained. Another disadvantage is the extra weight and cost involved. The problem of icing has also to be studied, and in the case of many of our largest bombers the possibilities of balloon barrage cables cutting into the leading edge. On these aircraft the leading edges are armoured, and this causes the fitting of slots to be impracticable.

For aircraft which are expected to take-off out of small fields and to land in restricted places, the fitting of slots is practically essential. The Westland Lysander is a typical example, as this aircraft was designed to operate from makeshift aerodromes when co-operating with the Army. The Germans have also adopted the slot method for their communication and army co-operation aircraft.

Built-in Slot

As an alternative to the movable slat, the incorporation of a permanent slot as shown in Fig. 2 has been adopted for several aircraft. The advantage of this idea is that there are no moving parts, the slot being merely a gap connecting the top and bottom surfaces of the wing.

The result of having a permanent slot in the wing is to reduce the efficiency at normal flying angles, as the slot is only normally required for the angles of incidence at which a stall occurs. Aircraft possessing bad wing-tip stalling characteristics may be partially cured if built-in slots extending for several feet from the tip inward are fitted, although this is not an efficient method.

If it were possible to incorporate sliding doors which closed the slot when required, this method might be more extensively used.

Auxiliary Aerofoil

By fitting a permanent aerofoil in front of the leading edge, the advantages of a slotted wing may be obtained. The main drawback in this case is the extra drag caused by the slot being permanently in the open position. This idea has not been generally adopted, and is not likely to be used in the future.

Simple Flap

As shown in Fig. 3, a simple flap consists of a movable trailing edge which may be moved downwards. The object of lowering the flap is to increase the amount of camber. The pressure on the wing undersurface is increased, due to the slowing down of the airflow in this region. On the upper surface the air is prevented from becoming turbulent by the dead air region which is caused when the flap is lowered.

Various sizes of simple flaps have been tried out, and it has been found that flaps with one-third the wing chord are the most efficient.

Slotted Flap

An improvement on the simple flap is illustrated in Fig. 4. This design is known

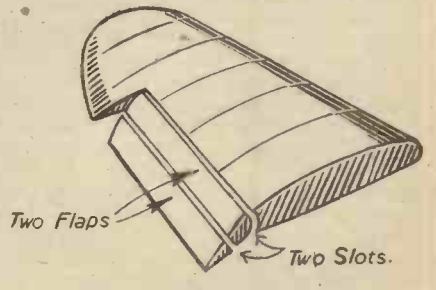


Fig. 5.—Multi-slotted flaps.

as a slotted flap. The wing trailing edge and the flap leading edge are so shaped that when the flap is depressed a slot is formed.

The airflow over the trailing edge is improved, due to the action of the slot, which is similar to that described in the paragraph entitled Handley-Page slots. The drag is reduced considerably as compared with the simple flap, and the lift may be increased by 15 per cent.

This flap is utilised both for landing and taking-off, and is fitted to many modern aircraft, e.g., Handley-Page Halifax (four-engined bomber).

Multi-slotted Flap

An extremely efficient method of increasing the lift is the fitting of multi-slotted flaps (see Fig. 5). The wing camber may be increased without any sudden changes in the airflow.

Although this device is more complicated than the previous types described, it will probably be utilised in the future. The flap is made in two pieces, each portion hinging down and forming a slot.

Fowler Flap

An interesting flap design which is fitted to the Lockheed Hudson is the Fowler flap. As shown in Fig. 6, the under-surface of the trailing edge moves backwards and downwards at the same time.

The advantage of this backward movement is that the wing area is increased as well as the camber. The flap is usually shaped to form a small aerofoil, and the operating loads are reduced by the backward movement.

Unfortunately, although this type of flap increases the lifting powers of the wing, there is a serious disadvantage. Due to the increase in the wing chord, the centre of pressure alters in position (the C.P. is the point at which a single force equivalent to the total lifting forces is assumed to act for calculating purposes). Normally the C.P. occurs at approximately one-third the chord from the leading edge, so that in the case of a 6ft. chord wing which is increased to 8ft., the C.P. will move approximately 8in. Thus the stability of the aircraft is affected, and unless the pilot adjusts his elevators or trimming gear, loss of control is likely to occur. The lift increase may be as high as 50 per cent. with this type of flap.

Zap Flap

An American flap which has proved successful is the Zap flap, illustrated in Fig. 7. As will be seen, the flap leading edge moves rearwards and the trailing edge moves downwards. By not allowing the flap to increase the wing chord, C.P. movement is avoided, and the main disadvantage of the Fowler flap overcome.

Due to the position of the pivot or hinge on this flap, the operating loads are reduced by a considerable amount. The airflow above the hinge helps to move the flap into its operating position.

To enable a Zap flap to be fitted along the whole of the wing trailing edge, special ailerons were devised. These, due to their outline, are known as "park bench ailerons," and are mounted above the trailing edge. By altering the angle of incidence of this auxiliary aerofoil the same effects as result from normal aileron movement are obtained.

The disadvantage of the Zap flap is that it is fairly complicated in operation and that the special ailerons are liable to flutter. An increase in lift of approximately 80 per cent. over a normal aerofoil may be obtained with a flap cord of 30 per cent. of the wing chord.

Split Flap

One of the most common types of flaps is shown in Fig. 8. The lower portion of the trailing-edge folds down from the hinge at the forward end. The advantage of this design over the simple flap is that the upper surface of the wing is left unaltered, and in consequence the airflow is not disturbed. The air pressure between the flap and the wing trailing edge is lowered, thus preventing the breakaway of the airflow to a higher angle of incidence than is normally obtained.

Various sizes of split flaps and varying angles of depression have been tried out, and it has been found that the most efficient figures are 30 per cent. wing chord and 60 deg. depression. In actual practice the flap chord rarely exceeds 20 per cent. of the wing chord due to the large operating forces required to move it into the down

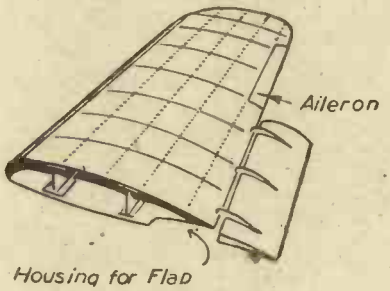


Fig. 6.—Fowler flap extended.

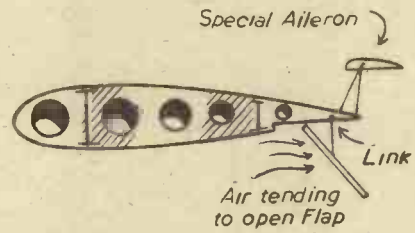


Fig. 7.—Zap flap.

position. If manual operation is required, then the figure is approximately 10 per cent.

The C.P. moves slightly backward when this type of flap is depressed, causing the aircraft's nose to drop. This movement is not so great as that which occurs when Fowler flaps are utilised. An increase of 70 per cent. lift is possible with split flaps.

Junker Flap

An effective means of increasing the lifting power of any wing is to instal an auxiliary symmetrical aerofoil section behind and under the trailing edge. This flap is capable of being rotated about a hinge fitted approximately at the flap C.P. When the flap is depressed, the effect is to increase the main plane chord, as the flap leading edge almost touches the wing trailing edge.

The drag of this design is very low, and approximately 50 per cent. lift increase may be obtained. The exact position of the flap is important and must be determined by

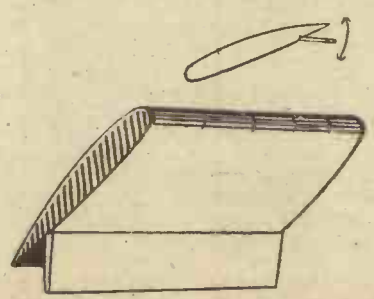


Fig. 8.—Split flap.

experiment, as it has been found that very slight alterations in position affect the increase in lift to a considerable degree.

Thurston Rotor

A novel idea which has the same result as the fitting of Handley-Page slots is the Thurston Rotor. A rotor taking the form of an auxiliary aerofoil is mounted at the wing tip. When this rotor moves away from the top wing surface it automatically revolves and the airflow is directed downwards, thus preventing a breakaway and delaying the stall. The rotor revolves about a spindle attached to the wing near to the leading edge.

Other types of flap which have been tested are the Marendez and Irving designs. The idea of the Marendez flap was to enable a flap to be fitted to a greater span of wing than normally. The flap was installed forward of the ailerons and extending to the wing tips. By housing this flap so that, when not in use, the wing profile was not disturbed, no extra drag was incurred.

The Irving flap was tried out to obtain a device whereby the operating loads could be reduced to a minimum. The flap was split in two halves, so that one half tended to push the flap into the operating position.

Conclusion

From the above description of several of the many devices which have been developed in the past, it will be seen that they all possess certain advantages which are counterbalanced by various disadvantages, such as weight, complication, etc. The ideal lift-increasing device has yet to be invented. To be a success it must increase the lift by 100 per cent. without increasing the drag.

The almost infinitely variable camber type of wing such as possessed by birds is likely to be used, the wing being split up into several sections, each capable of being altered in position. By this means a high-speed aerofoil (small thickness chord ratio) could be used to lift heavy loads from the ground by varying the camber. When sufficient flying speed has been gained the drag may be reduced by altering the camber back to the high-speed section.

Variable span and variable incidence wings have been tried out, but so far have not proved sufficiently good to warrant being put into production. Other possibilities include boundary layer suction and jet propulsion (the jet being directed downwards). A flap incorporating both the features of the split flap and the slotted flap may be usefully developed so that the advantages of both types could be utilised.

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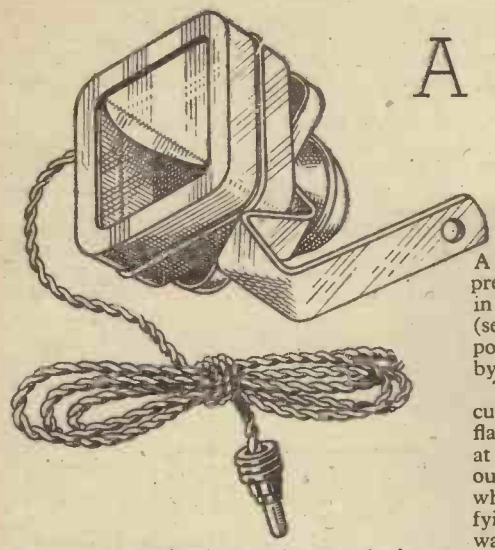


Fig. 1.—A simple, inexpensive bicycle lamp, using a single bulb for front and rear illumination.

A Two-way Cycle Lamp

Constructional Details of an Easily-made Unit

By R. J. CHAMBERLAIN

CYCLISTS requiring a head-lamp and rear red light for their machines will be interested in the rather novel lamp shown at Fig. 1. A single bulb is used, incorporated in a simple housing that permits the light to show at both the front and back, white in the former case and red-coloured in the latter instance.

Thus, one has not to purchase double bulbs or batteries. The one bulb and battery serves to supply the necessary illumination set down in the Safety First code. Moreover, the lamp house is designed to conform with present A.R.P. regulations; so, once made, and fitted to the cycle, you are ready for the road.

It is a money-saving lamp that will cost you nothing to construct. A model made

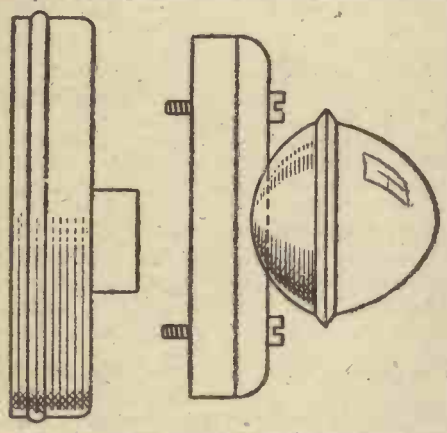


Fig. 2.—Side view of lamp house, and a flashlamp top piece.

by the writer was made from an empty Remington typewriter-ribbon box and the top part of an old flashlamp having a domed magnifying glass, plus a few other odds and ends which are sure to be found somewhere in the house.

The two-way lamp is, of course, affixed to the off-side front fork of the bike. The special support enables the lamp to be fixed somewhat below the level of the wheel axle. This is essential in order that the right foot, on the downward curvative, will not interfere with the rear red light too much. If arranged up high on the fork, of course, the light will be rather concealed by one's leg.

Lamp Housing

The lamp housing is the first part to make. A typewriter-ribbon tin, with lid, is wanted, preferably square. Special apertures are cut in the back part of it. Score these openings (see Fig. 3) after you have marked the position of the flashlamp top as indicated by the dotted lines.

The openings are not cut right out. The cutting is done so there is a small upper flap, with a hole in it, which is bent inwards at right angles. The lower flaps are pushed outwards at about 45 degrees; these flaps, while allowing light to pass to the magnifying glass, also act as reflectors in a small way for the front illumination.

It is necessary to drill $\frac{1}{8}$in. holes through the shoulders of the casework on which the magnifying glass is fixed. The holes are, of course, for fixing bolts, similar holes being drilled in the lamp housing as shown.

To cut the tin flaps, support the tin on a small square of thick wood which fits inside it to project. A block, $2\frac{1}{8}$ins. square by $\frac{7}{8}$in. thick will be suitable. The cutting implement was a sharpened large-size bradawl.

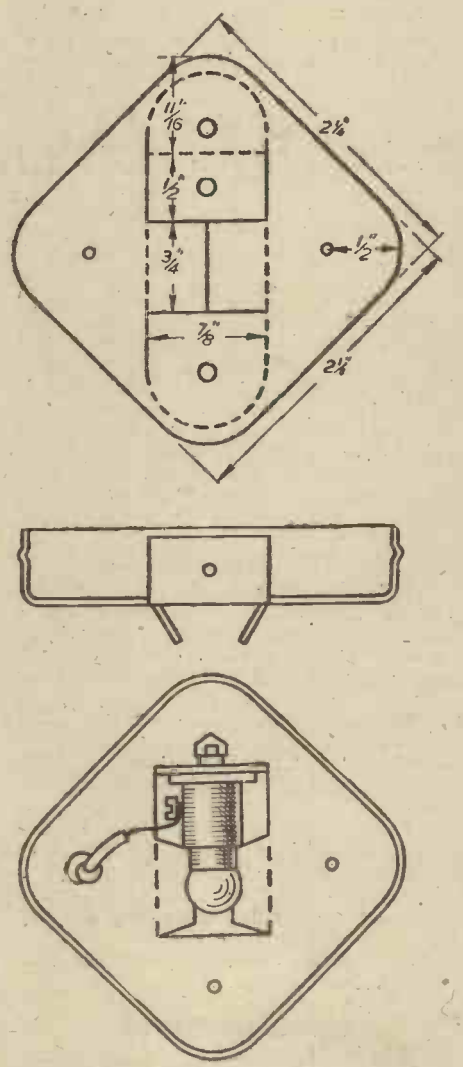


Fig. 3.—How the tin lid is marked out for cutting, and an interior view showing bulb in position.

One merely holds the point on the line and "rocks" it from side to side, meanwhile exerting a stiff pressure on the tin. The bradawl digs through the thin metal to make an $\frac{1}{8}$in. long cut. Thus, cutting is done gradually—a series of small cuts in line.

The Bulb Fitting

Having bent the flaps the lamp can be fitted. For this purpose, you need a bulb holder cup, this being screwed under the top flap, as shown at Fig. 3 by the interior

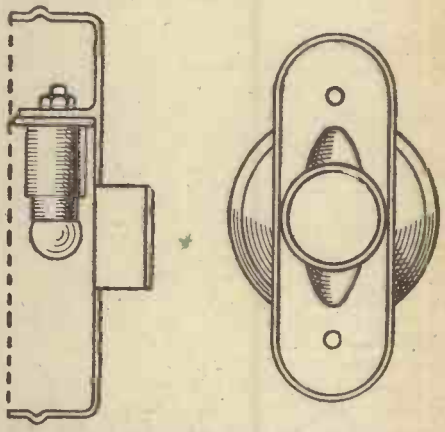


Fig. 4.—Cut-away side view, with bottom view of top piece.

view. A fibre or cardboard washer should go between the bottom of the cup and the flap in order to insulate the cup from the metal.

Typewriter-ribbon boxes are usually enamelled so that the cup screws on an enamelled surface, but this surface does not ensure absolute insulation; the washer mentioned must be incorporated.

This does not mean that the bolt, holding the cup on the flap, should be insulated too. The bolt head is a contact for the bulb, whereas the casing of the bulb holder is another contact. We must have one of these contacts insulated from the other, so the best choice is the casing of the holder to which the flex wire is connected. No wire is needed for the second contact as the lamp housing, in conjunction with the metal frame of the bicycle, acts as an electrical conductor (earthing).

The Rear Part

At this juncture the rear part of the lamp is bolted to the lamp housing. Prior to doing so, however, a piece of crimson-coloured film, or celluloid, must be placed before the magnifying glass. Alternatively, a few drops of red ink could be dropped into the magnifying chamber and shaken over the glass surface until the ink runs evenly. Keep the ink moving about until it dries up. You should work near a warm fire while applying the colouring, and heat the glass occasionally to speed up drying.

When the flashlamp part is attached, obtain a 4ft. length of flex and, having bared one end about 1in. long, tie a single knot in the flex about $1\frac{1}{2}$in. away, then thread the wire through the hole (see interior view at Fig. 3) until the knot is brought up against the back of the housing.

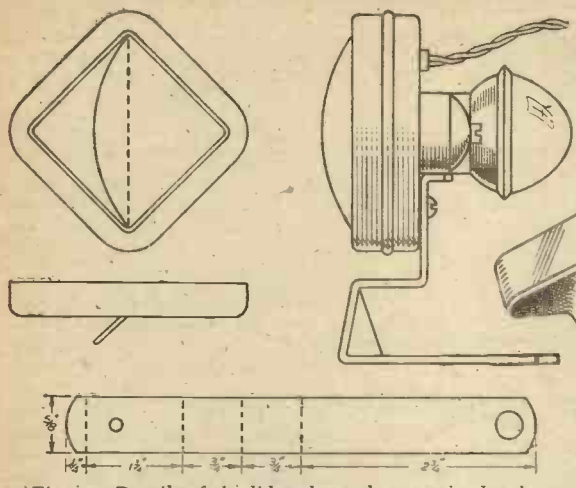


Fig. 5.—Details of the lid and metal supporting bracket, and side view of the complete lamp.

Preparing the Lid

The lid of the box has now to be prepared. It will be seen, from Fig. 5, that a triangular opening is cut in it, but in such a way as to leave a semi-circular "hood" at the top. Cutting is done with a bradawl, as previously explained. The indentation in the lid acts as a guide, whereas a straight guide line is ruled centrally across the surface, and the semi-circle for the hood scored with the compasses.

When cut, bend the hood outwards at a slight angle. A piece of clear celluloid, or thin glass, is cut to fit inside the lid, including a wooden frame (see Fig. 6). The frame must be a tight fit, so it will hold the glass firmly in place.

A better plan is to use a piece of glass and bed it in the lid with putty. It is only a matter of applying thin smearings of putty around the edges of the glass and then pressing the latter into the lid and trimming off any waste putty to make a neat job. In this case no wooden frame is wanted.

Holding Bracket

A special holding bracket is made from a piece of mild steel about 6in. long by $^{1}/_{16}$in. thick by about $\frac{3}{4}$in. wide. The marking-out details are given at Fig. 5. Drill the holes shown, then score the bending positions. A drawing of the finished bracket, together with Fig. 1, shows how the bracket is bent.

The bracket is bolted to the lamp housing. It is advisable to have the head of the bolt on the outside, on top of the bracket, with the nut inside, screwing down on a brass washer. If desired, the work can be given two coats of black enamel paint. The bracket is fixed to the front wheel axle.

A grid bias battery can be carried in the saddle bag, the flex wire running from the lamp being plugged into the battery, including a second wire, which is connected to some convenient part of the cycle where the metal is exposed, such as the saddle pillar, for example.

If desired, a small handle-bar switch could be fitted, as shown in the circuit, Fig. 7, but it is just as easy to insert the plug in the battery socket and remove it in order to switch the current off and on. Incidentally, an ordinary M.E.S. flashlamp bulb, such as a 3.5v., will serve, and, if used, be careful not to plug in to voltages above 4½ volts, so as to avoid fusing such a bulb.

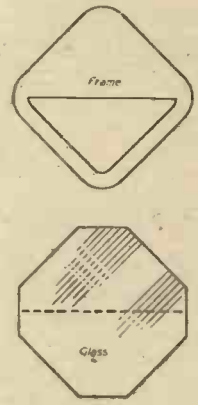


Fig. 6.—Thin wooden frame which goes behind glass, with shape of glass.

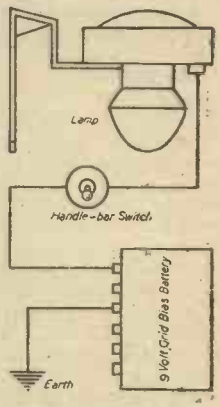


Fig. 7.—The wiring circuit.

Probes and Problems

More Mental Nuts for You to Crack

(*Solutions are given on page 173.*)

The Duchess's Diamonds

Crook, Thug, Spike and Tuff were being interrogated by Inspector Smart about the theft of the Duchess's diamonds, of which one of them, and only one, was known to be guilty. They made the following answers to the Inspector's questions:

Crook: "I had nothing to do with it; Thug's your man; he's been charged before. Tuff is perfectly straight."

Thug: "I've never seen the diamonds; I was out of town when the burglary happened. The police have never had anything on me. Spike is an ex-convict."

Spike: "I admit I did the job, I've never been in trouble before, though. Crook's a bad character; so is Tuff."

Tuff: "Thug's the man you want; he was in the vicinity at the time. I'm innocent; and Spike is as straight as a die."

The inspector knows that innocent men can be relied upon to answer the majority of their questions truthfully, while the replies of the guilty man will be all or mainly lies.

Who stole the Duchess's diamonds?

Husbands and Wives

Mr. and Mrs. Smith, Mr. and Mrs. Jones, and Mr. and Mrs. Robinson received between them 40 Christmas presents. All of them received different numbers, Mr. Smith being luckiest among the men and Mr. Robinson the least fortunate.

Sarah received twice as many presents as her husband, Jane five times as many as her husband, and Mary seven times as many as her husband.

What are the respective surnames of the three women?

Dummkopf's Code

When the notorious international spy, Karl Dummkopf, was captured, there was found in his possession a scrap of paper bearing the following cryptic message:

"Here is the password for to-night; I am sure you will soon get to the root of it:

12111692532411 6."

The best brains of the Secret Service have been working to discover the code word. Can you assist them?

Will This Bowl You Out?

"Right up to the last match of the season," said Battersby, "Stonewall and I had the same batting average. In the last match, unfortunately, we put up a very poor show, each of us being out for only one run."

"Then you finished the season level, I suppose?" said Green.

"Not at all," Battersby replied. "My final average was 29, while Stonewall's was only 25."

"How do you make that out?" asked Green, doubtfully. "I suppose you must have played more often than he did?"

"Exactly," said Battersby. "In all I must have completed something between ten and twenty inningses."

How many innings did Stonewall complete?

Menagerie Mix-up

"We were trying to pick out the animals in five different cages in the Zoo this afternoon," said Tommy. "Teacher offered a prize to the one who did best."

"How did you get on?" I asked him.

"Well," said Tommy, "my list was 1, lion; 2, camel; 3, tiger; 4, bear; 5, ape. Betty put them in the order: 1, camel, 2, bear; 3, lion; 4, ape; 5, tiger. And Harry's list was: 1, lion; 2, ape; 3, tiger; 4, camel; 5, bear."

"Who won the prize?" I inquired.

"Nobody," Tommy told me. "We all tied with two right each."

In what order were the animals really arranged?

The Astrologer and the Pyramid

The famous Pyramid of King Tutankhotep of Egypt was built on a square base with a side of 738ft., the distance of each corner of the base to the apex of the pyramid being 1,681ft.

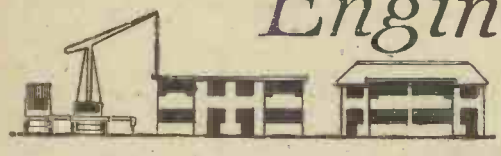
It happened that King Tutankhotep, finding himself at one of the four corners of the pyramid, desired to consult with his chief astrologer, who was standing at the opposite corner. The king was rather an impatient monarch, so the astrologer made the best speed he could, but was not quick enough to satisfy his royal patron.

"Your Majesty," said the sage humbly, "I ran as fast as I could; but I had to come right round two sides of the pyramid, a distance of 1,476ft."

"Dolt!" replied Tutankhotep. "Why didn't you take the shortest route?"

What *was* the shortest route, and, if he had selected it, how far would the astrologer have had to travel?

(*To be continued.*)



Engineer-built Houses of the Future—13

(Continued from page 125, January issue.)

Load-bearing and Non-load-bearing Internal Partitions : Partitions Which Stiffen Walls

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

Internal Partitions

THE various rooms and compartments of a house must, of course, be separated and enclosed in vertical planes by walls and/or partitions, and, as regards the partitions, they almost invariably have to, or should, do other duties than simply to separate and enclose and provide privacy. They should be designed to provide sound and thermal insulation to a degree as much as is practical according to modern codes of practice. They should be reasonably fire-resistant. Structurally, internal partitions can, if designed and constructed properly, add considerably to the strength of the walls, floors and roof of a building. As a matter of fact, the expert structural engineer and building technician examines most keenly the general layout of an architect's plans and sections to ascertain how every major and minor partition can be utilised to strengthen, buttress and tie-in external and party walls, and how certain partitions can be made to carry floor and roof loads. He knows that by spending a very little more money on some partitions a much greater amount will be saved in the cost of walls and other structural items.

Internal partitions can be considered under two main headings, viz.: load-bearing and non-load-bearing. Of course, both actually have to bear some load, even if it's only the dead weight of the partition; but the technical interpretation of a load-bearing partition is well defined by the L.C.C. by-laws as "*Load-bearing*" "*in relation to any part of a building (including the foundation) means any such part bearing a load other than that due to its own weight and to wind-pressure on its own surface.*" Figs. 76 to 79 are part sections through a house showing by Figs. 76 and 77 typical examples of non-load-bearing partitions, and by Figs. 78 and 79 load-bearing partitions. Note how in the former examples the loads of floors and roof are kept off the partitions, and how in the other examples the partitions may be very heavily loaded.

