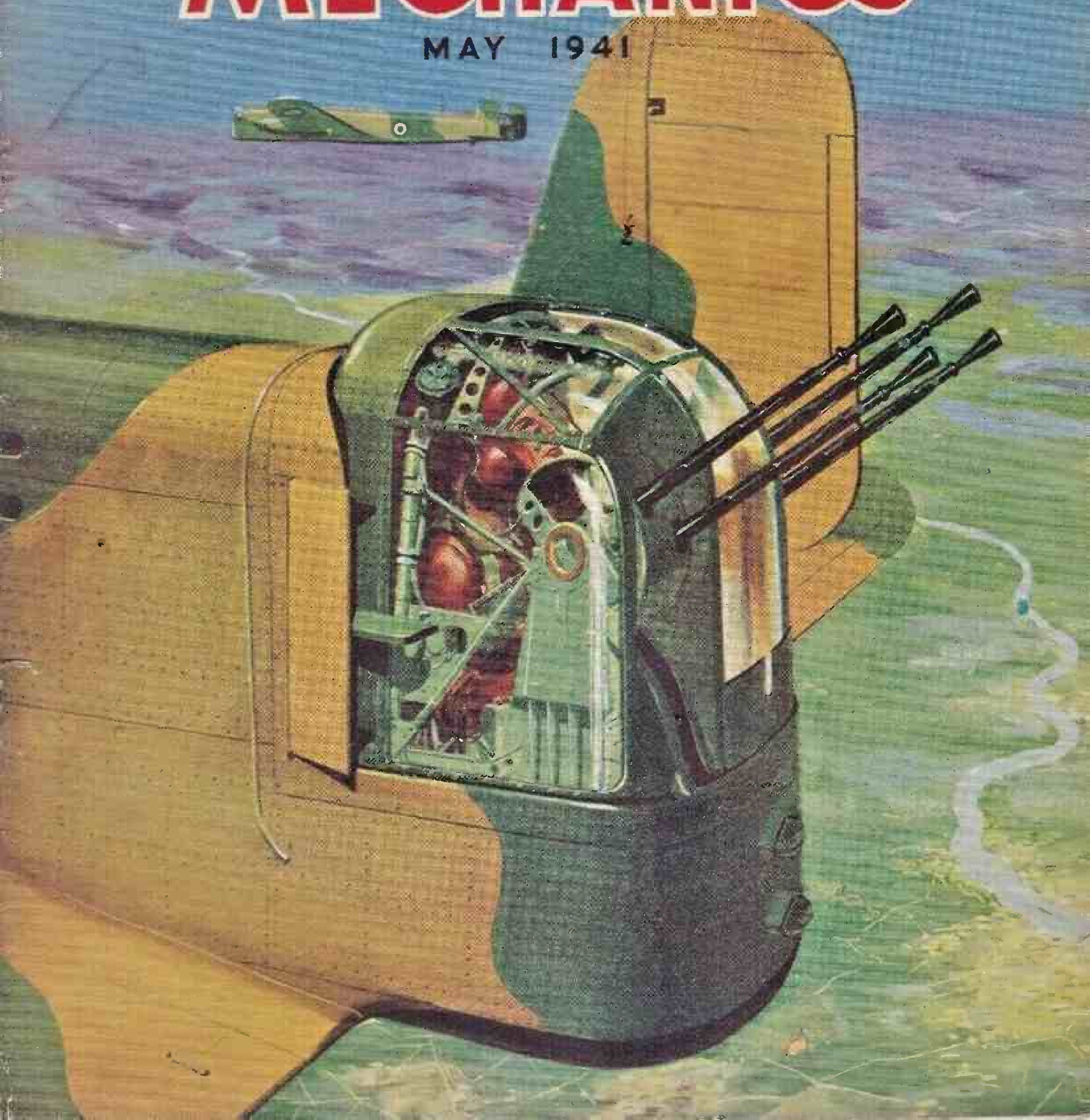
AIRCRAFT ARMAMENT

NEWNES

9d.

PRACTICAL MECHANICS

MAY 1941



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Editor: F. J. CAMM

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FAIR COMMENT
By the Editor

Brainpower as War Weapon

I HAVE raised the matter of inventors and inventions in these columns on a number of occasions, stating that there seemed little encouragement for inventors to tread the thorny paths of penury in the hope of eventual reward. In fact, inventors are positively discouraged, and looked upon as queer people. It must be admitted that many are, but that is no reason why we should continue so to regard all inventors. We need an organisation, sponsored by the Government, to sort the wheat from the tares. No one wishes to waste time on the crazy person who regards himself as a heaven-sent genius for inventing everything that needs to be invented—the sort of person who regularly writes to editors of papers asking for lists of things to invent. None of these has the necessary technical training or education to invent. They make some half-baked suggestion and want someone else to work it out. They have no knowledge of whether the idea has been tried before, and have not the intelligence to see the snags. Those are not the inventors to whom I refer. I am referring to those with technical knowledge and practical training who, by virtue of their knowledge and their work in dealing with and also making the inventions of others, are able to devise improvements. Their minds are trained to invent, and many thousands of them do invent and submit their ideas to firms and to Government departments. Most large firms encourage this by having a Suggestions Box, and rewarding those who submit suggestions adopted. In some cases a reward is forthcoming if the suggestion is good. but cannot be adopted for one reason or another.

Invention is a weapon of war, for anyone who can produce 101 shells in the same time as it takes at present to produce 100, is helping the war effort. So we require to give greater encouragement to what I prefer to call thinkers rather than inventors, and the only way this encouragement will be forthcoming is for the Government to form some new Ministry, composed of scientists, chemists, and technicians, who will investigate suggestions put to them and, if necessary, experiment with them. We are behind all other countries in this respect. Brilliant British inventions have, in the past, been sold abroad, because it has been impossible to evoke interest in this country.

Our first consideration must be to win the war, and if a Ministry of Inventions were formed it could help to solve the problems of the various Ministries associated with the fighting Services. It could help to solve problems of manufacture, and problems of marketing. It could circularise inventors and place before them the problems which need to be solved. It could place before appropriate manufacturers or appropriate Ministries, inventions which, after investigation, it knew to be workable and commercially possible. In a word, it would organise the thinkers of the country. Now is the time to set about it, for whilst it would perform great service during the war, it will more than ever be needed in time of peace, when manufacturers will be considering what to make and what to market. In fighting a war, we must not forget the peace which must inevitably follow. Do not let us make the mistakes which we made after the last war, in drifting into a state of national complacence. If, as we are told, we are to build again and to create a new order, it is not too soon to set about the task, even during the war.

We do not want unemployment to follow the war-time period of fierce activity. Work must be found to avoid unemployment. Inventive ability will be required in this direction.

I make the suggestion once again, therefore, that we require, at once. a Ministry of Inventions and Ideas. The Minister of Transport has recently formed the War Transport Council, whose function it will be to advise the Minister on questions of transport policy. In addition to examining all matters which the Minister will refer to them, members will be invited to put forward proposals which, in their view, would increase the contribution which transport is making to the war effort. We know that Germany for years had planned her transport from a strategic point of view, and we knew that her splendid motor roads were not constructed with the idea of providing fast and safe stretches for motorists. The Minister of Transport has realised that during the war we must remodel our haphazard transport system, which has been more concerned with building tubes to pleasure spots and carrying people to week-end holiday resorts, than it has with the safety of the country.

In many respects the British public had run soft. It was beginning to regard work as something to be avoided like the plague. It was plumping for more and more pay for less and less work; it required holidays with pay; it had developed the revolting Friday to Monday week-end holiday habit; it had become jazz-soaked, dance-mad, radio-minded; the war has stopped that, and brought us up with a jerk. We must all now eschew holidays and work long hours.

What the Ministry of Transport is doing every Government Department should be doing, and their efforts can only be co-ordinated by the formation of the new Ministry which we have suggested.

"Practical Engineering"

OUR weekly contemporary, "Practical Engineering," which is published at 4d. every Thursday, has recently completed its first year of existence, and finds itself in a leading position among engineering journals. Packed with articles which appeal to draughtsmen, designers, toolmakers, turners, fitters, foundrymen, pattern makers, millwrights, progress men, and all those engaged in engineering and kindred trades, it has filled a gap in engineering periodicals. It is obtainable only to order, of course, for newsagents are not allowed to return copies, by Government order, and naturally they merely order from us such copies as are ordered from them by members of the public.

Branded Goods

THE President of the Board of Trade, speaking in the House of Commons, said most people desired to keep their brands and trade marks in front of the public, and in many cases where industries were engaged in Government work, manufacturers were keeping their brands in front of the public by means of advertisements. The Government would give all the help they could to keep these trade marks alive. Mr. Norman Moore, President of the Institute of Incorporated Practitioners in Advertising, points out that there is a vast difference between the maintenance of the production of a branded article and the presentation of a branded name. The Government have decided that there must be further restriction of production and supply of certain goods, in order to release more labour and machine power for the nation's effort. This means that a number of firms engaged in the production of branded goods will have to pool their manufacturing resources and produce a smaller range of articles of war-time standards of quality instead of the widely varied and individually branded goods which they produce in normal times. This contraction of the range of branded goods available to consumers may be inevitable, but it is to be hoped that manufacturers will realise the importance of maintaining, so far as possible. the existence of established brands and trade names.

Defiants, which are two-seat fighters, tarting off for a night patrol.

Aircraft Armament

The Advantages and Disadvantages of Machine Guns and Cannon are Discussed.

THE design of military aircraft has made rapid strides during the past few months, and designers have succeeded in producing a plane that is both fast and heavily armed, two features that are essential for the success of the plane when engaged in aerial combat. The fire-power of the single-seat fighter has been considerably improved by the installation of machine guns and shell-firing cannon guns, or both. The enclosed, power-operated gun turret has also brought about an immense improvement in the accuracy of gunfire from multi-seater aircraft. The efficiency of the enclosed gun turret is proved by the fact that all of the leading air powers have adopted it in various forms, but there seems to be a difference of opinion regarding the effectiveness of a battery of machine guns as against the cannon gun. The cannon, which is classed as a large-calibre machine gun, is capable of firing a shell weighing anything up to 1 lb. and cannot be considered as a new weapon. It was first used in the Great War in 1918 by the French Air Force, but had to be abandoned because the heavy recoil of the gun was considered dangerous. Since its revival in the present war, however, it has been considerably improved, and its protagonists now claim for it a high degree of efficiency.

They claim that its power of destruction is far greater than any machine gun yet invented, that it has a longer range, and that its heavier shell will destroy a modern all-metal military plane far quicker than machine-gun bullets. In fact, if the plane is not hit in a vulnerable spot it can be practically riddled with machine-gun bullets without being put out of action.

Warming up! A pilot firing off a few rounds to make sure his gun is in proper working order.

Where the Machine Gun Scores

On the other hand, those who support the claims of the machine gun, whilst acknowledging the superiority of the cannon in these respects, state that the rate of fire of the cannon is much slower and, therefore, has a much smaller magazine capacity than the machine gun. Further, they advocate that a far greater number of projectiles can be fired by a machine mounting a battery of eight machine guns than any cannon-equipped machine. It is also claimed for the machine guns that when at close quarters it is possible to envelope your opponent in a veritable spray of leaden death, which they state is far more effective than trying to hit an enemy at six miles a minute with a cannon gun. From this it will be seen that there are advantages and disadvantages on either side, and the only way in which a plane can be efficiently armed is to fit it with both types of gun. In this way the pilot can use the large-calibre cannon gun for long range work, and the machine guns for pressing home the attack when at close quarters with the enemy.

The cannon gun has predominated in the armament of most of the German planes, but it is only of recent date that the Royal Air Force have tried it out on British machines. A number of Hawker Hurricanes and Supermarine Spitfires, at present armed with batteries of eight .303 machine guns, have been fitted experimentally with cannon.

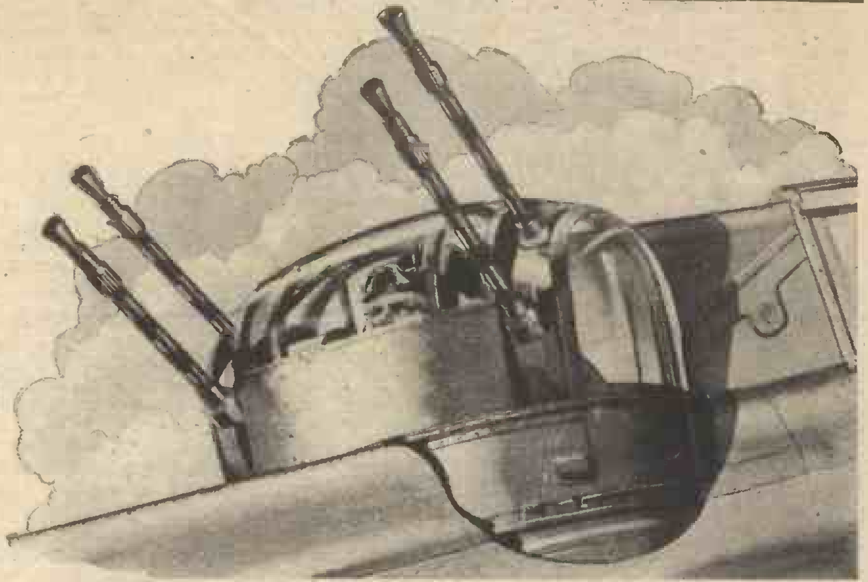
Types of Cannon

There are a number of successful types of cannon in use to-day, the best known being the Danish Madsen, the Oerlikon, which is of Swiss design, and the French-built Hispano-Suiza. Whether all of these guns are still being built at the present time I cannot say.

The Oerlikon gun is of 20 mm. (.786 in.) calibre and, complete with a 60-round magazine of shells, weighs 160 lb. The muzzle velocity of its projectiles is 2,700 feet per second, which is several times greater than that of a machine-gun bullet. This is an important point, since the greater the muzzle velocity the greater becomes the range at which a shot can be fired with only a small allowance for deflection.

The Danish Madsen, which is similar in weight to the Oerlikon, is a gun of 23 mm. calibre, and it is claimed, fires shells of considerably greater explosive power. Its rate of fire is given as roughly 400 rounds a minute, and its shells are carried in belts of 100 rounds instead of being carried in the usual magazine.

A special type of shell-firing gun, known as the *moteur canon*, was developed by the French Hispano-Suiza Company. The feature of this gun is that the gun barrel lies along the top half of a vee-shaped aero-engine, and its shells are fired through the hub of the propeller of the machine. The gun weighs about 100 lb., is of 20 mm. calibre, and carries a 60-round magazine weighing about 60 lb. Its rate of fire is the same as the Madsen—400 rounds a minute—and the muzzle velocity of the gun is about 2,890 feet per second. The use of the *moteur canon* is limited, however, in that it can only be incorporated in a machine with a vee-type engine.

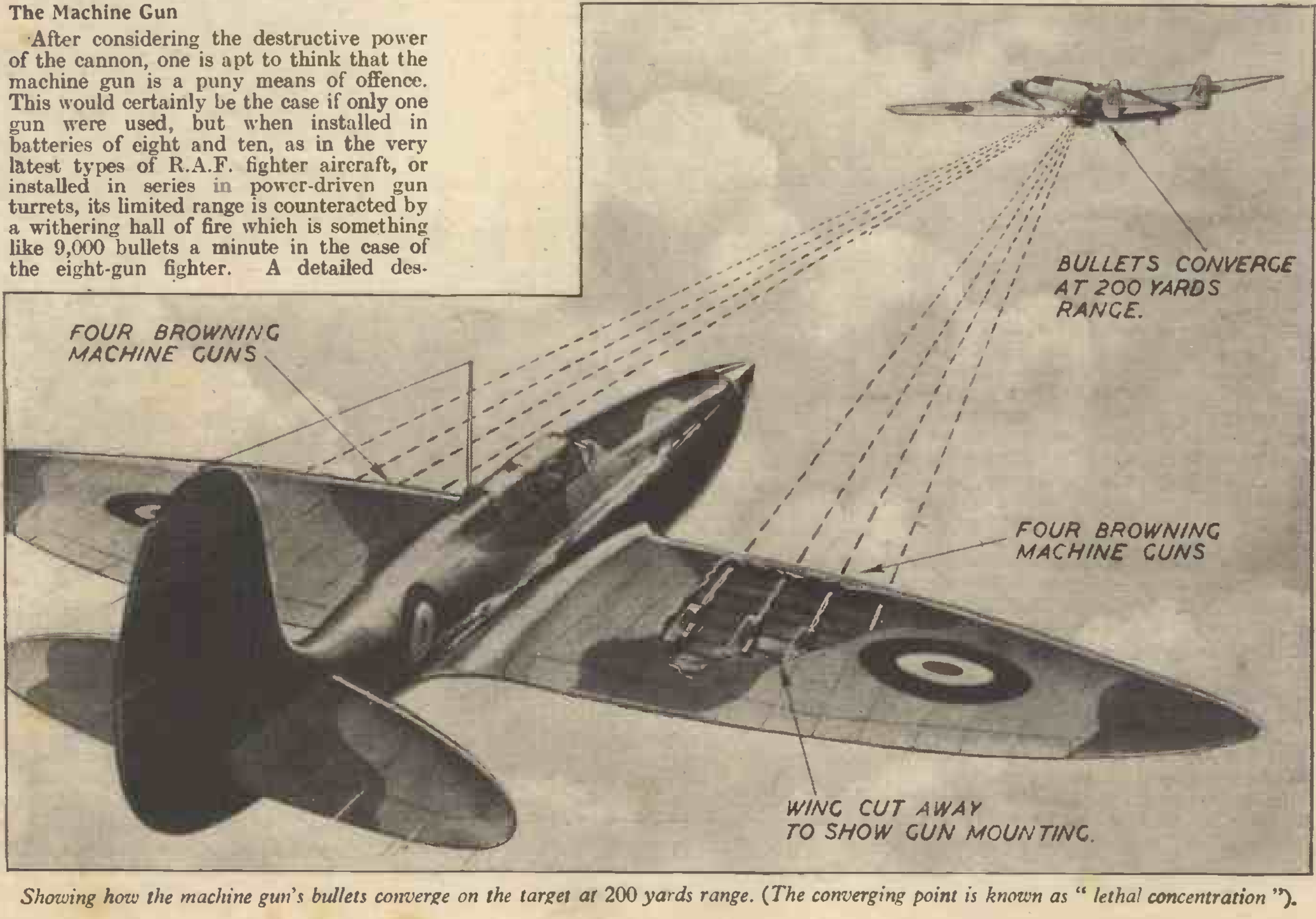


The gunner ready or action. Vertical slots each side of the gun turret enable the guns to be moved up or down over the full vertical range.

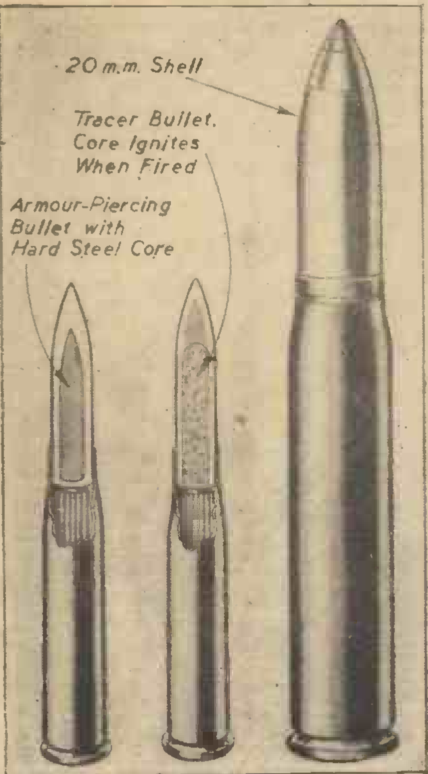
The Machine Gun

After considering the destructive power of the cannon, one is apt to think that the machine gun is a puny means of offence. This would certainly be the case if only one gun were used, but when installed in batteries of eight and ten, as in the very latest types of R.A.F. fighter aircraft, or installed in series in power-driven gun turrets, its limited range is counteracted by a withering hall of fire which is something like 9,000 bullets a minute in the case of the eight-gun fighter. A detailed description of the latest types of machine guns with which the R.A.F. are now experimenting is not possible as they are kept a close secret. It can be said, however, that a number of new weapons are known to be engaging the attention of armament experts, and are believed to show considerable advances on any existing type. The R.A.F. are at present using machine guns mainly of the Lewis. Browning and Vickers types. During the last Great War, the Vickers gun was used, but the gun in use to-day is of a greatly improved type which was first used in the R.A.F. in 1936. The Browning, which is sometimes called a Colt, is an American gun of modern design, which is now manufactured in this country.