Load-bearing Partitions

A subject of much importance in designing engineer pre-built houses is the necessity of well-balancing the main structural units, internal partition units, and the various materials which may be used. If the general framework of the walls, floors and roof is of light steel construction, or of reinforced concrete, it is advisable that any load-bearing partition be constructed with a similar general framework. The framework may be of a skeleton of steel framing, such as posts with a beam over, and the filling between the posts may be of any light form of construction. It is not considered good practice to allow timber-framed units to carry steel-framed or reinforced concrete floors and roof which require rigid and practically immovable supports which timber may not ensure owing to its often shrinking, warping and deforming. This does not infer that timber is incapable of supporting heavy loads, as it most definitely can. Well-balanced design and construction includes the use of timber load-bearing partitions to carry such as timber-framed floor and roof units.

In this article is described timber-framed partitions; those of other materials will be dealt with later. Load-bearing partitions, in having to support floor, roof and other possible loads, must be of stronger construction than those which have nothing but their own weight to support. By studying Figs. 78 and 79 it will be apparent that each partition in the first storey has to carry roof loads, and that in the ground storey not only has to withstand the loads of the superimposed partition but heavy loads from the first floor. Obviously the two partitions should be of different strength; the lower one must be much stronger than the upper one.

Load-bearing partitions should be designed to support safely the actual dead weight of all constructions on them, their own dead weight, and, what is of extreme importance, all superimposed loads in accordance with the recognised best codes of practice, which at the present time may be considered as those that are governed by the building by-laws. For housing work the by-laws require a superimposed load of 40lb. per foot super on floors (in addition to the dead load); and, as regards roofs, the following are required:

London.—Flat roofs, and roofs inclined at an angle with the horizontal of not more than 20 degrees—50lb. per square foot of the horizontal area covered. This is a very severe load, and it is hoped that it will be lessened in the future to enable more economical roofs to be built. This superimposed load only refers to the actual roof construction, and is reduced to 30lb. per foot super on binders, trusses and other main supports. Pitched roofs exceeding 20 degrees are required to have a minimum superimposed load of 15lb. per square foot of surface assumed acting normally to the surface on the windward side and 10lb. per square foot

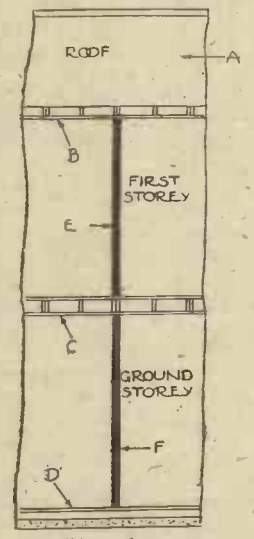


Fig. 76.

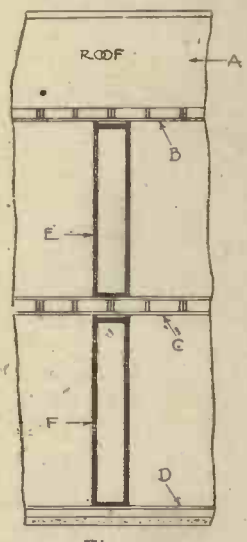


Fig. 77.

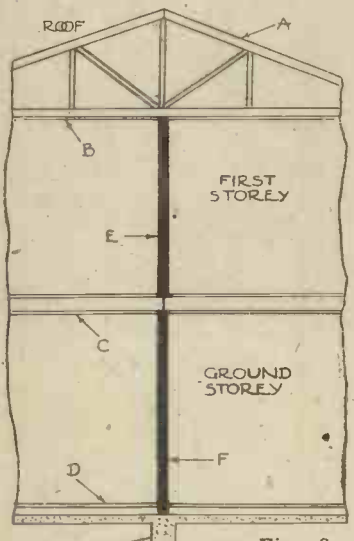


Fig. 78.

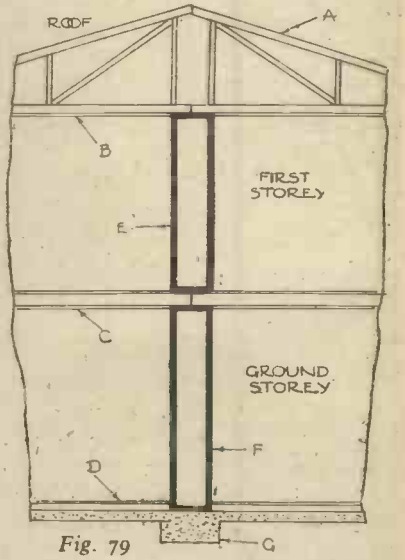


Fig. 79

Fig. 76.—NON-LOAD-BEARING PARTITIONS—SINGLE TYPE. A—Roof structure not deriving support from partition E. B—Ceiling structure not supported by partition E. C—Floor structure not supported by partition F. D—Ground floor. E—Partition in first storey. F—Partition in ground storey.

Fig. 77.—NON-LOAD-BEARING PARTITIONS—DOUBLE TYPE. A, B and C—Roof, ceiling and floor structures not deriving support from partitions. D—Ground floor. E and F—Double partition such as those forming cupboards, etc.

Fig. 78.—LOAD-BEARING PARTITIONS—SINGLE TYPE. A—Part of roof structure bearing on partition E. B—Part of ceiling structure bearing on partition E. C—Part of floor structure transmitting heavy loads on partition F. D—Ground floor. E—Partition in first storey supporting roof and ceiling loads. F—Partition in ground storey supporting loads from partition E and first floor structure.

Fig. 79.—LOAD-BEARING PARTITIONS—DOUBLE TYPE. A, B and C—Roof, ceiling and floor structure deriving support from partitions. D—Ground floor. E and F—Double partition capable of supporting considerable loads if designed properly. (See next article.)

of surface acting separately and not simultaneously on the leeward side. This requirement applies only in the design of the roof construction, and a vertical load of 10lb. per square foot of covered area shall be substituted for it in estimating the vertical superimposed load upon all other parts of the construction.

Outside London.—Flat roofs and roofs inclined at an angle with the horizontal of not more than 20 degrees—30lb. per square foot of covered area when calculating the superimposed loading on beams, pillars, piers and walls. Pitched roofs of more than 20 degrees—10lb. per square foot of covered area when similarly calculating.

The dead weight of any part of a building shall be assumed to be that set out in British Standard Specification No. 648, 1935 (Schedule of Unit Weight of Building Materials), or if not set out in that specification shall be determined by test.

The above data is really important, and shows that the authorities recognise the need of allowing reasonable loads on structures, and that fanciful claims in connection with light-weight housing should be analysed before accepting them as complying with reasonably good codes of practice and structural design. Although I am convinced that the building by-laws require modification in some respects to ensure economical housing, it must be admitted that they are reasonable in their requirements in accordance with pre-war ideals. The "50lb. and 30lb. flat roof superimposed loading" for London could be lowered; and the 30lb. for flat roofs of houses built outside the London area may be lessened a little. A 40lb. per square foot superimposed load on floors may be allowed as reasonable, although it could be reduced to, say, 35lb. (some Continental countries, I believe, allow 30lb.); but I definitely think that, as the 40lb. is based on the incidence of concentrated and live loads, it could be reduced in respect to the calculations in connection with supporting structures, such as walls and partitions; this would cause economy without adversely affecting structural stability.

Figs. 80, 81, 82 and 84 depict timber-framed partitions which are suitable for either load or non-load supporting partitions, subject to a very important condition, viz.: that the size of the timber studs or vertical members are sufficient to support the loads to be imposed on them, and that they will not buckle under load. This means that load-supporting partitions must, as a rule, be thicker than those which do not support loads; and this brings us to the important question as to what the thickness should be, that is the slenderness ratio. The L.C.C. by-laws for timber construction, which expert structural designers admit are good, stipulate that the slenderness ratio—that is the ratio of thickness to height in connection with the direction between lateral supports where there is a tendency to buckle—shall not exceed 40. This will permit a partition 8ft. 6in. high, i.e., 102in., to be $\frac{102}{40}$ equals just over 2½in. thick as regards its structural members. With such a ratio the permissible stress on the timber members is very limited, and calls for a degree of perfection in timber which is rather difficult to obtain at an economic price. For these reasons I recommend that:

The slenderness ratio of the structural members (excluding coverings) of timber-framed load bearing partitions shall not exceed 32 and preferably be between 25 and 28. In stressed-skin construction the thickness can be measured overall of the sheet material.

Various Types of Load-bearing Partitions

Fig. 80 depicts one of the simplest types of partitions which can be machine produced in units 3ft. or more in width and of a height equal to the usual storey-height of rooms, which is 8ft. to 8ft. 6ins. The construction consists of a timber framework, the main vertical studs at about 1ft. 6in. centres being designed to carry the superimposed loads on the partition, and of a depth, from face to face, to ensure that the partition will not buckle under load. The surfaces of the framework may be covered with any suitable kind of building board, such as the loose-fibre insulating type, hardboard, plywood or other sheet material which is purchasable in large sheets. The vertical junction between the sections must be designed so that they may be either bolted together, or an interlocking system be used to ensure a proper connection. The type of partition is not intended to be particularly good in sound insulation; but the use of good insulating building boards will be

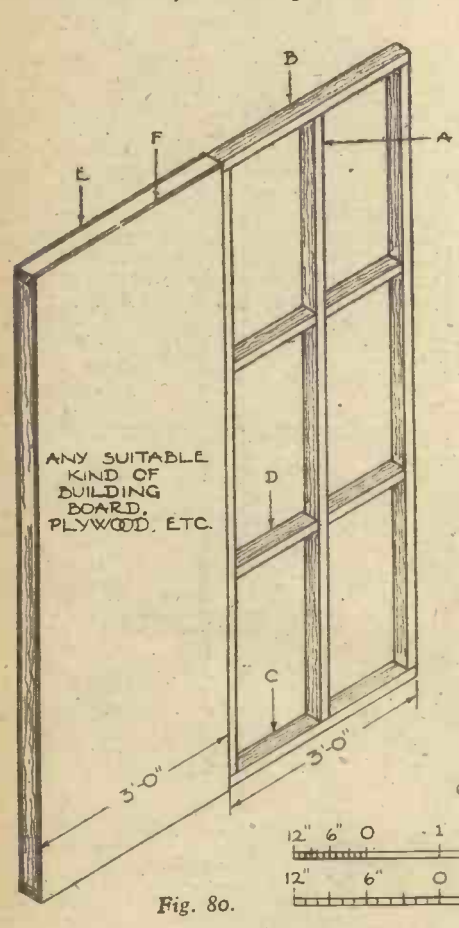


Fig. 80.

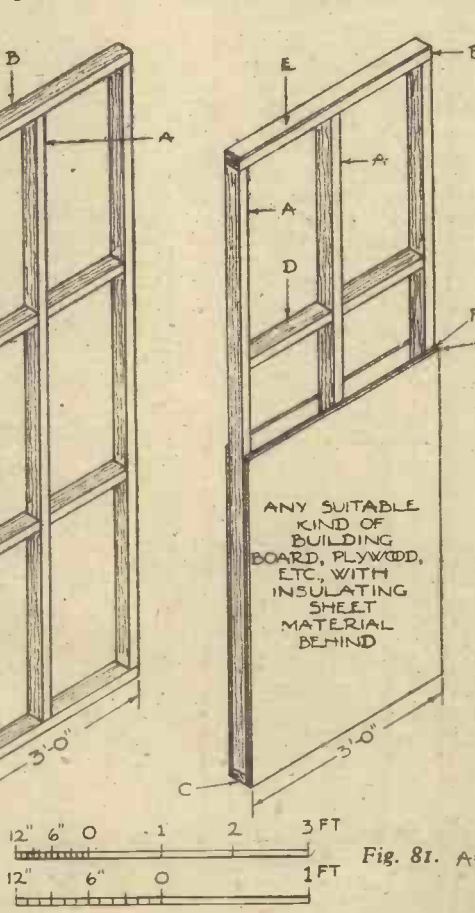


Fig. 81.

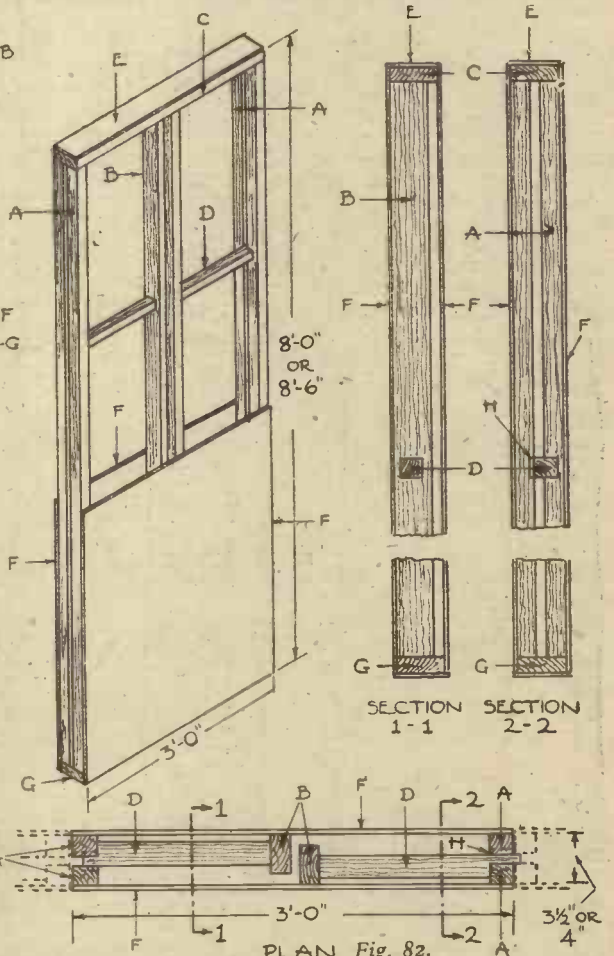


Fig. 82.

Fig. 80.—THE SIMPLEST TYPE OF PRE-BUILT TIMBER-FRAMED PARTITION WITH 3ft. WIDE by 8ft. or 8ft. 6in. HIGH UNITS. A—Studs. B—Head. C—Sill. D—Noggings. E and F—Front and back coverings or claddings.

Fig. 81.—PARTITION SIMILAR TO THAT AS FIG. 80, BUT WITH EXTRA INSULATING MATERIAL. A, B, C and D—Studs, head, sill and noggings respectively of timber framework. E—Sound-insulating strip. F—Insulating sheet material. G—Covering or cladding.

Fig. 82.—PRE-BUILT PARTITION UNITS OF SPECIAL DESIGN TO ENSURE GOOD SOUND INSULATING PROPERTIES. A—Double isolated side studs. B—Double isolated centre studs. C—Head. D—Partially isolated noggings. E—Insulating strip. F—Covering or cladding. G—Sill. H—Insulating pads let into studs.

found rather effective. Fig. 81 is similar to that at Fig. 80, but includes two layers of sheet material on one side (both sides if desired), the sheet immediately adjoining the timber framework being of the insulating type. This method of construction is useful if a poor-insulating type of building board is required for æsthetic or other reasons to cover the faces of the partitions. Fig. 82 is a method of construction designed by me to provide partitions of the timber-framed kind which will give a reasonable degree of resistance to the passage of sound. An examination of the method will show that both faces of the unit of the partition and their structural framework are isolated from each other except at the head and sill and at small points between the small twin studs at the sides. In some cases, and particularly with non-load-bearing partitions, the head and sill can be modified so as to isolate the two faces; but in this respect it should not be overlooked that one of the troubles of acoustical insulation is to avoid the transmission of sound through floors and other main structural parts of a house to a partition. The design is such that the members can be of sufficient size to combat stresses due to quite heavy loading on the partitions: the twin centre studs can be of considerable strength; and the small side studs in twin formation, and with similar studs to the adjoining unit of the partition make a total of four members capable of offering great resistance. It will be noted that the nogging pieces are used solely for the purpose of giving lateral stiffness to the studs, and are not used to provide a fixing for the sheet material; the object of this is to avoid as far as possible any impact or other noises which affect the sheet material being transmitted too easily to the timber framework. An examination of the design will prove that no trouble would be experienced by engineers, or by those controlling machine-production methods, in making the units at a very economical price. Fig. 83 depicts a type of partition to which reference is made later, and is not suitable for load-bearing partitions, as the use of the three horizontal separate units in the dado, filling and frieze make it impracticable to form continuous vertical studs which are so very necessary to enable loads to be borne with safety. Obviously there would be tendencies for the three units to rather easily collapse under a heavy load. Fig. 84 shows a type of design which is receiving the attention of many research authorities and structural engineers. The layer of sheet material in the centre of the thickness of the partition or wall unit can be a good insulator, and the general construction, if on the stressed skin principle, can ensure a partition of considerable strength. Fig. 85 is a composite method of partition design. The actual partition units are of the light, non-load-bearing kind, the special head construction being intended to carry all superimposed loads such as of a floor.

Non-load-bearing Partitions

Any of the types of partitions can be designed for non-load bearing by simply reducing the sizes of the framework members; but it is essential that such reduction conforms to important rules regarding slenderness ratio. Nothing will be more damaging to the interests of engineer pre-built housing work than making partitions which are so weak as to cause them to bend laterally under normal pressures. I strongly advise that:

The thickness of the structural part (excluding the sheet covering material) of any timber-framed non-load-bearing partition be not less than 1/32 of its height between floor and ceiling (unless there is an intermediate lateral support).

This means that a partition 8ft. high should not be thinner than 96in. divided by 32 equals 3in. This rule may mean making the thickness as thick as some load-bearing partitions; but where economy may be effected is in the use of thinner studs. Whereas 3in. x 2in. may be required for a load bearing, 3in. x 1½in. would probably do for a non-load-bearing partition.

With stressed-skin construction, the thickness may be measured overall of the sheet material.

Partitions Which Stiffen Walls

When external and other main walls are designed on the basis that they will derive lateral support in their length, or, in other words, be buttressed by partitions, it is an essential of good design that such partitions be strong enough and will have no tendency to "whip" or deform by any pressure from the walls.

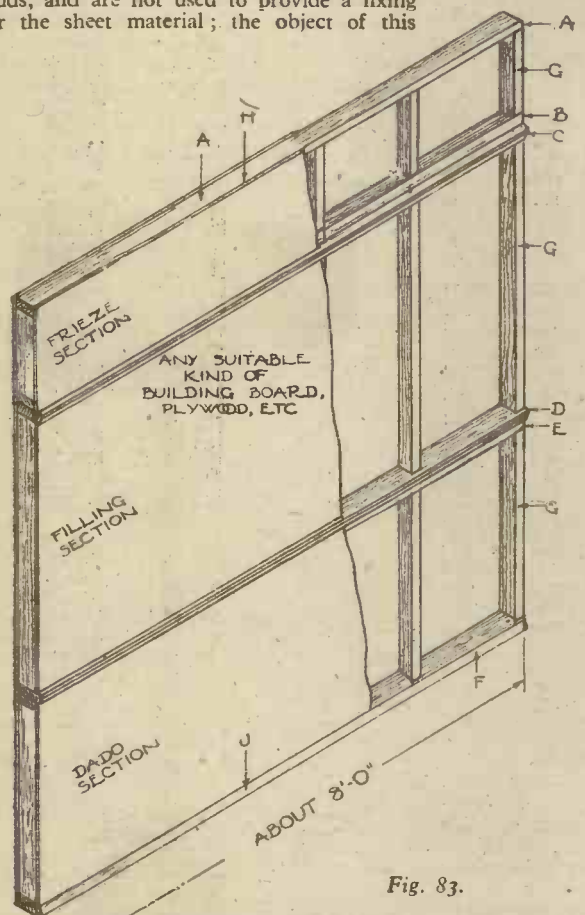


Fig. 83.

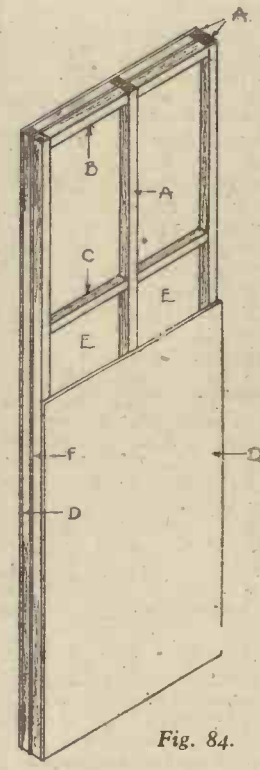


Fig. 84.

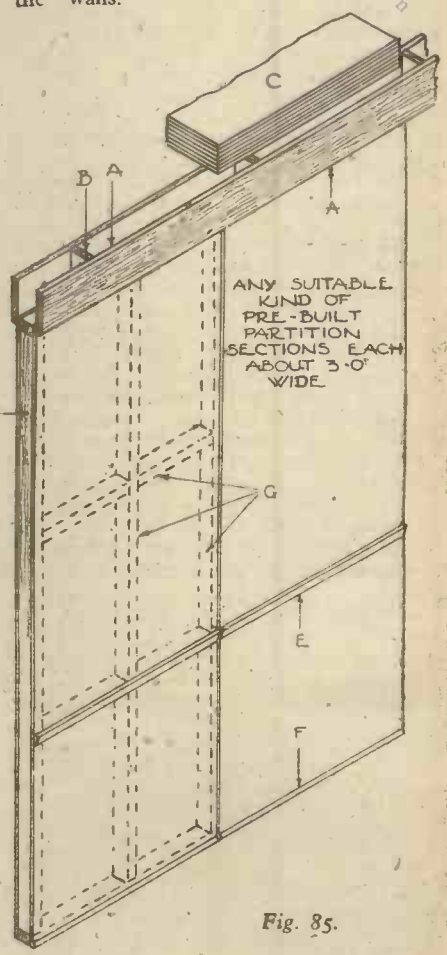


Fig. 85.

Fig. 83.—HORIZONTAL UNIT TYPE PARTITION. A—Head of frieze section. B—Sill. C—Head of filling section formed to provide picture rail. D—Sill of filling section formed with dado rail. E and F—Head and sill of dado section. G—Stud. H—Covering or cladding. J—Filler.

Fig. 84.—A TYPE OF STRESSED SKIN PARTITION. A—Studs. B—Top rails. C—Intermediate rails. D—Cladding. E—Centre insulating sheet material in elevation. F—Centre insulating sheet material fixed between the front and back timber frames.

Fig. 85.—COMPOSITE TYPE OF PRE-BUILT PARTITION CONSISTING OF LOAD-BEARING BEAM OVER NON-LOAD-BEARING PARTITION UNITS. A—Structural plywood built-up beam. B—Blockings. C—Floor units supported by beam. D—Partition units. E—Dado rail. F—Filler. G—Timber framework.

Masters of Mechanics—93

The Creator of the Kaleidoscope

Some Scientific Passages in the Life of Sir David Brewster

IN a pre-war world which was replete with toys and with gadgets galore for juvenile amusement, instruction and entertainment, a little optical instrument which was manufactured and sold under various guises, and which functioned with varying degrees of efficiency corresponding to the thoroughness of its construction, maintained its long popularity, and its power of fascinating young and old alike in spite of its more than a century-old origin.

This was the kaleidoscope, a truly engrossing optical toy which comprised essentially a number of fragments of coloured glass contained within a space surrounded by mirrors. When the kaleidoscope was shaken or rotated, the coloured glasses or other fragments of coloured material took up haphazard positions relative to one another, and, being subjected to multiple reflection in the mirrors, presented to the eye of the observer symmetrical patterns and designs, many of which were of a striking character and of great beauty.

The kaleidoscope was designed primarily as an amusing and interesting toy, but, as the years went by, it found its commercial uses as an aid to artistic designers in evolving new and hitherto unknown patterns. Throughout the Victorian and the Edwardian eras, and even in our own age, this interesting optical device constituted one of the main articles of the toy retailer's stock-in-trade, and, after the war, there is little doubt that it will again come into its own.

Yet by some curious whim of Fate the memory of the kaleidoscope's inventor has been permitted to grow dim, notwithstanding the fact that, in this country, he was regarded as being one of the scientific "lions" of his day. Many Victorian scientific treatises abound with references to the work of Sir David Brewster, who was the above-mentioned inventor, yet nowadays he is not often referred to. Brewster's once widespread fame and reputation have long since departed. Even his very name seems to be fading out of the annals of science. Yet Brewster lived an intensely busy life. His scientific activities were many and varied. He was a physicist and a scientific investigator, and his inventions were important ones. He was also one of the first popularisers of scientific matters, in which respect he functioned for many years as one of the world's first scientific journalists. A busy and an indefatigable individual altogether

A spectroscope of Brewster's day (1830). *It was by means of an instrument of this nature that he discovered the "absorption bands" of the spectrum.*

Sir David Brewster.

was Brewster almost to the day of his death, which occurred in his eighty-seventh year on February 10th, 1868.

Border-country Man

David Brewster was a Border-country man. He was born in the then diminutive town of Jedburgh, in Roxburghshire, some ten miles from the Scottish border, on December 11th, 1781. He was the third child and the second son of one James Brewster, who was at that time rector of the Grammar School at Jedburgh.

Young Master David turned out to be a thoughtful boy, with a quiet, retiring disposition. He was only nine years old when his mother died. During the hours off from school the lad roamed the immediate countryside observing the manifold changes of Nature from every aspect. He made friends with various individuals in the neighbourhood, and, in particular, with a James Veitch, who lived on a little property of his own about half a mile south of Jedburgh, and who augmented his slender income by making ploughs and by performing odd constructional jobs, particularly if they were of a mechanical nature.

James Veitch was a self-educated man. He had great mechanical skill, some considerable mathematical knowledge, and his favourite occupation comprised the making of telescopes, which he constructed entirely in his own workshop, even down to the formulation and grinding of the lenses.

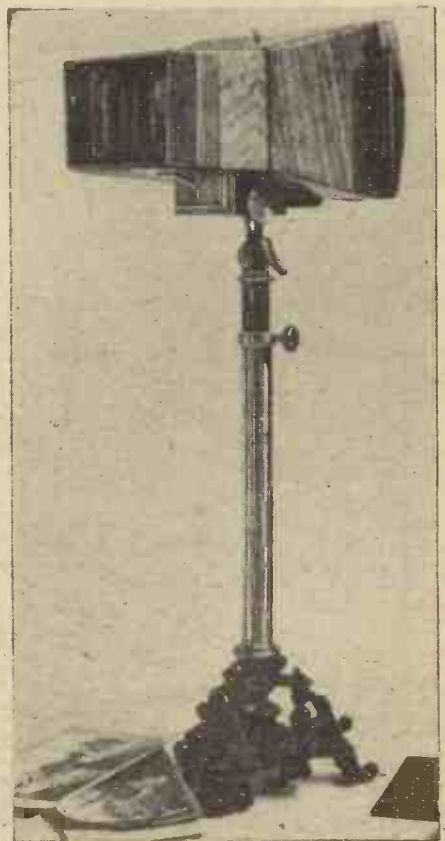
David Brewster's love for mechanics and scientific investigation received its first encouragement, to say nothing of practical development, at the inspiration of James Veitch, in whose little 'country workshop, hidden away in a secluded spot, he spent innumerable hours contriving to fashion for himself crude instruments and working models with the few materials which he found available therein.

M.A. at 19

In 1793, at the early age of 12 years, David Brewster was sent to Edinburgh University. Here he still engaged in his mechanical pursuits, making electrical machines (frictional machines) for himself and others, and conducting systematic observations of the stars and the other heavenly bodies. He kept in touch with James Veitch during his Edinburgh career, and no doubt received considerable help from the latter worthy, who, in many respects, acted as foster-parent to him. At Edinburgh he studied classics and "Natural Philosophy," with a decided emphasis on the natural philosophy. At the unusual age of 19 he took his M.A. degree, and in the same year (1800) he made his first scientific discovery which concerned an observation of the reflection of light.

After leaving Edinburgh in 1800, Brewster, for the next four years, took upon himself a private tutorship in a Scotch family at Pirn, in Peeblesshire. It was during this portion of his career that he first became interested in literary pursuits. He wrote scientific papers, and began to plan the outlines of a work which subsequently made him famous, to wit, the *Edinburgh Encyclopædia*, which was not completed until 1830.

Ever experimenting and working away during his spare time in a little private



A typical Victorian form of lens-stereoscope invented by Brewster, an instrument which attained great popularity during 1860.

workshop which he built for himself, David Brewster found that life passed very pleasantly for him, as, indeed, it seems to have done throughout his long career.

In 1813 Brewster published his first book, a *Treatise on New Philosophical Instruments*, which work dealt with the features and the construction of various types of laboratory devices. In 1807, whilst still engaged in tutorial activities, he became a candidate for the Chair of Mathematics in the University of St. Andrews, but he did not succeed. Nevertheless, in that year, he was made an LL.D. of the University of Aberdeen and an M.A. of Cambridge, whilst in the following year the Royal Society of Edinburgh conferred its Fellowship upon

The modern version of the Brewster lens-stereoscope—an instrument which is light, portable, and which folds up when not in use.

him. Brewster evidently had succeeded in making a scientific reputation for himself as a result of his writings and his theorisings.

The ensuing years of Brewster's life were ones of teaching, writing, lecturing and travelling. He journeyed to London not infrequently and made the acquaintance of the leading scientific personalities of the period, including Cavendish, Davy, Carnot, Arago, Charles, Gay-Lussac, Cuvier, and many others.

The Coming of the Kaleidoscope

In 1816 Brewster invented his famous optical device which he called a "kaleidoscope"—from the Greek words, *kalos*, "beautiful," *eidos*, "form" and *skopein*, "to see." The kaleidoscope immediately caused a furore in fashionable circles. Although Brewster patented his device, the legal protection proved quite useless. The patent was infringed far and wide, and it is said that Brewster himself never made a penny out of his invention.

The invention of the kaleidoscope came about as a result of Brewster's studying the polarisation of light by means of successive reflections of light between planes of glass. This work was commenced in 1814, and it was after Brewster had observed the multiple images of a burning candle which was surrounded by mirrors that he hit upon the working principle of his kaleidoscope. By employing a draw-tube and a suitable lens to magnify the reflected images of the kaleidoscope, Brewster brought into being a remarkable toy, and one from which almost infinite amusement and instruction could be obtained. With a kaleidoscope containing merely 24 fragments of glass, it is theoretically possible to obtain thousands of different images from it.

The "kaleidoscope fever" lasted for two or three seasons in London. Then it died away with the approach of other novelties. Nevertheless, while it lasted, hundreds of thousands of kaleidoscopes must have been sold to members of the public, yet, as has been previously mentioned, Brewster himself made nothing out of the temporary rage for his scientific toy.

Continuing his experiments, Brewster discovered the connection between the refractive index of a medium and its light-polarising angle. He found that the phenomenon of "double refraction," whereby two images of the one object are seen through a transparent object placed in front of them, is due to internal strains in the latter.

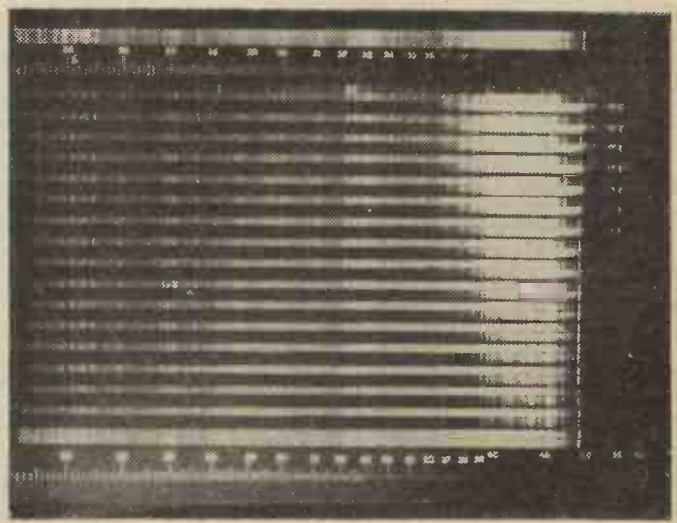
Despite, however, his great enthusiasm for what we now term the "mechanics" of light, Brewster clung literally to Newton's explanation of light, i.e., that it consists of a stream of material or sub-material "corpuscles," and, to the end of his existence, he opposed the "undulatory" theory of light, which explains the various phenomena of light on the assumption that light is a species of wave motion.

Brewster did pioneering work in investigating that not uncommon failing of the eyes whereby a person is unable to distinguish colours or certain sets of colours. It was he who first coined the expression "colour - blindness" to designate such a defect, instead of the previously used high-falutin' *chromato-pseudopsis* (or "false vision of colours") which had been applied to the defect.

Spectroscopic Experiments

In 1882, Brewster conducted experiments on spectroscope analysis. He introduced the method of using salted wicks in spirit lamps for the purpose of obtaining monochromatic (one-coloured) light for spectroscope measurements.

Continuing his experiments, he passed the light through bases, notably the red-coloured "oxides of nitrogen," before it was allowed to enter the spectroscope. Instead of obtaining a normal band of spectrum colours, Brewster found that this band was characteristically interrupted by a series of dark lines, which arrangement of lines varied as the gas through which the light was passed was altered. These dark spectral lines were, therefore, known as *absorption bands*, or *absorption lines*. At a later date they came to be of enormous importance in the development of chemistry and physics. The absorption bands discovered by Brewster have no relationship whatever to the actual colour of the gaseous substance through which the light is passed before entering the spectroscope. Thus "oxides of nitrogen" and bromine vapour have almost the same orange-red colour, yet they give rise to totally different sets of absorption bands in their spectra. Unfortunately Brewster had too many other interests. He failed to concentrate his energies on the intensive investigation of the spectral phenomenon which he had discovered, and, as a result, he missed making many important discoveries in the science of chemistry.



The spectral bands of light which have been passed through a brown solution of bitumen. Note the "absorption bands" or dark lines on each spectral band.

British Association

In 1831 he played a large part in the formation of the present-day British Association for the Advancement of Science, and in the following year (1832) he received the honour of Knighthood at the hands of the then reigning monarch, William IV.

In this latter year, also, was published Sir David's "Letters on Natural Magic," which he addressed to his friend, Sir Walter Scott, the novelist. This curiously written scientific miscellany, a veritable classic in its way, illustrates the abiding interest taken by Brewster in mechanics and invention. It sought to popularise mechanical discovery and the history of inventions. It dealt with the physical discoveries of the ancients, the curiosities of chemistry, and a host of other themes, all of which were addressed to the general reader. "Letters on Natural Magic" makes interesting and curious reading even in these days, and it forms something of a perpetual memorial to the versatility of its author.

The Brewster Stereoscope

Many people have credited Sir David Brewster with the invention of the stereoscope. This, however, is not correct. The principle of "solid vision" was the discovery of one of Brewster's contemporaries, a Londoner, Sir Charles Wheatstone by name, who is nowadays immortalised in the electrical "Wheatstone Bridge" for the resistance-testing of circuits. Wheatstone, however, devised merely a cumbersome form of stereoscope which was based upon principles of mirror reflection. It is to Sir David Brewster that we owe the invention of the present-day "lenticular," or lens form of stereoscope instrument, whereby the eyes view two separate images through two paired lenses which are set apart in a suitable optical frame.

Wheatstone's first "reflecting stereoscope" came out in 1838; Brewster's instrument

(*Continued on page 173.*)

An Improved Striking Mechanism

For Electric, Pendulum, or Synchronous Clocks

By C. T. DRUMMOND

THE accompanying drawing shows the striking mechanism in detail. The notable feature is that it has no wheels or rack.

In order to operate the arrangement it is necessary to have an electric circuit which is continuously momentarily closed.

In the case of a pendulum clock the necessary switch is operated by the pendulum, and in the case of a synchronous motor a switch is mounted to one of the revolving spindles.

Fig. 1 shows a section through a clock in which, for the sake of clarity, only the parts necessary for the understanding of the invention are shown; Fig. 2 is a similar section but with most of the parts removed in order to show the operation of a lever carrying an actuating pawl and a retaining pawl hereinafter referred to; Fig. 3 is a section through the serrated member; Fig. 4 is a view of the pawl-carrying lever with the cover removed; Fig. 5 is an underside view of the cover; Fig. 6 is an elevation of the pawl-carrying lever; Fig. 7 shows the electrical circuit for a pendulum clock.

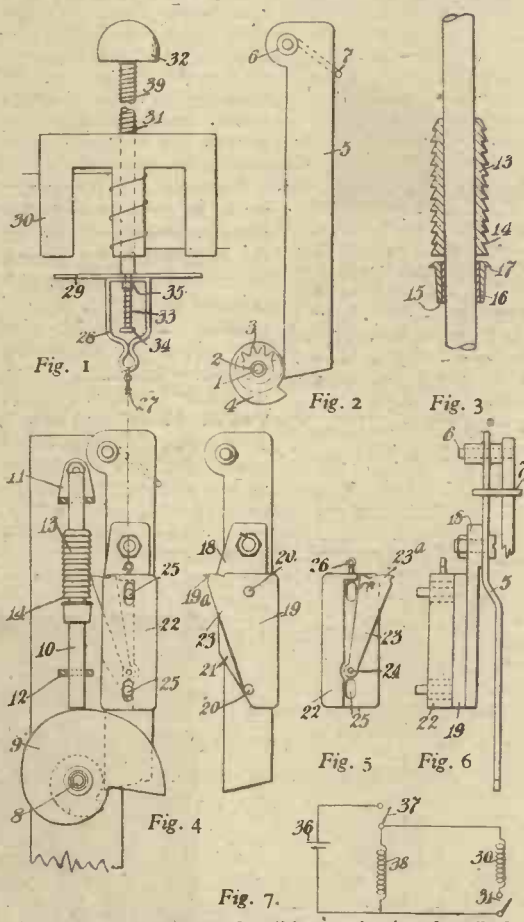
Referring first to Fig. 2, the spindle for the second hand of the clock is shown at 1, the sleeve for the minute hand being indicated by 2. Mounted on the sleeve 2 is the gear wheel 3 which actuates the gearing for rotating the sleeve carrying the hour hand; this gearing and the sleeve carrying the hour hand may be of the usual kind and are not shown. Immediately behind the wheel 3 and rotating with it is a snail, 4, which therefore makes a complete revolution once every hour. Co-operating with this snail is a lever 5 pivoted at 6 to the frame of the clock. A spring, 7, bears upon the lever to cause it to maintain contact with the snail 4.

Referring now to Fig 4, fixed to the sleeve 8 for the hour hand is a snail, 9, and co-operating with this snail is a vertical rod, 10, which is freely supported at the upper end by a bracket, 11, and at the lower end by a bracket of which a part is shown at 12, both brackets being fixed to the frame of the clock. A sleeve, 13, is fixed on the rod 10, the sleeve having a number of circular grooves formed by serrations, 14. Below the sleeve 13 is fixed a sleeve 15 of insulating material (see Fig. 3) and mounted thereon is a metal sleeve, 16, the upper end of which has one serration, 17, which is slightly larger in diameter than the diameter of the other serrations, 14.

The lever 5 has fixed thereto a layer of insulating material, 18, on which is mounted an actuating pawl and a retaining pawl which are thereby insulated from the lever. The retaining pawl is shown at 19 in Fig. 4 and is rigidly fixed to the insulating material 18. This pawl has two pins, 20, and a portion of 21, all three of which project outwardly. A cover, 22, fits over the retaining pawl and this cover is not shown in Fig. 4 for the sake of clarity, but the position which will be occupied by the pawl 23 will be understood when it is remembered that Fig. 5 is an underside view of the cover. The pawl 23 is pivoted on a pin, 24, fixed on the cover. In assembling the arrangement the pawl 23 is placed in position in the cover, as shown in Fig. 5, and the cover is then fitted on the pawl 19. Fig. 1 shows the cover, 22, in position and it will be seen that it is capable of a limited amount of vertical movement by reason of the fact that the pins 20 of the retaining pawl pass through holes 25 of elongated shape in the cover 22. The two pawls cannot be separately distinguished in Fig. 1 since the actuating pawl is immediately above the retaining pawl.

Fixed to the top of the cover 22 is an eyelet, 26, to which is attached one end of a chain, 27. During the striking period this chain is repeatedly raised and lowered as will be more fully explained hereinafter. When the chain is raised the cover 22 is lifted to an extent which is limited when the bottom of the holes, 25, meet the pins, 20.

Prior to the lifting of the cover 22 the retaining pawl 19 will have the point, 19a thereof in one of the grooves between the serrations 14. During the lifting of the cover 22 the actuating pawl 23 will be raised. The actuating pawl rests on the portion 21 with the point 23a thereof situated below the point 19a by a distance equal to half the distance between two serrations 14. As the actuating pawl rises it turns slightly on its pivot 24 and the point 23a moves forward towards the serrations 14 and enters one of the grooves there between and lifts the sleeve 13 and with it the rod 10, one of the serrations meanwhile slipping past the retaining pawl. This is possible since the retaining pawl is mounted on the lever 5 which lever yields by reason of the spring 7. The retaining pawl then again holds the sleeve 13 in position During the lowering of the cover 22 the actuating pawl leaves the groove in the sleeve 13 into which it had entered and descends with the cover but at the next raising of the cover the actuating pawl again lifts the sleeve 13 and another serration is forced past the retaining pawl. On each upward pull of the chain 27, therefore, the rod 10 is lifted by an amount corresponding to one serration on the sleeve 13.



Details of the improved striking mechanism described in the text.

The upper end of the chain 27 is fixed to a wire loop, 28, attached to an armature, 29, operated by an electromagnet, 30. A rod, 31, carried by the armature 29, passes freely through a hole in the electromagnet, the top of the rod carrying a hammer, 32, which is adapted to strike a bell (not shown). The lower end of the rod 31 is reduced in diameter for a short length which passes through a hole in the armature. This portion of the rod is covered by a spring, 33, the lower end of which bears on the flange, 34, at the bottom of the rod and the upper end of which bears on a collar, 35, fixed to the underside of the armature. When the electromagnet is energised the armature is attracted upwardly and the momentum causes the hammer 32 to continue to move for a short distance depending upon the compression of the spring 33 after the movement of the armature 29 is arrested. During such further movement of the hammer it strikes a bell, the position of which is suitably adjusted.

A spiral, 39, is provided around the upper part of the rod 31, the said spring taking the weight of the rod 31 and its associated members, when the armature 29 is in open circuit position. When the electromagnet is energised the spring will assist the initial upward movement of the rod 31. If desired, the spring may be omitted, in which case the rod 31 is supported, when in open circuit position, by a flange provided on the said rod and abutting the upper surface of the electromagnet.

Referring to Fig. 7, the circuit which gives the impulses is shown as comprising a source of power, 36, an intermittently closing switch, 37, the pendulum coil being represented by 38. The eletromagnet 30 is connected as shown and is in series with the contacts 31, which represent the contact made between the actuating and retaining pawls 19 and 23 and the sleeve 13. For this purpose one wire from the elcetromagnet 30 is connected to the metal parts 19, 22 and 23 mounted on insulating material on the lever 5. No wire is necessary from the other contact constituted by the sleeve 13, since this sleeve is earthed to the frame of the clock.

The arrangement operates as follows. The snail 4 is fixed so that shortly before the hour it has moved the lever 5 away such a distance that the retaining pawl 19 no longer supports the rod 10 which then falls by its own weight on to the snail 9. When the hour is reached, the lower end of the lever 5 jumps off the end of the snail 4 and moves to the left as viewed in Fig. 1 or 2 under the pressure of the spring 7. This causes the pawl 19 to contact the sleeve 13 and so complete the electric circuit of the electromagnet 30. The electromagnet then receives continuous voltage impulses. On the

energisation of the electromagnet the armature 29 rises with a sharp action and causes the hammer 32 to hit the bell. At the same time the sleeve 13 is lifted a distance corresponding to one serration. The energisation being only a momentary one the armature 29 then falls but at the next impulse the operation is repeated. Each time the sleeve, and with it the rod 10, is raised by one serration the bell is struck and the time interval between strikes depends on the frequency of the closing of the contacts 37; this frequency is arranged to be suitable for the strikes.

The operation continues until the last serration 17 has been lifted above the retaining pawl 19. This serration is insulated from the rod, as has already been explained, and when this serration is engaged the electric circuit to the electromagnet 30 is completely opened. The rod 10 then remains in its elevated position with the pawl 19 under the serration 17 until the snail 4 again moves the lever 5 a sufficient distance to the right to disengage the pawl and to allow the rod 10 to fall upon the snail 9. This takes place shortly before the next hour when the operation described above is repeated. The distance which the rod 10 will fall each time depends upon the position of the snail 9. This snail is designed so that at each advancing hour the rod falls a greater distance, the increase being equal to the distance between a pair of serrations.

Hourly Striking

In consequence, at each advancing hour the rod is lifted by a further serration and the number of strikes is increased by one each hour. The snail being mounted on the sleeve for the hour hand, it is clear that after the position at which twelve strikes is given, there will only be one strike at the next hour. Since the rod 10 is only allowed to fall shortly before the hour there is no possibility of the rod being fouled by the radial surface of the snail 9 during the period from twelve o'clock to one o'clock.

Science Notes of the Month

New Blast Furnace

A NEW blast furnace was recently put into operation at one of the plants of Bethlehem Steel Company. The new unit, with a capacity of 432,000 net tons a year, will produce about 1,200 tons of pig iron every twenty-four hours, and has a hearth diameter of 27ft. and is 105ft. high.

Jet-propelled Fighter 'Plane

IT was recently revealed by the Air Ministry and the Ministry of Aircraft Production that Britain and the U.S.A. will shortly have in production jet-propelled fighter aircraft. These machines will be powered by the Whittle engine, invented and developed by Group Captain Frank Whittle. Remarkably high speeds have been attained in experimental aircraft, and it is already apparent that when the jet-propulsion system is developed to the same extent as the petrol aero engine, astonishing changes will take place in aircraft performance.

The jet-propelled aeroplane has no airscrew or propeller. Air is drawn in at the nose of the fuselage and then highly compressed, which heats it. The compressed air is then further heated by burning liquid fuel. The heated compressed air is then discharged at high velocity through a nozzle in the tail of the machine. The reaction set up produces the propulsive effort. Jet propulsion eliminates carburation difficulties at high altitudes, and dispenses with much of the complicated mechanism of the ordinary aero engine and airscrew.

Smokeless Fire

IT was revealed recently by Sir Evan Williams, Coal Research Chief, that a new fireplace that consumes its own smoke and uses only half the coal used in an ordinary open fireplace, will be available for all houses, old and new, after the war. The new fireplace will also provide hot-air heating for bedrooms.

Bombing Through Cloud

SCIENTISTS have invented a new method which enables daylight bombing to be done successfully through solid cloud cover. While the bombing accuracy is not equal to that usually attained in high altitude attacks, when the target can be seen, it is satisfactory and gives promise of improvement. The method has already been used on a number of bombing missions recently.

Steel Welded Launch

AN experimental all-steel welded motor launch is being built in a south coast shipyard to the order of the Metropolitan Police. The new boat will look like the familiar 30ft. patrol boats seen on the Thames, but the building method is revolutionary. The deck has been laid first, then the frames and, finally, the keel. During construction the boat is suspended in a revolving framework, which can be quickly turned round so that welders can always be above the work. The new launch will be powered with 80 h.p. Diesel engines, giving 12 knots, as in the present wooden launches, but the saving in weight is estimated to give a higher speed.

Improved Flying Fortress

IT is reported that the offensive and defensive powers of Flying Fortresses and Liberators based in Britain have been increased by various armament modifications.

All Fortresses can now carry extra 1,000lb. bombs on external racks under the wings, and a new chin turret, providing greater angles of fire, is equipped with sufficient ammunition for its two machine-guns to discourage head-on attacks by fighters.

This chin turret, which is electrically operated, is underneath the nose and gives the Fortress four pairs of machine-guns, in addition to the single guns in the nose, the waist, and near the radio operator.

The new Liberator is equipped with two additional power-operated turrets, making four in all. In the nose turret the gunner is protected by half-inch metal armour and 2½in. bullet-proof glass

Jungle-crashing Tractor

WHAT is likely to prove a nightmare to Nazi and Japanese troops in the future is an 18-ton tractor, which has been specially designed for crashing through woods and jungles or over shell-holed countryside at high speed with an anti-aircraft gun and crew in tow.

The new tractor, the M4, carries a crew of 11, is propelled by six-cylinder petrol engines, and has space to store ammunition.

Magnetic Nail Pickers

DURING the last two years the State Highway Authority of Texas has had in use two magnetic nail pickers, which have retrieved over 80 tons of nails, bolts and nuts, and other fragments of iron and steel from roadways during that time. The magnetic pick-up device is suspended from the back of a 1½ ton lorry, the energising current being supplied by a generator driven from a four-cylinder auxiliary engine. These two units are mounted on the lorry and the magnets when in operation are suspended about 4in. from the ground. The lorry travels from five to eight miles an hour, and after the magnets have picked up a quantity of metal, a canvas stretcher is placed beneath them. When the current is switched off the metal pieces fall on the canvas, thus permitting easy removal.

Saving Life at Sea

AN invention which will save many lives at sea is now being fitted in British ships. Launching lifeboats under fire, or in heavy weather, has always been dangerous because of the likelihood of one end of the boat dropping out of control, and throwing the occupants into the sea. The new invention prevents either the fall rope running away and, even if the operator is shot, the lifeboat will not tip up.

A field gun being shipped into an M.E. 323 transport 'plane.

The Story of Chemical Discovery

Plant Hormones

The So-called "Vitamins" of Plant Life. A New Development of Chemical Science

UP to very recent times the view which was universally held concerning the growth of plants was based on the idea that the plant takes all its nourishment from the soil in which it grows, and from the gaseous constituents of the air which pass in and out of its leaves. It was considered that such a nutritional mechanism was responsible solely for the growth and well-being of the living plant.

The modern chemical discovery that there exist certain substances (which have been dubbed "plant vitamins," although they are not vitamins at all) which can be administered in minute doses to a plant and which are capable of exercising a profound influence upon its subsequent growth has caused botanists, plant physiologists, horticulturists and chemists alike to modify their fundamental concepts of plant-growth mechanism. These newly - discovered chemical substances, all of which can be made synthetically, act on the plant in much the same manner as a stimulating and energising drug acts on the human system. So potent are they in nature that they are capable of acting when applied in small amounts merely to the stem of the growing plant. Even, indeed, before the actual plant has made its appearance, the new plant-growth substances or "plant hormones," as they have now come to be called in chemical circles, can be applied to the seeds, with the result that the latter often undergo speedier germination and produce stronger and more rapidly-growing plants.

Plant cuttings being given a dose of a "growth substance" in a laboratory before being planted out in the usual way.

The modern discovery of these plant-growth substances may be said to have originated some 25 years ago in experiments which were then being made on the apparent ease with which a number of externally applied substances were able to enter the leaves of certain selected plants, and to effect substantial changes in the chemical balance or economy of the leaf cells.

At about the same time, also, some experiments were performed on the growth of various yeasts, which, as the reader is perhaps well aware, consist of unicellular or single-cell plants of microscopic dimensions.

The great French chemist and biologist, Louis Pasteur, had done a fair amount of work on the yeasts in the last century and his idea was that, given a sugar solution of the right strength, the right temperature, and one which contained traces of certain mineral salts, yeast cells could be cultivated to any degree.

"Bios"

More refined experiments which were made soon after the beginning of the present century showed that this was not the case. For their proper development, the yeast cells demanded sugar, water, mineral salts and, also, traces of an unknown vitamin-like substance to which the name "bios" (Greek, *bios*, "life") was given.

Then followed years of research with the aim of isolating and discovering the nature of this still hypothetical "bios." The quest was partially ended about 1928 when a number of Canadian workers in the University of Toronto showed that a chemical substance called meso-inositol was identical with at least one of the basic components of bios.

From Canada, the problem went over to Holland, where, in 1932, another constituent of bios was isolated. This was named *biotin*. It was obtained from yeast, and it was proved, also, to exist in egg yolk, but to such a minute extent that the (pre-war) cost of extracting one single gram of biotin from eggs would work out somewhere in the region of £35,000! No wonder, therefore, that biotin has remained an uncommercial commodity.

Without going into the actual chemical composition of bios (which is still the subject of dispute), its major component, biotin, to which the chemical formula $C_{11}H_{18}O_3N_2S$ has been provisionally given, seems to be an almost universally distributed material. It seems to be present in all soils and in all growing plants, and, probably, even in all forms of germ life. From what we can learn about it, this substance appears to be one of the most physiologically active materials known. It is, as it were, an indispensable plant vitamin, a trace material which is essential for the growth and development of any plant, and without which the plant will wither away and die.