The method of operation of both types of gun is on the barrel-recoiling principle, and two forces automatically operate them. The recoiling parts are forced backward by the explosive charge in the cartridge, and they are then carried forward to their original position by a strong spiral spring. During the period whilst this movement is taking place, the empty cartridge is ejected and replaced with a live cartridge, and a fresh round is brought up into the feed



Showing how the machine gun's bullets converge on the target at 200 yards range. (The converging point is known as " lethal concentration ").



Tracer and armour-piercing bullets, and a 20 m.m. shell.

block. The calibre of the ammunition is .303, and the cartridges are in belts of 250 rounds. The pins in the links of the belts are the cartridges themselves, and as they are fed into the block, the link, of which it was the pin, falls away. In order to avoid the metal clips and empty cartridge cases falling into the slipstream and causing damage to the plane, they are collected into chutes or similar receptacles fitted on either side of the gun. Vickers and Browning guns generally fire at the rate of 1,000 rounds a minute, although in some cases this is speeded up to nearly 1,500 rounds a minute by means of a special speeding-up device.

Synchronised Guns

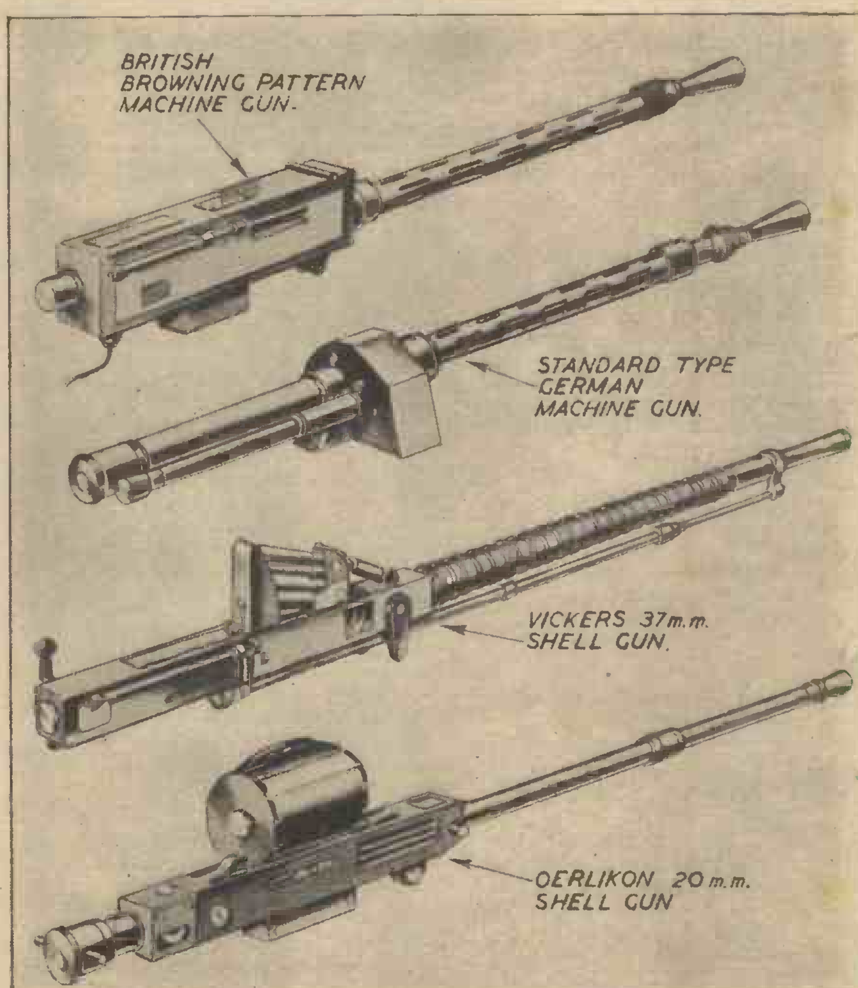
At one time, R.A.F. fighters were armed with two fixed guns fitted on either side of the engine in troughs and synchronised to fire between the blades of the propeller. The advantage with this type of installation was that the pilot was able to make suitable adjustments if the guns jammed as the gun breaches were inside the cockpit. In fact, the entire gun block could be replaced, if necessary.

To-day, greater fire power has necessitated drastic alterations in the position of the guns (usually a battery of eight), and they are now mounted in the wings of the plane. This outboard method of installation has meant that the guns can be fired at their maximum speed, whereas in the former method the rate of fire was dependent on the speed of the engine. With the outboard layout, however, the pilot is at a disadvantage, as the gun breaches are not accessible, and therefore he cannot clear the guns if they jam. This cannot be called a serious drawback, however, as with a battery of guns, it is hardly likely that they will all jam at the same time.

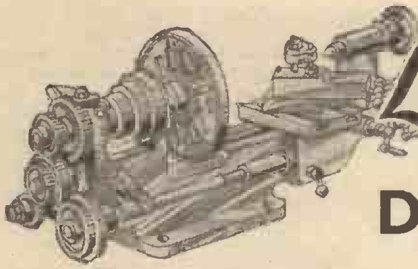
The firing of a battery of guns of the outboard type is usually carried out by means of electric solenoid trigger motors, connected through the battery circuit to a trigger mounted on the pilot's joystick. Loading handles operated by remote control reload the guns. Also the pilot need not fire the full battery in unison as there is a switch panel in the cockpit which enables him to select any particular group of guns he wishes to fire. The Spitfire and the Hurricane are two typical examples of multigun outboard installation, both of which have eight .303 Browning guns set in the leading edge of the wings, and firing clear of the airscrew disc.

Gun Turrets

It is not possible to give very much information concerning gun turrets, as details are not available for publication. They are generally fitted in the nose and tail of bombing planes, and consist of a cylinder with dome ends covered with transparent material. The guns which are of the single, or double Lewis type, are carried on a pivoted gun arm inside the turret. Vertical slots extend the whole depth of the turret, and through these the guns project. The slots enable the guns to be moved up or down over the full vertical range. The seat for the gunner is supported by a hydraulic ram, which, in turn, is connected to a pair of smaller rams coupled to the elevating gun arm. The rams are so arranged that the gun arm just balances the weight of the gunner, and as the seat goes down, the guns go up, and *vice versa*. The necessary power to rotate the turret bodily on its bearings is supplied by a reversible pneumatic motor geared to the turret and operated by an engine-driven air compressor. Thus, the gunner is able to follow his target through the gun sights by a slight pressure on a handle. Hot air drawn from a heater muff on the engine exhaust is used to warm the interior of the turret. It is turrets such as these that have added considerably to the defensive power of the bomber. In conclusion, it is interesting to note that many of the latest type of aircraft are now being fitted with both cannon and machine guns, so that they can be equally destructive at both long and short range.



Various types of British and German Machine Guns and Shell Cannon as used in modern aircraft.



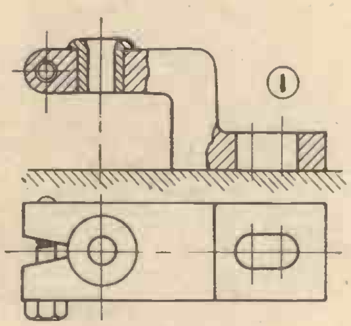
Lathe Work

DRILL STEADIES

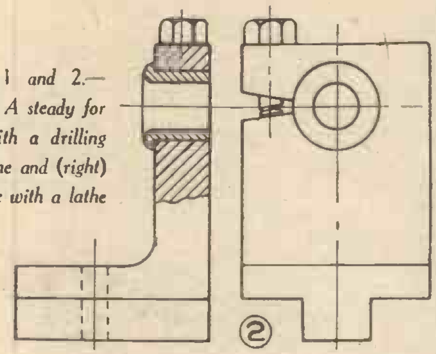
Two Types of Steady are described below. One for use with a Drilling Machine and the other for a Lathe

WHERE accurate drilling is desired on a number of parts a drill steady helps to obtain holes of correct diameter. It prevents the drill cutting larger than its own diameter even if slightly incorrect in the grinding.

It is well understood, of course, that a drill ground with one lip larger than the other will, if not guided, cut a hole of a diameter larger than its own size. Roughly the hole will be in diameter twice the length of the long lip of the drill. Also a drill ground unequally, and not guided may cut a hole wrongly located—a little to one side or the other of the exact location desired.



Figs. 1 and 2.—(Left) A steady for use with a drilling machine and (right) for use with a lathe



The two drill steadies shown in the accompanying drawings will suggest similar jigs for use in special cases. Fig. 1 is a steady for use under the drilling machine spindle and is bolted to the machine table with the guide bush axial with the axis of the drilling machine spindle. Fig. 2 shows the same principle for drilling in the lathe.

The Base

The steady shown in Fig. 1 can be forged out of a piece of wrought iron bar. Its dimensions will be according to the job it has to do. The base is flat and the top forward extension is flat also and dead parallel with the base. The hole in the forward extension is to take hardened and tempered guide bushes for drills of different diameters. It is intended that these bushes shall be interchangeable, and to ensure their firm fixture in the jig the latter is slotted as shown and a set screw is fitted to draw the jig tightly around the guide bush.

All guide bushes are of the same diameter externally to fit the hole in the jig. Their internal diameters are varied to suit the drills which will or can be used on the various jobs.

To make the jig or steady, forge the iron to the shape shown having top and bottom surfaces as near parallel to each other as possible. Then drill holes along a central line to make the slot in the base. Drift these holes into each other and file the slot. Now chuck the steady on the lathe face plate by the slot so that the position for the centre of the hardened guide bush comes in the axial line of the lathe mandrel.

Surface the top and drill a $\frac{1}{2}$ in. hole. Then, with an inside tool bore out the hole to the outside diameter size of the bushes we are going to use. Let this diameter be a standard diameter—say $\frac{3}{4}$ in. for medium-sized work. Then drill a hole, tapping size for the clamping set screw, right through the end of the top surface of the steady and then open it out, for half its length, to the over thread size of the clamping screw. Now saw the solt, shown in the plan view. The hexagon headed set screw can then be fitted and will clamp the hardened guide bushes tight in the steady.

Bushes

Now chuck the steady by its top surface on the face plate of the lathe, place a bolt and nut through the guide bush hole, and surface the bottom surface. The two surfaces will then be parallel with each other. The bushes will be turned from cast steel bar to the shape shown in the side sectional view, Fig. 1. They will be bored inside to suit the drill to be used and turned outside to fit the slotted clamping hole in the steady forging. At the top they have a shoulder to locate their height and are flared inside for drill entry, when commencing the drilling, and rounded outside for symmetry as shown in the sectional view.

They are hardened and tempered by heating to a full red colour, quenching, drawing to a golden straw colour and finally quenching. To draw the dead hard bush to the straw colour use a piece of red hot rod in the hole. When the straw colour appears at the inside rounding at the top, quench. This procedure will apply to all the bushes mentioned in this article.

The Body

In Fig. 2. is shown a drill guide for use on the lathe. The body is of cast iron, cast from a wooden pattern of the same shape. The tenon at the bottom fits deep between the lathe ways and a hole is drilled, as shown dotted, for a holding down bolt and nut to clamp the steady anywhere along the lathe bed. First file up the bottom flat and the tenon to fit between the lathe bed ways without shake sideways. To drill the casting for the bush slide the casting along the lathe bed feeding it up by the tailstock barrel. Then forge a cutter and chuck it in the three jaw chuck. Turn it to the width of the hole required and then back it off, leaving the cutting edge that size. Harden and temper it and re-chuck it. It can then be used to bore the hole (already drilled undersize) in the steady feeding the casting up by the tailstock barrel as when drilling the preliminary hole.

The bushes will be made to the diameter of the cutter across the cutting edges. The hole is now slotted as seen in the front view, a tapping size hole is drilled for the pinching set screw and tapped for the right thread and drilled out thread clearance size at the top. The set screw fitted will clamp the steady around the bushes and always the centre will coincide with the lathe mandrel axis.

In Figs. 3, 4 and 5 is shown a drill guide (also for drilling in the lathe) which will accommodate six guide bushes of different sizes. The bracket A is cast from a wooden pattern of the same shape and size and is fitted to the lathe bed as in the case of Fig. 2. The central hole should come at a height below the lathe centres equal to half the diameter of the circle upon which the row of guide bushes are arranged in the disc. The body, after the central hole has been drilled, can be driven on a stub mandrile held in the three-jaw chuck and turned to fit the casting hole a driving fit. The surface against which the guide bush disc fits can then be turned. The base must be parallel with the lathe axis. This will be ensured by feeding up the casting by the tailstock barrel when base and tenon are in close contact with the lathe bedways to drill the first hole.

The Back Plate

The central hole is then tapped, a suitable Whitworth rate, and the screwed stud is turned and fitted as shown in the sectional view. The back plate of the casting is slotted (by drilling and sawing) as shown at x in Fig. 4, the central view.

Figs. 3 to 5.—A drill guide for the lathe which will accommodate six guide bushes of different sizes

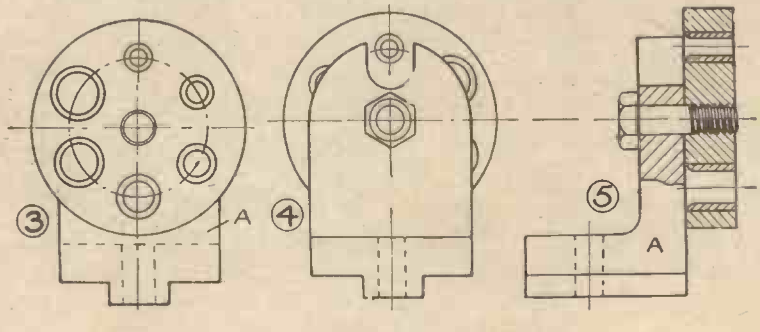


Fig. 11. Position of lifeboat, carriage, and tractor, when carriage is ready to be pushed into the sea.

Launching Lifeboats

A Description of the Method of Launching a Lifeboat by Tractor—A Paper Read Before the Recent Annual General Meeting of the Institution of Mechanical Engineers, by Lt.-Colonel P. H. Johnson, C.B.E., D.S.O., M.I.Mech.E.

(Continued from page 249, April issue.)

WITH the ever-increasing weight of the boats, coupled with the desire to provide lifeboat stations where the beach conditions presented difficulties, the necessity arose for some improved equipment for carrying the weight over the softest of surfaces. After many years of design and experimental work, the type of track unit shown in Fig. 6 and in Fig. 9 was evolved, and this in its present form enables the lifeboat to be carried without appreciable sinkage over surfaces where it is virtually impossible to walk.

On a level beach with a reasonably firm surface the rolling resistance offered by the lifeboat and carriage mounted on these track units is of the order of 100-150 lb. per ton. Under these conditions, therefore, a drawbar pull of 1,100-1,650 lb. is all that is necessary to maintain movement.

Lifeboat Carriage Track Units

The track employed for these units is commonly referred to as the rigid girder type, and in various forms has been well-known for many years, though both the actual endless track and the complete units themselves as used for lifeboat work possess special features which are novel and not used elsewhere. In principle, the girder track itself is so constructed that it forms in effect, the rim of a wheel of large diameter (Fig. 6). If it were practicable to build wheels of the diameter shown, and if they could be of reasonable weight and cost, and if again there were no objections to them on the grounds of overall dimensions, axle height, etc., then there would be no object in providing the girder track units. The girder effect is obtained by interlocking the plates one with another and a special feature of this particular design is that, as shown in Fig. 7, a double interlock is provided so that no stresses are thrown upon the hinge pin, with the exception of such as are involved in preventing the lements of the track from falling apart when passing slackly round the ends of the complete track unit. Thus these track pins are, for all practical purposes, immune from wear and tear. Pins which have been in employment for eight years and more show no reduction in diameter.

Curvature of Track

The curvature given to the track is essential from many points of view. It is true that if it were flat, in contact with the ground, better flotation without sinkage on very soft surfaces would be obtained, but rolling resistance and undue wear and tear would be set up by the necessity for the track plates to hinge into the locked position round the ends under load, whereas they now fall loosely into the locked position before the load is applied to them. Moreover, if the tracks were flat, steering of the vehicle would become difficult. The curvature given to the track is sufficiently slight, however, to ensure that when sinkage occurs in very soft ground the area of support rapidly increases.

Rigid Inclined Plane

Another important feature of these track units is that the girder track, in combination with the pivoting of the unit about a central axis, provides for a rigid inclined plane up which the vehicle is borne when surmounting an obstacle (Fig. 9). Thus, the drawbar pull required when an obstacle is met is minimised. A seeming anomaly is the fact that with 1 inch of sinkage in soft ground, these particular track units carrying the 11 tons of lifeboat and carriage exert a pressure on the ground surface of about 14 lb. per sq. in., whereas under the same conditions a man exerting a pressure of not

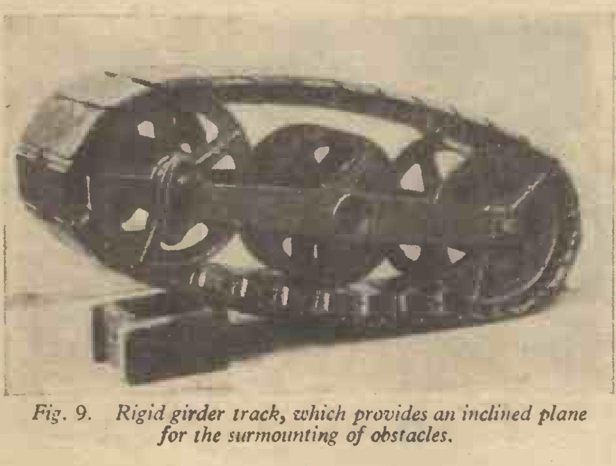


Fig. 9. Rigid girder track, which provides an inclined plane for the surmounting of obstacles.

Fig. 12. Respective positions of lifeboat, carriage, and tractor immediately before launching.

more than about 10 lb. per sq. in. will sink far more deeply into the surface than the units themselves. This apparent anomaly is explained by the fact that the units offer a rigid unbroken area of surface to the ground many times greater than that offered by a man's foot. This tends to trap the material below the units and prevent its flow laterally, thus making practicable pressures which would result in excessive sinkage if applied to smaller unbroken areas of contact. This points to the desirability for appreciable track width, especially as an attempt to obtain any considerable unbroken area of ground contact by means of increased length would interfere with ease of steering. The track units shown in Fig. 9 are 22 inches wide, though not more than about 20 inches of this width is really effective for supporting purposes. From the point of view of actual flotation over soft surfaces, advantage would be gained if the edges of the track plates were turned down instead of being rounded in an upward direction, but this would interfere with steering and would increase the rolling resistance, so a compromise has to be effected.

Fig. 14. Respective positions of lifeboat, carriage, and tractor immediately after launching.

Fig. 13. Lifeboat ready for launching

A novel feature of these girder track units not found in those built elsewhere is the centre wheel. Without this centre wheel the length of unsupported girder is doubled and the stresses imposed upon the girder quadrupled. If no centre wheel is fitted, then the maximum stress in the girder is obtained when the unit passes over a rigid obstacle and this obstacle is immediately under the central axis. With the addition of the third or centre wheel the maximum stress in the girder occurs when the obstacle lies midway between one of the end wheels of the unit and the centre wheel, but in this position the load at the point in question imposed by the weight of the vehicle cannot exceed half the load imposed on the unit as a whole, owing to the fact that the unit is pivoting about a central axis. Hence, the great advantage of the centre wheel.

It will be obvious that the three wheels which form the mechanism of the unit cannot perform their proper function unless the weight is at least approximately evenly distributed between them. Provision is made for this by means of a vertical adjustment to one of the end wheels by which means an alteration to the curvature of the girder occasioned by wear of the locking faces of the track plates can be allowed for. A rough but effective guide to this adjustment is obtained by allowing the centre wheel when unladen to run about ½ inch clear of the girder. When the load is applied, the spring in the girder takes up this clearance and the three wheels carry their proper proportion of load.

Having, by the methods described, provided the lifeboat and its carriage with means of traversing over the most difficult surfaces liable to be encountered, the problem remains of providing for a means of haulage; in other words, a tractor capable of surmounting all obstacles and difficulties likely to be met with, and able to exert the required drawbar pull for hauling the lifeboat and carriage under the worst of conditions and up appreciable gradients.

Method of Launching the Lifeboat

In order to appreciate the conditions which the lifeboat tractor has to meet in service, it is necessary to give a brief description of an actual launch from the beach.