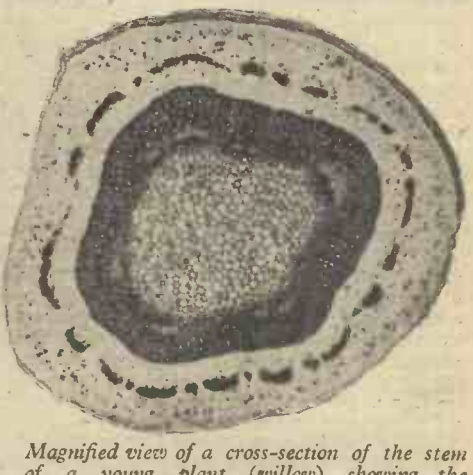
It was during experiments on bios and related subjects that the plant hormones were discovered. These are much simpler things altogether, and their chemical constitutions were quickly worked out, with the result that these interesting and rather remarkable chemicals are now on sale at very reasonable rates.

The Chemical Messenger

A "hormone" has been described as a "chemical messenger." The name was first applied to certain chemicals which are present in the human and in the animal body, and whose function it is to exercise a profound and specific influence upon some particular organ of the body. Hormones are produced in very small quantities by the tissues. After entering the blood-stream they proceed at once to some particular organ and stimulate it to energetic reaction. Hormones are chemical energisers, tonics, stimulants, regulators, their influence in every case being extremely potent and effective.

Now, the new materials which have been discovered in the realm of plant life have similar effects. When applied to the plant, they stimulate it to active growth. If the plant gets too great a dose of a "plant-growth substance" or plant hormone, it rapidly dies, just, also, as an overdose of a body hormone substance would at once kill the animal to which it was given. Plant hormones, similarly to body hormones, are essentially substances which perform their functions in small amounts only. In any large amounts, they act as destroyers rather than as stimulators.

It was the Utrecht school of plant chemists and physiologists which was responsible, a few years ago, for the identification of the several plant hormones which are now known and manufactured. The late Professor Went, of Utrecht, and his son proved conclusively that, under the influence of light, certain trace materials are formed in the leaves of growing plants and that these materials are transmitted to the roots, in which area they excite active growth. It seems, therefore, that one of the functions of plant leaves is to manufacture these "root-growing" materials, without which the plant could not thrive, or even develop.



Magnified view of a cross-section of the stem of a young plant (willow) showing the cellular structure of the stem through which liquids are absorbed and transmitted to other parts of the plant.

Auxins

Exactly how the leaves produce such active materials is very much a chemical mystery at the present time, as is, alas, the chemical mechanism underlying the formation of all other plant products. When the new "growth substances" were first brought to light they were termed "auxins." The

Dutch workers at Utrecht managed to extract from plants a growth substance in a fairly pure form. This they termed "hetero-auxin." It was obtained as a white crystalline substance, which subsequent investigation identified with an organic chemical substance known as beta-indolyl acetic acid, a material which could readily be synthesised.

Quite a number of these plant hormones, growth substances or "auxins" have since been investigated. Curiously enough, the majority of them may all be considered to be derivatives of acetic acid, which latter is well known as the active principle of vinegar.

Besides the above-mentioned β-indolyl acetic acid, there are methyl-β-indolyl acetate, indolyl butyric acid, indolyl propionic acid and naphthalene acetic acid, all of which can readily be manufactured at reasonable cost.

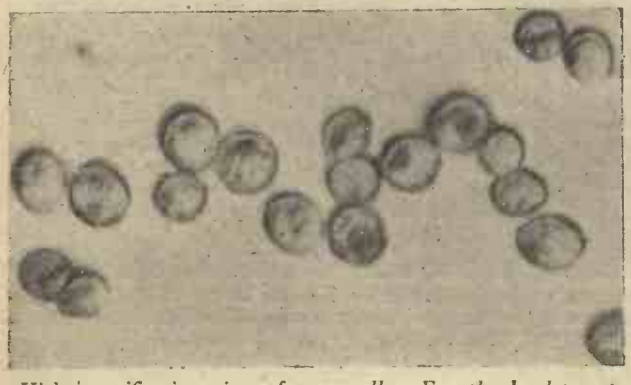
These materials are not very soluble in water. They are, therefore, usually made up in the form of 1 per cent. solutions in pure alcohol, which solutions are diluted with water for use. The actual application strength of these solutions is of the order of 1 in 10,000. Such a dilution is effected by diluting one part of the 1 per cent. alcoholic solution with 100 parts of water.

Plant Treatment

Plant cuttings are allowed to stand in solutions of this dilution for about 12 hours. The depth of the solution in which the cuttings stand should not exceed an inch so that only the lower portions of the cuttings are actually in the solution. If the cuttings are woody, a solution strength of 1 in 20,000 will suffice. This can be provided by adding one teaspoonful of the 1 per cent. alcoholic solution of the plant-hormone to 1¼ pints of water.

After the foregoing solution treatment, the plant cuttings are planted in the normal way. It will be found that all such cuttings "come on" with great rapidity and that they provide stronger plants than the untreated cuttings.

It must be borne in mind that these plant hormones or growth substances are *not* plant-fertilisers. Any attempt to increase the dose or higher the solution strength will result in the death of the plant just as much as an attempt to inject more than a certain maximum minute amount of strychnine into the blood-stream of a man suffering from a relaxed system would at once bring about the death of the patient.



High magnification view of yeast cells. For the development of these a minimum trace-amount of "bios" is considered to be necessary.

Certain of the synthetic plant-growth substances have been made up in the form of lanolin pastes and applied to the stem of the growing plant in this condition. Notably, β-indolyl acetic acid has been made up as a 1 per cent. lanolin paste (that is to say 1 part of the acid in 99 parts of lanolin). Applied sparingly to the plant stems, these pastes are productive of more vigorous root development which, of course, is manifested by the speedier growth and the enhanced well-being and general robustness of the plant.

Such, in brief, is the present-day technique of plant hormone application as it has been worked out by plant chemists and horticulturists. For all practical purposes, β-indolyl acetic acid is about the most potent of the plant hormones, although naphthalene acetic acid is a close runner-up to it. These growth substances not only energise and speed up a plant's development but they also give it an added protection against disease, although, in this respect, it is more than likely that the disease protection is the result of stronger rooting of the plant rather than of any direct influence of the growth substance.

Manurial Action

It has previously been stressed that these growth substances are not fertilisers or manures. Thus the continual watering of a plant with a highly dilute solution of a growth substance such as β-indolyl acetic acid will result in the withering and death of the plant. Despite this fact, however, it is possible and, indeed, very probable that growth substances (many of them, perhaps, of a yet unknown nature) are present in natural manures and that, in this manner, the plant is stimulated by the manurial treatment.

In face of the admitted efficiency and acknowledged convenience of the present-day artificial fertilisers, many experienced farmers have long insisted that, for many purposes, natural manuring of land gives results which cannot be achieved by artificial fertilisers, no matter how carefully the latter may be chemically "balanced" so as to impart the correct nutritive elements to the soil. Good farmyard manure is claimed by multitudes of plant culturists, professional and amateur alike, to be superior in plant-growing properties to soil treatment with "artificials."

One school of chemical thought attributes this superiority to the presence of "bios" in the natural manures. It seems quite likely that such is the case, but the practical proof of this suggestion is still wanting.

Animal Hormones

On the other hand, it has very recently been shown that certain animal hormones which are responsible for the effective breeding of live-stock are partially excreted in the urine of farm animals. These animal hormones, whilst being unsimilar in chemical composition to the plant hormones of the indolyl acetic acid type, are, nevertheless, similar to the latter in their growth productivity. The effect of farmyard manures of known hormone content upon plant growth has been carefully tested and it has definitely been shown that these animal-derived trace-materials do, in actual fact, act as energisers and growth stimulants to the plants. The inference, therefore, seems to be that a portion of the beneficial effect of natural manurial material upon plant and crop growth is to be ascribed to the presence in such material of plant growth substances which are related in some way to the nowadays well-recognised hormones of the animal body. The whole matter, however, has, as yet, by no means been worked out fully. Indeed, the subject may yet be said to be in its infancy. Nevertheless, the clear connection or relationship between the reproductive faculties of the animal and the growth of the plant is truly remarkable. It would, indeed, appear that this relationship constitutes one of Nature's provisions to ensure the multiplication of food plants being effected in consonance with the increase in the number of animals in any one area of pasture land.

A magnified view of the component cells of a green leaf. By the action of light, each cell is able to synthesise minute amounts of growth substances which are carried down to the plant roots in order to aid the development of the plant.

The means by which the various plant growth substances exert their powerful and characteristic action is forming the subject of the investigations of a number of plant chemists and physiologists. The prevailing theory is that these relatively simple plant growth compounds (speaking from a point of view of structural chemistry) are readily able to penetrate the plant tissue at all points and that, having been absorbed into the plant cells, they set up some abstruse chemical action within the plant cells, which action results in the increased activity of the plant-growth mechanism as a whole.

No Explanation

Such an explanation may not appear very satisfactory to the reader. Indeed, it is a far from satisfactory explanation. Yet it is the only one possible at the present juncture. The whole basis of plant hormone action is on a par with the action of the hormones of our own bodies. It is hormone activity which gives to a man much increased strength and muscular power in moments of danger. In such moments, a chemical hormone is suddenly secreted into the blood stream solely for the purpose of effecting its intensely potent energising action in the emergency of the moment.

The question arises as to whether the plant growth substances are necessary for the spread and development of bacteria, which latter are, after all, merely single-cell plants. If such is found to be the case, it may be possible to work out a method of over-dosing bacteria with these newly-discovered substances and, in this manner, annihilating them.

Inventions of Interest

By "Dynamo"

Lifebuoy de Luxe

THE latest thing in lifebuoys is visible in the offing. An application for a patent for yet another equipment of this description has been accepted by the British Patent Office.

The new device consists of a sea rescue suit. The inventor has borne in mind the fact that persons compelled to use life-saving equipment in a cold sea, though they keep their heads above water, may die from exposure.

Not only does this suit enable the wearer to float, but it also imparts warmth for an indefinite period irrespective of whether the sea be smooth or rough.

The garment comprises a hood, a trunk with arms, and trousers, all composed of a flexible waterproof material. With the possible exception of the face, hands and feet, it completely envelops the wearer in a practically watertight rig-out. Boots and socks may be added.

When one lies in the water, there are one or more buoyant pillows which underlie the nape of the neck and, if desired, a part of the shoulders.

Likewise there are panels of the same kind which overlie the chest and extend down to a point near the abdomen. And, in addition, cork blocks are situated in the neighbourhood of the knees.

Floating in Comfort

THE pillows and panels above-mentioned are incorporated permanently or detachably with the suit. They are of such a form and size that, when the wearer is in the water, they automatically place and maintain him in a semi-lying position with his head and chest well out of the water, the face and chest being directed upwards and to a slight degree forward.

Not only is this outfit buoyant, but its pillows and panels are heat-retaining. They consist of watertight envelopes packed, at least with respect to part of their interior, with kapok, wool or feathers.

The suit may further include a warm lining or external covering which is buoyant as well as heat-conserving.

The garment is of an accommodating nature. When the wearer is not in the water, it can be used as an ordinary weather or waterproof suit. Sufficiently light, it enables one to wear it while doing not too heavy work. In such circumstances, however, the hood would be removed, the gloves would be doffed and the arms open at the wrist.

Attic Garden

THE brave new world promised after the war is to include ideal houses. For some years garden cities have flourished in our country; now there is visualised residences surmounted as well as surrounded by gardens. If an invention submitted to the British Patent Office materialises, our future abodes may be crowned by pocket editions of the Garden of Eden.

The inventor has designed a house—it may be a villa, bungalow or mansion—and he proposes to utilise profitably the previously wasted space and heat.

The invention consists in increasing the normal height of the attic and substituting a roof of glass for the customary one of tiles, or slates. Beneath this roof is a practically airtight space fitted to catch all the sunlight possible. This space can be heated from the rooms below by way of flues passing through the attic, and these flues are furnished with metal plates in order to utilise the waste heat to a maximum degree. Consequently, the formerly idle attic can be employed for horticultural purposes.

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

The attic will also be fitted with a waterproof floor to act as a foundation for beds of earth. The floor will slope in a manner which will allow the waste water to be drained off through trapped gulleys. There is likewise an arrangement whereby the attic can be maintained at the same or any desired temperature throughout the year. As a result, it will be possible to grow all kinds of vegetables and flowers.

By means of this attic garden, the designer is sufficiently sanguine to hope that not only may there be grown enough vegetables to meet the needs of the occupier, but that there will be a surplus which he believes could readily be disposed of.

Further, he contemplates an estate built up with these houses so that it would be possible, out of the proceeds obtained by growing the vegetables and flowers, to employ one or more gardeners periodically to visit the attic greenhouses. This would relieve the householder, who might not have time to devote the necessary attention to his elevated garden.

Good Soles

FOOTWEAR again figures in a device submitted to the British Patent Office. In this case the applicant for a patent is of opinion that, generally speaking, the forepart of the sole is subject to wear. Consequently, he holds that this portion of the shoe should be of leather of superior quality.

It appears that proposals have already been made for the manufacture of soles in two parts, the front part being made of leather of good wearing quality, while the waist and heel are made with less expensive material.

The principal object of the new invention is to provide an improved method of forming a joint between the two parts.

The device comprises the making upon these two parts complementary bevelled surfaces and a permanent joint between the surfaces by means of adhesive substance and of hollowed rivets.

The joined parts are positioned for rounding to the final shape by means which engage the hollowed portions of the rivets.

Cushion Comfort

FOR cushions and the backs of seats in road vehicles it appears that sponge rubber has been largely used. To a less degree it has also been employed for the cushions of theatre seats.

Such a substance possesses advantageous qualities, since, through a long period, it retains its moulded shape.

Ordinary upholstery fillings are not suitable as substitutes for rubber in the uses mentioned above, because the filling moves about and has an annoying tendency to work downwards to the bottom of the case.

To improve upon previous seat-cushioning, an inventor has devised a substitute for sponge rubber, which keeps its place after use.

His device consists of an open weave interlaced spiral wire mesh. This is cut or fashioned to the shape of the cushion and is placed as a resilient foundation in a case. The case is stuffed on each side of the foundation with appropriate upholstery filling material anchored by its engagement in the interstices of the foundation.

At a Ministry of Supply experimental station in the South of England all types of wheeled Army vehicles are put through severe tests before being passed for service. The illustration shows a tank transporter being tested over a specially pot-holed road.

Making a Success of Your Photography

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

I BELIEVE I am correct in saying that everyone has a liking for animals. With some it is something more than liking, especially when the animals are pets, or are included in the class recognised as "domestic" animals such as dogs, cats and horses; and one has only to look through the entries in a photographic competition to realise that amateur photographers can certainly be considered generally as animal lovers. Let us therefore turn our thoughts to the subject of animal studies this month.

I have known of some professional photographers who specialise in the "portraiture" of dogs, and I have always been very greatly impressed when examining some of their results, and wondered how they have managed to get such fine poses. Some of the results may have been taken in a studio, with its variety of lighting effects and backgrounds, but most are in the natural surroundings of gardens or fields, and therefore the animals are more "at home" and ready to respond to the artifices of the camerist. It is this "at homeness" which really produces the natural expressions that are so much admired in good dog studies.

There is another important point requiring consideration when you examine with a critical eye a clever animal study; you might be inclined to remark: "What a happy snap," or "How lucky to get him looking like that." The photographer may have spent an hour or two coaxing and persuading the animal to get into position and to assume a natural expression. To be successful with animals you must have patience, which is your most valuable asset.

If you have a Collie, Setter, Terrier or any other dog, and you are anxious to get a good picture of him, try this plan. Take him into a field and after a little time sit yourself down in a suitable spot where there are no heavy trees; if possible, select the top of a hill where you can make the sky your background, and perhaps have the advantage of a small group of clouds. Give the dog a little dressing with a comb or brush, and set your camera to take a "close-up." While you are doing this he will perhaps be nosing about or resting close by you waiting for you to move. Do not hurry matters but wait till he is at the right distance and is recorded in the view finder; then suddenly give him one of those familiar calls as "Cats" or "Find it." You know what will happen, he will jump to attention with head erect, his whole body showing expectancy. Now is your time to click the camera. A few such attempts and success is sure to come your way.

Patience must also be used when on your rambles you come across a handsome horse. You have got to make him feel you are a friend; a little coaxing is necessary and while doing this you have also to make up your mind what sort of picture you desire. Is it to be a head and shoulders or full length? Set your camera ready and wait for the moment when the head is well above the shoulders or line of the back.

Zoo Subjects

Let us now go farther afield for our animal studies and pay a visit to a zoo. Choose a fine sunny day and, if possible, go early before too many visitors arrive. On a fine day the lions, tigers and similar creatures will be in the open air cages, and you should note the position of these, and also where the lighting will be about an hour before "feeding time." Usually the animals are fairly active then, watching and waiting for the attendant to bring their meal. If you can get a word with the man in charge he may permit you to place your camera near the bars of the cage, but do not put your hands too close; remember these animals have nasty tempers at times and can spring quite suddenly at the bars and put their paws through. Therefore, hold the camera so that the lens is pointing between the bars and you are at least a foot away. Bars and wire meshing are a nuisance to the photographer, but very necessary to safeguard the public.

The Polar bears are always a great attraction, and it is my impression that they know a camera as soon as they see one, for they appear to be always ready to pose, usually in a begging attitude; but wait your time, and patience will make it worth while and you will get the snap you want eventually.

Elephants, camels, llamas on a fine day are employed in giving rides to countless children, and as such offer a different type of subject. It is possible, however, to get shots at these animals before they leave their houses, and a request of their keepers may give you the opportunity of a good study.

You should make a point of securing a good front position for the feeding of the sea lions, much more interesting than the feeding of the tigers, lions, etc.; if you are near enough to any one of the sea lions to snap it just as it is catching a fish from the keeper you will have a good shot. To ensure this, try to gauge the distance from your camera to the beast, and see that it is in the viewfinder; then keep your eye fixed on the keeper so as to watch the fish leaving his hand.

Now at this point I want to give you a few details of technical interest; during the last two or three years I have always had Selo HP.3 films in my camera, and have found them excellent for the variety of work one gets in a zoo. Most subjects require fast exposures, and when the light is good I set my shutter to 1-100th and for open-air animals use either F11 or F16 if very bright; for the indoor work such as monkeys, birds, etc., then I can open out with any stop from F3.5 if the subjects are quick-moving ones, or the shed is very poorly lighted, but I have found that with F6.8 and 1-50th second I have managed to get good results. If, however, your camera only works at F8 and 1-50th, I think you can be successful if the light is good.

For the photographs of dogs, as mentioned earlier, make the exposure as short as you can, that is, set the shutter at its fastest time and use a large stop if dull, or a smaller one if the sun is shining.

Always, when taking animals, you should aim at getting them in as natural a position as possible. I know the act of sleeping is natural, but a photograph of a lion with its eyes fixed on some object in the distance will give you a much more natural picture of a lion.

The penguins will stand and pose for you, but do not shoot until they are just making an attempt at walking. The eagles and owls are usually playing shut-eye, but if you wait they can be caught in the more natural expression with eyes and body alert.

There is another type of bird which may appeal to you. I refer to the ostrich, flamingo and peacock; I cannot claim to having been very successful with these myself, but no doubt good results are obtainable, and I would suggest that the main feature you should aim for is to try to record the proud, almost disdainful air which these creatures assume so naturally.

Many of you may have had the experience of stalking the deer in some of our English parks, and therefore will appreciate how seldom you can get close enough to get something that is worth calling a study. At a zoo, however, the animals have very little room to wander far, and are generally very ready to accept a biscuit from your hand. With such facilities it should be easy for you to get a first-class result, either head and shoulders or full length; if there are several deer in the pen you should focus your attention and your camera on one only and wait for it to separate from the others of the herd.

A good snap of a bear.

When taking close-ups your camera will automatically only register in sharp detail the objects within a few feet; the remainder will be diffused, and this is at times a very great advantage. Sometimes the houses, dens, pits or other places in which the animals live are not in the least pictorial, and therefore tend to spoil what might otherwise be a good all-round picture. Should you have negatives where this fault is particularly noticeable, you can, to a certain extent, overcome it, when making your prints, by shading or vignetting as much of the background as possible, or, alternatively, by using a coating of matt varnish on the back of the negative and retouching out with a stump and charcoal powder all parts of the image which have to be subdued, then removing the varnish, with a spot of turpentine, from the image of the animal or bird. Before attempting this work on a good negative make a few experiments on some others. A little practice is necessary.

Keeping Out the Frost

Necessary Precautions to be Taken to Protect Pipes and Boilers Against Damage by Frost

By JACK HOAR

NOW and during the next month or two our homes may be visited by a most unwelcome and insidious natural enemy, frost, which plays havoc with our water supplies and pipes, the danger of which, I am sure, is not fully known to the majority of house occupiers.

Pipes that burst through frost, and boilers, that lie snugly behind a roasting fire, that may burst and do considerable damage to property and persons through frost being at work at some distance from the fire, are dangers that should be given more thought than they are by the majority of building men and house occupiers. I will explain some most interesting and probably little known facts as to how frosts, or English low temperatures, work, how they freeze, what they do, and how they can be combated with a little care and trouble, to save inconvenience, damage and danger.

Let me explain what frost does to water; how water at first shrivels under the first attack of low temperatures, and then, as it nears freezing, how it begins to puff itself out and *expand*, and *not contract* with cold.

Expansion and Contraction

It may be thought that water, like other liquids, expands when the temperature is raised, and contracts when the temperature is lowered, and the thoughtful person often wonders why a pipe will burst when, according to common logic, the colder a thing is the more it should contract. Water does expand and contract like other liquids, but this applies only when the temperature is above 39 deg. Fahrenheit, that is, 7 deg. above freezing point, and at lower temperatures water possesses the peculiar nature of *expanding* with cold, and this expansion continues until freezing point, 32 deg. Fahrenheit, is attained, when it is converted into ice.

This peculiar expansion is considerable, as in cooling from 39 deg. to 32 deg. Fahrenheit, when it becomes ice, water will expand quite considerably. As an example of this, it would be possible to practise a little scientific conjuring by exactly filling nine half-pint glasses with water at 39 deg. Fahrenheit, emptying those nine glasses into a container, taking the container outside where it is freezing, and, when the water is just above 32 deg. Fahrenheit, it could be emptied into and would fill, not nine, but about ten, half-pint glasses. Another proof of the damaging power of water when it is near to freezing point is to fill a glass bottle having a screw stopper with water which is a degree or so above 39 deg. Fahrenheit, and then to place it outside the house where it is freezing and note the effect. The bottle will burst before the water in it freezes.

Another fact which aggravates the matter and increases the liability of pipes to burst, is that the metal of which pipes and boilers are made *contracts* with a lowering temperature, whereas the water, as before explained, expands. Therefore, the metal is tightening its grip on the water, and the water is increasing its bulk, and, if it cannot escape, something has to go, and the metal inevitably has to yield to the strain, and bursts or cracks.

In the types of houses in which the majority of us dwell, there are pipes that contain cold and hot water, and both the cold and hot water can, under certain circumstances which I will explain, be locked in, or be free to escape. This also applies to boilers, tanks, and other containers of water. When water that is likely to boil and produce steam which cannot escape, serious consequences are likely to result, and there is no doubt that, when a severe frost is prevalent, the danger is indeed great.

Because of these reasons it behoves every occupier of a house to thoroughly master his water system and protect his interests in the manner explained below.

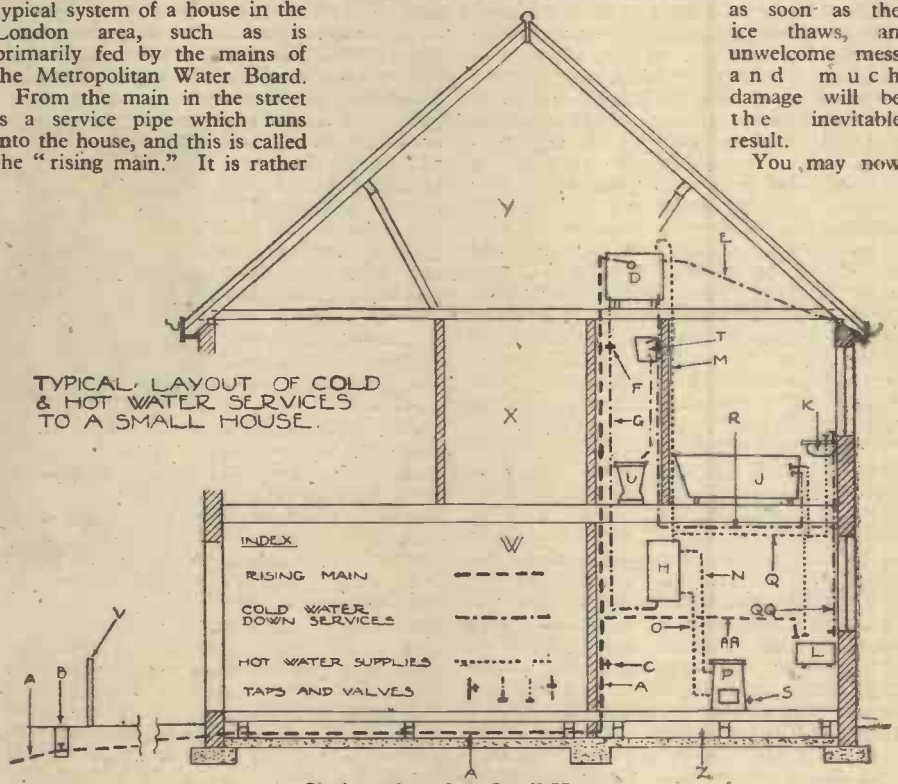
Domestic Water Systems

Let us first study the principles of the water system of the ordinary house as illustrated—they are not difficult to understand—and much interest can be gained by following the various pipes and fittings, and making a simple diagram of them. I will explain a typical system of a house in the London area, such as is primarily fed by the mains of the Metropolitan Water Board.

From the main in the street is a service pipe which runs into the house, and this is called the "rising main." It is rather jealously guarded by the Water Board. This pipe runs underground to the building and up the inside of the building to the cold water cistern, which is usually placed in the roof. The only branch from this pipe that is allowed is one to feed the drinking-water tap over the kitchen sink. No others are allowed. Some water companies outside the London area allow a branch to be taken to a water closet on the ground floor. Under the pavement is a stop valve on the main which regulates the supply of water to the house. There is another stop valve inside the house which opens or shuts the supply to the cistern and drinking-water tap. The water enters the cold water cistern through a ball valve; when the cistern is full the ball of the valve, by floating on the high-level water, closes the valve, and when the cistern empties it falls with the falling water level and opens the valve.