The tractor first hauls the lifeboat to that portion of the beach from which the launch is to be made, finally entering the sea to a depth of perhaps 2 or 3 feet. Turning sharply then up the beach the boat is hauled in a shoreward direction until the bow of the boat which is at the rear of the carriage is facing the sea and at right-angles to the breakers. The tractor is then uncoupled from the carriage and turned round; the front steering wheels of the carriage are locked and the tractor pushes the lifeboat seaward by means of the buffer provided for this purpose. Launching ropes which are fixed to the stern of the boat and pass round pulleys at the rear end of the carriage are brought back to the tractor and attached to eyebolts on the launching platform. When the tractor has pushed the lifeboat into the sea to a sufficient depth for launching, and the fastenings of the boat to the carriage have been released, the tractor is driven in reverse up the beach, when the pull on the launching ropes slides the boat into deep water off its carriage. The empty carriage is then hauled up the beach to await the return of the boat. Fig. 10 shows a tractor, carriage, and lifeboat travelling over a stretch of sand. Fig. 11 shows the position arrived at in preparation for a launch after the tractor has been reversed and placed ready to push the carriage into the sea. Fig. 12 shows the position immediately preceding the actual launch. In this case the beach is steeply shelving, but in some cases the tractor has to push the carriage many hundreds of yards through the water before sufficient depth for launching can be obtained. Fig. 13 is a view of another launch where the tractor is more deeply submerged, the shelve of the beach being less in this case. Fig. 14 shows the respective positions of the tractor, carriage, and lifeboat immediately after the launch has been effected.

In many circumstances the tractor has to be submerged to a depth of about 3 feet, and holes are often found in the beach into which it may be submerged to a much greater depth. In stormy weather, which is naturally much more usual than otherwise, the breakers may pass completely over the tractor. Fig. 15 shows a launch on the coast of Holland. The conditions here emphasise the need for a submersible tractor.

The Lifeboat Roadless Tractor

It will be appreciated from the foregoing paragraphs that, apart from the special requirements incidental to launching, the tractor must virtually have the characteristics of a submarine in that it must be capable for long periods of being submerged in salt water without any interference to its proper function and without the entry of salt water into any of the working parts where subsequent trouble would arise. In case the engine is stopped inadvertently, it must be possible to start it when under water, and every other possible precaution must be taken to guard against the stranding of the tractor on a rising tide. Instances have occurred in the past in which in-

Fig. 15. Launch on the coast of Holland.

adequately protected tractors have been stranded in the water, due to mechanical failure, on a rising tide, and have been completely submerged for several hours; in consequence they became filled with salt water and in some cases half buried in sand.

The most elaborate and thorough precautions are taken to prevent the possibility of mechanical failure or inadvertent stoppage. These may be summarised in the following nine paragraphs.

(1) Air for the engine enters through an intake at a height of 7 ft. 6 in. from ground level, the exhaust being carried to a similar height. The air vent for the fuel tank is also carried up to the same height as the air intake for the engine.

(2) A large casing of sea water-resisting aluminium is provided on one side of the engine (see Figs. 16 and 17) for the housing of the sparking plugs and other electrical gear which includes dual ignition but does not include the starter motor or battery. Access to this chamber is provided by a series of watertight but easily removable doors (Fig. 17). The air intake for the engine is coupled to the forward end of this casing, thus ensuring that cool air passes over the electrical apparatus inside on its way to the engine.

(3) The driver's control board is enclosed by a casing in front of the operator, again of sea water-resisting aluminium; movement to the outside of the casing for external operation is made through synthetic rubber diaphragms.

(4) It is impracticable to provide glands for waterproofing the governor gear, as this would interfere with its free working, so this part of the engine is completely encased in a separate housing.

(5) The box containing the batteries is placed to the rear of the fuel tank and engine and in front of the driver's control box. Though this battery box is seldom fully submerged, it must yet be completely watertight to be unaffected by spray and waves breaking over the tractor.

(6) In addition to the usual lighting equipment for travelling on the road at night, a powerful searchlight is mounted conveniently for the driver's control, and is an invaluable aid for launching on a dark night. All this equipment and the electrical leads associated with it are specially waterproofed.

(7) If under exceptional circumstances the tractor is unable to move the boat and carriage by direct haulage, then resort can be made to a bollard, provided at the rear end of the tractor, which is capable of giving a 10,000-lb. pull with the tractor stationary. Special gear is also provided for anchoring the tractor if necessary against the pull of the rope, but normally the resistance of the tractor to skid bodily, with the brakes fully applied, suffices.

(8) Other than those referred to, every possible inlet for water is "proofed" by some special form of sealing device or connected to the engine air-intake. Such inlets include, of course, the crankcase and gearbox "breathers." Many of these sealing devices would have presented far greater difficulties than were, in fact, experienced but for the comparatively recent introduction of synthetic rubber. Owing to the oil-resistant qualities of synthetic rubber (never attained to any appreciable degree by the natural product) it is remarkably efficient as a sealing medium. It is also used throughout the tractor for sealing such bearings as those of the weight-carrying rollers, bollard, steering shaft, etc. All sliding shafts are provided with glands and stuffing boxes.

(9) A special ventilation valve, which is left open when the tractor is not in use, but is closed as soon as the engine is started, is provided to prevent accumulations of petrol gas which may lead to an explosion. Such an explosion occurred with the first tractor built, though fortunately the damage was confined to hand-hole doors which were blown off the casing which housed the electrical gear. By an error of judgment, or by oversight, the vent from the fuel tank was not open direct to air at a height of 7 ft. 6 in., as is now the case, but was connected indirectly to the atmosphere through the air intake pipe. After a trial run during which the whole machine became thoroughly heated, it was shut down, and not started again for two days. In the interval, petrol vapour from the vent in the tank must have found its way into the electrical gear housing, and a violent explosion occurred as soon as the starter button was pressed. The precautions now taken make a recurrence of a similar explosion impossible.

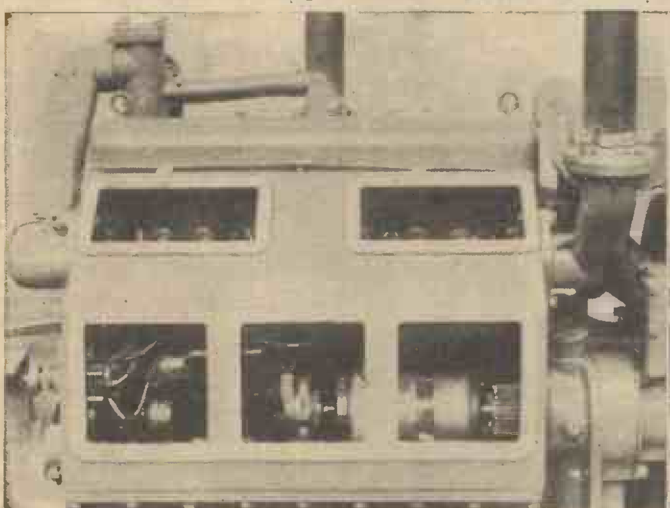


Fig. 16. Housing for ignition equipment, doors removed.

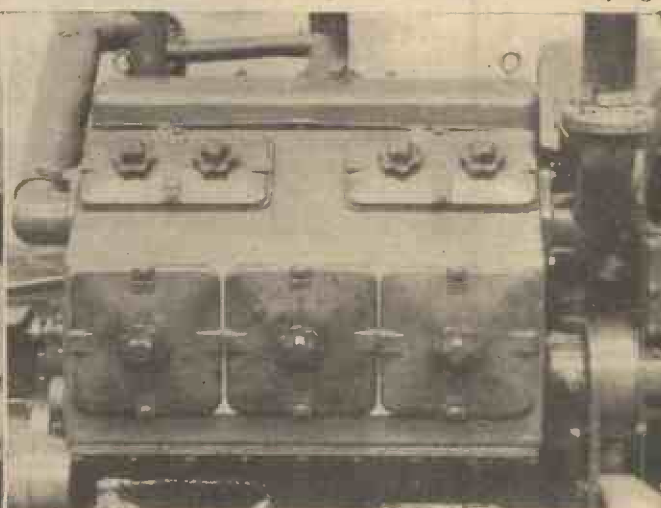


Fig. 17. Housing for ignition equipment, showing doors closed.

Rubber-jointed Tracks

The endless tracks with which the tractor is equipped are of the rubber-jointed variety; the joints are thus immune from the action of sea water, sand, and corrosion. The tractor drawbar is of the laterally swinging variety pivoted at a point sufficiently forward of the centre of ground contact to ensure that the drawbar pull assists the steering.

Sprag and Unditching Beam

Reference is made in the foregoing to special gear for anchoring the tractor against the pull on the rope when the bollard is in use. This consists of a sprag beam—somewhat longer than the width of the tractor—which is laid on the ground at the rear of the tractor, each end of it being coupled by chains to the tractor frame. The chains are of such length that when the pull comes on the bollard the tractor is hauled backwards on to the beam with one track resting on each end of it, so that the combined weight of the tractor and pull on the rope forces the beam into the ground. In this position the chains between the beam and the frame arrest further backward movement. This sprag beam is also adapted for use in emergency as an unditching beam.

Origin of the Unditching Beam

In exceptional circumstances, such as mud pockets, or quicksand, the surface may be so soft that even track-laying machines will sink sufficiently to cause the weight to be supported by the frame of the vehicle; the tracks then idle round in the mud without propulsive effect. This was a common experience with the tanks used in Flanders mud during the war of 1914-18, where the problem was made increasingly difficult by the effect of high explosives on the soil. When shattered, aerated, and pulverised by the explosion of the shells, the soil became in effect a sort of sponge for the absorption of water. Numerous types of "spuds" or "grousers" were devised for attachment to the tracks in the hope of increasing adhesion but largely without effect, and in extreme conditions the result was merely to channel the mud beneath the tracks to a greater depth thus increasing the difficulty of climbing out. Scores of tanks were lost due to their inability to extricate themselves from shell craters in swampy soil. Early in 1917 it was discovered that if the tracks were connected together by a beam consisting of a light tree trunk or a heavy branch, forward movement became possible under almost all conditions. This beam, having passed under the belly of the tank, had to be detached from the tracks and man-handled from the rear to the front as many times as might be necessary for the tank to reach firm ground, and during the whole time thus occupied the crew were exposed. This was all very well during training periods and where suitable timber was available, but in action something better was called for, and eventually the continuous unditching beam was evolved. *(To be concluded)*

Electric Micro-Motors

Constructional Details of an Efficient Motor With Tri-polar Armature

THERE is a well-known and widely used class of electric motors to which one refers by the title of "Fractional Horsepower Motors." Their application to domestic and industrial uses is almost illimitable, and in the majority of cases they are designed and wound so that they may be connected direct to the high voltage service mains. Their outputs range from the smallest sizes—that lend themselves to commercial mass-production methods—of about a hundredth of a horsepower or so, up to anything less than one horsepower. Larger sizes than one horsepower cease to be "fractional" motors, while those smaller than one hundredth of a horsepower are hardly worth the serious attention of the firms who cater for large buyers, since the cost of production below a certain size becomes excessive in relation to its utility.

Such very small motors as these "micro-motors"—if one may coin the term—are generally left to the province of the amateur who has models to drive from low-voltage batteries, and who has seldom the special training required to wind them with the very fine gauges of wire required for operating on high voltages. A certain high standard of insulation is imperative for any motor to work satisfactorily from supply voltages of the order of 200 to 250 volts, whereas no such problem is encountered when dealing with voltages associated with a few dry batteries, or even a 12-volt accumulator. Small motors intended to work from the house service mains will usually necessitate enamel-covered windings of such extremely fine gauges as No. 40 to No. 44 S.W.G., and this needs a deal of experience to handle successfully. On the other hand, the same size of motor adapted to work on a low voltage battery or accumulator might not require windings of smaller gauges than No. 24 to No. 30 S.W.G., which is infinitely easier to handle, as well as vastly simplifying the standard of insulation requirements.

Model Requirements

The home worker will therefore be able to undertake his model motor with a much greater certainty of success if he begins by discarding any idea of winding it for high voltages; also by not insisting on standardising its output in horsepower, or its speed within too close a limit. The science of motor design is very highly developed, even in fractional horsepower sizes, but there are too many disturbing factors when the size is still further reduced to what are actually little more than "gnat-power" motors. The slightest variation in frictional losses in the bearings, excessive spring-pressure on the brushes, variations in the air-gap between pole faces and armature core, etc., may all be the cause of considerable discrepancies between the performances of two exactly similarly sized motors, and instead of worrying too much to account for the cause, it is far quicker and easier as a rule to add one or two more cells in order to get the results aimed at.

The majority of micro-motors are usually required for the purpose of driving models such as tramcars, railways, boats, etc., and if scale proportions are to be adhered to, the most difficult point to meet is the restriction of overall height sufficiently to enable the motor to go into the space permitted by the design of the model in question. As a rule, there is not so much difficulty in finding end room. A case in point arises when the motor has, for instance, to be incorporated in the boiler of a model engine, or carried in its tender, no part of it being visible externally. The electrical characteristics, too, must be such that the motor develops a high starting torque directly it is switched on, as one of the outstanding features of nearly all mechanical models is the static resistance to motion, far more power being required to start up the mechanism than to keep it in motion when once running. Such requirements can be best met by providing the motor with the largest possible armature permitted by top height, and giving it a "series" field winding. By this means the most powerful field is produced by the momentary rush of current that occurs when first switched on, before the armature has had time to develop its back E.M.F. due to actual rotation; in other words, the magnetic polarity of both fields and armature is at its greatest in a static condition. Another advantage of series-winding is that such motors are "universal" without any change of connections, in the sense of being able to operate on either direct or alternating current, although the power developed on A.C. will be rather less than on D.C. of the same voltage.

Field-magnet Forms

If the variations in possible field-magnet form are studied, such as Overtype, Undertype, Manchester, Simplex, Ironclad, Edison, etc., it will be appreciated that the latter is the only one that really complies with the essential point of providing the largest possible diameter of armature within any prescribed space limits. This is the type chosen therefore in the present design, the dimensions of which will be found in the accompanying drawings—Fig. 1, the detail drawings in Fig. 2, and Part Number List in the table below.

Simplicity in design is the first essential for those who undertake motor construction with limited workshop equipment, and whose previous acquaintance with electrical instrument making does not extend very far. Fortunately, the winding of low-voltage motors such as these is free from many of the pitfalls that are present with the use of very fine gauges of wire, and the exacting nature of high-voltage insulation. Armature and commutator details, too, can be reduced to a very elementary form without appreciable detriment to the performance. Bearing all these points in mind, it is possible to produce a perfectly serviceable micro-motor on the lines of the illustrations given in Fig. 1. The field magnet is a solid soft iron casting in one piece, the armature of the laminated tri-polar type, while the disc type commutator adopted is far easier to construct than any cylindrical multi-segment forms having a large number of segments, which are necessary for satisfactory working on high voltage circuits. The disc type is suitable for all low voltages up

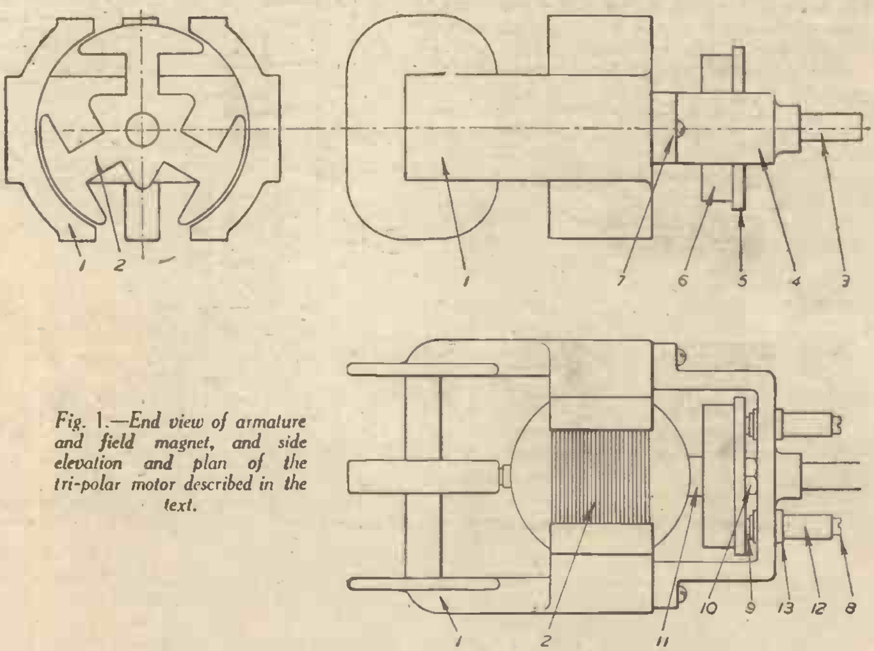


Fig. 1.—End view of armature and field magnet, and side elevation and plan of the tri-polar motor described in the text.

PART NUMBER LIST

No.	Description	Material	Quantity
1	Field Magnet	Cast Iron	1 off
2	Armature Stampings	Lohys sheet	30 off
3	Shaft	Mild steel	1 off
4	Bearing bracket	Brass	1 off
5	Commutator ring	Hard brass	1 off
6	Commutator back	Fibre	1 off
7	Bracket screws	Mild steel	2 off
8	Clamp screws	Brass	2 off
9	Brushes	Copper-Carbon	2 off
10	Commutator nut	Brass	1 off
11	Armature clamp Nut	Steel	1 off
12	Brush holders	Brass	2 off
13	Insulation	Presspahn	2 off

to say 12 volts direct current, and can even be used when running from the secondary of an A.C. bell transformer.

Patterns

Two wood patterns will be required for the castings, one for the field magnet, and one for the front end bearing bracket. Being small, these parts could, of course, be shaped out from solid metal if one has suitable workshop facilities, although this entails a good deal more work. The patterns are by no means difficult to make, contraction allowances are unnecessary, and the patterns themselves are an exact replica of the finished castings, except that the field magnet should have a core print left in for the armature tunnel, one eighth of an inch smaller than the finished size of the bore to allow for machining. Both patterns should be divided along their horizontal diameter in two halves, and dowel pins inserted to keep them in register while they are moulded. A coat of waterproof varnish is also a good thing, as it prevents the moulding sand from sticking to the wood, and leaves cleaner cast surfaces.

Machining operations on the castings should be carried out in the following sequence. First mount the field magnet in a 4-jaw independent chuck, or by strapping to a face plate with the pole pieces outwards, and bore the armature tunnel to size. Before the casting is disturbed, also face off the ends of the polepieces, and centre and bore the hole for the back journal bearing. All this work requires accuracy, as the bearings must be properly in line for the motor to run well, and the airgap between armature and pole faces exactly equal all round.

Next rough out the steel shaft to size between lathe centres, after which the part receiving the stampings is finished to size and threaded for the clamping nut which holds them. Assemble a sufficient quantity of stampings to match the length of the armature tunnel, clamp them firmly with the nut, and then finish the remainder of the shaft to drawings, and polish.

The next step is to drill the boss of the front bearing bracket one sixty-fourth of an inch under size, finishing out by hand with a fluted reamer. An ordinary twist drill seldom makes a good running fit. Mount the bracket on a steel mandrel, and then shape the feet in the lathe where they bed on the pole faces, so as to ensure them being exactly square with the bore.

Armature and Stampings

The armature can now be centred in its tunnel by wrapping a strip of presspahn firmly round the stampings until they just push tightly into the bore. This ensures an even airgap all round, a point which is very important in obtaining the best results. The smaller this airgap is within reason, the more powerful the motor, and a reasonable clearance is one fiftieth of an inch all round, for armatures of this diameter.

Slip the bracket bearing over the front end of the shaft, and notice whether the feet bed squarely against the pole faces. If not, they must be scraped or filed carefully until they do, so that the holding screws when tightened up do not pinch the shaft. The latter should spin with perfect freedom, without any appreciable side shake, but with one thirty-second of an inch end play.

The Commutator

The disc commutator consists of a backing of horn fibre to which is secured a ring of hard brass by three countersunk brass screws, and is held against the face of the nut which clamps the stampings by another locknut. This enables the commutator to be rotated to any position on the shaft, when setting the best brush position, instead of providing a "rocker." Three narrow sawcuts divide the brass ring radially, when all else has been turned to size and polished, forming the three segments of the commutator, each insulated from the others. Note that the brass ring projects slightly beyond the fibre disc and has three shallow cuts in the middle of each segment, for convenience in soldering the armature wires without getting in the way of the brushes. It is necessary that the flat face of the commutator runs perfectly true, otherwise steady contact with the brush faces at high speeds may be interrupted, causing sparking and unsatisfactory running.