Before dealing with the other pipes in the house I will explain what to do during frosty weather to protect the rising main. It will be readily understood that, if the stop-valve under the pavement, or that inside the house, is closed, and the drinking-water tap is closed, and the cistern is full, and therefore the ball valve is closed, the most dangerous conditions result by all the water in the pipes being quite locked in, and that when the water expands something must go. The lead pipes will bulge, if they do not burst, but probably they will crack and leak and/or, as soon as the ice thaws, an unwelcome mess and much damage will be the inevitable result.

You may now ask how this is to be prevented. Firstly, prevent the water in any of the pipes being locked in, and so allow it to escape when it commences to expand. By doing this the majority of the trouble that may ensue is avoided. Such prevention is ensured by shutting down the stop valve in the pavement and opening the drinking-water tap that is fed from the rising main. No water will come from this open tap, but as soon as any water in the rising main begins to expand it will find an outlet through the tap. There is a chance that isolated sections of the rising main may become frozen and lock in water between such sections, but you must take your chance with this, and be comforted with



Section Through a Small House.

A—Rising main from water main in street. AA—Branch off rising main to sink (water for drinking purposes). B—Stop-valve under pavement. C—Stop-valve inside house. D—Cold water cistern with ball-valve. E—Overflow. F—Stop-valve on cold supply and hot-water tank. G—Cold supply and hot water tank. H—Hot water tank. J—Bath. K—Lavatory basin. L—Kitchen sink. M—Expansion pipe leading from hot water tank to and turned over top of cold water cistern. N—Flow pipe. O—Return pipe. P—Boiler. Q—Hot water branch taken off expansion pipe to feed bath, lavatory basin and sink. QQ—Sometimes this cold supply is omitted. R—Cold water supply feeding bath, lavatory basin and sometimes sink. S—Draw-off tap on boiler. T—Water waste preventer. U—W.C. V—Fence. W—Ground Storey. X—First storey. Y—Roof space. Z—Ground floor.

the knowledge that you have done your best to prevent damage.

Cold Water Cistern

I will now deal with the cold water cistern, which is usually situated in the roof and readily subject to attack of frost. It is seldom that the cistern will fracture under freezing conditions, as the sides of the tank will bulge under any pressure, but it is very essential to guard it, as it feeds many taps in the house and also the hot-water system.

Unfortunately, the cistern is usually placed nakedly in the roof without any insulating covers, and those of you who value your house should protect naked cisterns with a proper casing of boarding placed 2in. away from the side of the tank, packing the space between the boarding and the tank with sawdust or slag wool. The top of the tank should have a boarded cover, preferably of two thicknesses of board, with hair felt between them. This method of protection will prevent, for a considerable time, the water in the cistern becoming frozen, which is essential, otherwise the ball valve will stick in the ice at the top of the cistern, and it will be found difficult to regulate water into the cistern. There will be either no flow or water will flood, with dire consequences. The only effective way to prevent trouble is to drain the water out of the cistern when the external temperature is low.

Provided that the main supply into the house is shut down by means of the stop valve which I mentioned before, it is quite an easy matter to drain the cold-water cistern by simply turning on the cold-water tap that feeds the lavatory basin or bath—preferably the bath, as a store of water may be kept in it for use should the frosty weather continue for some time, and it be impossible to get water through the mains. It may be stated that the water companies do not favour waste of water, so care should be exercised.

The general principle of the cold-water pipes that lead from the cistern to the various points in the house is as follows: There is usually a pipe, known as the "down service," which is connected to the cold water cistern, and serves cold water to the lavatory basin, bath, water closet, and sometimes the kitchen sink, in addition to the cold drinking supply that is taken directly off the rising main. In good class work there should be a stop valve on the down service, near the cistern, to allow the service to be closed down in the event of repairs being necessary. During very cold weather these pipes, as well as the cistern, can be emptied, possibly with the exception of small lengths, by turning on all the taps to bath, lavatory basin, etc., and emptying the water waste preventer in the water closet. Of course, before the taps are turned on, the main supply to the house must be turned off, otherwise the taps would run interminably.

Hot Water System

With regard to the hot-water installation, it must be borne in mind that if this is not cared for during frosty weather it may cause serious damage to person and property. On the one hand ice may choke one of the feed pipes, and a fire in the boiler may create steam which cannot escape—unless there is a safety valve on the system—and an explosion may result. It is quite simple to understand the ordinary hot water installation of an ordinary house. It consists of a cold-water feed pipe from the cold-water cistern to the hot-water tank, which is usually placed in a linen or other cupboard. From near the bottom of the hot-water tank is a pipe, called "the return," which goes to the boiler and conveys the lowest temperatured water from the tank to the boiler, in which it is heated. From the boiler is another pipe, called "the flow," which conveys the heated water to the top of the hot-water tank. When the boiler fire is going the water in the flow and return pipes is continually circulating, and the water in the tank is raised to a high temperature. From the hot-water tank are taken branches or loops to feed the hot-water taps to lavatory basin, bath and kitchen sink. Also from the top of the hot-water tank, or from the highest point of the hot-water branch or loop, is run a most important pipe, known as "the expansion pipe," which ends over the cold water cistern. This expansion pipe is often a continuation of the loop that feeds the basin, bath, etc. The object of this pipe is that should the hot-water system absolutely boil there would be a safe outlet for water and steam.

The reader may naturally be wondering as to the danger of keeping a fire going in a boiler during a severe frost. Whenever the temperature is so low as to make it prudent to drain down the cold down service, then do not put any more fuel on the boiler fire, but let it slowly die, and do not kindle the fire until it is safe to turn on the water into the house. There is no need to speedily rake out the fire, as it is advantageous to keep the water in the boiler and pipes and tank as hot as possible; provided it does not boil. I may mention that, provided the expansion pipe, which is usually in the cold roof, is not blocked by ice, it is usually quite safe to keep a very small fire in the boiler, but if this is done hot water should not be drawn. The water in the hot-water tank should not be allowed to get too hot, and certainly not be allowed to boil, and when either of these conditions are evident the fire should be damped down or drawn.

Final Precaution

Before concluding, here are a few particulars as to the temperatures when action should be taken to protect your home against frost, and to make your house as immune as possible I want you to help yourselves by making a little interesting experiment. In the early morning when it is cold, place a Fahrenheit thermometer outside the house in the coldest and windiest position. Leave it for half an hour, and then make a note of the temperature. Then place it in the coldest part of the inside of your house, preferably the roof, leave it for half an hour and again make a note of the temperature. The taking of these temperatures must be done in the morning when the cold is usually most severe inside and outside the house. The difference in the readings is the difference between the temperature inside the house and outside the house, and you are in possession of very reliable information that will guide you as to what to do in the case of a visitation by Jack Frost. You will readily understand that it is the internal temperature that does the most damage to your pipes and fittings, and the lowest internal temperature will usually be found in the roof, in which are situated pipes and the cistern.

As the pipes in the roof usually do not contain locked-in water, it is safe to assume that no damage can be done until the temperature is near to 32 degrees, but to be on the safe side I will place it as 35 degrees.

The final action is now quite simple. Late in the evening take the external temperature, add to it the difference previously found in the morning between the external and internal temperature and, if the result is more than 35 degrees, then go to bed and do not worry about frost bursts. If it is 35 degrees or lower, then shut off the main supply and drain the down service by turning on all cold-water taps. Let me give an example. If the recorded difference between the external and internal temperature is 10 degrees, and the temperature reading at night, outside your house, is 30 degrees, that is two degrees below freezing, then the internal temperature is about 40 degrees, and no trouble by freezing is likely to result.

Leave the hot-water system until the morrow, and, should the low temperature still then prevail, do not light the fire, or, if you do, then only a very low one for that day only. If the frost is continuous for more than two days it is advisable not to light a fire in the boiler, and to drain the hot-water pipes by turning on all the hot-water taps and also the one that should be at or near the base of the boiler. Keep your house very warm by means of the ordinary fires.

Mobile Repair Van

The interior of a Ministry of War Transport Mobile Repair Van, showing an operator at work on the oxy-acetylene welding plant.

A 12ft. scale model of the Inglis Bridge.

THE WORLD OF MODELS

Scale Models for Training Purposes

By "MOTILUS"

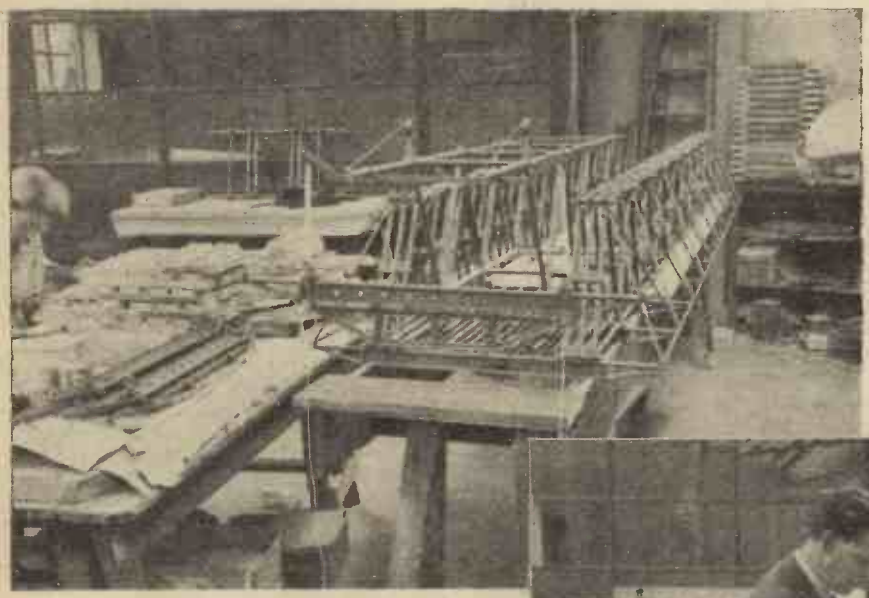
YOUR Editor—knowing the great use that has been made of models by the Army, Navy and Air Force in this war, and realising the interest that has been shown by the public in the photographic details of models made, and directly used, for the planning of campaigns—has suggested to me that I tell you about some of these.

Models have been found invaluable in connection with the development of new ideas and inventions, but there is also an enormous demand for them for training purposes, and of these I think the one that would perhaps interest you most is the famous Inglis Bridge, designed by Prof. C. E. Inglis, O.B.E., M.A., LL.D., F.R.S., of Cambridge University. This has been "off" the secrets list for some time now, and you may have seen the full-size section which was shown at the Army Exhibition held in Oxford Street, London, during last summer.

A 12ft. Model

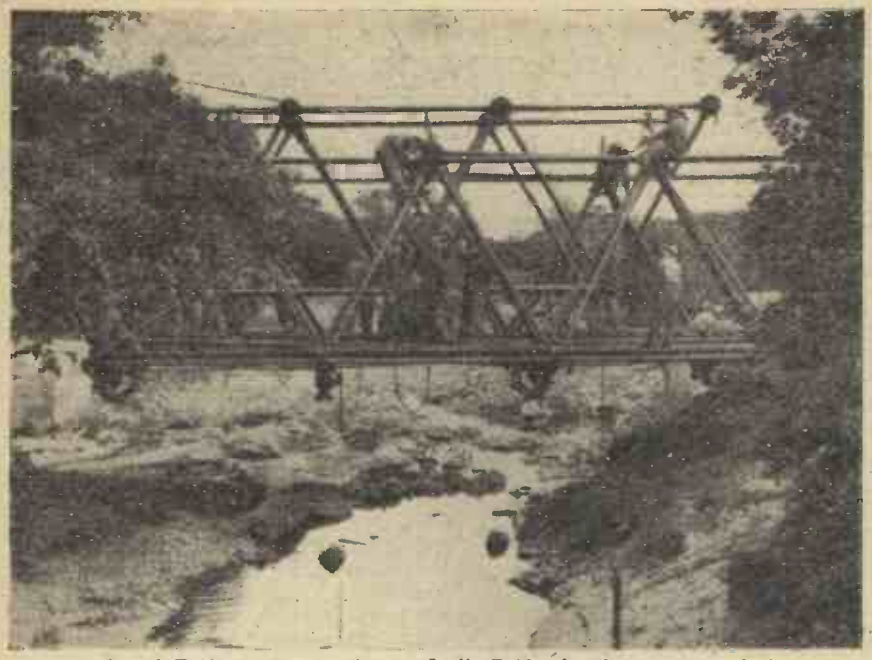
In connection with the training of Royal Engineers in the construction of this bridge it was decided to introduce models in an attempt to overcome certain disadvantages noticeable when training with the actual bridge, i.e., a man could only concentrate on one operation at a time, which made it difficult for the instructor to present a complete picture of every operation *and* give practical explanations as the work progressed. This will be understood when I say that the full-size members of the bridge are steel sections weighing many tons. A large number of complete sets of parts for building a model of a 120ft. span bridge were made to a scale of 1/10th full size. The tubing, girder sections (known as transoms) and joints, or junction boxes, were of non-ferrous metal and the platforms of hard wood. When constructed, the model bridge, 12ft. in length, was identical in every detail to its prototype, but had the following definite advantages for training purposes: Firstly, it could be built up indoors, which made it possible for the instructor to be in close contact with the work, and also for the whole of the bridge to be comprehended at a glance. Secondly, it could be constructed in a much shorter time, thus cutting down the necessary training period—always an important consideration.

Many of my readers are probably in the Army—maybe the Royal Engineers—in which case they know too well all there is to know about this bridge! But for the benefit of those to whom the Inglis Bridge is little more than a name I will tell you of a few of its features.



(Above) The model bridge partly completed, showing the erection gantry lowering a transom into position.

(Right) The finished model with the centre platform and sidewalks in position.



Royal Engineers constructing an Inglis Bridge by the gantry method.

Prefabricated Construction

The official general description reads: "The Inglis Bridge, Mk. III, has been designed to meet the need for a bridge that can be easily transported, rapidly erected and launched, and be capable of carrying any military load over spans ranging from 36 to 192ft." Its simplicity is its most striking feature. Constructed of prefabricated tubes and joint boxes, it can almost be compared with a boy's engineering constructional set; in fact, it is claimed that it can be built as simply. Personally I haven't always found these so simple, but still!

There are two methods of constructing the bridge: (1) building straight out over the gap as a cantilever, or (2) erecting on a trolley alongside the gap, and swinging into position or rolling forward. The former is the more universally used, but the latter, for which a long, clear bank is essential, is adopted when time is an important factor, as it is a slightly quicker method.

You will see from the illustrations that the sides of the bridge consist of a series of equilateral triangles, each side of which is 12ft. long. One of these triangles on each end of two transoms, each 15ft. long, forms a "bay." The simplest construction of the bridge is as a "single tube," i.e., with only one set of triangles on each side of the bay, but, for strengthening and permanency, a second, or even a third, set of triangles can be added. The photographs of the model show the treble tubing, and it will also be noted from these that the transoms can be extended and a lateral bracing—known as the knee-bracing—added. This forms a wind resistance, and also allows of a foot walk, which is a definite asset as it leaves the centre platform free for road traffic.

To Take Heavy Armour

Although originally intended for only light traffic, and infantry, this bridge has been developed to such an extent that it is now able to take heavy armour, which has played such an important part in this present war.

I hope, from time to time, to describe in these pages other models that have been made for the Services, and thus bring to your notice the important part that model makers have played in the war effort.

Solutions to Probes and Problems

(*See page* 158)

The Duchess's Diamonds

Thug stole the diamonds.

Husbands and Wives

Sarah Smith, Mary Jones, Jane Robinson.

Dummkopf's Code

The clue is given in the phrase, "get to the root of it."

The figures form a series of square numbers, 121, 1, 169, 25, 324, 1 and 16. We "get to the root" of the problem by taking the square root of each number, thus arriving at the series, 11, 1, 13, 5, 18, 1 and 4. Substituting letters for numbers gives the word KAMERAD, Dummkopf's password for to-night.

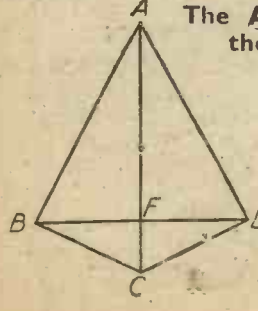
Will This Bowl You Out?

In the entire season Stonewall completed 5 innings. Before the last match Battersby had played 14, scoring 434, average 31. Stonewall had played 4, scoring 124, average 31. After the last match Battersby had played 15, scoring 435, average 29. Stonewall had played 5, scoring 125, average 25.

Menagerie Mix-up

1, Lion; 2, Bear; 3, Tiger; 4, Ape; 5, Camel.

The Astrologer and the Pyramid



The astrologer's shortest route was to climb partly up the pyramid, when the distance he would have had to travel would have been only 1,440 feet.

In the accompanying diagram the two sides of the pyramid are supposed to be "spread out flat." A is the apex and B, C and D three of the four corners. It is clear that the shortest route from B to D is the straight line BED.

AB, AC and AD equal 1,681 feet; BC and CD equal 738 feet; BD is 1,440 feet, and EC 162 feet.

MASTERS OF MECHANICS

(*Continued from page* 163)

was devised some years later (in 1844) after photography had become possible and popular. An enthusiast in the cause of photography, Sir David Brewster was a close friend of the pioneer of the photographic art in Britain, Henry Fox-Talbot, of Laycock Abbey, in Wiltshire. From Fox-Talbot he learned the elements of the early photographic process, and he applied them assiduously in his own experiments. Yet, curiously enough, even after Brewster had invented his lens-stereoscope, which is nowadays, and has long been, the popular form of the instrument, he continued to make his stereo photographs by means of a pair of cameras. It was left for that nowadays forgotten genius, John Benjamin Dancer, of Manchester (whose little-known career has formed the subject of a previous article of this series) to hit upon the notion of taking stereoscopic pictures by means of a single divided camera. Thus, partly unknown to each other, Brewster and Dancer formed a stereoscopic pair. Brewster popularised the stereoscope viewer.

Lens for Lighthouses

An important invention of Brewster's was a new lens system for the projection of light from lighthouses. Up to his time, a simple magnifying lens had been used in lighthouses. Brewster, however, devised an improved prismatic type of lens for lighthouse use which not only increased the effective range of the illumination, but also enhanced the reliability of the lighting system. It is still used in many lighthouses.

Another interesting Brewster invention was a microscope which employed a diamond lens, and which was capable of a 3,000 times magnification, a degree of enlargement which, at that time, was unheard of.

The mature working years of Sir David Brewster were spent at St. Andrews, in Fifeshire, as Principal of the College of St. Saviour and St. Leonard, to which he was appointed by Government in 1838.

Towards the end of his life he retired to a secluded country house near Melrose Abbey which was built for him years previously. It was his favourite residence, and contained his study, his laboratory, and his workshop. There he died, and near there, in the ancient and hallowed grounds of Melrose Abbey, he was laid to rest after a long life, pleasant and successful enough in its associations and its results, but one which was devoted severely and earnestly to scientific study and to the advancement of our knowledge of the manifold things around us.

To Frustrate Frost

ANY proposal which bids fair to prevent the formation and accumulation of ice in the mechanism of the aeroplane will always be sure of a hearty welcome. An inventor has been devoting his attention to the discovery of a method of antidoting the assaults of Jack Frost on the leading edges of airscrews.

His idea is an airscrew containing in the interior of each of the hollow blades one or more pipes or compartments open at the leading edge of the blade. These are connected near the root of the blade with a source of supply of de-icing liquid.

A Mystery Explained

Why a Tandem Can be More Easily Ridden Up a Hill by a Solo Rider in the Front Seat Only

By H. A. ROBINSON, B.Eng.

THAT the above statement is correct has often been remarked upon by those who habitually use this type of machine, but, as far as we know, no really satisfactory solution has ever been put forward. Yet upon careful investigation the reason is comparatively simple.

Perhaps the whole question is best understood if we consider the ordinary solo cycle first. With this, it is generally known that hill climbing becomes easier if the rider leans well forward or stands on the pedals, thus bringing his weight more towards the front of the machine. But why should this be? Let us analyse.

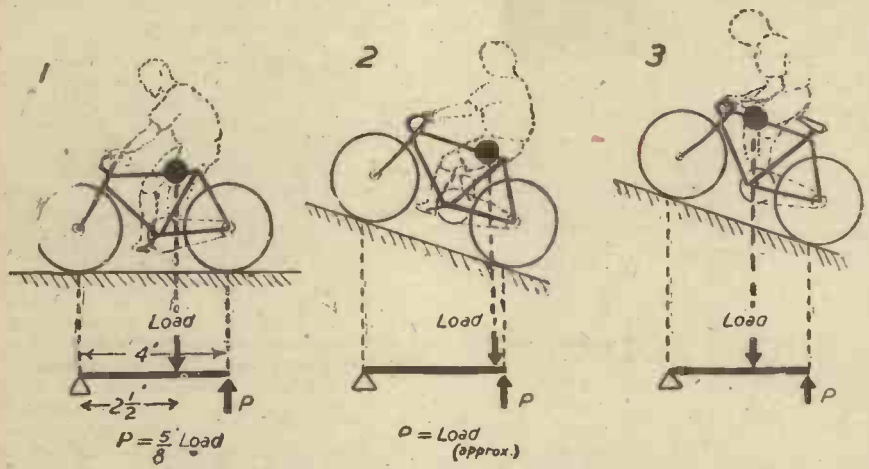
The effort necessary to propel any rolling object over the ground is directly proportional to the vertical pressure of that object at its point of contact, and is given by the formula $F = Pu$, where P is the vertical pressure, and u certain frictional resistances. Thus, even running on the flat, the less weight taken by a wheel the less effort it will need to send it along.

Now the total weight on the two wheels of a cycle can never be greater than the load on the machine, plus the weight of the machine itself; but the load on either wheel can easily be greater than one half of the total by various adjustments of the centre of gravity.

By increasing the weight or pressure on a wheel it is obvious from the formula that F, the force necessary for propulsion, at once increases, hence it may be accepted that the aim should always be to decrease "P" as far as feasible.

For mechanical reasons the back wheel of most cycles carries a higher proportion of the total load than the front. This is quite in order for flat or slight incline riding, but a glance at the sketches will show that upon reaching a real hill the centre of gravity, already well back, moves, in effect, further back still (Fig. 2), thus tending to make the already heavier loaded rear wheel, overloaded, and to increase the F of the wheel.

The centre of weight caused by the machine itself cannot be altered, of course, but the cyclist can adjust his own disposition. Hence the rider instinctively reaches forward in an attempt to carry his own C. of G. forward and thus counterbalance the backward displacement caused by the hill. He moves so forward till he feels a position of maximum efficiency has been attained, that is, a minimum concentration of load secured on each wheel. Or to put it another way, he moves forward till he re-establishes a distribution of loading approximating to the level riding conditions to which he is accustomed, and for which the machine is really designed.



Figs. 1, 2 and 3.—Diagrams illustrating the effect of altering the position of the centre of gravity of a rider and cycle.

Lever Principle

It is all a matter of the simple lever as will be seen by a study of the diagrams. The contact-point of the front wheel is regarded as a fulcrum, the load, acting through the centre of gravity, as a downward force, and P (the reaction from the road—which is equal and opposite to the weight on the wheel) as an upward force.

Fig. 1 is roughly normal riding conditions; the dimensions are hypothetical but show that with this disposition the pressure on the back wheel would be about 5/8 of the total load. Fig. 2 shows clearly how on a hill the C. of G. at once moves *relatively* backwards, weight always acting vertically downwards. This increases the load on the back wheel, as the lever arm operates at right-angles to the load, i.e., horizontally, till on a steep climb it could come near being equal to the total load, while Fig. 3 indicates how by leaning forward a disposition of loading approximating to Fig 1 can be restored.

The question may be very logically asked why, if getting away from the back wheel has such beneficial results, not move right forward till the weight on the back wheel is negligible? A reverse lever effect is in operation however with the back wheel contact point being regarded as the fulcrum. Hence the only thing that can be done is to find the point of maximum efficiency between these two leverage systems, which is what the hill-climbing cyclist instinctively does.

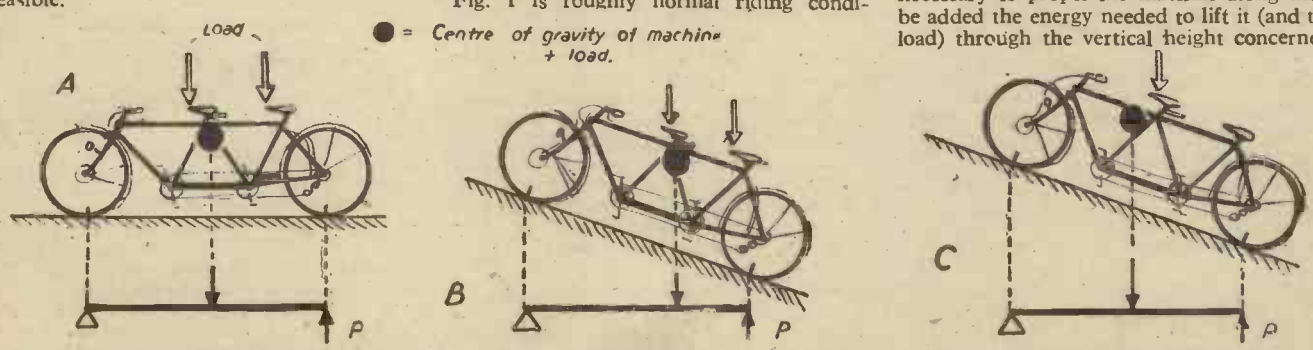
Distribution of Load

Let us now consider the tandem. The mechanics applicable to the solo cycle are also applicable to the tandem, only to a greater extent as obviously the lever arm is longer. All the principles of the lever are still there, but in the case of two riders it is impossible to move the centre of gravity so readily as when on a hill. The need for carrying the C. of G. forward, however, remains if the highest efficiency is to be obtained and this can only be done by the rear passenger dismounting, which immediately and automatically sends this important centre well to the fore.

The single rider in the front seat of a tandem then is equivalent to the solo rider of a single cycle getting up over his bars or standing up when breasting a rise.

A rear rider after reading the above will probably say "but on hills there is 'me' to add greater pushing power." Quite so, this is perfectly correct, but then the extra frictional resistances set up on the said hills by your weight and unalterable position on the machine outweigh the extra pressure you can bring to bear.

It may also be thought that we have left out the important point of machine and rider being lifted through a definite height when going up a hill. This is certainly so, and we agree that in finding the *total* energy required to get up the grade, to the energy necessary to propel the machine along must be added the energy needed to lift it (and the load) through the vertical height concerned.



A—Broad disposition of tandem loading. Below the leverage system set up. B—Shows how with two riders the C. of G. in effect moves backwards.

C—Leverage balance approximating to "A" restored by the rear rider dismounting.

Letters from Readers

"SEASONING" TIMBER

SIR,—I was greatly interested in your article in the November issue of PRACTICAL MECHANICS.

I would like to point out, however, that there is no evidence to show that there is any difference between the behaviour of timber which has been dried for a number of years in the open or in a few weeks or months by proper artificial means, providing that the drying has been correctly carried out and has been the same in both cases.

Drying kilns are operated scientifically, and timber dried in them is entirely independent of variable climatic conditions.

The term "seasoning," as distinct from drying, unfortunately gives one the impression that the wood has in some way been "mellowed"; this is not the case, and kiln-dried timber, providing it has been properly carried out, should be in as good a condition as possible and also sterilised, thus killing all likelihood of fungus growth and insects.

If as stated the planks in a kiln dry too quickly on the outside, then the kiln is being incorrectly operated, the initial temperature has probably been too high and the humidity perhaps too low.

Charts can be obtained as a guide to regulating the relative humidity and also the temperatures for the drying of timber, and if these are followed the timber should be in good condition when the desired percentage moisture content has been reached.

Timber that has been too quickly dried on the outside, thus shrinking and keeping the internal moisture trapped, will set up stresses in the timber, and it is known as "case-hardening." The timber is quite useless in this condition. Simple tests can be applied to prove that the timber is not "case-hardened."

J. R. HALLIDAY (High Burnside).

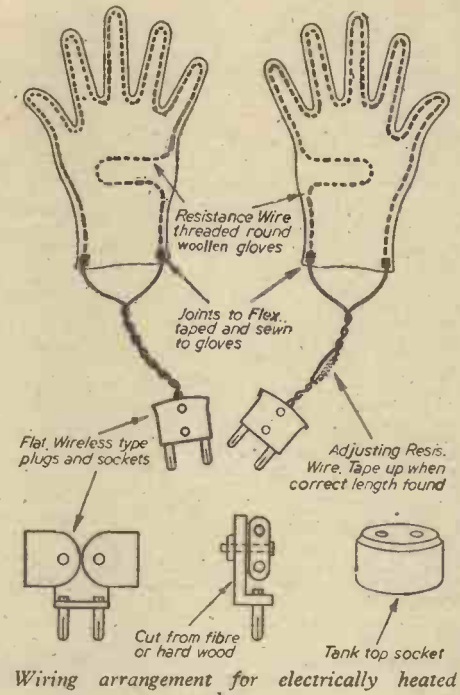
ELECTRICALLY HEATED GLOVES

SIR,—I notice in the December issue of PRACTICAL MECHANICS a reply to a reader *re* electrically heated gloves and I thought the following notes might be of interest.

In the winter of 1938/39 I made a few experiments on the same lines, but unfortunately I have no accurate records and the trial gloves have gone to salvage since the restrictions on motoring.

I found that resistance wire of 26 s.w.g. (or certainly no thicker than 24 s.w.g) the best size. This wire I threaded up and down each finger of a pair of woollen gloves which I wore inside my usual leather gauntlets.

I connected both gloves in series, and had a small amount of wire external to the gloves (which I wound on a piece of fibre rod) by means of which I adjusted the current to give the required heat. The current necessary is surprisingly small, being about 3 amps, and supplied by a standard 6-volt lighting set. Incidentally it pays to wear the gloves quite 15 minutes to each trial because I found that a seemingly small "heat" builds up to an uncomfortable extent after a time. To connect the gloves to the supply I found the best way was by using a twin flex about 20in. long from each glove, terminating in a wireless-type 2-pin plug, the sockets for which were arranged T-fashion on to another 2-pin plug, the socket for the latter being fixed to the tank top instrument panel. In riding the flexes were long enough to permit correct hand signals (but not, of course, full arm) with perfect freedom, and at the same time the least extra jerk in an emergency pulled the plugs out without damage to gloves or wiring.



Wiring arrangement for electrically heated gloves.

In closing I can say that a little trouble and experiment is amply repaid as the added comfort to winter riding is surprising.

The resistance wire I used was from an old element, and after a few *months* it began to break at the finger bends—here I must stress the point that the wire had been run previously for a long time at red heat. F. R. HOLMES (Darlington).

RUNNING CARS ON "CALOR" GAS

SIR.—I was extremely interested to read Mr. S. T. Jones's letter in the Queries section of the August issue of PRACTICAL MECHANICS, regarding the use of "calor gas" as a fuel for a Standard 9 automobile.

It is, of course, obvious that the most satisfactory means of supplying gas fuel is by way of the gas producer, at least as far as the operation of motors normally designed for liquid hydrocarbon fuel is concerned. The main reason for this being that it is possible to vary the gas composition to suit your engine, by the use of suitable solid fuels in the generator, whereas, if it is proposed to use a fuel such as "calor gas," it is, strictly speaking, necessary to design the engine round the fuel for optimum results. However, I see no reason why it should not be possible to run a Standard car very satisfactorily on "calor gas." Under peacetime conditions it is doubtful whether any great advantages would be apparent with gas fuel of this type (with producer-gas it is obvious that unless petrol goes down to about 5d. per gallon, the cost advantage will always be with the gas-producer) as the initial cost of "calor gas" is comparatively high, and the overall efficiency as a fuel is somewhat less than liquid hydrocarbon fuel.

With regard to Mr. Jones's queries, I should judge that the main reason for lack of power, etc., apart from the engine being in good mechanical condition, is due to the fact that, as the speed increases, the engine is getting insufficient fuel. This would be accounted for by the rather unsatisfactory method adopted for the introduction of the gas into the combustion chamber. In this connection I might point out that the basic trouble is an incorrect fuel/air ratio. Too much fuel and too little air, or vice versa, would have much the same effect, and it would be advisable to discard the present carburetter, and substitute a suitable and quite simply constructed gas-mixing valve. This would have to be designed to allow of close regulation of both gas and air supply to suit the piston displacement, and also to maintain the correct fuel/air ratio at all speeds. This would not be difficult to design. The ideal to aim at is a valve of the injector-type, which will more or less automatically maintain the correct ratios without any adjustment after the initial one. I would not, at this stage, attempt to feed the gas from the cylinder at over atmospheric pressure, unless it is found that by so doing it markedly improves matters.

Another thing to investigate is the matter of compression ratio. In my own experience the compression of a liquid fuel motor is usually too high for gas fuel, but it is possible that with certain types of engines it may be too low. After arriving at a suitable design for a mixing valve it would be well worth while to experiment with the compression. It can easily be made lower than normal by fitting two cylinder head gaskets, cementing them well together before putting them on. To raise it above normal you can dispense with the cylinder head gasket and make a good joint between head and block with a metallic gasket cement, such as bronze powder in shellac, or one of the high-temperature proprietary compounds.

Finally, suitable precautions would have to be taken that the manifold temperature does not rise too high. In the case of liquid fuel the heat of the manifold is desirable in order to vaporise or help vaporise the fuel. With gas, however, the heat would expand the gas and so cause less to be induced into the cylinders. Some sort of compensation would be necessary to allow for this.

Here is some data which may be of interest:

Composition, etc.—Fourth member of the homologous paraffin series having formula C_4H_{10}. Is a hydrocarbon gas commercially known as butane.

How available.—Generally stored in cylinders containing 14 or 28lb. of the liquefied gas.

Cylinder Pressure.—23lb. per sq. in. approx.

Gas Capacity.—28lb. cylinder is equivalent to about 190 cubic feet of gas at ordinary temperature and atmospheric pressure.

Calorific Value.—3,500 B.Th.U. maximum.

Ignition Ratio.—30.1, i.e., about 30.25 cubic feet of air are required for the complete combustion of 1 cubic foot of gas. The limits of combustibility of gas in gas/air mixture being between 2 per cent. to 8 per cent. N. SNEDDON (Kingsbridge).

USE OF BUTANE AND PROPANE IN MOTOR-CARS

SIR,—Referring to the letters which appeared in your August and January issues, we would advise you that use of any fuel in a motor-car, without first obtaining a permit from the Ministry of Fuel and Power, is irregular and prohibited.

We understand that permits are not issued for the use of "Calor" as (butane).

CALOR GAS (DISTRIBUTING) CO., LTD.,
London, W.C.

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.

Acetylene Gas: Dissolving Rubber

WOULD you please inform me why acetylene gas will not work like coal-gas in a bunsen burner? It is impossible for me to take coal gas to my shed in the garden and so I have been experimenting with acetylene from two ordinary cycle-lamp generators. I find, however, the smoky flame persists with a bunsen burner and when the air-hole is fully open the flame lights back to the jet. Is there any way in which I can remedy this?

Could you also tell me the name of a liquid which dissolves rubber in order that etching words in the rubber can be carried out?—Ernest Haden (Leigh, Lancs).

ACETYLENE gas will not burn with a non-luminous flame in an ordinary bunsen burner because acetylene is richer in carbon than ordinary coal gas. Hence it requires a greater proportion of oxygen to combust the carbon completely than it is possible to admix with it in an ordinary bunsen burner. If you fed the bunsen burner with oxygen you would, of course, at once obtain a non-luminous flame. You can prevent the flame striking back by inserting a fine-mesh wire gauze in the burner above the air-hole. Also you may be able to render the flame much more non-luminous by enlarging the air-hole or by making the gas jet narrower.

It is very difficult to dissolve any compounded rubber, since these materials contain a large amount of completely insoluble substances. Pure para rubber can be dissolved in xylene or solvent naptha and also to a certain extent in carbon bisulphide, but ordinary processed rubber is only softened by these fluids. When, however, such rubbers are thoroughly shredded, masticated and worked in hot naptha, they can be got to enter into a partial solution sufficient for the making of rubber cements, etc.

Orange Peel: Narcotic Drugs

(1) What is it that makes orange peel, mistletoe and holly burn so fiercely; is it some oil or chemical substance?

(2) Is it true that there is a drug which causes a person to become unconscious if he is scratched with it; is it acetyl chlorine bromine?—R. Prescott (Little Rissington).

(1) Orange peel contains a characteristic oil which is stored in microscopic cells just below the surface of the peel. This oil imparts the flavour to the peel. When the peel is allowed to dry, the moisture evaporates from it, but the oil, entrapped in its rows of cells, remains behind. It is due to the presence of this oil, and also to the essential inflammability of the cellulose material of the cells, that the dried peel burns so fiercely when ignited. Both dried holly and mistletoe are combustible for similar reasons, and the same applies, also, to many other kinds of fruit skins and leaves.

(2) There are quite a number of "narcotic" drugs which, when they are introduced into the blood stream, cause sleep and unconsciousness. Hence, it would be quite correct to assert that if a person were scratched with an instrument having on its edge sufficient of the sleep-inducing drug to penetrate into his blood-stream, the individual affected would become unconscious. The most potent of the sleep-inducing drugs is morphine or morphia, a drug which is obtained from opium. This drug, in this country, is very stringently controlled under the "Dangerous Drugs" regulations.

Chemical Life of Plants

CAN you tell me names of the 13 chemicals which constitute the life of a plant, and the amounts used for an average plant?—H. T. D. Eddison (Plympton).

THE supposition that there exist 13 chemicals which "constitute the life of a plant" is quite wrong. Various plants and vegetables require various types of chemicals to effect their growth. Usually, however, all plant life requires certain "elements of growth," which are: water, nitrogen (in the form of organic compounds), iron, magnesium, calcium, carbon dioxide and oxygen, but each of these materials can be applied to a plant or a vegetable in various ways and for various purposes.

Different plant growths take different amounts of these materials from the soil and the air, and the absorption of these materials by plants or vegetables varies considerably at different stages in the growth of the plant. Hence, it is quite impossible to state that such and such a plant will require so much of this particular "element" for its growth.

We would advise you to consult a textbook of botany (an up-to-date one) such as may be found in the Plympton Library, and if you will carefully read through the introductory chapters of any such volume you will realise the reasons why any particular plant cannot merely be reared upon certain groups of chemicals.

Pelton Wheel and Dynamo

I CONSTRUCTED and installed a Pelton wheel, which gives roughly 1 h.p. As a generator I use a ¼ h.p. "Century" compound-wound D.C. motor, 200 v., 1.7 amp. The light is very good, but it "flickers" slightly. Is this a common "ailment" with fractional motors used as generators, or can you suggest a means of getting rid of it? I may add that the water pressure is constant.—James Breslin (Dublin).

IT may be that the blades of the Pelton wheel are not correctly shaped, so that the water will enter smoothly and without interruption of the speed. If so it would be an advantage to load up the wheel or to add a flywheel in the drive to maintain a more constant speed.

If the dynamo is belt-driven it is quite likely the trouble is due to the belt joint not being quite smooth, so the speed varies slightly each time the joint passes over the pulley. It may also set up vibration, which interferes with the contact between the brushes and commutator. This may be particularly noticeable if a small pulley is used.

A less likely cause of the flicker is that the brushes are not quite free or that they are unable to maintain good contact with the commutator due to the latter being rough, dirty, or to the intersegment micas between the commutator bars projecting slightly. In the latter case we suggest you undercut the micas about 1/32in. below the surface of the copper. It is also possible the commutator is not perfectly true. If there is a short circuit in the armature this will be indicated by overheating of the faulty coil; whilst an open circuit, which might be due to bad soldering at ths commutator connections, would cause sparking on load and burning of the commutator segment connected to the faulty coil.

Electrically-driven Pump

I HAVE a Lucas 12 v. dynamo (C45L) and wish to use it as a motor to drive a small "centrifugal" water pump, and operated by an automatic switch. The motor would only be required to run for about one minute at a time. The pump would have an outlet of ½in. with a rise of 20ft.

What would be the best type of switch to use, and where could I obtain a pump to suit my purpose?—E. Cusator (Edinburgh).

PRESUMABLY you intend to supply the machine from 12 v. D.C. Such a small machine could be started up by switching it direct on to the supply through an air-break switch having a capacity of about 15 amps, protecting it by suitable fuses. Apparently you wish to control the motor by some type of float operated switch. Such switches are manufactured by Igranic Electrical Co., Ltd., of Bedford. Alternatively, you could use a push button direct on line switch as made by Midland Electrical Manufacturing Co., Ltd., of Barford Street, Birmingham. It would be an advantage to disconnect the third brush and feed the field coils direct from the main brushes through a variable resistance which could also be used for speed control. The motor should be capable of driving a pump with a delivery of about 10 gallons per min. If you intend using a direct-coupled pump we suggest you run the motor unloaded and measure its speed, so this information can be supplied to the pump suppliers. Perhaps you could obtain a pump from Gamages, Holborn, E.C.1.

Squirrel-cage Induction Motor

I HAVE a squirrel-cage induction motor fan which is very weak, and I would like to rewind it to get extra power. The rotor is 2¾in. diameter and 1¾in. long, and I believe it should be possible to get about 1/12 h.p. from a rotor of these dimensions. The stator has 24 poles and is wound for 4 poles. Would you please give me winding particulars for 220 volt 50 cycle winding which will give me the greatest power output from the motor? Also what would be the h.p. obtainable from the motor?—G. Maxwell (Plumstead).

ASSUMING the motor is designed for operation on a 220 volt 50 cycle supply it is hardly likely you could increase its power by rewinding the machine unless you rewind it as a 2-pole motor with a speed of about 2,850 r.p.m. The torque required to drive a fan increases considerably with the speed and the motor would be overloaded at the higher speed. As a 4-pole motor running at about 1,430 r.p.m. on full load the motor should develop about 1/12 h.p. A suitable winding for this speed would be to wind the stator as a 4-pole machine, the winding on each main pole comprising 600 turns of 26 s.w.g. single silk covered enamelled wire wound in three concentric coils in three pairs of slots, the whole of these coils being connected in series to create adjacent poles of opposite magnetic polarity. The starting winding, cut out of circuit when up to speed, could be fitted in the same slots as the main winding but arranged to create starting poles midway between the main poles. Each pole of the starting winding could have 300 turns of 32 s.w.g. wire wound in three concentric coils.

Talkie Projector

I POSSESS a 9.5 m.m. talkie projector and wish to convert the light source. I require particulars as regards gauge of wire, number of turns, etc., for constructing a series-wound resistance to overrun a 12 v. 36 w., or 12 v. 60 w., car headlamp bulb from 230 v. A.C. mains. Please advise.—J. H. Prichard (Birmingham).

THE resistance must be capable of carrying 5 amps. for the 60-watt bulb and must have a resistance of 73 ohms to be suitable also for the 36-watt bulb. The number of turns on the resistance does not matter but the resistance wire should be capable of withstanding about 500 deg. C., together with the former on which it is wound. You would need about 46 yds. of 20 s.w.g. nickel-chrome resistance wire; either bulb could then be tapped on to the resistance at a convenient point to obtain the desired degree of illumination.

Electrolyte for Condensers

IN view of the shortage of can type electrolytic condensers (wet type) I should be glad if you would inform me of the name of chemical used as electrolyte in same, and where it could be obtained.

I have a large number of these condensers in which the electrolyte has broken down, and should like to refill them to use again.

Would you also let me know of a good grade thin oil, which could be warmed to eliminate water, and used as electrolyte in order to obtain working voltage of about 750 volt at 300 mA, or possibly you could suggest a method of obtaining this working voltage by other means?—R. H. Ryder (Southampton).

THERE are many types of electrolytic condensers, and we cannot tell you what fluid your particular condenser contains without an actual inspection of it. However, the following is a list of common electrolytic fluids, with the approximate "critical" voltages necessary for effective working of the condenser:

Electrolyte	Voltage
Ammonium chromate	122
Ammonium carbonate	425
Ammonium phosphate	460
Ammonium citrate	470
Borax	480

The above figures assume the employment of steel and aluminium electrodes.

Borax (or ammonium borate) is very commonly used as an electrolyte solution in condensers. Such a solution may be prepared by neutralising a saturated solution of borax with ammonia, that is, by adding ammonia to the borax solution until a very faint smell of ammonia is retained by the borax solution. The latter is then boiled for a minute or two in order to expel the excess ammonia.

An ordinary medium-thin "spindle" or machine oil will suit your purpose for electrolyte use. This can be obtained from any oil supplier. The oil should have a golden colour with a greenish fluorescence.

THE P.M. LIST OF BLUEPRINTS

The "PRACTICAL MECHANICS" £20 CAR
(Designed by F. J. CAMM),
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Blueprints (2 sheets), 2s.

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Full-size blueprint, 1s.

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Full-size blueprint, 1s.

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Complete set, 5s.

The 1-c.c. TWO-STROKE PETROL ENGINE*
Complete set, 5s.

STREAMLINED WAKEFIELD MONOPLANE—2s.

LIGHTWEIGHT DURATION MODEL
Full-size blueprint, 2s.

P.M. TRAILER CARAVAN*
Complete set, 10s. 6d.

The above blueprints are obtainable, post free, from Messrs. G. Newnes, Ltd., Tower House, Strand, W.C.2.

*An * denotes that constructional details are available, free, with the blueprint.*

Invisible Ink

I REQUIRE an ink which will become invisible in about three days, or not less than two. Will you state the recipe for the ink and also if any of the chemicals are hard to obtain? Will you give the address of any firm likely to supply them in small quantities.—D. V. Beeney (Burwash).

AN ink which will fade away within a day or two can be made by adding a few drops of tincture of iodine to a thin solution of starch. The latter will be coloured blue by the addition of the iodine, and writing in this medium will appear pale blue when dry. After a day or two, the colour will disappear, leaving the colourless starch behind on the paper, which, if it has not been too thick or too strong, will not show.

Another method is to write with a strong soap solution to which a few drops of tincture of iodine have been added. A brown colour will result, and this coloration, like the starch solution, will lose its colour on paper after a day or two. Both the above colour-fadings can be speeded up by warming the paper. You can obtain tincture of iodine from any retail pharmacist.

Dynamo Markings : D.C. Supply

I HAVE a dynamo which is marked 1 phase, 2 phase and 3 phase. Could you please tell me what is meant by this, and what are the correct connections to the terminals?

Also, we are on D.C. mains which gives 5 amps. 220 volts.

I wish to increase the amps. and decrease the volts, is there any way in which I could do this? —H. Crockett (London, S.E.).

THE markings on your dynamo seem rather unusual. Single phase means that the voltage between two terminals starts from zero, rises to a maximum, falls to zero, reverses and rises to a maximum in the opposite direction, then falls to zero again, this cycle being repeated as many times per second as is the frequency of this A.C. output. Two phase means that a similar cycle of voltage is generated between two terminals, one of which may be common to the other voltage cycle. The second voltage will occur one quarter of a cycle out of phase with the first, that is, the voltage on one phase will be a maximum when the other is zero. Three phase means that there are three similar cycles which are displaced one-third of a cycle from each other. A single phase machine would have two output terminals, a two-phase machine would have either three or four output terminals, and a three-phase machine three or four output terminals. In addition, each machine would have two terminals for the field windings, unless the machine happened to have a permanent magnet field. In order to describe to which terminals you should connect your leads we should like a full description of the machine, arrangement of the windings, number of slip rings, number of terminals with any markings they may have, together with a description of the load you wish to supply.

The only way in which you can increase the current with reduced voltage from your D.C. supply without overloading the cables and meter, assuming these have a maximum capacity of 5 amps., is by using a 220-volt motor to drive a dynamo having the required output, or else to use the existing supply to charge accumulators in series, then connecting the accumulators in parallel to supply the load circuit. It is, however, likely that the cables have a capacity of more than 5 amps., and the supply authority may be able to allow you to take more than 5 amps. by fitting a meter and fuses of higher rating. In this case, you could reduce the voltage by connecting a resistance between the mains and the load circuit.

Soldering Lead

I SHALL be obliged if you would advise me on the following: When working on lead for the purpose of soldering, the cleaned lead section and the solder are left conspicuously bright. Can you suggest any simple chemical treatment which will immediately tarnish both the lead and the solder so as not to be visible against the old work?—N. E. Teirnen (Goodmayes).

A VERY weak solution, say 1 per cent. of sodium sulphide, will serve your purpose. Dissolve one part of this material in 99 parts of water and apply to the bright part of the metal with a soft brush. Since this chemical is in daily use by photographers for the toning of bromide prints, it can usually be obtained from most large dealers in photographic requisites.

Alternatively, you can boil together in a saucepan equal parts of lime and sulphur with about three times their weight of water. Boil for about 10-15 minutes, and then strain off the resulting yellow solution. This will have an effect similar to that of pure sodium sulphide solution in tarnishing bright surfaces of lead and lead-containing solders. If the action of the solution is too rapid or intense, merely dilute with water.

Shoe and Furniture Polish

I HAVE recently attempted to manufacture some black shoe polish and used the following ingredients. One quarter of a pound of bees and paraffin wax in one-ounce blocks, one half pound of dry vegetable black and when melted, a sufficient quantity of paraffin and turps substitute in equal parts and a tablespoonful of vinegar. When the liquid had cooled, I found that a very thick coating of fairly hard white wax had formed on top, leaving the remainder totally black, but too hard to be of any domestic use.

1. What is the cause of this? Have I mixed the correct amounts, and in their correct order?

2. What dye is used in dark brown shoe polishes?

3. What ingredients are used in the manufacture of floor and furniture polishes?—F. J. Waterfall (Carshalton).

1. Your trouble appears to have been that you have not adequately stirred your molten wax mixture until it has cooled. Hence, you have not obtained complete mixture of the waxes and the other ingredients. Moreover, you have used too much vegetable black, and, furthermore, the use of vinegar was not advisable.

In general, boot and shoe polishes are made up on a basis of beeswax. A softer wax, such as paraffin or montan wax, is added to lower the cost. Carnauba wax (the hardest of all waxes) is used to increase the hardness of the mixture, and, also, because carnauba wax gives the best surface appearance to the polish on leather. Turpentine or other solvent enables some of the wax to penetrate to the leather, whilst soap acts as a lubricant and thus improves the rubbing qualities of the wax. By increasing the proportion of any one of these ingredients in a shoe polish, you can enhance the properties of the polish in any desired respect.

A good shoe polish is the following:

Beeswax	1 lb. } or Beeswax
Paraffin wax (or montan wax)	1 lb. } 2 lbs.
Carnauba wax	6 ozs.
Turpentine or turps substitute (NOT paraffin oil)	3 pints
Soap	6 ozs.
Oil-soluble dye (black or brown)	Sufficient quantity.

Method of Procedure:

Shave the soap finely and dissolve it in the smallest possible amount of hot water so that it forms a sloppy paste.

Melt the waxes together in a metal container. Add the turps or turps substitute. Stir well. Add the dye. Then stir in very gradually the soap solution. Finally, continue to stir the mass until the mixture is nearly cold and ready for pouring into tins.

If you are making a black polish, it is permissible to reinforce its blackness by adding a small amount of lampblack, say 2 ozs. of this material to the above quantity of waxes.

The dyes used must be oil-soluble dyes, such as "Waxoline Black" and "Waxoline Brown," both of which are obtainable from Imperial Chemical Industries, Ltd., Millbank, London, S.W.1. Similar dyes are also obtainable from Messrs. A. Boake, Roberts and Co., Ltd., Buckhurst Hill, Essex.

2. Floor and furniture polishes of the wax-oil type (i.e., of the well-known "paste" variety) are simply solutions of mixed waxes in turpentine and/or turpentine substitute (white spirit). Take a wax mixture containing, say, beeswax (and/or montan wax), two-thirds; carnauba wax, one-third. Dissolve this in about five times its weight of white spirit. Add any wax-soluble dye to colour, if required, also any perfume which may be required.

Furniture polishes contain greater proportions of carnauba wax, on account of which they give a hard polish film which does not fingermark.

Making Emery Wheels

COULD you tell me how emery wheels are made, as I have to make some of an awkward pattern? I should be pleased if you could tell me of what the moulds should be made and also the material to be used so as to avoid the wheels sticking to the mould.—W. R. Kettle (London, E.)