Brush-holders

To make up the brush-holders, two lengths of square brass tube are employed, fixed in the web of the front bearing bracket by grub-screws, after first insulating them by a wrapping of $\frac{1}{32}$ in. fibre. If the brush tubes are cut as in the detail drawings, with one side left longer than the other three, the long side can be afterwards folded down squarely closing the end of the tube, and forming a tab for attachment

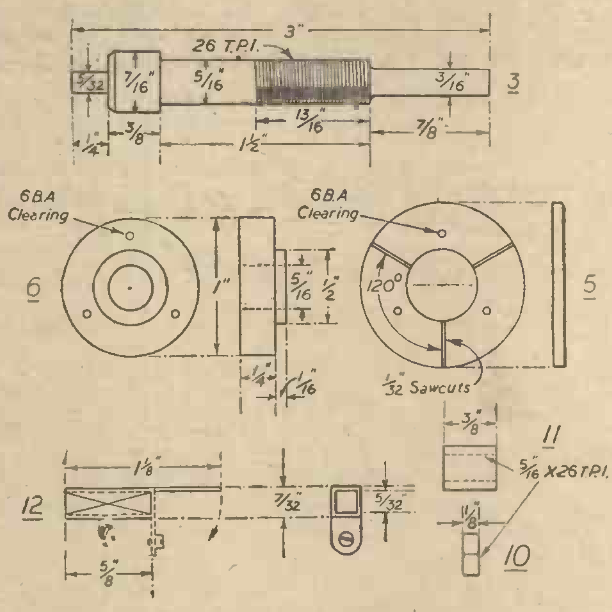


Fig. 2.—Constructional details for a small tri-polar electric motor.

of the field wires under the head of a small screw. The brushes themselves are of copper-carbon mixture, known as "CM" grade, made an easy sliding fit in the holders. The brush springs are of No. 28 g. hard brass wire, adjusted to give the lightest possible pressure of the brushes on the commutator face, to avoid what would be otherwise a heavy braking effect. Ordinary hard black carbon is useless for the brushes of low-voltage motors such as these, since its contact resistance is far too high.

Winding the motor is quite a simple job.

Volts	Armature	Fields	Connection
2	1½ oz. No. 24	4 oz. No. 20	Series
4	,, No. 26	,, No. 22	,,
6	,, No. 27	,, No. 23	,,
8	,, No. 28	,, No. 24	,,
12	,, No. 30	,, No. 26	,,

Winding table for different voltages.

Begin with the field magnet and first insulate the whole of the metal parts which come in contact with the coils with one layer of 8-mil presspahn or leatheroid sheet. This can be secured in position until the coils hold it by a touch of sealing wax or Chatterton's Compound. A diagram showing the direction in which the two halves of the field coils are wound, and their connections to the brushes, is given in Fig. 3. Enamel covered wire is used because of the greater number of turns that can be got into the winding spaces. The utmost care is necessary to avoid damaging the covering. The last turn on each coil is held in position by tying it down with fine thread which has been previously overwound by the last two or three turns of the outside layer. The start of the winding must be protected from leakage to the adjacent layers by a slip of thin presspahn where they cross it at the end of each coil.

Winding the Armature

A winding diagram for the armature is given in Fig. 4. All three sections of the armature coils are wound in the same direction, and when completed the finish of each one is connected to and twisted up with the start of the next coil, so that there will be three junctions formed, one of each

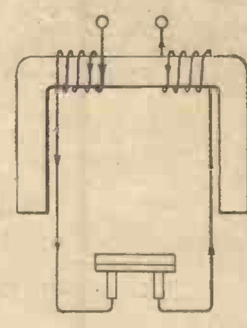


Fig. 3.—Diagram showing the direction of winding of field coils, and connections to the brushes.

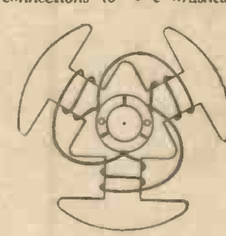
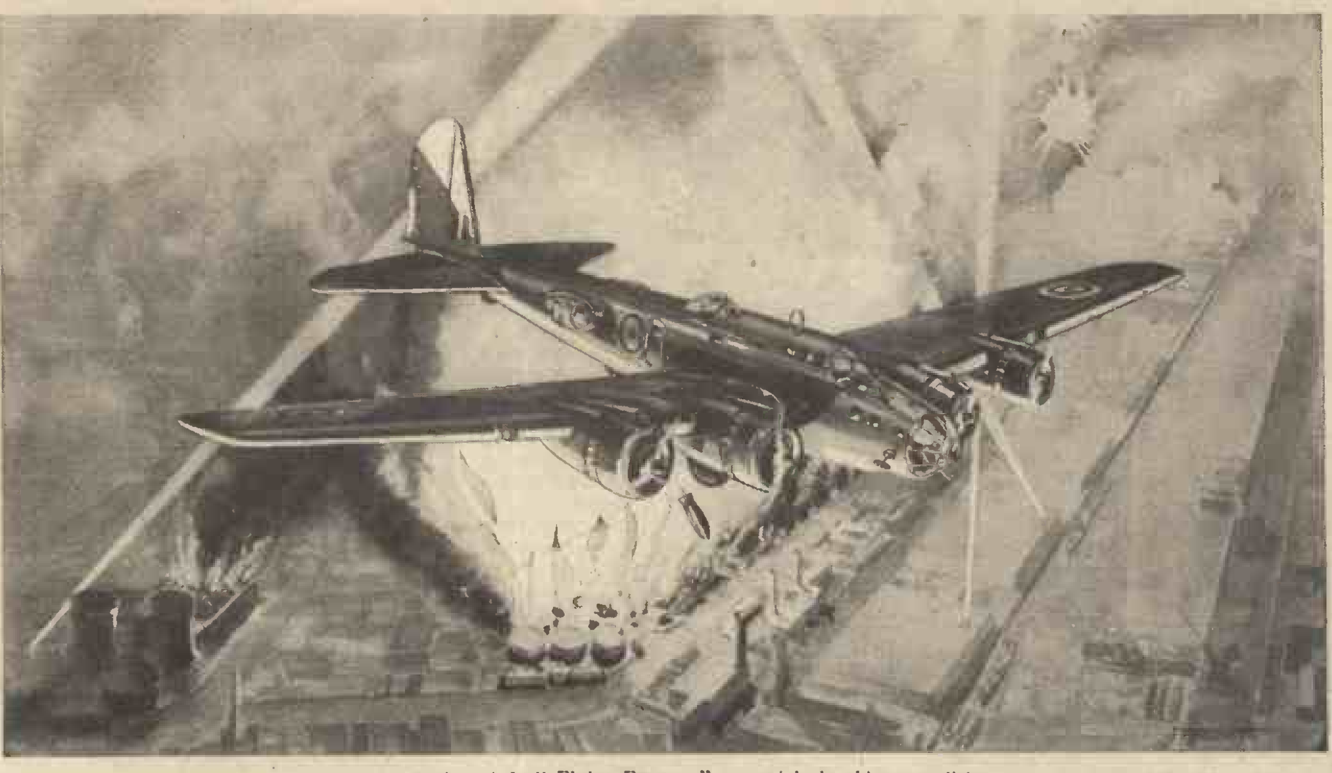


Fig. 4.—Winding diagram for the armature.

being taken down and soldered to one of the commutator segments. A sufficient amount of slack should be given to these armature connections to allow of the commutator being rotated slightly either way on the shaft so that the best possible position can be found from trial to give the highest speed and least sparking when running.

The windings recommended for various battery voltages are to be found in the list on this page.

About the same weight of wire will be required for either of the above windings, namely 1½ ozs. for the armature, and 4 oz. for the field coils, to allow for a little unavoidable waste. Remember in winding that all parts in contact with the wire must first be protected with 8 mil presspahn insulation. Any damage to the covering must be scrupulously avoided and, finally, every additional turn that can be got into the available winding space will add to the performance of the motor.



An impression of the " Flying Fortress " on a night bombing expedition.

Aircraft Recognition

Suggestions for Home Study, by *R. A. Saville-Sneath*

Types of American Aircraft—5

NO phase of the war can be more encouraging than this friendly invasion of our shores by hosts of American aircraft. They come in an ever-increasing flow, the smaller species crated, the larger under their own power, across the Atlantic.

Fifty-six varieties are reported to be on order—it rather looks as if the purchasing commission didn't like the fifty-seventh !—but even so, the selection is embarrassing by its richness. From the point of view of operation, maintenance and replacements, it would be preferable to receive the same total composed of fewer different types, but time and the emergency presses, and every U.S.A. aircraft fit for serious service and released *now* will help to blast Hitlerism out of Europe.

It follows that the spotter's bag will be infinitely more varied as this second year of the war develops. The American invasion, plus new and hitherto secret types which may be revealed in action by both belligerents, will keep the keen student of aircraft recognition continually on his toes.

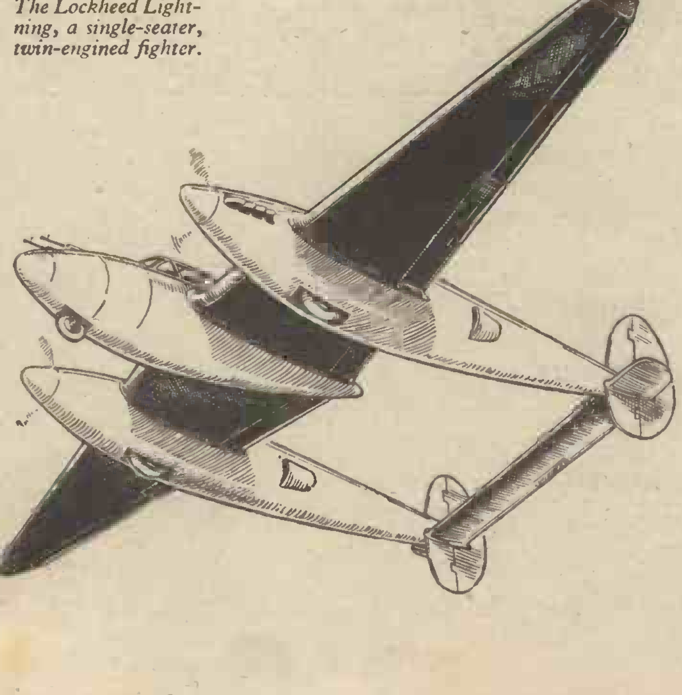
In previous articles I have recommended concentration of study upon not more than two or three different types at once as offering the surest and the easiest path to progress. With this in mind, I have selected the following preliminary list of 24 U.S.A. aircraft types which, by reason either of numbers actually in service or more advanced production programme, merit priority in study. As in the case of previous lists, the *first six* types suggested for study are indicated in capitals, whilst the *second six* names are printed in italics.

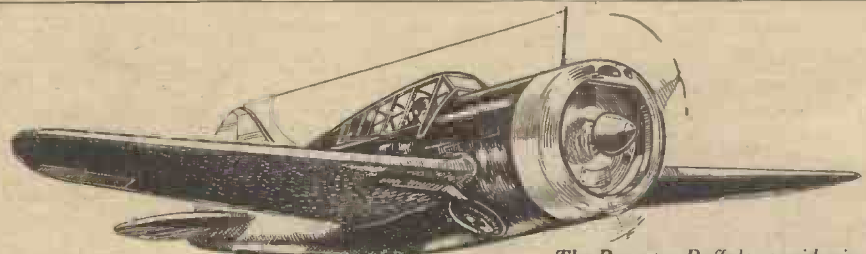
Four important omissions may be noticed. Two of these are already almost as familiar as our own aircraft—the Harvard trainer, and the Hudson reconnaissance bomber—the latter being the military version of the well-known Lockheed 14 air liner. Both of these were included in the first list of 24 important R.A.F. types published in this series. The remaining two are the long-range flying boats, R.A.F. Catalina (Consolidated 28 or PBY 5), and Consolidated 31, both of which were described in last month's article on " Marine Aircraft."

The First Twenty-four

R.A.F. Bermuda (*Brewster* 138)
Boeing 314 Clipper
BOEING B299Y Flying Fortress
Boeing 307 Stratoliner
R.A.F. BOSTON (Douglas D.B.7)
R.A.F. BUFFALO (Brewster 339 & 439)
R.A.F. Caribou (*Bell Airacobra*)
R.A.F. Chesapeake (*Vought-Sikorsky* 156)
R.A.F. Cleveland (Curtiss Helldiver 77)
Consolidated 29
Douglas DC 2
Douglas DC 3
R.A.F. LIBERATOR (Consolidated 32)
R.A.F. Lightning (*Lockheed* 322-61 *or* P38)

The Lockheed Lightning, a single-seater, twin-engined fighter.





The Brewster Buffalo, a mid-wing monoplane fitted with a Wright Cyclone radial engine.

Lockheed 10 or Electra
Lockheed 12
Lockheed Lodestar
R.A.F. MARTLET (Grumman G 36-A)
R.A.F. Maryland (Martin 167)
R.A.F. Mohawk (Curtiss Hawk 75A)
R.A.F. Mustang (North American NA 73)
Northrop A 17A
R.A.F. TOMAHAWK (Curtiss Hawk 81A)
R.A.F. Ventura (Lockheed Vega 37)

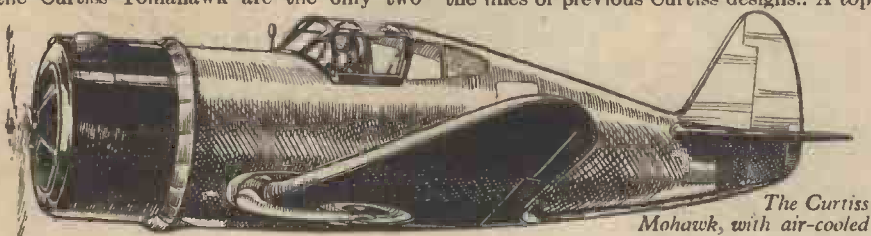
Although the majority of these types have been re-christened by the R.A.F., some of them may be more familiar to readers under the makers' designations which are quoted in brackets. Certain of the better-known designs such as the Flying Fortress, and the R.A.F. Lightning, have received considerable publicity under their U.S. Service designations, Boeing B 17B and Lockheed P 38 respectively, but most spotters will, I think, be content if they are able to identify these American eagles by the R.A.F. name alone.

Look for These Points

The most important recognition features of the first twelve types recommended for study are briefly outlined below, the aircraft being grouped, for ease of comparison, according to their principal structural characteristics.

Low Wing Single Engine Types

The Bell CARIBOU is a low wing single-seat fighter with liquid-cooled in-line engine (1,150 h.p. Allison) and single fin and rudder. It is credited with a maximum speed in excess of 400 m.p.h. This machine and the Curtiss Tomahawk are the only two single engine fighters fitted with in-line engines at present coming from the States. Thus, they are much nearer in general appearance to the Hurricane and Spitfire.



The Curtiss Mohawk, with air-cooled twin Wasp engine.

The Caribou, however, is extremely unconventional in design, the engine being placed behind the pilot's cockpit. A long shaft carries the drive to the airscrew, this arrangement permitting the installation of a cannon firing through the airscrew hub. Eight machine guns are also fitted.

As a result of the arrangement just described, the nose lines of the Caribou are exceptionally clean and free of the bulges caused by external ducted radiators. The nose is unusually long and the enclosed cockpit small. The wings of low aspect ratio are normally tapered to rounded tips, with full dihedral. The tail unit is rather angular, both in side and plan views and the tail plane is mounted level with the top of the fuselage. The nose-wheel type of retractable tricycle undercarriage is fitted.

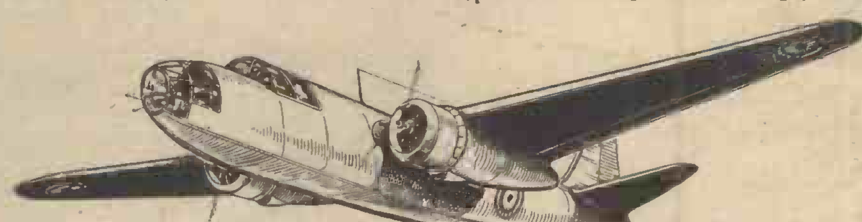
The Curtiss TOMAHAWK, a low wing, single-seat fighter, also fitted with the Allison liquid-cooled engine, has a superficial resemblance to the Caribou. The long, stream-lined nose, however, in this case actually houses the engine, and is fitted underneath with a ducted radiator which, by reason of its unusual size, is a useful recognition feature. Two large-bore machine gun chutes project from the top of the fuselage, just behind the airscrew spinner. Four wing-guns are also carried.

The Tomahawk wings are without taper on the leading edge, except for the centre section, which is swept forward from the hinge covers of the retractable undercarriage to the fuselage. The trailing edge is sharply tapered to rounded tips. In the head-on view, the moderate dihedral-angle, the deep radiator forward, and the unusually prominent undercarriage hinge covers already mentioned are helpful points. The tailplane is mounted high on the fuselage and the tail unit closely follows the lines of previous Curtiss designs.. A top speed of about 360 m.p.h. is claimed.

The Vought-Sikorsky CHESAPEAKE is a two-seat dive bomber supplied to France in the early stages of the war and now coming into service with the R.A.F. Bomber Command. Its maximum speed is slightly over 250 m.p.h. and range about 1,000 miles. It is a low-wing monoplane of typical American design, fitted with an 800 h.p. Twin Wasp Junior radial air-cooled engine.

The wide centre-section of the wings is without taper or dihedral. Outboard of this, the wings taper uniformly to rather wide rounded tips, with full dihedral. The long glazed cockpit cover, which is a distinctive feature, is divided into a forward and a midships section. The single fin and rudder is tall and angular and the tailplane has similar angular outlines. The extremity of the fuselage projects in a small "peak" or point, aft of the rudder, a detail which helps to distinguish the Chesapeake from the Northrop A 17A, which it very closely resembles in the side view.

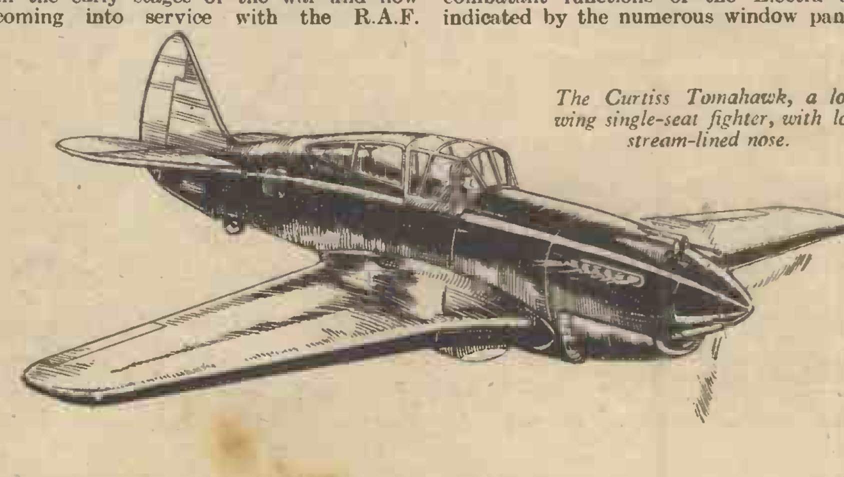
In general design, the Curtiss MOHAWK is similar to the Tomahawk, except for the air-cooled radial Twin Wasp engine developing 1,100 h.p. This gives the short, stubby, rounded nose which we are accustomed to expect in American 'planes. Two large-bore machine-gun chutes project from the top of the cowling and four wing-guns are fitted. Wing plan, tail unit, fuselage and the undercarriage fittings closely resemble the Tomahawk. As the Curtiss Hawk, this single-seat fighter was delivered in considerable quantities to France. and was one of the first of the American aircraft to give a good account of itself on active service. Its maximum speed is 323 m.p.h.



The Boston, a high-performance light bomber.

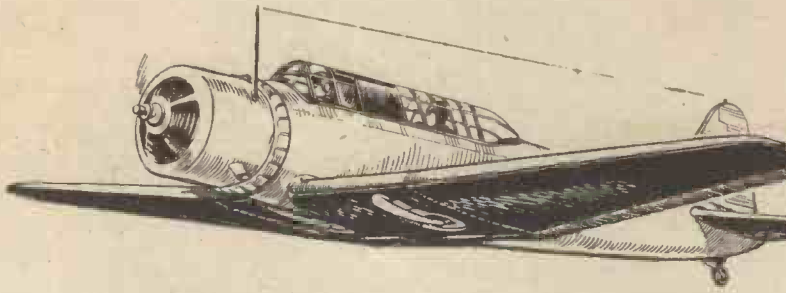
A Low-wing Twin-engine Type

The Lockheed ELECTRA, forerunner of the well-known "14" and "Hudson," was operating in Great Britain as an air liner before the outbreak of war and is now chiefly employed for communications and training. Fitted with two Wasp Junior engines of 450 h.p., it has a top speed of 210 m.p.h. and range of about 800 miles. The Electra's wings are very sharply tapered to narrow rounded tips, with full dihedral. Like the later Lockheeds, it has a twin fin and rudders but these are easily distinguished from other Lockheed types, being nearly circular, in contrast to the egg-shaped fin and rudder units of the later designs. The non-combatant functions of the Electra are indicated by the numerous window panels



The Curtiss Tomahawk, a low-wing single-seat fighter, with long stream-lined nose.

and the absence of gun-turrets or provision for bomb-aiming. In this respect it resembles the Lockheed "12," a slightly smaller aircraft which is also used for general communication work. In addition to the absence of armament, etc., both types are fairly easily distinguished from their larger brothers by the low wing position, slimmer fuselage and the absence of the projecting Fowler flap guides which are a conspicuous feature of the trailing edge of the "14" and "Hudson."

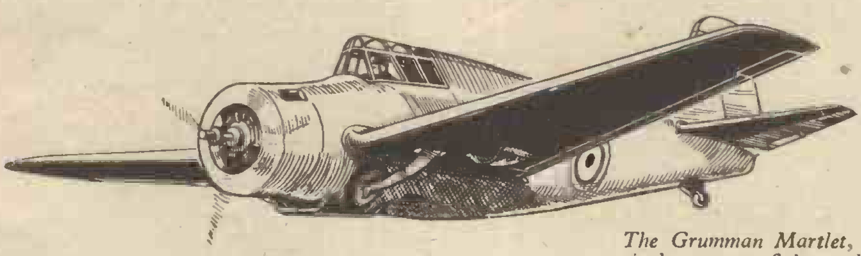


The Vought-Sikorsky Chesapeake, a two-seat dive bomber.

Mid-wing Single-engine Types

The Brewster BERMUDA two-seat dive bomber, a U.S. Navy type which is coming to the Fleet Air Arm, is a mid wing monoplane fitted with a Wright Cyclone radial air-cooled engine developing around 1,000 h.p. The long cockpit is divided into a forward and a midships section. At the after end of the latter a small glazed turret houses a single gun.

The wings have slight taper and dihedral, with wide rounded tips. Seen from the side, the single tail unit is wide and well rounded.



The Grumman Martlet, a single-seater fighter developed for the U.S. Navy.

The tailplane is elliptical in plan, and is mounted in the mid-fuselage position. Maximum speed is 302 m.p.h. and range 776 miles.

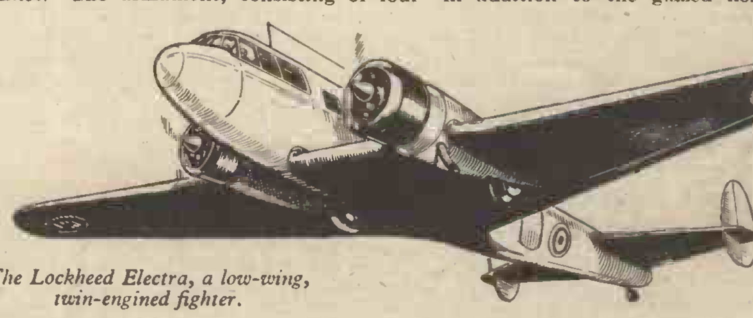
The Brewster BUFFALO, developed in the U.S. as a single-seat Fleet Fighter, has been operating in this country with the Fighter Command for some months. It is a mid-wing monoplane of comparatively short, tubby appearance, fitted with a Wright Cyclone radial engine of 1,200 h.p., which provides a maximum speed of about 330 m.p.h. Two large bore machine guns are installed in the fuselage, and two .303 guns in the wings.

The wings of low aspect ratio have moderate taper and dihedral, with rather wide rounded tips. The fuselage, which is unusually wide and of circular section, tapers rapidly aft. The single tail unit is very wide at the base, with large rudder. The tailplane, in mid position, is elliptical.

The Grumman MARTLET, another single-seat fighter developed for the U.S. Navy, is now operating with the Fleet Air Arm. A mid-wing monoplane which in many respects resembles the Buffalo, it is also fitted with the Wright Cyclone radial engine of 1,200 h.p., and its maximum speed is about the same. The uniformly tapered wings with wide, square-cut tips and the clean-cut angular lines of the tail unit contrast sharply with the well-rounded lines of the Buffalo. In the head-on view the dihedral of the Martlet wings is more marked and they are slightly higher on the fuselage.

Mid-wing Multiple-engine Types

The Lockheed LIGHTNING, a single-seater twin-engine fighter, is an interesting unconventional, and therefore easily recognisable type. Fitted with two 1,100 h.p. Allison liquid-cooled in-line engines, it is reported to have a top speed exceeding 400 m.p.h. and cruising range of 1,000 miles. The armament, consisting of four machine guns and one cannon, is installed in the nose.



The Lockheed Electra, a low-wing, twin-engined fighter.

The Lightning has no fuselage, in the usual sense of the word. The nose and the pilot's cockpit form a streamline central nacelle which terminates at the trailing edge of the wings. The two engine nacelles, however, are prolonged rearwards in the form of slender streamline booms, which support a long, narrow tailplane and twin-fins and rudders. The tailplane is untapered, with well rounded tips. The outline of the fins and rudders resembles the usual egg shaped Lockheed design. The wings, which have full dihedral, taper uniformly to narrow rounded tips. A retractable tricycle undercarriage of the nose-wheel type is fitted.

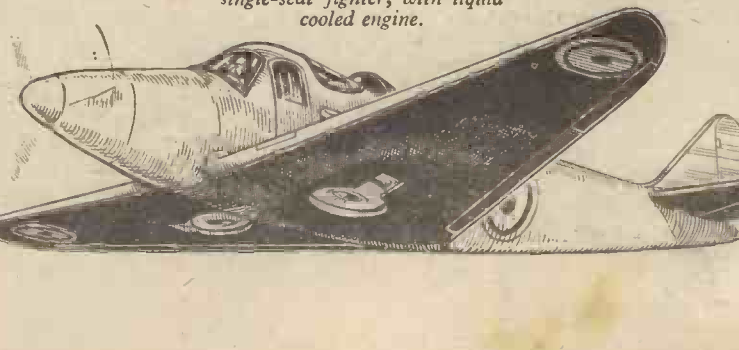
The Boeing "FLYING FORTRESS," so called because, in the American version, it is fitted with five gun-turrets, is generally supposed to be of huge proportions, although its span is, in fact, about nine feet less than that of our familiar Sunderland. It is difficult to determine whether the illusion is due to high aspect ratio or high pressure publicity! The Flying Fortress, fitted with four 1,200 h.p. Wright Cyclone radial engines, has a maximum speed approaching 300 m.p.h., and its range of nearly 4,000 miles enables deliveries to be made by air.

Principal recognition points—in addition to the four radial engines—are: high aspect ratio wings, uniformly tapered to rounded tips; moderate dihedral; an uncommonly tall single fin and rudder of distinctive shape, and an angular tailplane. The fuselage is slender, of circular section and, in addition to the glazed nose-turret, is studded on top, bottom and both sides with "blister" type turrets.

High Wing Types

Developed from the Douglas D.C.5 air liner, the BOSTON has been delivered to the R.A.F. in useful quantities since the autumn of last year. It is a high-performance light bomber having a top speed, with two 1,150 Twin Wasp engines, of about 320 m.p.h., or, with two 1,600 h.p. Double-row Cyclone engines, over 350 m.p.h. Its cruising range is 1,200 miles. Like the two Dornier bombers, the Boston is a "shoulder-wing" type, rather than true high wing, but its generally distinctive lines are not likely to be confused with those of either Do 17 or 215. In the first place, it has a tall single fin and rudder which is almost as conspicuous a feature as that of the Wellington. The two radial engines are mounted in long underslung nacelles which project aft of the trailing edge, thus providing an uncommon recognition feature which may be observed

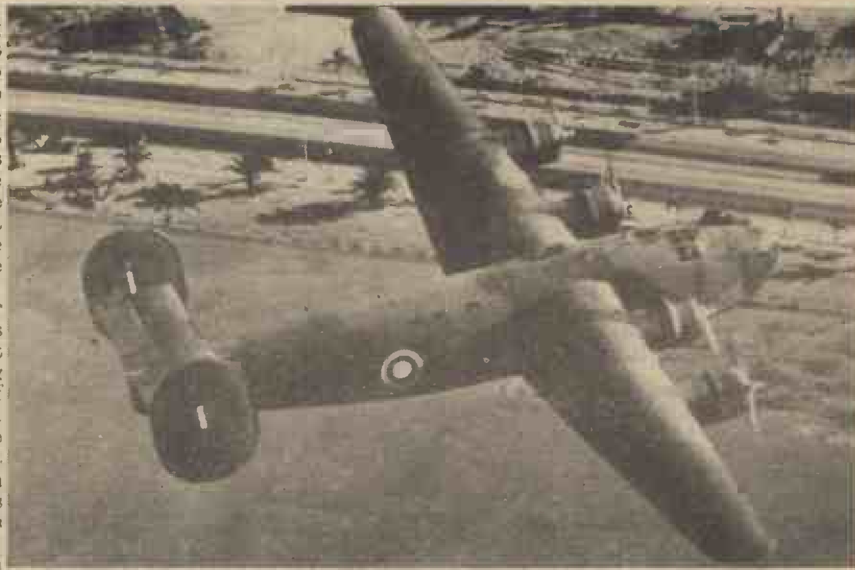
The Bell Caribou, a low-wing single-seat fighter, with liquid cooled engine.



from several points of view. The leading edge of the wings is without taper, whilst the trailing edge is sharply tapered to narrow rounded tips. The dihedral of the wings is moderate, but that of the tailplane is very marked—a particularly useful point to note in the head-on view. The fuselage is deep and rather narrow, with glazed nose well forward of the engines. There is the usual glazed control cabin forward and a similarly shaped glazed cabin just aft of the trailing edge, facing rearward. A tricycle type of retractable undercarrigge is fitted.

The Consolidated *Liberator*, a four-motor bomber of shoulder-wing type with twin fins and rudders, has a span of 110 feet, about 6 feet longer than that of the Flying Fortress, and, with a maximum speed of about 330 m.p.h., it is appreciably faster. Having a cruising range of 3,000 miles, the Liberator is being delivered to Great Britain by air. In addition to gun turrets in nose and tail, there are several gun positions in the fuselage. A tricycle undercarriage is fitted.

The four 1,200 h.p. Twin Wasp radial engines are almost fully underslung. The "Davies" thin wing is of high aspect ratio, with moderate taper and dihedral to rather wide rounded tips. The twin tail unit is an easily recognisable feature, the large fins and rudders resembling shields with rounded ends and flattened sides. The tailplane is practically rectangular. The fuselage is well-rounded, deep and capacious. It suggests the ability to carry heavy loads at high speeds to the point where they will have most effect. In this respect let us hope that the Liberator will prove to have been well and truly named!

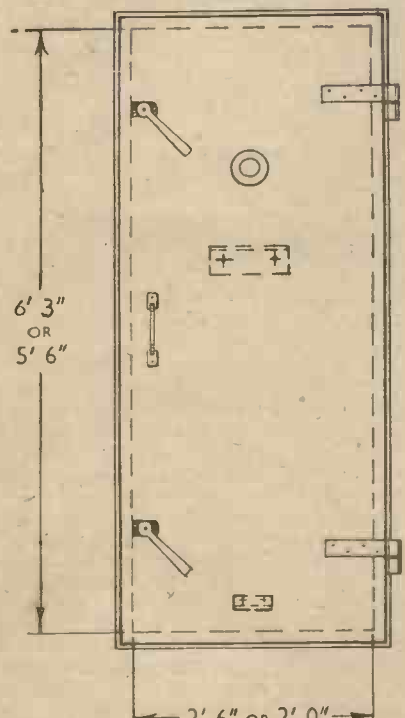


The new Consolidated Aircraft (model 32), known as the "Liberator."

Modern Steel Doors

Notable Gas and Splinter Proof Designs

THE manufacture of metal doors and windows is now an important section of engineering, and much interest attaches in this connection to special designs of gas-proof and splinter-resisting steel doors for buildings of all types, large and small, and for A.R.P. shelters, made by Williams & Williams Ltd., Reliance Works, Chester.



A splinter-proof and gas-proof steel door.

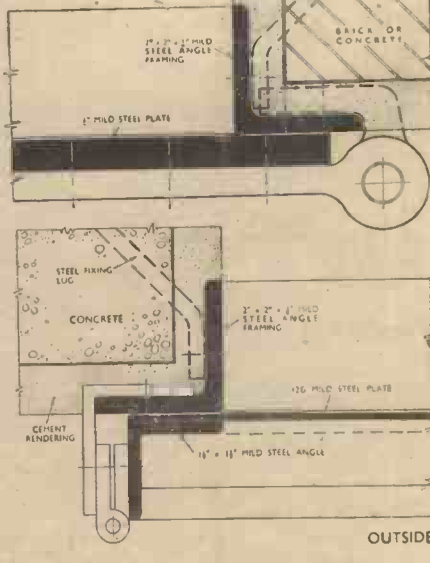
The standard gas-proof door is 6 ft. 3 in. high and 2 ft. 6 in. wide (clear opening), constructed of 12-gauge mild steel plate on angle frame, with heavy butt hinges, and two handles near the top and bottom for closing. These are of the twin-lever type, so that opening and closing can be carried out either from inside or outside. A horizontal steel stiffening bar is fixed across the door at the points where each of the handles operate, and there is included a protected glass observation disc, a pull handle on each side of the door, and a hasp and staple for a padlock.

Gas-tight Joints

One of the main features is the use of a special plastic material known as "Densyl," which is used to make the final gas seal, and which ensures an absolutely gas-tight joint as soon as the door is closed. The material is contained in lead tubes, normally stored in a small steel box attached to the inside of the door, and the joint is made in a simple and quick fashion by squeezing it from the tube all round the edges of the door on to the contact face. Further, it does not deteriorate with age, although not applied until the necessity arises, thus ensuring the efficiency of the gas seal at any time, while if necessary the material can be instantly removed with a dry cloth, and should contamination occur, another application can be made immediately.

The heavier splinter-resisting gas-proof door is on the same principle, but constructed of solid mild steel plate, ½ in. thick, and in two sizes, 6 ft. 3 in. high by 2 ft. 6 in, wide, and 5 ft. 6 in. high by 2 ft. 0 in. wide. Also the hinges are of the "lift-off" type, so arranged that in the event of debris falling against the outside, the door can be lifted off with a crowbar. Gas-proofing is effected by means of the plastic sealing compound as before. In addition, there are now available horizontal sliding splinter-resisting steel shutters, in two leaves of special lapped construction, for fixing in window openings to protect machinery, and other equipment.

Incidentally, the numerous air raids have demonstrated in striking fashion the highly resistant qualities of the metal window, generally of mild steel, which have repeatedly remained intact although the glass has vanished.



Constructional details of splinter-resisting gas-proof steel doors, using "Densyl" plastic sealing material.

Our Busy Inventors

By "Dynamo"

Vertical Bombing

WHEN an enemy bomber is droning in the sky, the safest place is immediately beneath it. If one could move parallel with the path of the hostile plane one would generally be immune. Upon being discharged, a bomb partakes of the forward velocity of the aircraft. Much greater accuracy could be achieved if the bomb could be given a line of descent unaffected by the motion of the plane and, consequently, approximating more nearly to the vertical than has hitherto been accomplished.

Proposals have been made to effect this by a pneumatic or a spring-operated discharge. One of the latest ideas on the subject emanates from the brain of a Russian prince, who has applied to the British Patent Office for a patent. This gentleman resides in England and, as there are now no princes under the domination of the Soviet, one concludes that he was a prince under the regime of the Czar. His idea was conceived before the outbreak of the present war; but the complete specification relating to it has only recently been accepted by the British Patent Office.

According to this invention, there is combined with an aeroplane a bomb-ejecting gun of low velocity. By means of an explosive cartridge, this gun projects rearwardly a bomb in a direction opposite to that of the travel of the plane. The gun is constructed to impel the bomb at a rearward velocity in relation to the moving plane sufficient to neutralise the forward velocity of the bomb, which would otherwise be imparted to it by the motion of the plane.

The direction of discharge of the bomb may be horizontal, and the rearward velocity of the bomb may in such case be equal to the forward velocity of the plane.

If, however, the bomb be expelled downwardly from the ejecting gun by a force in excess of gravity, as well as rearwardly, the horizontal component of its motion should be equal and opposite to the horizontal velocity of the machine on which the gun is mounted.

Should this type of aircraft artillery become general, the presence of an enemy plane immediately overhead will no longer afford a sense of security.

Vitamins and Treacle

FOR some years the vitamin has obsessed the minds of authorities on nutrition. It is now claimed for this factor in feeding that it braces the nerves against the shock of loud noises. When sirens wail, anti-aircraft guns thunder, shrapnel rattles, air-raid shelterers snore, bombs bang, and the champion big noise, Herr Hitler, raucously orates, provided you are fortified with Vitamin B1, your taut nervous system successfully resists the waves of blatant sound.

A medical officer in Suffolk announces that he has discovered a yet further use for vitamins. He affirms that, in the case of certain young patients, these vitalising substances are good for weak arithmetic and poor spelling. The particular brand which has this orthographical effect would appropriately be termed Vitamin Spelling B.

It is not only the human race which is benefited by these substances. We are informed that Vitamins A and D are very important ingredients in the feeds of cattle and poultry, because these vitamins promote growth and the development of strong bones. In the case of poultry, egg production is increased and the shell of the egg is strengthened.

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

The source of the above-mentioned vitamins is stated to be exclusively fish liver oils, of which cod liver oil is regarded as the most desirable product. However, these oils have an unpleasant smell and taste. As a consequence, foods with which they are mixed do not appeal to young animals.

Sgt. Frank Newton, a U.S. ordnance expert, with the new suction silencer he has invented. Further particulars are given on page 299.

An application has been made for a patent in this country relating to an improvement in vitamin compositions for use in feeding poultry and livestock. And the inventor has aimed at making these feeds attractive. His method consists in drying a mixture of a fish liver oil vitamin concentrate with molasses—a palatable and highly nutritious syrup. Unfortunately, at the present juncture we do not enjoy a Niagara of treacle.

Picture Money-Box

IN this age when we are urged to save; any device which will induce the juvenile members of the public to form the habit of thrift is of national importance. A new children's money box has been designed which will tempt the young folk to insert their pence into its slot. When a coin is placed in this box, a picture automatically appears. There may be provided a variety of pictures enticing the little spectator to insert in the tiny coffer a large percentage of his pocket money.

The ideal money box should be constructed with a view to a one-way traffic for coins. It should not be possible for the money put into it to return through the aperture whereby it gained admission. The slot should be marked "No exit." There should be no danger of coins being extracted by means of a cunningly manipulated knife baited with butter or treacle, which, by the way, can be ill-spared in these days of rationing.

Vibrations In Step

MUSICIANS will be interested in a device which has recently made its debut. This has for its object the production of vibrato in sound-amplifying systems.

Vibrato has been described, in the case of the voice, as an alternate partial extinction and re-inforcement of a note. As regards an instrument, it is the rapid change of pitch producing a trembling sound or trill. A short definition states that vibrato is a tremulous quality of tone, as opposed to a pure equal production.

The inventor asserts that it is a common practice for the player of a musical instrument to produce vibrato by his own effort. But in an orchestra, when each player makes his vibrato individually, the whole orchestra is not likely to produce the same number of vibrations per second, and this would result in an out-of-step assembly of the several vibrato effects.

The invention comprises means for artificially producing vibrato in an amplifier of the proper proportions and wave form to give agreeable effect to the tones of singers and musical instruments. The device may also be applied to whistles, bells and motor horns.

It is interesting to note that Sir Charles V. Stanford, the eminent Irish musician, once characterised vibrato as the most detestable of devices except when used in the proper places.