EMERY powder can be bound by mixing it with waterglass and allowing the mass to dry out in a mould, but the resulting product is apt to be brittle. In your case, therefore, it would be better to adopt the magnesium oxychloride method of producing these articles, which method is as follows:

Make a mixture of equal parts of fine emery powder and calcined magnesite. Slake this to the condition of a sloppy paste with a 40 per cent. solution of magnesium chloride (i.e., 40 parts of magnesium chloride dissolved in 60 parts of water). Pack the mass into wooden or metal moulds for 48 hours. The moulds should be well greased to prevent the mixture adhering to the sides. After 48 hours, the material will have set hard and it can then be removed from the moulds.

By varying the degree of fineness of the emery powder which you use you can modify the "fineness" of the resulting emery wheel.

Output of Shunt-wound Dynamo

WILL you please clarify the following doubtful points?

(1) Is there a difference in voltage output if a shunt-wound D.C. dynamo has the field coils re-connected *in series* with the armature?

(2) What procedure is necessary to convert a motor 110 v. D.C., 1 h.p. (in running order) into a dynamo?—F. Foster (Newark).

THERE is a very considerable reduction in the voltage output of a shunt dynamo if this is reconnected with the field coils in series with the armature. A dynamo which is designed with series field coils has a comparatively small number of field turns of heavy gauge wire and only generates voltage when the external circuit is closed. The terminal voltage depends on the resistance of the external circuit so that the voltage of all series dynamos varies considerably with the load. If shunt field coils are connected in series the high resistance of these fine wire coils will cause the terminal voltage to be practically nil. The dynamo would only pass as much current as could the field coils and practically the whole output of the dynamo would be absorbed in feeding the field coils.

A shunt D.C. motor can be converted into a dynamo by simply driving it at the correct speed (slightly higher than its speed as a motor) in the same direction of rotation as when motoring. This assumes the field magnets have residual magnetism, if not, the fields would have to be magnetised from some external source of supply. You may find commutation of the machine is improved by moving the whole set of brushes slightly forward in the direction of rotation.

Palladised Barium Sulphate : Hydrogen Gas

I HAVE been doing some preparations in organic chemistry and one of them is a hydrogenation which requires for catalyst palladised-barium sulphate. Could you please tell me how to prepare this catalyst in lots of from between 5-10 grams? I should also like to know about how much it costs to hire a cylinder which contains hydrogen, and the price of the gas; and also where I may obtain these?—M. Green (London, W.).

1. PALLADISED barium sulphate can be prepared by taking perfectly pure, dry barium sulphate and by saturating it with a 5 or 10 per cent. solution of a palladium salt, such as palladium chloride. The barium sulphate is now placed in a silica crucible and strongly heated to a dull red heat. The palladium chloride thereby decomposes, leaving metallic palladium deposited upon the particles of barium sulphate.

Palladium chloride can be obtained from Messrs. Johnson, Matthay and Co., Ltd., Hatton Garden, E.C. This firm would also prepare the palladium-deposited barium sulphate for you in lots of 5-10 grams, and we think that your best plan would be to allow them to do so, if only for the reason that palladium chloride is an expensive salt and that any inexperience on your part might result in some of it being wasted.

2. Hydrogen gas in cylinders can be obtained from any branch of the British Oxygen Company, Ltd. We suggest that you write to this firm at its Wembley offices. The price of the gas was formerly about 7d. per cubic foot, and, in some instances, small cylinders containing about 20 cu. ft. could be hired. Since all these hiring costs have become unstabllised, we are unable to quote you the most recent figures, but an inquiry made to the above firm at Wembley will soon put you in possession of the information which you require.

Diesel Engine : Air and Fuel Ratio

COULD you please tell me (1) the ratio of air to diesel oil (by volume) in a diesel engine of about 30 c.c.? (N.B.—Please quote volume of diesel oil liquid—not vapour.)

(2) Where can I get drawings of an electric motor of 1/20 to ¼ h.p. of the high-speed type? I have a lathe, also facilities for welding and brazing if these should prove necessary.—J. C. Turner (St. Albans).

1. IN the average diesel engine, air is compressed to a pressure of about 500 lb. per sq. in., its temperature being thereby automatically raised to about 1,000 deg. F. At the height of this compression, the fuel valve opens and injects a quantity of diesel oil into the cylinder. We presume, therefore, that you desire to know the exact quantity of diesel oil which would have to be injected into a diesel cylinder of 30 c.cs. capacity. We cannot, however, give you the exact figures. They would have to be calculated from the vaporisation capacity of the oil which was used as a fuel and, also, from a knowledge of the exact temperature attained by the compression of the air in the cylinder. As a rough guide, you may take it that one part of (gaseous) diesel oil fuel requires approximately 12 parts of air to combust it economically.

2. It is impossible to procure electric motor drawings nowadays. There are, however, a few existing books which would interest you in this connection. They are:

"Practical Design of Small Motors and Transformers." (Geo. Newnes, Ltd., "Electrical Engineer" Series), 7s. 6d.

C. G. Veinott: "Fractional Horse-Power Electrical Motors." 23s.

Above-quoted figures represent the nett pre-war prices of these volumes.

Making Dolls' Heads

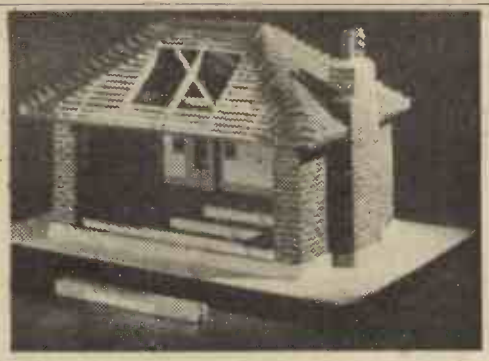
1. COULD you please tell me the raw materials to use, and the way of mixing, for making an unbreakable doll's head, and what to use for preventing it sticking to the mould, which is made from Pyruma putty cement?

(2) Also, what method is used for making canvas faces for dolls?—V. H. Hardcastle (Liverpool).

1. THE unbreakable dolls' heads are made in either xylonite or non-flam celluloid. They are not mineral or cement-like in nature, and then cannot very well be made at home on a small scale. Celluloid and xylonite, as you probably know, are plastic materials, which are heat-moulded and pressed out of large masses of material by powerful hot presses. You cannot make an unbreakable doll from plaster or semi-plaster materials. Using such materials, the nearest approach to this idea which you can produce is to slake calcined magnesite with a 40 per cent. solution of magnesium chloride. Pack this paste into well-greased moulds and allow to set for 48 hours. A very hard and tough material will result, but we are much afraid that you will find it too heavy for doll's head making.

The only successful way of making these things is to use hot presses, and this is quite out of the resources of any individual worker. As a matter of fact, it is likely that, after the war, all dolls' heads and limbs will be made in one of the new tinted synthetic plastic materials.

2. From your description, we are not quite sure of the type of doll face to which you refer. We think, however, that you signify the semi-hard type of doll face which is made up on a fabric basis. This usually comprises a base of a good hempen material, strongly and closely woven, which is suitably painted and then varnished over on both sides with an ordinary clear cellulose varnish such as can be obtained from any modern paint shop.



REAL BUILDING IN MINIATURE

is a possibility of Pyruma Modelling, because by making and baking Pyruma bricks and tiles, and using Tiluma as a binding cement, normal building practice may be followed closely. The above shows a partly completed bungalow built by this method. Pyruma modelling is fully explained and illustrated in an Instruction Sheet obtainable from the manufacturers of

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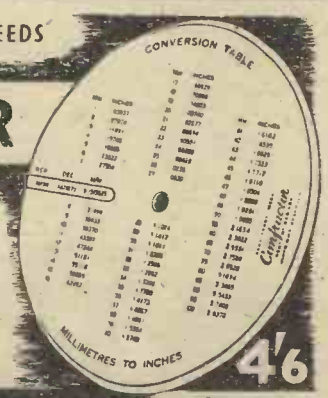

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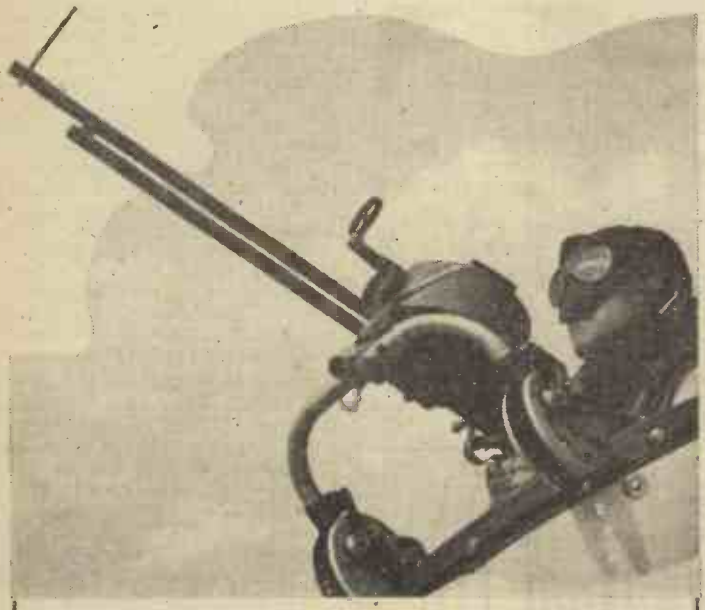

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THE Cyclist
Editor: F. J. CAMM

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Phone: Temple Bar 4363
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Comments of the Month

By F. J. C.

Mass Start—The Latest

READERS will remember that after the M.O.T./Home Office joint announcement that mass-start racing was "undesirable" we investigated the reason which led up to it, stating that we did not believe that this announcement had been made without outside prompting. We addressed a questionnaire on the subject to the national bodies asking them to confirm or deny that they had approached the Ministries on the matter. The N.C.U. refused to answer our question for publication. The R.T.T.C. have since considered our letter and we learn from the secretary that he was instructed to let the letter remain on the table, and that no reply be sent to it.

The publication by us of this correspondence has forced the R.T.T.C to admit that they and the N.C.U. had been in communication with the Government on the matter, and in a long statement the R.T.T.C. endeavours to excuse its attitude in so doing. To excuse is to accuse!

We receive press notices from other national bodies but not from the R.T.T.C. When we complained of this some years ago we received a letter of apology from the secretary stating that "the notices must have gone astray in the post." The Post Office does, of course, occasionally trip up, but it is a strange coincidence that none of the notices were received. However, the secretary promised to see that notices were sent, but to date we have not received them.

Into the Open

IT will be interesting to know why! However, we are able by means which have enabled us in the past to publish exclusive news and information to ascertain our facts. We are glad that we have forced the R.T.T.C. into the open on this matter. It is probable that they did not reply to our letter because they found it impossible to answer it without disclosing information which would damage them in the eyes of the clubs—namely, that because they were opposed to mass-start racing they were determined to get it stopped.

In making their apologia at a recent council meeting, the first to be held since the R.T.T.C. threw road sport overboard at the start of the war (evidently our disclosures on mass-start racing have stung its dictatorial council into action at last!), the R.T.T.C. coupled with it the name of the N.C.U. as having also communicated with Government departments, expressing opposition to mass-start racing. It would seem that both of these bodies were most anxious to keep this information secret. They were willing to wound, yet afraid to strike. They quite smugly imagined that no one would ever know they had really prompted the joint announcement. They did not reckon with us. As we have stated before, cycling politics have become unclean, and these are the methods which make it unclean.

We can now state that we formed one of a delegation to the Ministry of Transport on the subject of mass-start racing, when the case in favour of it was fairly put, and the Ministry learned the facts concerning it for the first time. A 2,000 word memorandum set these facts on record.

Our readers will remember that a prominent member of one of the leading bodies expressed, in a newspaper interview, opposition to mass-start racing, stating that it was run by "hot-headed youths," a statement which he has since admitted to be wrong. It is worth setting on record the fact that the C.T.C. itself has what is known as hard-riders' sections, and these sections not only mass-start but stay massed throughout their ride, which is accomplished at speeds certainly not less than those accomplished in a mass-start race. Presumably the C.T.C., in view of the announcement of its secretary, will now abolish its hard-riders sections!

Uncontrolled Mass Start

IF Government departments are really concerned about a bunch of 30 or so cyclists (all riders of long experience) lawfully using the highway for a race whose rules provide that the competitors must obey the law, and that they may not pass in built-up areas, a race which is under continuous and close supervision throughout, we suggest that it should be more concerned with several thousand cyclists leaving a factory in mass-start formation. One has only to visit Coventry, Birmingham, Wolverhampton, or Slough, to mention but a few places, to witness when the works close in the evening the most appalling congestion on the roads due to cyclists. We are not attaching blame to them, but many accidents occur every week outside these factories. That is really uncontrolled mass-start.

At the R.T.T.C. council meeting to which we have referred a motion confirming the previous attitude that this type of racing cannot be approved by the council while the present attitude of the Government remains unchanged, was carried. What a disgraceful farce such a resolution is. Having goaded the Home Office and the M.O.T. into issuing the statement by presenting strong opposition to mass-start racing, the R.T.T.C. now endeavours to "pass the buck" over to the Government! It seeks to create the impression that because the Government is opposed to mass-start racing the council must be opposed to it, when the facts are that the Government would have done nothing about it but for the N.C.U. and R.T.T.C. Certainly the Government had no need to do anything about it, for the races were properly conducted; they complied with the law; cycle racing on the road is legal; there were no accidents either to the competitors or to members of the public. The whole matter is another unclean page in the history of cycling politics.

An Open Mind

NOW we wish to make our attitude on this subject quite plain. We preserve an open mind on the subject. We are determined to see that the B.L.R.C. has fair play. We do not believe that the opposition of the N.C.U. and the R.T.T.C. is sincere. We do believe that the opposition has been raised out of jealousy, because mass-start racing is proving more popular than hole-and-corner time trials, which interest very small numbers of cyclists. On the other hand, if, after full investigation of the facts, the attitude of the Government remains unchanged, then it must apply the same ban on time trials and attempts at records.

We believe that the B.L.R.C. has had a raw deal, and we are determined to the full limits of our power to prevent cyclists or cycling organisations having raw deals. It is not too late for the N.C.U. and the R.T.T.C. to recant. They can send further communications to the Home Office stating that upon reconsideration of the facts they wish to withdraw their previous letters. In any case cyclists should remember the attitude of these two bodies, which are not reminiscent of sportsmen or sportsmanship. The hole-and-corner principle of time trials has been adopted in the case of mass-start in order to get it banned. Our advice to the B.L.R.C. is to continue to promote mass-start racing, and to continue to act as a disciplinary body by exercising its powers over those who may transgress the rules and bring the sport into disrepute in its early stages. In this connection we are glad that the small rifts within the lute of this new organisation have been healed.

It is significant that the R.T.T.C. at its last council meeting is adopting many of the methods of the B.L.R.C. It is going to promote a national championship. It is going to permit the use of jerseys. This, of course, will make the B.L.R.C. rock at the withers—with laughter. However, we have taken particular care, and have pleasure in announcing the fact, to see that the Home Office is kept informed of this championship; we have also apprised other bodies who should be interested. Of course, the idea of this championship is merely to act as a counterblast to mass-start racing, and it will also, of course, be conducted in the hole-and-corner fashion of time trials—early in the morning, all kept very hush-hush. The R.T.T.C. is another of the boneless wonders.

Paragrams

Stratford St. Mary, Suffolk.

In German Hands

F/O. C. R. FARMER, Arden Wheelers, previously reported missing following an operational sortie, is now known to be a prisoner of war in German hands.

M.M. for Hertfordshire Man

MEMBER and founder of the South Hertfordshire Road Club, Sergeant R. G. Grimes, Reconnaissance Corps, has been awarded the Military Medal.

N.C.U. Loss

THE National Cyclists' Union lost a valued official and worker with the passing of H. G. Mance. He was 78.

Killed in Action

FORMERLY reported missing, Sergeant Air-Gunner Stan. Eastwood, Colne Valley Wheelers and Yorkshire Vegetarian Club, is now known to have been killed while on a bombing raid over Germany.

Scottish Welcome

A CORDIAL invitation to any serving cyclist to take part in club runs is extended by the Edinburgh and District United C.C., of which W. Aitken, 146, Dundee St., Edinburgh, is hon. sec.

Brentwood's Loss

SERGEANT PILOT JOHN A. B. RADLEY, Brentwood C.C., was killed in a flying accident in this country. He was one of the club's most active members.

Exeter's 70th

EXETER C.C. has celebrated its 70th birthday.

Founder Member

A. C. CRANE, founder member and first secretary, presided at the Golden Jubilee Luncheon of Finsbury Park C.C.

Cycle Track for Nottingham?

THE suggestion that Nottingham might have a cycle track after the war was made at the annual dinner of Notts Centre of the National Cyclists' Union.

A Sterling Effort

OVER £200 for the Red Cross was raised last year by the Cycling and Athletic Sports held at Ipswich. Local cycling clubs gave strong support to the wheeling events.

In Strange Company

W. BILLINGS, former hon. time trials sec. of the Kings Lynn C.C. and now a prisoner of war in Germany, has met—in a prison camp—R. McHugh (Merseyside Road Club) and other cycling clubmen.

Serving Abroad

W. CARVEY, Swindon Wheelers, and P. Ellery, Bath C.C., are serving with the Forces in Italy. The former has been overseas for over three years.

Extremes Meet

W. J. CARTER, home from Iceland, and A. C. Elliss, home from Canada, were recently out together on a Southgate C.C. fixture. Carter was an outstanding short-distance rider a decade ago, and Elliss was just making his name when called up.

A Fine Haul

JACK SIMPSON and Alf Martin, prominent Yorkshire riders, each won 35 prizes last season

News of Pennine Members

FOUNDER member of the Pennine C.C., J. Fearnside has returned to this country after lengthy service in North Africa. Clubmate C. G. Rae, former prisoner of war in Italy, has been transferred to a German camp.

Missing at Sea

ALBERT HOLMES, Bradford Victoria C.C., is reported missing from a minesweeper in which he was one of the crew.

Met in Canada

S. ROWLES, Ealing Manor C.C., now in Canada with the R.A.F., has met Max Gibson, well-known West London rider.

Fleet Air Arm Casualty

LEADING Airman L. H. Beale, East Midland Clarion C.C., has been killed in action while serving with the Fleet Air Arm. Before joining up a a year ago he was on the threshold of a brilliant road career.

A Good Record

TWENTY-THREE of the 69 members of the West Pennine Road Club are serving with H.M. Forces.

De Laune Loss

ACTIVE member of the club since 1937, R. Brisley, De Laune C.C., has been killed in action in Italy.

Addiscombe's Sad News

W. POLATCH and Edgar Checkley, two members of the Addiscombe C.C., have made the supreme sacrifice. The former was reported missing "believed killed"—a statement subsequently confirmed—and the latter killed in action in Italy.

Wisbech Wheelers

MEMBERS of the Wisbech Wheelers are spread all over the world: some in Iceland, India, Ceylon, Canada, while others are with B.N.A.F., M.E.F. and C.M.F. Two members are prisoners of war and another five are missing. Yet the club remains a pillar of strength in East Anglia.

"Wings" in Rhodesia

LARRY PHILPOTTS, Ridley C.C., has been awarded his "wings." He did his training in Rhodesia.

Eric White Killed

ERIC WHITE, Highgate C.C., brother of Ron. White, well-known North London official, was killed in action in Italy when flying.

Cycling-Runner

C. T. WHITE, Scunthorpe C.C., former prominent time-trialist in the East Midlands, has turned into a first class runner and, in Palestine, represented his Army unit with distinction.

Doncaster's Record Membership

DONCASTER Wheelers have 97 members—excluding those serving in the forces—the number being a record.

Anfield "Twins"

TWO members of the Anfield C.C., now in the Middle East, went through five campaigns together. They are Sergeant P. Rock and Driver E. Reeves. Both come from Port Sunlight.

Provost Was Cyclist

LORD PROVOST WELSH, new civic head of Glasgow, was formerly a keen cyclist and a member of the Clarion.

Gift of Hostel

THE Scottish Y.H.A. has been given £4,000 to provide a new hostel in the Highlands after the war. The donors are the parents of a young naval lieutenant who was killed on active service in 1940.

Clarion Jubilee

THE National Clarion C.C.'s Jubilee meet at Buxton at Easter will bring together many old members of the club. A sports and social programme is being held during the holiday.

Death of Macmillan's Son

JOHN MACMILLAN, son of Kirkpatrick Macmillan, who fitted the first drive to a two-wheeled vehicle, died on December 12th at Liverpool.

"Prince" Bendon

THE death is announced at the age of 84 of "Prince" Bendon, a variety performer, who attained great fame in the '90's as a hill-climbing cyclist.

Farmer a Prisoner

FLYING-OFFICER CLIFF FARMER, of the Arden Wheelers, is a prisoner of war in German hands.

Track Opening

THE Butts Track at Coventry is expected to re-open this summer. It was formerly one of the best in the Midlands.

A cyclist's nightmare. A road in Syria with a corkscrew turn.

Club Notes

Hendry in 1944

ALEX. HENDRY, Glasgow Wheelers, star Scots rider of 1943, is to ride again in 1944.

Poloist Dies

GEORGE GOURLAY, Royal Albert C.C. and a star polo player in pre-war days, has lost his life while serving with the Navy in the South of England.

Kerr Changes

LEN KERR, the North Lancashire crack, has changed clubs. He is now a member of the Preston Wheelers, not the Fylde Road Club.

Mentioned

A MEMBER of the National Clarion C.C., Rochdale Section, Harry Brooks, has been mentioned in dispatches while serving in North Africa.

More Girls' Events

TWO open girls' events, at 25 miles and 10 miles, are to be held in Ayrshire in 1944. The 25 is an innovation for the county.

Around the Wheelworld

By ICARUS

The 43rd Wheelers' Annual

THE 43rd Wheelers, a new and progressive club, held its first annual dinner a few weeks ago. This lively Birmingham club, with Ray Crane as its secretary, has rapidly jumped into the forefront of active clubs. The "dinner" was held at Wootton Wawen, under the chairmanship of Mr. S. P. Busby. Members of the Redditch Road and Path Club, Rover R.C., the M.C. and A.C., Alton Wheelers, West Heath, and Birmingham Crescent Wheelers were represented.

Cycling on Synthetic

CYCLE tubes manufactured from GR-S (synthetic rubber) are now being issued. A letter "S," ½ inch high, will be marked on such tubes, rendering identification easy.

Ordinary patches may be used for the repair of synthetic tubes provided the surface of the tube is thoroughly cleaned with an abrasive material (sulphur remover or sandpaper); solution must be used to ensure good adhesion of the patch to the tube.

The Uncompromising Attitude

IN the course of a discussion with cyclists the other day, I drew attention to their uncompromising attitude during the past 50 years. I stated then, and I reassert here, that this uncompromising attitude has antagonised the Government Departments, and the time has come when those who lead our national organisations must make concessions and also take care to sound their members' views on particular aspects of cycling before representing views to Government Departments. If they do not do this they must get out. As it is, they merely represent their own views. It is certain, and Government speakers have hinted as much, that they will have to make concessions anyway, as they have over reflectors and rear lights, and it is much better to do it gracefully, and show a little of the spirit of sweet reasonableness rather than have the decision forced upon them willy-nilly.

Some of the leaders of the cycling movement have done it grave disservice.

1944 N.C.U. Diary

THE N.C.U. regrets to announce that the 1944 Diary is now completely sold out.

N.C.U. Renewals

THE secretary has to ask the indulgence of many members who are being kept waiting for their new membership cards and certificates. The difficulty is the tremendous rush of seasonal work in the office, and it is impossible to cope with everything immediately.

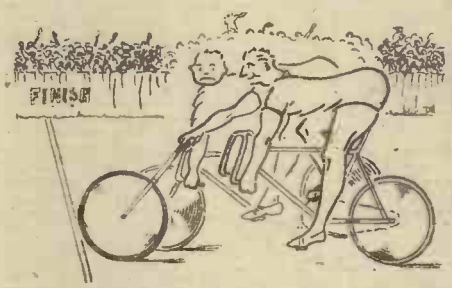
Members are assured, however, that every effort is being made, and applications for membership are being dealt with as promptly as possible, and in strict rotation of receipt.

Members will be interested to learn that membership for the 1944 year already shows an appreciable advance on 1943 at the same period.

Offer

THE C.T.C. offers a reward of 10s. to anyone giving information *which will lead to the conviction* of anyone depositing broken glass on the road or breaking glass on the road. This is, of course, a wonderful piece of work on behalf of cyclists. The C.T.C. in 50 years' time will tell the cyclists of that period of their great work on behalf of cyclists in the matter of broken glass on the roads!

We offer a prize of £1 to any cyclist who gives information to us which leads to the conviction of anyone found stealing a bicycle or a bicycle pump, or a bicycle lamp or any other part of the equipment. These are more important items than broken glass. But then we had forgotten! How very careless of us!! For has not the C.T.C. the right, which it obtained many years ago, to erect danger signs at the top of steep hills? The fact that those hills are no longer dangerous because of improved brakes, and improved bicycle design, does not take away from the C.T.C. its right to go on erecting them. Then, of course, the C.T.C. appoints tea houses where you can obtain watercress, bread, butter and jam at 1½d. cheaper than elsewhere. It will also teach you how to tour with half a comb and a



A trick cyclist takes up track racing.

toothbrush for 1s, 9½d. a week! Of course, as a member you must not be expected to have a say in cycling affairs. You must be *told* what to say by the council. You must learn to hate motorists, and cycle paths, and rear lights, and registration, and anything which the C.T.C. Council tells you to hate. On no account must you have views of your own. You may turn up at an A.G.M. of the C.T.C. and pass a resolution, but you must not expect any notice to be taken by the C.T.C. Council of such resolution. It claims to be a democratic body, but then so does Hitler-Germany. You can say what you like but no notice will be taken of you. That is the first principle of democracy—to be ignored.

Stupidity

LET us look at some of the stupid things that have been done by the national bodies. The N.C.U. made Dunlop a professional cyclist, although at that time he could not ride a bicycle. The N.C.U. accepts affiliation from time trial clubs, and yet it is opposed to time trials. It has a working arrangement with the R.T.T.C., which is the governing body for time trials. It claims to represent cyclists, when as a fact it represents a few hundred (at the most) licensed track riders. A record may not be made on any trial which has not been measured by the N.C.U., yet Harry Hill broke a record on the Paddington track; the record was disallowed because of a dispute over measurement, and it was not until we sent a surveyor over to measure the track that it was found that Hill had broken the record by a greater margin than was claimed. In any case, as the record was made on a track which *at the time* had not been measured by the N.C.U. the record was invalid anyway.