To Hide Your Lights

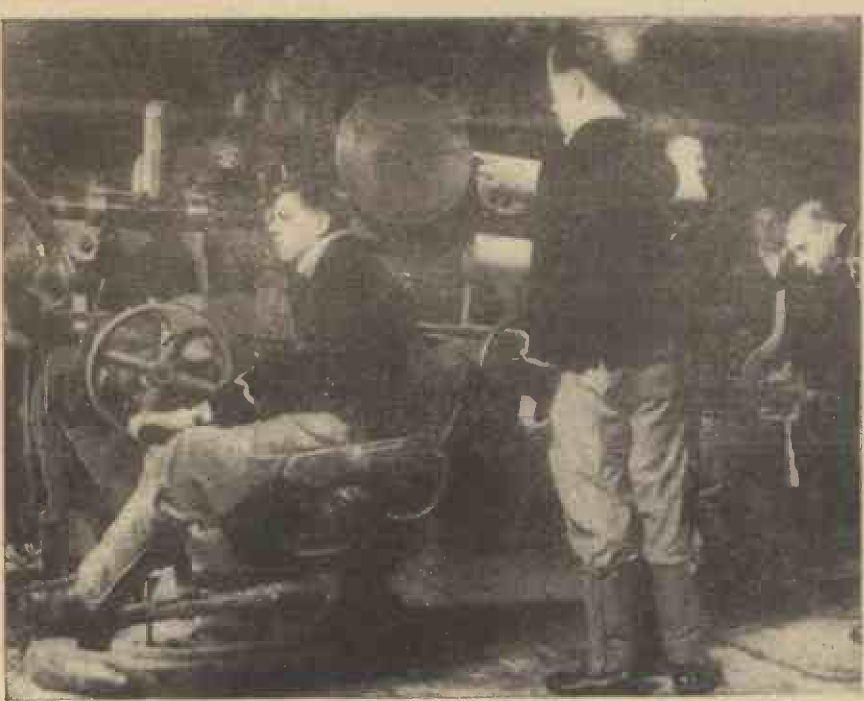
THE black-out being still with us, an effective window screen is worthy of consideration An application for a patent in this country for a screen of this type has been accepted. It comprises flexible material secured to a number of battens which are spaced apart. The ends of these battens are guided by interchanging tongues and channels provided on the battens and the sides of a frame.

A black-out arrangement that can be conveniently applied is a boon, and it is claimed for this invention that, in addition to screening lights, it protects against broken glass and would temporarily exclude unpleasant weather.

Limpet-like Linoleum

FLOOR covering is generally composed of a face layer of linoleum and a backing of fabric. Such covering is usually fastened to the floor by means of a mastic or adhesive cement.

An inventor contends that this method is not invariably satisfactory. He maintains that a number of factors can diminish the power or the adhesion; for example, humidity. To counteract loosening, he has devised a sheet of linoleum without a fabric backing, having on its underside protuberances which fix the linoleum to a hardened cement surface. Into this surface, prior to its being hardened, the protuberances are forced. This method will anchor the linoleum to the floor to which it wlil adhere with the constancy of a limpet.



Young officer cadets at their station at a big gun during part of their training course at a shore establishment.

THE MONTH OF SCIENCE

Living to 185

MR. WILLIAM MARIAS MALISOFF, Professor of Biochemistry at Brooklyn Polytechnic Institute, recently described a new chemical which may increase man's life span to 185 years. It is called sodium thiocyanate, and is used in the treatment of the arteries. In tests on fifty-two rabbits, the Professor says he has been able to reverse the symptoms of old age.

Twelve-Gun Fighters

ACCORDING to reports quoted by American flying experts, R.A.F. fighters are to be armed with twelve guns or four cannon. Though there is no confirmation of this report in Britain, experts here point out that the cannon being mounted on our fighters have already proved immeasurably superior to those of the enemy.

Battleships' Fuel Tanks

NAVAL circles have long discussed whether it is worth while increasing a battleship's radius of action by adding to her oil fuel tanks at the expense of other features. It was established by the Washington Disarmament Treaty that actual fuel is exempt from the modern reckoning of standard displacement, but it is impossible to carry more fuel without making the ship's hull bigger, and that counts in displacement. Other features would be of more value if battleships were regarded as entirely coast defence vessels, designed to spend the greater part of their war time at the bases, but our battleships have been used far afield during the present war.

Paint Drying by Infra-Red Rays

A NEW trick at a U.S. factory is the drying of paint in twelve minutes to a finish so tough that it will take the pounding of a machinist's hammer without cracking. An automobile manufacturer started it about five years ago when he used it first for touch-up painting on car bodies damaged in shipment. He now uses it for finishing entire bodies. The process consists of passing painted cars slowly through a tunnel of lights; carbon filament lamps that give off infra-red rays. Whereas glass cracked by the old method of baking in an oven, it passes through the tunnel without harm.

The process is being used by a Baltimore company to finish jackets for heating furnaces, in panels about four feet by two.

Hygroscope for Textiles

AFTER many months of experiment, a London firm have introduced a special type of hygroscope for ascertaining the percentage of moisture in bales of cotton, jute, wool, etc., without unbaling the fibre. The action of the instrument is based on the principle that the humidity of the air in the interstices of a substance, such as a bale of cotton, is a correct indication of the percentage of water present.

The apparatus comprises three units. First, there are two specially designed wet and dry bulb thermometers, mounted in a casing. Second, a double-acting suction hand pump, and, third, an insertion piece which is introduced into the substance to be tested. This insertion piece is made of half-inch steel rod, and is strong enough to be hammered into a bale or bundle with a wooden mallet.

The operation of the pump requires from 60 to 90 seconds and ensures a constant flow of the air from the substance over the wet and dry bulbs of from eight to ten feet per second. An automatic release valve ensures that excessive vacuum is never obtained. The differential between the readings of the two bulbs is taken and the correct relative humidity is ascertained at once by reference to psychrometric tables supplied with the instrument.

Coffee for Planes

BRAZILIAN scientists have discovered that surplus coffee can be made into a plastic material for use in the manufacture of components for aircraft and cars. A factory for making the plastic is on point of completion.

Banknote Rejuvenator

GERMAN banks are to adopt a banknote rejuvenator which cleans, smooths, and disinfects old, crumpled and worn notes. The machine can rejuvenate 3,000 banknotes an hour. It is driven by a tiny motor, and is about the size of a small cash register.

Sea Tanks

TANKS which can travel on land and on sea have been invented in the United States by Donald Roebling. They can be used for landing troops, and are said to resemble a flat railway car, with a pilot's seat in front protected by an armoured shield.

Oxygen Flask

A NEW method of supplying pilots with oxygen-rich air up to altitudes of 35,000 to 40,000 feet, has been exhibited at an air show in Miami. It is an oxygen "flask" weighing less than 8 lb. which has been developed at the Mayo Brothers' clinic. The U.S. Army Air Corps are to use it, and specifications have been sent to the British Government for use in the treatment of bomb victims suffering from lack of oxygen.

Engineering Achievement

CANADIAN "hard-rock" miners, with other British mining experts, are giving a new meaning to the word "impregnable" at Gibraltar. They are making a new underground Gibraltar, tearing through the solid rock with the latest type of drilling machines, at an incredibly high speed. Inside "The Rock" they are carving out a subterranean town, with underground roads and passages, hospitals, canteens, stores, magazines, shelters, offices and rest centres.

Nothing like it has ever been achieved in the history of engineering.

Remarkable Aircraft Engine

ALLISON Engineering division of the General Motors Corporation has designed a new 2,000 h.p. aviation engine which experts believe is too powerful for any aeroplane or propeller now being produced.

Shifting a Mountain

BECAUSE American mining engineers decided it was too expensive to tunnel under a mountain, they took the mountain away. The mountain was near Morenci, Arizona. The reason the engineers went to all that trouble was that there was enough ore under it to yield 5,000,000,000 pounds of copper. They had known for years that the ore was there. The trouble was that it was low-grade ore which could not be profitably worked by the methods then in existence. New methods made the ore worth working, provided they could get at it, but the cost of tunnelling remained too high. So the engineers decided to level the huge peak and make an open pit mine Production is expected to start next year.

New Troop-Carrying Plane

THE world's largest bomber-troop-carrier —it can take 125 fully equipped soldiers 7,500 miles without refuelling—will shortly be in production in the United States. It is the monster B19 Douglas bomber, which has already been named "Hitler's Headache." Figures just disclosed show that it is more than twice the size of the famous Whitley, Britain's largest, having a wing span of 212 ft., and an overall length of 122 ft. Carrying a crew of ten, with sleeping accommodation for eight of them —and weighing 80 tons fully loaded, it carries a "war-load" of 28 tons—18 tons of bombs and 10 tons of armaments, fuel, stores, etc.

A Plane Muffler

FRANK NEWTON, the American ordnance expert, claims to have invented a new suction silencer for muffling the roar of aeroplane and tank engines in order to make them more difficult to locate by an enemy. Newton claims that his new device also purifies the toxic gases of the exhaust.

Radio Gas Mask

THE latest novelty receiver is a gas mask equipped with a short-wave radio telephone having a range of a few hundred yards. It was recently demonstrated to the Ontario Civil Defence Committee.

All Clear

TO keep glass continually clear it is stated that there has been prepared a new expedient in paste form. It is maintained that it will retard condensation and preserve the surface of all glass from the blurring effect of frost and fog. A single coating, we are told, which can be applied in a few seconds, will give protection for a considerable period. In addition to being used on house windows, it is said to be equally suitable for motor wind-shields, show cases, mirrors and eye-glasses.

We have no particulars of the ingredients of this magic paste but, if it can achieve what is claimed for it, it must be a paragon of window clarifiers; in fact, the areas treated with it could be described as perpetually "All Clear."

IN THE WORLD AND INVENTION

Harnessing Niagara Falls

A JOINT plan has been worked out by the Americans and Canadians whereby the rushing waters of Niagara Falls have been harnessed, throughout the war, to drive machines for making aeroplanes, ships' engines, munitions, etc., to send over to Britain.

Fog Screens

MESSAGES reaching New York from neutral sources in Berlin say that German armed forces have carried out military manoeuvres recently involving extensive use of new types of smoke screens developed in the laboratories of the Reich Defence Council. One form is said to be a grey sandy material, with particles of differing sizes stored in air-tight containers. It can be strewn from planes and develops a heavy screen on contact with the oxygen in the air. The larger particles fall farther than the smaller. It is thus possible to control the depth of the shielding cloud by varying the sizes. Another type, these reports state, is in the form of pellets which may also be dropped from planes. They give off smoke when they come into contact with water. Experiments have been carried out with coloured smoke more blinding than the usual grey variety.

A Novel Broadcast

A 22-YEAR-OLD Norwegian skier, Torger Tokle, recently gave a jumping demonstration at Lake Placid, New York State, U.S.A., with a short-wave transmitter strapped to his back. He described his flight through a microphone welded to a catcher baseball mask that he wore. His words were relayed to WGY in Schenectady, and there placed on a national network.

Building Ships in Sections

MERCHANT ships which can be built on the ground in sections and then hoisted into place for rapid assembly will be Britain's answer to submarine sinkings.

The first will be turned out at a shipyard which was closed some years ago and is now to be reopened. It is planned to scrap four of the berths, and to use the space for erecting huge sections on a scale never before attempted in the industry.

Two powerful cranes will haul the sections into place for final assembly by welding instead of riveting.

A Close Shave

ACCORDING to an American journal, the average man has to shave about 24,000 hairs on his face and adjacent parts of the neck every time he uses a razor. Research workers at the Mellon Institute have found there are about thirty-one variables in shaving conditions. The most important are time of beard softening, concentration of soap, temperature of softening water, time elapsed since the previous shave, the condition of skin and hair as influenced by fatigue, by sunburn and windburn, and by dietary factors.

Shocks for Calves

FOR some years, cows have been milked by electricity. The same power may now be used to wean calves. There has been patented in the United States an electric weaning device which includes a kind of head-stall with a switch unit adapted to be mounted on the nose of the calf. This, we presume, by giving the animal mild shocks, eventually induces the bovine suckling to abstain from its first source of nourishment.

R.A.F.'s New Bomb

IN a recent raid on Emden the R.A.F. used a new type of bomb which has blasting effect five times greater than any they have previously dropped. The Ministry of Aircraft Production has been conducting research work for some time, and because of the terrific blast effect some difficulty was experienced finding a sufficiently large uninhabited area of the country for testing them out.

Photographing a map by means of an arc lamp in the new mobile unit attached to the Corps Field Survey Coy. of the R.E.'s. With this apparatus maps can be printed and photographed at the rate of 3,000 per hour. The complete unit can be brought into operation in a few minutes

MASTERS OF MECHANICS

No. 66.—The Extraordinary Creations of Walter Hancock, London's "Steam Omnibus" Inventor.

ON the morning of the fourth of July, 1829, Londoners who happened to be walking along what is now Euston Road experienced a mild sensation. For on that morning an entirely new type of horse-drawn carriage, capable of holding two dozen passengers, began to run from the old "Yorkshire Stingo" hostelry at Paddington to the Bank of England at the east side of the city. Painted across each side of the new vehicle was the name "Shillibeer" in large and glaring characters.

The vehicle was the creation of a Monsieur George Shillibeer, a Parisian coachbuilder, who, for a time, had been a midshipman in the British Navy. When more of its type were put on the roads, the vehicles were dubbed by the public, "Shillibeers," although, as George Shillibeer himself pointed out, it would be better to term them "omnibuses," since they were for the use of all and sundry.

Shillibeer's Omnibus

The route from Paddington to the Bank of England had for some years previous to Shillibeer's introduction of his omnibus been "worked" by a number of stage-coaches which charged two shillings for outside seats and three shillings for inner ones. Shillibeer, however, charged but sixpence for the whole journey. Hence, it was that his vehicles caught on with the public, their popularity being still more enhanced when, in the January of 1832, a new stage coach Act was passed by Parliament, which Act permitted omnibuses and stage coaches to take up and set down passengers in the London streets.

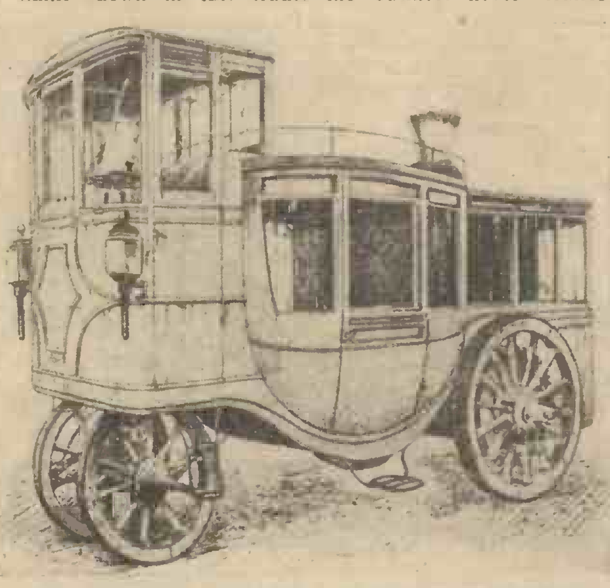
Among the numerous passengers on the first of the London "Shillibeers" was an inventive individual who was particularly interested in the subject of street transport, albeit in an entirely different manner from the means provided for that purpose by the enterprising George Shillibeer.

Shillibeer's innovation of the horse-drawn public service vehicle was good, pondered the above-mentioned passenger, but it ought to be possible, as he had long conjectured, to go a definite step forward and to substitute the new power of steam in place of the humdrum, jog-trot type of locomotion derived from the employment of horses.

Even before Shillibeer placed his first horse-drawn vehicle on the streets of London, Walter Hancock (for such was the name of the inventive passenger) had made numerous experiments on the subject of steam locomotion. He was as yet not thirty years of age, an enthusiast in the application of steam power, and a man of more than usual persistence and energy.

Walter Hancock was not a Londoner by birth. He was born in the town of Marlborough, Wiltshire, on 16th June, 1799, his father, James Hancock, being a hard-working cabinet-maker who, later in life developed into a timber merchant in a small way. Thomas Hancock, the British discoverer of the vulcanisation process for rubber, and a man who afterwards pioneered the rubber industry in Britain, was his elder brother and, apparently, the two Hancocks went to London at about the same time.

Walter Hancock, the subject of our present narrative, served an apprenticeship to a jeweller and watchmaker in London. But although he made an attempt to settle down in this trade, the business never suited him. He became dissatisfied and restless, and more and more he turned for solace to his one hobby—the constructing of steam-driven models, and the designing of larger pieces of power-driven machinery.



A late type of steam coach made by an engineer named Randolph. It was unsuccessful.

With his brother, Thomas, Walter Hancock conducted some early experiments in the dissolving of rubber in naphtha and other liquids. He had, it would seem, a fair knowledge of chemistry which he had doubtless picked up by regular attendance at one or more of the courses of lectures which were then being given on chemical matters by some of the leading scientists of the day.

Nothing is known about Hancock's early mechanical training in engineering. Probably it was non-existent but, nevertheless, Hancock undoubtedly possessed the ability to work with machine-shop tools, and to fashion parts and components of machines out of metal and wood.

Early Invention

The earliest recorded invention of Walter Hancock was made in 1824. It comprised a peculiar type of steam engine in which the usual variety of piston and cylinder mechanism was replaced by a flexible bag made up of several layers of stout canvas united together by means of rubber solution. Rotary motion was given to a wheel by the alternate filling and exhausting of a couple of these bags by means of steam, and a 4 h.p. engine was built in the inventor's workshop at Stratford, to the east of London, which engine turned out to be quite successful. The main feature of the engine was its lightness and portability. Hancock from these features, conceived the idea of fitting the engine to a road vehicle, and of employing it for the transport of passengers along the streets of London. Two or three model steam carriages were made, but none of them was very successful.

Hancock's Steam Boiler

In 1827, Hancock produced his steam boiler, which invention made possible the steam carriages which he ultimately brought into being.

The Hancock boiler combined safety, economy of fuel and space, together with reasonable working efficiency. It consisted of about a dozen wrought-iron compartments which were bolted together so as to form a multi-partitioned boiler. The compartments were filled two-thirds with water, the remaining one-third being left for the generation of steam. The sides of the boiler formed conduits which led to the chimney at the top. The boiler was about a couple of feet wide and three feet high. It was heated by means of a coal fire.

Hancock's steam omnibus, Enterprise, which in 1833 ran between Paddington and the City of London.

Hancock claimed a maximum possible margin of safety for his new type of boiler, pointing out the fact that if the boiler did happen to burst, the explosion would be confined to one compartment of the boiler only and would thereby localise the damaging effects.

Three-wheeled Carriage

Utilising this boiler, Walter Hancock, in 1829, built his first road carriage. The vehicle was designed to carry four passengers and it ran on three wheels, two at the rear and one at the front, this front wheel having attached to it a pair of oscillating cylinders which took their steam direct from the boiler at the rear.

The steam carriage never ran satisfactorily, although Hancock tells us that it sometimes ran to Epping Forest and frequently to Whitechapel. Nevertheless, it gave Hancock the opportunity of obtaining valuable experience in the running of road locomotives, and also of sizing up the commercial and technical possibilities inherent in the operation of such vehicles for public service use.

Then came Shillibeer with first his solitary omnibus and, later, with his fleet of horse-drawn omnibuses. The success of Shillibeer impelled Hancock to further efforts at perfecting his projected steam-powered omnibus.

First Steam Coach

After about a couple of years, Hancock overcame the more outstanding of his practical difficulties and produced (with the aid of a local coach-builder) his first steam coach which, for some reason or other, he gave the name of *Infant*. The *Infant* carried ten passengers, and had trunnion engines. Its boiler fire was kept aflame by means of a mechanical blowing device worked off the engine, whilst the driver sat on the front seat of the vehicle and steered it by means of a tiller mechanism.

The total weight of the *Infant* was about 3½ tons, inclusive of fuel and water, but exclusive of passengers. Its design was patented and the vehicle was first put on the road in February 1831, when it began to ply for hire between Stratford and London.

The feasibility of being able to run steam coaches had been very much doubted. Particularly had it been asserted that such coaches would never be able to ascend even moderately steep hills. In order to remove all doubts upon the subject, Hancock gave a public demonstration with his *Infant*, taking the vehicle up Pentonville Hill, London, which incline has a rise of about one in twenty. Afterwards, referring to this demonstration, he wrote :—

"A severe frost succeeding a shower of sleet had completely glazed the road so that horses could scarcely keep their footing. The trial was made, therefore, under the most unfavourable circumstances possible; so much so that, confident as the writer felt in the power of his engine, his heart inclined to fail him. The carriage, however, did its duty nobly. Without the aid of propellers or any other such appendages (then thought necessary on a level road), the hill was ascended at considerable speed, and the summit successfully attained while my competitors with their horses were yet a little from the bottom of the hill."