The Use of the Highway

THERE seems to be a popular belief, which apparently has been promoted by some of the less intelligent members of our national bodies, *that a pedestrian has first use to the right of the highway.* I therefore desire to inform the national bodies that this is not so. Everyone has an equal right to use the highway—a dog, a cat, an ox, an ass, a human being, a cyclist, or even (lowest form of life!) a motorist.

R.T.T.C. Copies the B.L.R.C.

THE R.T.T.C. is very concerned about massed-start racing. Having tried to kill it by subterfuge, they are now endeavouring to promote a rival event, a national championship. Now be prepared for an important item of news. The R.T.T.C. is actually going to permit the riders to wear jerseys. But there is a snag! The jerseys must be inconspicuous!!

Query

IF a man is awarded the D.S.O., does that mean he immediately qualifies for the Victoria Cross?

B.L.R.C. Notice

THE policy of the British League of Racing Cyclists is to encourage, and promote, in Great Britain, all forms of amateur and professional cycling, based upon international practice, and in conformity with Union Cycliste International rules. The league is willing to co-operate with other promoting bodies who are prepared to further this aim.

The foregoing statement was authorised for publication by the special general meeting of the league which was held last year.

Bartleet's "Museum"

HERBERT GOODWIN rang me on the telephone after the publication of my notes last month on the wrong claims made by Bartleet for a number of items in his museum, and confirmed what I had written. It is announced that he was a member of many cycling clubs. I think this is true in that he paid his subscription and attended the annual dinners, when he was expected to speak and receive the adulation of an admiring multitude! I repeat that he was not a cycling historian, and he was hardly a journalist. He wrote articles largely inspired by old cycling periodicals and books, and simply loved to be known as "Sammy." It was one of his beliefs that he was the natural successor to Bidlake, when, of course, he had not the training or mental ability or knowledge of cycling which Bidlake possessed. To compare Bartleet and Bidlake is to compare chalk with cheese. I suppose a memorial will be erected to him, but I do not know why, for he has no real claim to such perpetuation.

New Dunlop Director

MR. G. E. BEHARRELL has been appointed joint managing director of the Dunlop Rubber Co., Ltd. Mr. Beharrell was for some time director of equipment sales at Fort Dunlop, and has latterly been resident director at Birmingham and vice-chairman of the Dunlop Rim and Wheel Company. He is 44 years of age.

Mr. H. L. Kenward, director of general sales for the tyre division, has now been appointed a director of the company. He is chairman of the Tyre Manufacturers' Conference.

Wayside Thoughts

by F. J. URRY

Sheepstor, Dartmoor village.

Spares !

THE shortage of repairs and replacement is growing to the size of a scandal. Many of us with friends in the trade fail to understand the trouble and worry of the average rider in finding replacements for worn or damaged parts, or of the repairer in giving his customer the essential service to keep his bicycle on the road. Indeed, the position of the latter is pretty desperate; for he is often spending half the day searching for repair material, time that could be far more usefully given to actual repair work. Telephoning, I am told by many repairers, is just useless, because suppliers seem to have instructed their staffs to regret inability to supply, no matter what the commodity requested. Personal visits seem to be the only method by which the repairer can obtain essential goods. It is difficult to imagine that this state of things cannot be improved, for I believe if the material was made more readily available to manufacturers the labour shortage would to some considerable extent be overcome. We know—you and I—that firms solely on munitions have labour to spare, labour not so fully employed that it cannot undertake another job in the slack times. Then take the case of the repairer, worried and anxious to oblige his customers in the knowledge that an immobilised bicycle means a long and trying bus or train journey for his customer, and yet that willing man of repairs has to waste half his day searching for material that should be readily available. Week by week the position is becoming more difficult, and candidly I believe much of it is due to bad planning, and sheer lack of understanding by the officials responsible for the supply of bicycle material in not realising the major part the bicycle is playing in the solution of the transport problems. This paragraph, I agree, is destructive criticism, based on observation and a certain knowledge that the labour force in numerous factories is not being fully employed, and could be used to supplement cycle supplies; but how can anyone be constructive in their remarks when our present bureaucratic control treats bicycles as subsidiary, and not necessary articles to assist in solving transport troubles ?

The Right Way

J. A. PHILLIPS AND CO., LTD., have recently issued a neat little illustrated booklet on the upkeep and adjustment of the bicycle, and you can obtain one by writing to them at Credenda Works, Smethwick, Birmingham. The firm obtained permission to issue this booklet because Army machines were so terribly neglected by their riders, and there was no bicycle instruction book available. The firm has done a service to themselves and the trade by such forward policy, and it is to be hoped when the time comes along, and machines can be made in quantity and quality, the industry will see to it that every buyer has a volume of instructions on bicycle upkeep, and suggestions on the value of cycling for health and pleasure and utility. Too long have we taken it for granted that the general public know everything there is to know on the subject of cycling; they do not, and that has been proven during these war years to an extent that I would never have believed. I have had cases where a newcomer did not know that handlebars could be adjusted, or that a head bearing could be tightened. It doesn't sound true, but such experiences are within my own knowledge, and make me keener than ever on giving the post-war buyer all the information possible on the subjects of cycling and the bicycle.

The Latest Release

IN the middle of September my family went to Barmouth for a short holiday, and I joined them later, making the journey from Wolverhampton by bicycle. I could not start sufficiently early in the day to make one hop of the journey, and I'm not sure I'd have tried so to do in any case, for it is a pity to rush through Wales at the turn of the year (or any other time) when the colours are so varied, and the outline loveliness seems the more enchanting because you are not likely to see it again for several months. And, wonderful to relate, I had a hot, sticky east wind to waft me on my way, a misty wind that subdued the colours and limited the visions. In the late afternoon and evening I drifted forty miles to a comely cottage on the Severn plain, from the garden of which the Stretton Hills, the Brieddens and the border ridges make an inviting panorama to tempt the inquisitive wanderer. Next morning, after a night of thunder which did not clear the air, armed with lunch and fruit, and aided by that persistent and sticky east wind, I trickled comfortably through the valley of the Tanat, that pleasant introduction to Wales that leads to the barrier pass beyond Llangynog, Millter Cereg. It is a fairly stiff climb of 4½ miles running along the mountain shelf, and I walked the first 500 yards to eat an apple and change the exercise of leg revolutions, and then quietly rode the rest on a 43in. gear, taking just 50 minutes to make the complete ascent to over 1,500ft. I was duly rewarded with a glint of sun as I reached the moorland, a moving pool of shafted light dropping from the clouds and walking the heather with beauty of colour and form. To within sight of Bala Lake I scarcely turned a pedal and revelled in the steady fall from the wild moors to the greenery, grey-shaded with mist, in the deep valley.

More Thunder

FOUR miles beyond the road conjunction with Bala Lake I found a cottage willing to make me tea, and there for an hour I fed and smoked and watched the blue-black clouds gather below the ridges with the threat of storm. As a matter of fact the rain caught me at the summit of the rise on the Dolgelley road, just by the second railway bridge, where I sat at the foot of a mighty oak and watched the lightning play far down the valley. I did not want to unship cape and leggings and hoped this aerial anger would be but an interlude, but on this occasion fortune was not on my side, except in so far that the next seven miles were mainly a fall by the riotous river union to Dolgelley. There was no let-up that afternoon so the remainder of my journey down the glory of the Mawddach Valley was filmed with heavy rain that set every rill chuckling and streaked the mountain sides with the foaming passion of storm. It was a good ending to a good day, for only the mack got wet and tea was awaiting my arrival. Unfortunately, however, the thunder seemed to stir up the weather to do its worst, and the several days that followed were grey with rain. I cannot stay "put," for the habit of roaming is too strong in me, so out I went into the steady beat of water for a 20-mile jaunt amid the reeking, seeping rush and rustle of over-fed streams. There is a joy in wet-weather riding, you are doing something and seeing a lovely land under a different aspect than the one we all most adore, the sunshine and the purple cloud shadows. It was a grey-green swamp of a day and district, but there were pictures amid it, and the comfort of movement that makes a man appreciate the good fortune of a break from the dull round of work. And I thought as I came over the Bridge, how our desert lads would appreciate such an experience.

Quiet Times

I RATHER like this mixture of cycling with family excursions on train and bus. There is nothing violent about it, and you feel you are doing your duty and also managing to fill your own inclinations. With a pass in my pocket we went to Precipice Walk on one of the few fine days, the family per train and me per bicycle; lunched near the little lake and cooked our food with the aid of a primus, walked that glorious mountain terrace, and when I had seen them to the station, time left me a couple of hours to meander down the Mawddach Valley. And I meandered in the glow of the late afternoon sunshine, when for a change all the hill ridges were clear and seemed to lean against the sky and caress it. For nearly an hour I sat on a rock and watched a busy fisherman, busy with his lures, but I never saw that ripple of the stream that raises excitement in the heart of weilder and watcher alike. Still, I expect he enjoyed his smoke as much as I did, and both of us in our separate ways were doubtless saturated with the surrounding loveliness. Part of the enjoyment of cycling is undoubtedly in this pleasant pithering along a beautiful way, using kindly time amid the glory of the earth, totally unconscious of the fact that time is killing you. I went to Beddgelert and to Cwmbychan Lake on similar excursions, made contact with old friends whose English rippes o'er their tongues like the song of a mountain stream. And the value of a primus on such occasions is marvellous; you can always have a cup of tea, and if you have the knack of persuasion in your make-up can usually obtain something to cook and eat with the golden fluid.

And So, Home

THE day I started for home the atmosphere had in it the tang of autumn, and, glory be ! the wind had gone N.W. by W. and blew quite briskly. What luck to have a friendly breeze both coming and going; but the gods evidently meant to be gracious to the white-nobbed old thing. It was hard on 11 o'clock before I kicked off, for as I intended to make a two days' journey of the hundred odd miles, I was in no rush. Slowly the sunshine came through the mists and by the time I had reached the long slopes beyond Dolgelley everything was glittering with gold and the multi-coloured foreground of the Arans sweeping up from the green valley make the perfect mountain scene. So easy was the running that I slipped over the low pass on normal gear, and was in Bala just before 1 o'clock, a very hungry man, for toast and tomatoes do not make too reliable a foundation for 27 miles of riding, easy as it may be. Luck was with me on the third attempt, and I lunched well, was over the hill road to the Dee Valley, and into Llangollen all too soon, for that beautiful wind would not let me rest. A very good tea at The Hand, at Chirk, and 13 miles further a little nest made me welcome with warm hospitality that has sheltered me aforetime. And on the morrow I was sprinkled with numerous storms and sat sheltered while they blew over, once in the car of the High Sheriff of Merionethshire whom I met by Shifnal on his way to fill an official duty call. And so to Wolverhampton and the train, with the holiday season of 1943 ended for me.

Two cyclists arriving at a hostel, over two hundred of which have been provided in England and Wales by the Youth Hostels Association for catering for walkers and cyclists.

CYCLORAMA

By H. W. ELEY

An out-of-the-way inn at Sparsholt, Berks.

The Angler-cyclist

TALKING to a keen angler-cyclist the other day, he asked me whether I knew if any cycle manufacturer had ever devised any special fitment for the carrying of fishing rods, creel, and the other impedimenta of the angler. I had to confess that as far as I knew there was no such device or fitment on the market, but I may be wrong. This particular disciple of Izaak Walton seemed to think that it was high time that some such contrivance should be available, and he demonstrated to me, with rods and cycle, that it was a very awkward and amateurish business fixing rods and tackle to the bike. Also, he told me how good he found the combination of cycling and fishing—the bike enabled him to ride to distant stretches of water, where the wily roach, the pugnacious perch, could be tempted from their lairs with all those mysterious "baits" beloved of the fisherman. Well, I commend the idea of some special angler's device to our ingenious cycle manufacturers for what it is worth!

Haggis or Spam!

I FOUND myself, the other week, in the pleasant county of Berkshire, and I lunched at that good inn, "The Lamb," at Wallingford. Now, in these days of stringent rationing, one never expects much when the waiter comes round with the menu, but sometimes one does get a surprise . . . and I got one that wintry day in Wallingford, for the choice of dishes struck me as not a little extraordinary—*haggis*—or *spam*! Now, why should one have to go to Wallingford for haggis? It seemed a strange dish to find in a Berkshire town, and as I ate and enjoyed it, I fell to wondering why it came to be on the menu; was the proprietor of this very English and very comfortable inn an exiled Scot? It did not matter; but I will record that the haggis was delicious, and so was the satisfying jam-roll which followed it! But I could not help but think that to do the honours properly to this dish of Bonny Scotland there should have been a "wee drappie" of the genuine "mountain dew!"

Dunlop Rally

DUNLOP advertisements are usually interesting, and I took particular notice of one I saw in a cycling journal the other day . . . it reproduced a picture of a rally at Fort Dunlop, some time in 1938. And what a goodly crowd of cyclists were assembled on the Dunlop canteen veranda! Those "visits" which the Dunlop people used to arrange with such care were grand events, and will live long in the memory of anyone privileged to take part. Many cyclists, I fancy, find it very fascinating to see how tyres are made!

Cycle Locks

THEFTS of cycles are still far too common, and in view of the fact that the abominable thieving business gets a lot of publicity, and therefore no cyclist can pretend that he is not aware of the epidemic, it is strange that so many riders still fail to lock their machines when they leave them outside shops and inns and other places. I know that it seems a bad business that we have to take such precautions, but it is only common wisdom to protect our bikes . . . especially in these days when it is not altogether easy to secure a new mount to replace the one which some thief has "commandeered."

The Way to Health!

IT is always interesting to fall in with a veteran cyclist — some "old-timer" who can recall the good old days, and talk of makes of machines which have long ago disappeared, and muse upon the happy club "runs" of the long ago—in an age when our roads were innocent of cars, and there were good cottages which catered for cyclists, and provided wonderful teas for ninepence or thereabouts! I met such a man the other week not far from the ancient little city of Lichfield, with its stately and lovely cathedral, and its wondrous store of memories of Doctor Johnson. This old man was as keen a cyclist as ever he had been, and I smoked a pipe with him as we leaned over a little bridge and watched coots and moorhens disporting themselves in the water. He told me of the heavy "roadster" he used to ride in 1906, and waxed enthusiastic over the achievements of cycle manufacturers in reducing weight without sacrificing strength. He told me, with a certain nostalgia, of tours he made in Wales and Devon and East Anglia in pre-1914 days. He had had two loves—cycling and photography, and he emphasised how well these pastimes went together—how he had a wonderful collection of views of the English scene, all taken when on cycling holidays. And I fell to thinking how deep is the well of cycling joys; how possession of a bike enables one to indulge in all sorts of happy outdoor hobbies. And the old-timer emphasised something else, too—he was a splendid specimen of fitness, and he put it all down to cycling—and I do not think he was far from the truth! The cycling way is the way to health!

Importance of Cycle Tyres

THE war has given us all a greater appreciation of the vital importance of *tyres* in our modern world; and not motor tyres only! Oh, no! The cycle tyre is playing its regular and important part in the great struggle, and I was reminded the other day, by a girl cyclist who works in a cycle tyre factory, that she considered herself "very much on war work." Now, if she had been engaged in making shells, or tank parts, I could have understood her emphatic attitude . . . but I realised that she was right when she asked me how I thought the munition workers, thousands of them, would get to their jobs were it not for cycles and cycle tyres? And what about the farm worker—sometimes living some miles from his job? Yes, cycles, and the tyres with which they are shod, are very vital items of our gigantic war-effort. Let us not forget it.

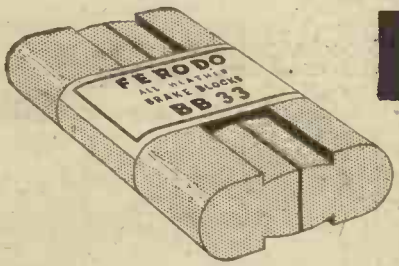
December Joys

A GREY December morning, and the air was very keen, and those great elm trees which, in high summer, were so gorgeously arrayed in green, were but bare and stark sentinels, lifting their arms to great and threatening skies. But I was tempted to ride out, nevertheless, to my village, where there is a farm I know, and a church, and an inn. And I soon became all aglow as I rode along the hard road—a road almost deserted. The plovers rose from the brown fields, and the rooks sailed overhead. In one cottage garden, although it was December, a solitary rose still bloomed, to make me dream of rose-glories next summer time. And when I arrived at my village there was a merry peal from the church bells . . . good campanologists are practising. The inn, with the swinging sign which depicts a reddish-brown fox with a duck in its mouth, was open . . . and after my ride I was ready to do full justice to a tankard of ale. December—yes—but the joys of the out-o'-doors are always there for the nature-lover.

Now Ready
REFRESHER COURSE IN MATHEMATICS, 8/6, by post 9/-, from Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

AWHEEL . . .
IN SAFETY

When the winding road calls again and you are spinning awheel far afield among your favourite haunts, look to your safety. You will be wise if you fit Ferodo All-weather Brake Blocks. Wet or dry they possess great holding power yet grip smoothly and noiselessly, providing safety in all emergencies. Be sure to fit



FERODO

ALL-WEATHER BRAKE BLOCKS

FERODO LIMITED CHAPEL-EN-LE-FRITH.

REGD. TRADE MARK FERODO


St Mary the Virgin, Adderbury (Oxon)
'For Strength'

My Point of View

BY "WAYFARER"

Starting Well

ON the first day of the New Year it was my good fortune to see primroses in bloom in a Worcestershire lane. On the following day—a day of great beauty, with an amazing colour scheme—I obtained long-distance views, from various standpoints, of the grey line of the Malvern Hills. I saw also Bredon Hill, and had a "close-up" of the Cotswolds. Altogether, thanks to the good old bicycle, I made a jolly fine start in 1944.

Unheeded Warning

AT one point on my daily ride to business I descend a short hill and skirt a roundabout. On winter mornings, when Jack Frost has been at work, I treat that descent and bend with considerable respect. I "mind my step," always believing that discretion is the better part of valour. Not so some of my brother (and sister) cyclists, who dash forward as though conditions were normal. As I go on my way, with quickening pace as the road surface improves, it is quite usual for me to hear a crash, and I know that somebody has failed to use his (or her) head, and, in consequence, has "taken it lying down." It seems a pity, because the lesson is so obvious.

Stepped-up

ELECTRIC battery lamps have recently been stepped-up in my estimation. Reaching home from business at 8 p.m. the other day, I put my bicycle in its stall, switched off the front lamp—and forgot all about the red glow behind! Three hours later, when locking up the house prior to retiring to bed, I discovered my omission, and did the right thing, conscious of being a temporary squander-bug. I have no record of what service that battery had previously given me, but on the following Saturday the lamp was in use for two and a half hours, and a week later for another two hours. Thus, with various odd quarters, the life of the battery must have been in the neighbourhood of 10 hours, which I submit is not at all a bad performance. Evidently I thought the thing would "go on for ever," after the manner of Tennyson's brook: I continued to use the lamp, which ultimately, of course, let me down along the road. Despite this last experience (which served me right), I think rather more of battery lamps than before—though I am known to develop considerable conversational powers when anything goes wrong!

Improved Forward Lighting

MENTION of lamps reminds me that I have been just a bit slow in the matter of wartime lighting. At the outset it struck me that the use of a gas lamp might constitute a breach of the spirit, if not the letter, of the law. Moreover, I had no stock of carbide, and there was then some little difficulty (so my information went) in obtaining supplies, a licence, or something of the sort, being necessary. So, without more ado, I wrapped up all my gas lamps, to exclude the moth, and put them away, determined to be satisfied with electric battery lamps. For short journeys these are very convenient and fairly adequate, but they do not fill the bill for the amount of riding in the dark I desire to do, even in wartime, and the length of my night jaunts was considerably restricted.

The improvements in the masking arrangements, announced a few months ago, was certainly a step forward, which was reflected in the extension of my evening journeys. I observed, however, that some of my friends, using dynamos or gas lamps, were showing a volume of light which approximated to that exhibited in pre-war days, and at long last the penny dropped, as the saying is. For a nimble tanner I had one of my medium-sized gas lamps masked to conform with the law as revised, and a supply of carbide (of which, it is said, there are ample stocks in the country) was obtained, and now I am doing considerably longer rides in the dark, in greater comfort and safety, and at much better speeds. The forward beam of my lamp is certainly not up to pre-war standard, thanks to the blacking-out of the top half of the front glass, but I travel with a good flood of light to herald my coming, and the glare spreads right across the average road, from one hedge to the other. This is certainly a vast improvement on the feeble illumination that I have been using in the last few years, and I look forward to a new lease of life as a night-riding cyclist, content with wartime restrictions until that happy day when the Defence Regulations can be set aside and pre-war illumination resumed.

"Danger"

I HAVE my own views on the subject of cross-roads, bends, and hills, etc., which are marked down as "Dangerous," believing that the label should be transferred to the careless individual who creates the hazard by his bad behaviour—and believing, also, that these danger-signs, in any case, are so hopelessly overdone that they defeat their own purpose. In other words, "Wolf!" is cried so often that the reaction of the man-in-the-street can best be indicated by the scathing "Sez you!"

The worst example of this prostitution of "danger" signs came specially to my notice one day recently when I saw a man repainting a "Dangerous Cross Roads" announcement. On investigating the matter, I found that a few yards ahead two other roads did indeed enter the highway on which I was travelling. On the right was a road carrying, in normal times, very light traffic; on the left was a narrow lane which is practically a *cul de sac*. And mark this: *both these side roads are provided with "Halt" signs!* So where, please, is the "danger" to users of the main road?

I trust that it is not too much to hope that, when the good days return, our roads will not be so thoroughly cluttered up with warning signs as they were prior to the war. Many of these roadside announcements proclaim the obvious and can well be spared, and if seems to me that our energies could be much better employed in the education of road-users, of every class, so that they would learn to appreciate the folly of doing mad things on the public highway.

Timely Warning

A WORD of warning may be uttered with regard to the elongated carriers (45 or 60 feet in length) which are used for conveying damaged aircraft to repair depots. The service name for these vehicles is "Queen Mary," after the Atlantic liner. I have seen cyclists accelerate when overtaken by one of these immense vehicles, but wisdom suggests that the reverse operation should be indulged in, so that the "Queen Mary" can get clear as quickly as possible. There is always the likelihood that the driver may have to move into the side of the road before he has completely passed the cyclist, and the latter may thus unconsciously be placed in a position of grave danger. So that it is a good plan to let the big stuff pass out of your life as quickly as possible. Retard your own speed slightly, and let the "Queen Mary" get on with it.

Notes of a Highwayman

By LEONARD ELLIS

Blacksmith or God

NOT only Sir Walter Scott but also Rudyard Kipling was intrigued by the romance of the spot called Wayland's Smithy on some maps. The place is also known as Wayland Smith's Cave. It figures in the historical novel "Kenilworth," and is also referred to in "Puck o' Pooks Hill." It is a lonely spot and one that the cyclist would most probably miss unless directed there by prior knowledge. The cave or smithy is merely a heap of stones standing in a tiny coppice. The spinney is just one of many on the Berkshire Downs along the Ridgeway, and surrounded by the flinty soil of the neighbourhood, covered, according to the season, by waving corn or stubble. The heap scarcely deserves the name of cave as the enclosed space would only shelter one person, and then only if he were content to sit on the floor. It is really just one of the hundreds of burying places or long barrows that has weathered, in other words the core of a tumulus from which the earth has eroded or been removed. It is doubtful whether a Wayland Smith ever existed, but one story of his origin says that he was a heathen god named Weland, a relative of Thor, the god of thunder. With the downfall of the gods Weland was compelled to earn his living as a smith.

An Ancient Highway

STILL conscious of his god-like ancestry he did nothing to encourage custom and the only way to obtain his services was to put a silver penny on a stone and leave the horse for ten minutes or so. At the end of that time the customer returned to find the horse ready shod and the penny gone. The fame of Wayland Smith is of course much older than the mere shoeing of horses on the Berkshire Downs. In the old legends, even outside England, he was famous as the forger of swords, and the maker of magic boats. The old trackway on which the cave stands is one of the most interesting in the country—it is of course the Ridgeway or Ickneild Way. The tourist will not waste his time in this locality, as apart from the Smithy, there is the famous White Horse only a mile or two distant. As a horse it cannot compare with many of Wiltshire's more modern examples, but there seems little doubt that it can give all of them many centuries, and is supposed to date back to the Iron Age. This hill carving and the quaint old "blowing-stone" at Kingston Lisle are mentioned in "Tom Brown's Schooldays." The stone is simply a huge chunk of perforated rock. By applying the lips to it and blowing in a certain way weird wails can be produced and it is said that these were used as a rallying call by Alfred's soldiers.

A Cornish Ogre

CORNWALL is a land of legends and one of the wickedest of its ogres was called Tregeagle. It is rather curious that many of these stories, supposed to go back thousands of years, seem to centre around a man who actually lived in the seventeenth century. Jan Tregeagle was the steward of Lord Robartes, and his record in dealing with the local peasantry was black indeed. So far is fact, but the stories about the ogre Tregeagle are centuries older in style. For his sins he was condemned to perform all sorts of hopeless and impossible tasks. To complicate matters the demons were perpetually on his track and they attacked him if ever he ceased work or completed a job. One of his tasks was to empty Dozmary Pool by means of a limpet shell with a hole in it. Looe Pool, near Helston, is caused by the River Cober swelling into a lake owing to a sand bar preventing its exit to the sea. The sand is said to have been spilled by Tregeagle in endeavouring to carry out one of his hopeless missions.


Looe Pool, Cornwall.

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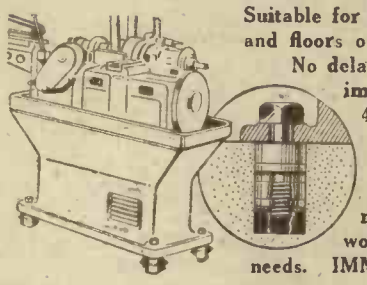

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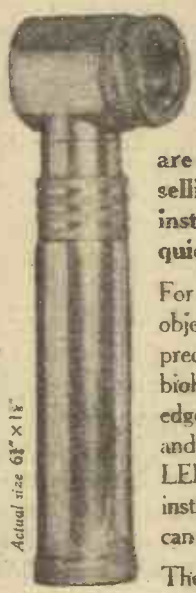

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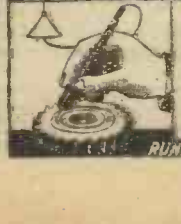

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