In the following year, Hancock completed a second steam coach, the *Infant II*, with which (on October 31st, 1832) he made a journey from Stratford to Brighton. The journey was marred by two or three breakdowns which were due mainly to the inability of the road locomotive to carry sufficient stores of coal and water. Nevertheless, the London-Brighton trip was accomplished two or three times, the average running time being less than six hours on each occasion.

The "Era" Steam-driven Omnibus

The first really successful steam-driven omnibus was the *Era*, a vehicle built by Walter Hancock in 1832. It was constructed by him for the London and Brighton Steam Carriage Company, which transient concern formed one of the many commercial companies which were formed about that time for the purpose of owning and operating steam-driven vehicles for public service requirements.

With the construction of the *Era*, Walter Hancock first definitely entered into competition against the proprietors of the horse-drawn buses, and notably against those of the "Shillibeer" type.

The *Era* was a well-constructed vehicle and flattering things were said of it. It was predicted by responsible persons that, given reasonable freedom from engine trouble, the vehicle would enable a greater number of passengers to be carried more swiftly, and at a cheaper rate than was possible with the "Shillibeers."

The *Era* was put on the Paddington-Bank route in London in direct competition with the then popular "Shillibeers" or horse-drawn omnibuses. It carried ten passengers at sixpence a time, and it travelled at about ten miles an hour. The boiler (of the original Hancock "partitioned" type) consumed from 8 to 12 lbs. of coke, and 100 lbs. of water per mile.

Whilst the novelty lasted, the *Era* was well patronised. But it broke down frequently, and it was sometimes hours before it could be made to proceed on its journey. The position, therefore, becoming somewhat akin to that typified by the fable of the hare and the tortoise, the "Shillibeers" were able to retain their popularity as constituting the slower yet the surer means of getting from Paddington to the Bank in a definite time.

The "Enterprise"

Hancock followed up the *Era* with a new and improved public steam-driven vehicle which he named the *Enterprise*. This appeared in April, 1833, being made for the London and Paddington Steam Carriage Company. The *Enterprise* was run under Hancock's personal supervision. It did three journeys a day between Paddington and the City in order, as it was announced, "to prove its capability of proceeding through crowded thoroughfares without inconvenience or liability to accident to the persons in the coach, or others."

The *Enterprise* acquitted itself well on its initial trials. It ran up the steep Pentonville hill at a steady rate of half a dozen miles an hour, and the entire journey from Paddington to the Bank of England was done in a little less than an hour.

The "Autopsy," a steam-bus placed by Hancock on the London Roads in 1833.

Hancock's vehicles were now becoming successful and, as such, were arousing the anger of the horse-drawn vehicle proprietors. Everything possible was done by the latter fraternity to discourage Hancock, and to drive his vehicles off the roads. Even serious accidents were courted by the opposing interests, as the following extract from a contemporary journal shows :—

"In watching, as I have done, the early operations of the new steam coach, the *Enterprise*, on the Paddington road, I have been pained, though not surprised, to see the malignant efforts of some of the drivers of the horse conveyances to impede and baffle the course of the new competitor. They must be taught not to endanger the lives of the passengers, who have entrusted themselves to their guidance, by a wanton courting of collision with a vehicle so vastly more weighty, more strong and more powerful than their own frail vehicles and feeble, staggering beasts of draught. One of these infatuated men to-day crossed about the path of the steam coach, palpably with a mischievous design, which was only rendered abortive by the vigilance and prompt action of Mr. Hancock."

The "Autopsy"

Somehow or other, the London and Paddington Steam Carriage Company and Hancock failed to agree. In the end, Hancock took the *Enterprise* into his possession and pulled it to pieces, and in the October of the same year (1833) he completed the building of another of his vehicles to which he gave the name of *Autopsy*, the name signifying a means of personal inspection or of seeing for oneself.

The *Autopsy* ran for a short time between Finsbury Square and Pentonville, in London. The vehicle was moderately successful, but it was run, in combination with the *Era* on different London routes for a year or more. During its active career, the *Autopsy* carried upwards of 4,000 passengers without a single serious accident, its average daily speed being of the order of twelve miles per hour.

For various reasons (mainly commercial ones) the steam-coach was now beginning to decline in popularity in London. The railroads were being mooted and planned, and public interest was now turning over to the new "iron roads" with their neat little stations and smooth-running trucks and carriages.

Despite, however, the fact that a railway was built from London to Greenwich, Hancock still kept up his enthusiasm for the steam-driven coach, even to the extent of threatening to "drive the railway off the road!" He built another carriage, the *Automaton*, which appeared in full working trim in July, 1835, and which proved to be his best and, also, his last steam-driven carriage.

The *Automaton* was the largest of all the Hancock carriages. It accommodated twenty-two passengers and its average speed was thirteen miles an hour. The vehicle was put on a number of routes, for when Hancock found the public interest to be waning on one route, he quietly changed the vehicle over to another one.

In 1836, Hancock had four or five of his coaches running on various routes in and around London. The carriages were fairly comfortable and, it is said that Hancock's engines made practically no noise, so that they did not frighten passing horses. Moreover, the coaches emitted the very minimum of smoke and fumes.

Unfortunately, for Hancock, however, many interests were proceeding in directions opposite to his. The railways, the intense hatred and malignancy of the horse-vehicle owners, who even went so far as to dig up sections of the roadway so as to render them unsafe for steam-driven coaches, and, most of all, the general indifference of the public to speedy and horseless road travel all combined in the end to bring about the final failure of Hancock's efforts.

As early as 1835, the *Era* was taken off the London streets and shipped to Dublin, in which city it was regarded as a great novelty and ran with conspicuous success for a year or two.

Hancock persevered with his steam carriages and coaches until 1840, and by that time he had built ten or eleven of them, all of which had been more or less technically sound, and all of which had been operated without any serious accident.

After 1840, the success of the steam-driven road vehicles underwent a rapid and precipitous decline. All the "Steam Carriage" companies failed in rapid succession, and Hancock found himself without a single customer for his vehicles.

In Partnership with Brother

In despair he gave up the task of designing and building steam-powered road vehicles. Instead, he combined with his brother, Thomas Hancock, who was achieving fame in the pioneering of the rubber industry in Britain.

The two Hancocks formed an admirable partnership, the younger brother, Walter, apparently entering into the practical aspects of rubber technology with as much freshness and enthusiasm as he had formerly shown over the construction of his steam-driven road vehicles.

In 1843, Walter Hancock, the erstwhile steam coach inventor, obtained a patent for a method of automatically cutting rubber into strips and, also, for a process of preparing rubber solution.

These were the last of Walter Hancock's patents. During the rest of his life, we hear little more of him, his better-known brother, Thomas, taking the inventive lead.

In 1838, Walter Hancock published a book descriptive of his steam-driven coach experiments. The volume is entitled *A Narrative of Twelve Years' Experiments* (1824-1836) *demonstrative of the Practicability and Advantage of Employing Steam Carriages on Common Roads.* The volume is now a rare one, but occasionally copies of it still turn up in out-of-the-way and unexpected places and, to the student of engineering history, Hancock's printed narrative is one of truly absorbing interest.

Walter Hancock worked in harness with his brother for about eleven years. Afterwards he fell ill, and died, somewhat prematurely, on 14th May, 1852.

Care of Accumulators in War-time

(*Concluded from page* 206, *March*, 1941 *issue*)

THE discharge rate of a battery is limited mainly by its ability to withstand buckling of the plates and loss of paste from the grids. The higher rates of discharge result in lowering the total ampere-hour capacity. On the other hand, there is no reason whatever why a battery should not be charged at a much lower rate than its maximum, except that of the time element, which, of course, becomes longer correspondingly. In most cases slow charging is to the distinct advantage of an accumulator since chemical action has ample time to take place, heating is reduced, and gassing almost absent. In fact, "trickle" charging is widely resorted to, by which is meant a long slow charging at only a fraction of the normal charging rate. Nothing tends to restore a sick accumulator to health again quite so satisfactorily as trickle charging. The ways and means of carrying this out will depend primarily on the nature of the electric supply available, that is, whether alternating or direct current. Where the supply is direct current the matter is simple enough, but there are relatively few public services of direct current supply, while alternating supply is almost universal. Some means of conversion from A.C. to D.C. is therefore necessary, as well as a reduction of the main voltage to a figure more comparable with the E.M.F. of the accumulator, otherwise there will be a great loss in the limiting resistance it would be necessary to include in the circuit to control the charging rate.

Charging Arrangements

The car owner having comparatively few batteries to look after will not as a rule care to go to any great expense such as entailed by a petrol-electric charging set, or a rotary converter driven from the main supply. Both these are running appliances the initial outlay of which is high, and in need of frequent attention while in use. All he wants is something that can be hitched on to the nearest lampholder or plug point leaving matters then to more or less look after themselves. In other words, he wants a simple rectifier of a stationary type of the no-trouble kind, and fortunately there is now available the exact device that meets the demand, in the form of the "dry" rectifier, either of the copper-oxide or selenium type. Valve rectifiers may, of course, be considered as an alternative, and are a little cheaper in first cost, but their lifetime is definitely limited, seldom exceeding 1,000 working hours, whereas the dry rectifier appears to have a practically unlimited lifetime, besides which it is not so fragile. One form of dry rectifier consists of oxidised copper discs alternating with lead discs clamped in close contact, provided with cooling fins, and bolted closely together on a central insulated spindle. Others employ selenium-coated nickel-plated iron discs similarly mounted, the size and number of which are chosen to suit the current to be carried and the circuit voltage. The general assembly of component parts of a selenium rectifier is shown in Fig. 6.

Function of Metal Rectifiers

The peculiar property of dry rectifiers in passing current so much more freely in one direction than in the other arises by virtue of the different resistance they offer to opposite directions of the current, as shown in Fig. 7. This can be turned to good account when charging from alternating current by practically suppressing the half-wave of reverse current, as in Fig. 8, or, better still, by providing two alternative routes as in Fig. 9, which utilises both half-waves of A.C., alternative routes being provided first right and then left with each reversal, so that current in the same direction always reaches the accumulator by whichever route it travels to it. Naturally the "full-wave" rectification is the more efficient for charging purposes.

A standard rectifier set of the selenium type for trickle-charging is illustrated in Fig. 10, and consists first of a transformer for stepping down the A.C. mains voltage to a figure slightly in excess of the counter E.M.F. of the accumulator on charge. The primary and secondary windings are protected by double-pole fuses in each circuit; there is an ammeter for indicating the exact charging current passing to the battery, and a variable regulating resistance for its control. The circuit diagram of such rectifiers is given in Fig. 11.

Storage of Accumulators

Where nickel-iron type accumulators are concerned, their storage when completely out of service gives but little trouble. The makers advise them to be filled with electrolyte, and kept in a half-charged condition. The filler caps should be kept closed, the cells stored in a clean dry place, and the only attention then needed is to occasionally inspect them to ensure that the plates remain covered to the correct depth. When taken into service again the cells should be given a charge at normal rate for twelve hours before use. Above all things, remember that lead-battery acid put by mistake into nickel-iron cells will ruin them completely. Nothing but potassium hydriate in distilled water must be used, the correct specific gravity being 1.17.

The treatment for lead-acid cells when put by and totally out of service may take either of two courses. The battery may be fully charged and the acid left in, and a freshening-up charge given every four weeks or so, the cells being stored as far as possible in a constant temperature. Occasional topping-up when the acid is found to be at low level is then sufficient to maintain them in good condition indefinitely. When facilities for re-charging are absent the battery may receive first a full charge; the acid is then emptied out, the vent plugs quickly replaced and sealed against admission of air, otherwise the plates may heat badly through absorption of oxygen. Alternatively the battery may be half charged, the acid emptied out, and replaced with pure water until such time as required for service again. It will then be necessary to empty out the water and replace with fresh acid. If the cells are provided with wood separators these will have absorbed a certain amount of water, so that acid of the usual 1.200 sp. gr. may require modification, that is, it may need stronger acid added to allow for its dilution when mixing with the retained water in the cells. This can be checked up by the usual hydrometer test. In any case, an accumulator that has been out of use for a considerable period must invariably receive a long charge before being brought into active service again.

Collieries without Colliers

The pit-head gear of a colliery somewhere in England.

A New and Revolutionary Method of obtaining Power and Energy from Underground Coal Deposits

NEARLY half a century ago, the great Russian chemist, Dmitrii Ivanovitch Mendelejeff, discoverer of the famous "Periodic Law" of the chemical elements, indulged in a little tentative prophecy.

"There will probably come a time," he wrote in one of his papers, "when even coal will not be extracted from the earth, but deep down in the earth the coal will be transformed into combustible gas and sent through pipes over long distances for distribution."

Such words were written in the hey-day of our coal-mining age, at a time when the collieries of Britain were exceedingly prosperous, and when man-power was cheap and plentiful. Mendelejeff, of course, was dubbed a visionary, even as he was by many of his chemical brethren, and his attempt at prophecy was quickly forgotten.

Nowadays the words of Mendelejeff have come true. In his own country, Russian technicians last year succeeded in winning the latent power and energy of coal without actually handling or mining the mineral. The feat has, as yet, only been accomplished in an experimental manner, although it has been effected on quite a large scale.

When we consider the fact that coal still remains for most nations the main source of their heat and power, the new plan for extracting the latent energy of coal without actually mining the material reveals itself as one of extraordinary daring and sphere of application. For, with the new method in operation, although the number of colliery workers will be very much reduced, the sad tale of coal-mine accidents which has dogged the colliery industry relentlessly throughout its history will be ended at last. Man will become the master of coal and of its store of energy without having at first to make himself a slave of its mining.

Still further, the new Russian method will very considerably lower the cost of coal-energy to the ultimate consumer. It is calculated that coal-energy obtained from the Russian process can be supplied at a cost of one-third to one-quarter the cost of mining and handling the coal and of transporting it to the place where it is to be consumed.

Simple Principle of Working

Russia is the only country which, up to the present time, has developed the new method for extracting the energy of coal in the above-mentioned manner. In principle, the new method is extremely simple. It consists merely in the boring of two sloping narrow shafts down into the coal bed, and joining these shafts together when they reach the coal seam. This task is obviously a one for miners, because, in practice, the single shaft running along the coal seam is best augmented by a number of small "drills" or short-length, narrow, auxiliary shafts running off the main shaft connecting the two surface shafts together.

The making of this system of underground shafts and tunnels is, to a mining engineer, a very simple job, and, using up-to-date drilling methods, it is possible to accomplish the task in a very short space of time.

The tops of the two sloping surface shafts are suitably "capped," i.e., provided with gas-tight coverings to prevent the escape of gas from the shafts. A blast of heated air, or, preferably, of air "fortified" with extra oxygen is forced down one of the sloping shafts into the underground workings. The rapidity of the blast sets up an oxidising action in the coal seams. In time, the coal actually heats up and attains a temperature of almost red heat.

Under these conditions, the coal is more or less completely changed into gas and volatile products which pass up the opposite inclined shaft and are suitably collected, purified and transported in pipe lines away from the actual scene of operations.

The first experiments of this nature were made in Russia as long ago as 1933, when four or five experimental sets of shafts were sunk by engineers in various coal-bearing areas of the U.S.S.R. The results obtained were so excellent that the Russian mining engineers were encouraged to proceed with their investigations.

First "Gasification" Station

In 1937, the first large-scale "gasification" station was erected in the Donets mining area of the U.S.S.R. This experimental plant, operating on the simple plan described above, was successful from its very inception, and since that time millions of cubic feet of coal gas have been supplied by this plant for the use of a nearby factory.

The above "gasification" station was regarded as one for the purpose of enabling the Russian engineers to study the various technical problems of the new and revolutionary method of the underground gasification of coal.

It was found that the plan could be put into successful operation without even a

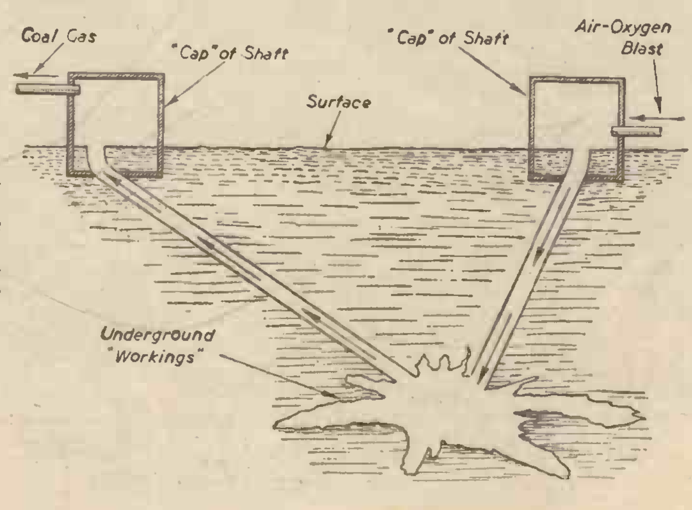
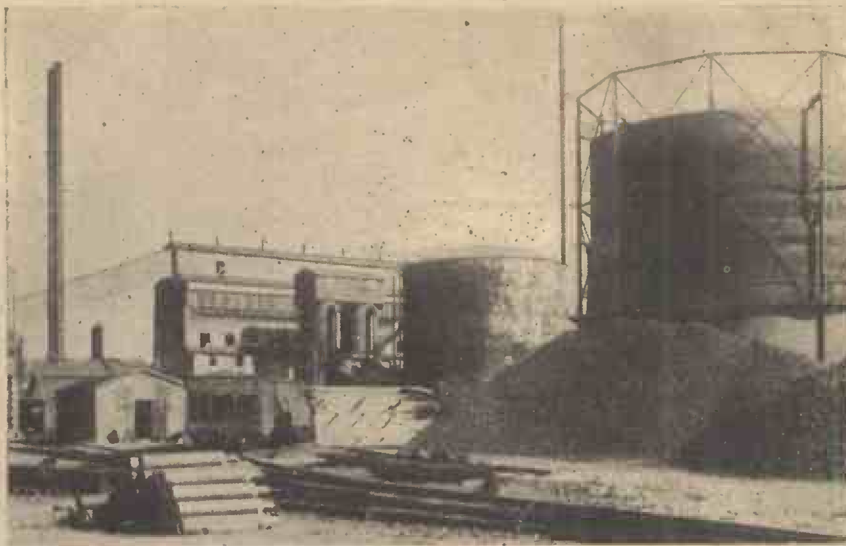


Diagram illustrating the principle of the new Russian method of "gasifying" underground coal.

single human being having to delve beneath the surface of the earth in order to construct the various interconnecting shafts for the passage of the air blast, and the resultant coal gases. All that is necessary is to drill a number of small but deep bore holes into the coal seams, the bore-holes being given a slanting direction so that they meet somewhere in the middle of the coal seam. These bores are all "capped" and the air blast is forced simultaneously down two or more of them, the remaining bore holes serving as exit shafts for the passage of the escaping coal gases.

Operating upon this still further simplified principle, a large "gasification" station is now being put into operation in the Donets Basin coal-bearing area of the U.S.S.R. Last year, a preliminary station was erected in the same area, but this was one utilising a system of underground tunnels and workings which had been prepared by human labour underground. This latter station, which was completed in November, 1940, is now supplying "natural" coal gas to a neighbouring chemical factory which previously had consumed some tens of thousands of tons of liquid fuel annually.



A plant for the conversion of bituminous coal into a high-grade anthracite on a large commercial scale.

Production of Coal Gas

The underground gasification of coal seams results not only in the production of vast amounts of coal gas, but, by modifying the conditions, as, for example, by sending down into the coal seams, a mixture of steam and oxygen-fortified air, it is possible to produce vapours which can be condensed to liquid petrol-like fuels and, also, to tars which can subsequently be distilled in the same manner as coal tar, and from which the various extremely valuable chemical components may be extracted for use in the dyestuff and the various other chemical industries.

The coal gas derived by means of the new U.S.S.R. system of underground gasification is of high calorific value. It may be compressed, stored in gasholders or converted directly into liquid fuels and other chemical products.

The gasification method can be effected by very simple and relatively inexpensive plant. Hence, for this reason, the necessity of heavy capital investments is done away with. And since the number of workers necessary for the running of the process is relatively small, the labour costs of the process are correspondingly lowered.

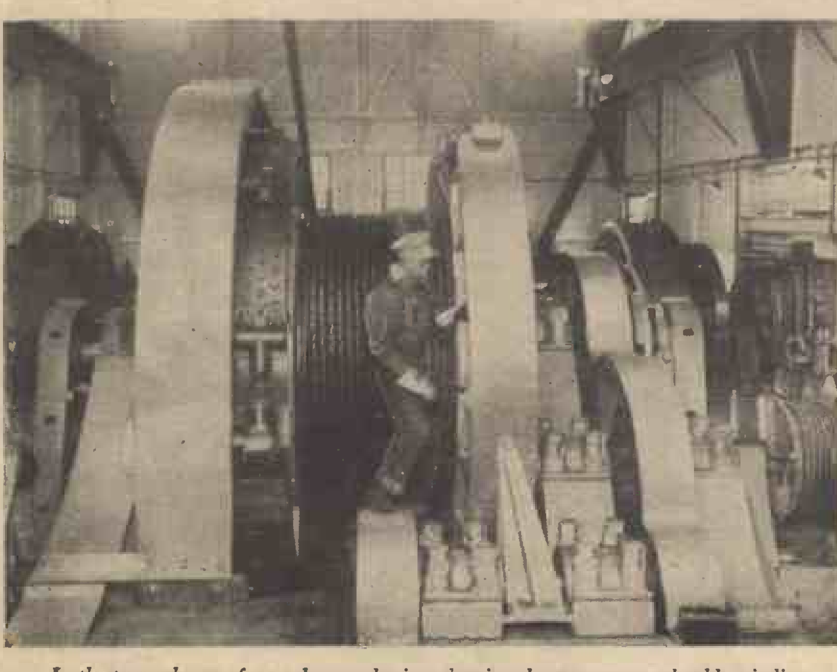
The main cost of the process lies in the necessity of supplying oxygen continuously to the underground shafts, for it is found that the higher the percentage of oxygen in the air blast which is driven down into the coal seam, the higher the calorific value of the coal gas which is thereby produced.

Oxygen for Air Blast

Fortunately, oxygen is not nowadays a very costly commodity. It is obtained by the liquifaction of air, the liquid air being fractionally evaporated, and the oxygen thereby being separated from the nitrogen. By employing large-scale air-liquifaction plants, and running them continuously, the cost of the necessary oxygen for the air blast can be reduced to very small proportions.

Although several more gasification plants are being planned in the various districts of the U.S.S.R. and in localities as far apart as the Ural Mountains, and Moscow, it is hardly feasible that the new method will become general in Britain for many years to come. The coal-mining industry in our country is a hereditary one, and, owing to the large amount of displacement of experienced labour which the introduction of the new gasification method into Great Britain would bring about, it is almost certain that it will not be attempted at the present juncture.

Yet, of course, if the method could be brought into action without causing labour hardships, difficulties and unemployment, it would be, for our country, a truly progressive step, since it would abolish underground working in coal mines and would, therefore, put an end to all the discomforts, hardships and accidents which constantly attend such duties.



In the power house of a modern coal mine, showing the generator and cable winding gear. The steel cable is 3 in. diameter.

SPONGE MAKING

AMONG the numerous imitations of natural objects is the artificial sponge. It appears that circular sponges of this type are usually manufactured by individual moulding. And it is stated that forming them with economy from material of rectilinear shape is extremely difficult owing to the amount of the cut product which cannot be utilised.

To obviate this, an improved method of manufacture of artificial sponges and apparatus for that purpose have been devised, and are the subject of an invention for which an application for a patent has been made to the British Patent Office.

The subject of sponges brings to mind an islet in the Eastern Mediterranean. This is Syma, near the island of Rhodes, an Italian possession which has lately been in the news. Syma was once upon a time famous for sponges, which were obtained only by skilful divers. It was a laborious and dangerous occupation, but it was so lucrative that five or six successful days' work afforded those engaged in it the means of support for a whole year. The diver went down even a hundred feet and sometimes remained under water for five or six minutes. There was a curious law in the Isle of Syma. No young man was permitted to marry until he could dive a certain distance, and remain a specified time under water. One imagines that a better qualification for the marriage state would be the ability to remain unperturbed when in hot water.

NEW SERIES

Making a Success of Your Photography

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

Avoiding Mistakes in Exposure Times

This print of a simple landscape shows the value of half-tones for pictorial effect.

IT should be the aim of every amateur photographer to secure a dozen perfect negatives on each spool of a dozen exposures but, owing to the many little items which we are all prone to forget, also the errors we make in the consideration of the light and the subject, it is only seldom that even the experienced hand will succeed in getting such a percentage of good results.

Having reviewed the various parts of our cameras, and learned something about the excellent quality of British made films, it should be possible for any individual to achieve a good average of successful negatives, so let us give a little thought to this very important question of exposure.

The "Perfect" Negative

We must first get a clear understanding as to what is meant by, or rather what constitutes, a perfect negative. Here is the definition:

It is a film or plate that has been exposed for just that fraction of time by which the reflected rays of light given off from every point of the scene or subject may act on the emulsion in a degree equal to their intensity or light power; thus a pure white will act greatest and a black the least, and all between these extremes will only act proportionately, and it is these "betweens" which are responsible for what we know as "half-tones," or "gradations," and the more there are of these in a negative, the more pictorial it usually is. There are, of course, negatives where half-tones are not required, such as simple black and white subjects, generally known as "contrasty" negatives.

This, however, is only the first part of the making of a perfect negative, the second is the developing, for, although the exposure may have been correct in every detail, yet it is possible for the amateur to spoil the result by over or under developing, thereby cutting out the half-tones or reducing their number, resulting in a negative having a poor line of gradation, and one that tends to too much contrast.

So the perfect negative is one that is correctly exposed, and also correctly developed.

Some readers will think that it is going to be a long time before they can expect to get one such negative unless they have a spot of luck or learn a lot about Optics and Light. This is not the case, for if a fair amount of care is used with every exposure made, it will soon become very easy to calculate the approximate correct exposure and, as regards the development, we shall endeavour to put you at your ease in another article.

You will have noticed that we used the word "approximate"; this is because films and plates are so good in these days that it is possible to take a certain amount of liberty with exposure, but it does not do to take this too literally.

Reducing Risk of Failures

How is it best to work so as to reduce the risk of errors?

Throughout these hints and tips I shall be very persistent in advising "standardisation" wherever it is possible; it can be practised very extensively, and will be found to be the best preventative of waste as regards both material and time, not to mention temper and disappointment, so let us make a start and consider standardisation even in exposure.

In the article on the parts of a camera and their functions, it was demonstrated how the light action could be controlled by two of the parts, the stops and the shutter; in the article on sensitised material you were advised to always purchase a good make of film and stick to it.

That second hint needs no explanation, but let us see what can be done about the stops and shutter. If by using stop F11 we have to set the shutter to ½ second, we should have to make it one second if we used stop F16. That means that we have altered two controls, thus giving the opportunity for a mistake to occur by only changing one. For the majority of exposures it is possible to use one stop and alter the shutter speeds as and when required, or to keep to one speed and alter the stop when necessary, but it is advisable to refrain as far as possible from making two changes; this system has this advantage that if mistakes are made it is easier to remember how they have arisen. In the summer days one can often make a number of exposures with F11, using a speed of 1/25th or 1/50th of a second, and the only alteration required will be when an exposure is being made on a subject which is very different to those you are in the habit of taking, such as very heavy shadows, or an abundance of very bright lighting on a white foreground. This is my first suggestion for standardising your work.

Exposure Meters

My next hint in connection with exposure is one which I am certain all experienced photographers will agree is a good one; it is to get an exposure meter, a very good one if you can afford two or three guineas, but if you cannot, then get a cheap one for a shilling or two. They are of different types, one being a piece of apparatus, whereas the other is only a strip of cardboard, but here is the rub, they are both capable of giving fairly accurate reckonings, but there is no exposure meter that will be accurate for all subjects at any time, and, unfortunately, even with the more expensive ones, there is so much variance that no two register alike. As this is the case, it behoves each one of us to select one for our use and to stick to it, for as soon as we have proved or checked its readings we shall know exactly how to act by them. I have used several of the cheaper type where a card is shifted to correspond with code letters referring to the film, or time of day, etc., also those with a circular disc, and, again, those with a piece of sensitised paper, and having mastered them can give them credit for being quite serviceable. Whatever make you decide to adopt, do be sure to read all you possibly can about it, and see also that you make a few tests so as to get the necessary experience before putting all your reliance on it.

Notes of Exposures Made

At this stage I want to impress on all readers the real advantage and help which one can get by recording in a diary, or any small book, a complete detailed entry of every exposure made; it should be something like the following:

June 21st. 2 o'c. p.m. Very sunny, open Landscape, F11. 1/100th X X X spool. For purpose of identification a place name can be included if desired. When the film has been developed, the result of the exposure should be added as: very good result, perfect exposure, or, if it is not too good, then state over or under exposed.

The usefulness of these entries is that you will have made a record for future reference, and the fact that you have used your pencil to make an entry such as this will cause you to be just a trifle more careful in your calculating.

Try it, and you will see the average of good results gradually getting higher.

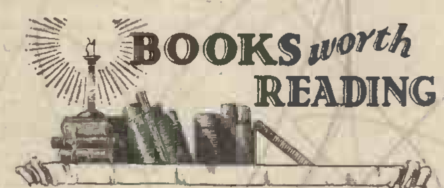
It is not easy to judge what is the accurate shot to make; some subjects are particularly difficult if you are without the help of a meter, a very strong light on subjects with heavy shadows is never easy, neither is a soft lighting of early morning or late afternoon and, again, interiors present difficulties which are not always apparent, but with a meter the exposure can be calculated satisfactorily. There is an old rule which still holds good in these days, and it is "always expose for the shadows and the high lights will look after themselves." This is quite right in average scenes or subjects, but when those shadows are very deep and details are hard to distinguish, I think the best plan is to decide that it is not worth wasting a film on the scene, for the result will be very disappointing, because if the shadows are correctly exposed, then the highlights in almost every instance would be over-exposed, so much so that it would be impossible to print any details from them, and the print would only be one of those unpleasant contrasty type.

The question arises here as to what happens if the camera is only fitted with a small and a large stop; the booklet of directions with these cameras advises that the small one is to be used for sunny subjects, or at midday, and the large one for dull days, before 10 or 11 o'clock, and after 4 o'clock in the months of June to August. Now, these cameras are recognised as cheap ones, and although they are capable of making some very good snaps, yet it must be recognised that their capabilities are definitely limited. I am sure that if the owners of such will only make good use of, and learn to master a meter, then they will find that it is possible to take many more pictures than they think is possible.

With a Cheap Camera

Here is one example which will serve to demonstrate this point; one day in July, time 3.30, very dull with heavy clouds, rain had been falling for some hours, but had just ceased; the scene was the mole of a South Coast harbour with a few boats and one or two small groups of persons on the wet pavement. My meter registered an exposure time of 1/50th, using FII. Several exposures were made on this reckoning, when along came a young friend with a cheap box camera expressing a wish that she might take the picture. Why not take it? I asked, and she replied that "it was impossible as there was no sun." I asked her to lend me her camera, and to allow me to take the view for her, promising that if it was a dud I would make her a present of an enlargement from my own exposure. A few days later she brought a batch of prints to me for criticism, the most outstanding one was that of the harbour scene, and even the chemist who had made the prints congratulated her on the result. The point which I want to make clear to all is that by using an exposure meter it is possible to make snaps which you would be inclined to think were impossible, and also the recording of the meter would tell you that it was not possible for you to take others.

Incidentally, it will not be out of place to remind you that the soft light of the day is the best for really pictorial effects; midday in summer time tends to hard contrasts, and the lack of gradation or "half-tones."



"The R.A.F. In Action." Published by Adam and Charles Black. Twenty-two pages of text. Sixty-two pages of photogravure illustrations. Price 7s. net.

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The British Journal Photographic Almanac, 1941. Published by Henry Greenwood and Co., Ltd. 416 pages, and a 32-page pictorial photogravure supplement. Price 3s. 6d. net.

AS in previous years, this book is a handy *vade mecum* for the photographer. In addition to the photogravure supplement there is a series of articles by well-known authors. Other contents include a Description of New Methods and Processes; Editorial Reviews of New Materials and Apparatus; Formulæ and Instructions for the Various Photographic Processes, including Cinematography; Tables, Chemicals and Miscellaneous Information. There are also a Directory of the British Photographic Trade, and Indexes to the text and advertisers.

The Practice of Arc-Welding. By W. Heigh. Published by Sir Isaac Pitman & Sons, Ltd., Price 5s. net.

AS in other handicrafts allied to engineering, successful welding largely depends on the skill of the operator, but this skill of the craftsman can be improved when he learns the fundamental principles upon which the practice is based. This book, which deals with the practice of arc-welding from the point of view of the artisan, presents the principles of the craft in convenient form. In general, an effort has been made to collect the experiences of others from as many sources as possible, and all data given has been thoroughly tested by the author. There are five chapters, dealing respectively with Arc Processes? Metallic Arc Welding? Faults? Procedures and Training? and Distortion and Cost. The book is well illustrated.

The Joyous Wheel. By James Arnold. Published by Hamish Hamilton, Ltd. 132 pages. Price 6s. net.

THIS book, which forms a collection of observations and experiences during cycle journeys by the author, will prove interesting reading to all cyclists, and lovers of the open road. Various runs from the Downs to the Cotswolds and the Chilterns, the Malvern Hills, Bringewood Chase, Caban Coch, the Wye and the Severn, Chipping Campden, Turkdean, all are entertainingly described. The book is illustrated with various woodcuts.

The Air and its Mysteries. By C. M. Botley, F.R.Met.Soc. Published by The Scientific Book Club. 272 pages. Price 2s. 6d. to members.

THE scope of this book is indicated by its title. It is in no sense a text-book, but an attempt to give the reader an insight into some of the secrets of the atmosphere. The lower atmosphere is revealed as the sustainer of life, scene of the weather, and carrier of sound. Weather is treated in a very full and interesting way, and there are separate chapters on wind, rain, clouds, thunderstorms, and climate. The triumphs and difficulties of mechanical flight are described, and finally the book tells what has so far been learned about the less familiar upper atmosphere, and explains how information about it is obtained through the use of balloons, radio waves, and the observation of meteors and cosmic rays. The book is illustrated with line diagrams, and many interesting photographs.

"Photographic Facts and Formulas." By E. J. Wall, F.R.P.S. Revised and largely rewritten by Franklin I. Jordan, F.R.P.S. Published by Chapman and Hall, Ltd. 384 pages. Price 18s. 0d. net.

THIS book is intended as a working guide to the serious amateur photographer, and to the professional, giving them within the covers of a single volume, plain working directions and formulas for all the most commonly used photographic processes. The book contains the latest information on such up-to-date subjects as colour-photography, film development, the Kalli-type, or the wash-off relief process. There are twenty-five chapters covering, amongst other subjects, optics, exposure, development, duplicating negatives, intensification, iron processes, gum-bichromate printing, photo-mechanical processes, stereoscopic photography, and lantern slides. The book, completely indexed, should prove an invaluable ready reference.

"The Social Life of Animals." By W. C. Allee. Published by The Scientific Book Club. 264 pages. Price 2s. 6d. to members.

THE author of this book is a well-known American scientist, who has spent more than thirty years exploring the group behaviour of animals, and whose conclusions on the subject are now revealed to the reading public. Interesting analyses of group organisations are given, and throughout the book the reader will notice a gradual development of social attributes suggesting a sub-stratum of social tendencies that extends through the entire animal kingdom. The book is illustrated with many interesting photographs and line drawings.

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Transformer Building

The Design and Construction of Small Static Transformers.

By A. H. Avery, A.M.I.E.E.

(Concluded from page 264, April issue)

MENTION should be made in passing of special cores, again more useful in radio work, which are composed not of sheets or stampings, but of nickel-iron alloy in powder form. This metallic powder is mixed with a suitable binding material after being carefully graded for size and granular formation, and then is pressed into the desired shape and heat treated. The avoidance of magnetic joints, and the adaptability of this construction to difficult shapes of core is, of course, a valuable feature, but it is not a process that lends itself to amateur facilities.

Overlapping Stampings

Magnetic joints in a transformer core must be arranged so as to reduce air-gaps to a negligible amount. This is met by assembling the stampings in such a way that the joints of one layer are overlapped by the unbroken surface of the next layer. Fig. 14 illustrates this method. Here the succeeding odd and even layers are seen assembled with their joints alternately right and left, so as to avoid any serious interference with the passage of the magnetic lines. Another point to be noted in core building is that all bolting up studs passing through the stampings for clamping-up purposes must be lightly insulated themselves to prevent contacting with the edges of the stampings, otherwise they will short-circuit them and defeat the object of lamination.

Obviously the least expensive type of core is the one that can be built up from plain strips without the need for special tools. These can be built up after the manner of Fig. 6, and a range of standard cores of standard dimensions arrived at that will cover the requirements of most experimenters. Each core will consist of two long and two short sides, all stampings being of the same width, sufficient being used to pile up to a depth equal to their width. The result is a core whose limbs have a square cross section when clamped up, which has the advantage that coils of circular section, wound in the lathe, can be employed, leaving small air spaces at the sides for ventilation (Fig. 16). The table of sizes (Table I) will be found very useful for those who have limited experience in working out their own designs, the output capacity of each sized core being also stated for all ordinary commercial frequencies, between 25 and 100 cycles.

Output Obtainable

It will be noticed that the output obtainable from any core size in Table I given below is determined by the frequency of the circuit to which it is connected, that is the speed of the magnetic flux reversals. In this, a resemblance to the behaviour and output capacity obtainable from generators and motors will be traced; their outputs also largely depend upon speed, although in their case it is in the form of rotation of the armature instead of oscillation of the flux. Another thing to note is that although the weights and sizes of core specified are found to give satisfactory performances from extended use and trial over a number of years, it does not follow that they are the only possible dimensions from which these performances are obtainable. Larger and heavier iron cores with smaller copper coils could quite well be used to attain the same outputs, and *vice versa*. But in general there is a relationship to be found between the proportions of iron and copper which give best all-round results, and which entail the least expense in construction.

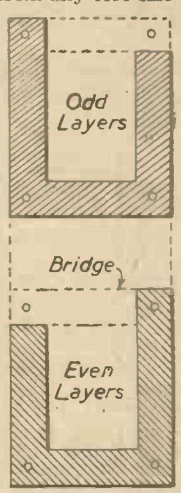

Fig. 14. Showing method of overlapping stampings.

Core No.	Inches				Section sq. in.	Weight lbs.	Watts Output. Continuous Rating			Core Depth in inches
	A	B	C	D			25 cycles	50 cycles	100 cycles	
1	4	2¼	1	7/32	1	3½	35	70	140	1
2	4¼	2⅜	1¼	9/32	1½	6	60	120	240	1¼
3	4½	3	1½	9/32	2¼	9¼	90	180	360	1½
4	5¾	3⅜	1¾	11/32	3	15½	150	300	600	1¾
5	6	3⅞	2	13/32	4	22	220	440	880	2

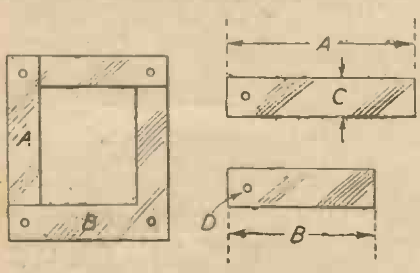

Table I. Particulars of transformer cores. (Left) Diagram showing forms of stampings.

When working at a definite flux density in the iron core of a transformer, the number of turns required in either the primary or secondary coil will depend on the cross sectional area of the iron, and on the frequency of the circuit. If a stalloy core has a sectional area of one square inch, for instance, and is working at a frequency of fifty cycles with an economical flux density, eight turns per volt would be required in either primary or secondary coils. If the core had a sectional area of two square inches, there would be twice as many flux lines as before threading the coils and, therefore, only four turns per volt would be necessary. If the frequency were doubled to one hundred cycles, only one half the turns required for fifty cycles are wanted; if reduced to twenty-five cycles, twice as many turns would be needed. These facts are included in the following Table; the factor "Turns per Volt" will be found given for each of the core sizes appearing in Table I for all commercial frequencies between 25 and 100 cycles per second, and can be applied direct to all calculations of voltage for either primary or secondary windings.

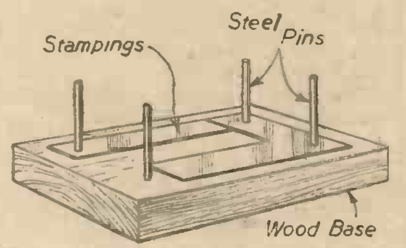

Fig. 15. Simple jig for assembling stampings.

Transformer Coil Calculations

Fifty cycles per second is almost universal for public services of A.C. supply nowadays, but the other frequencies mentioned were in constant use formerly, and are still sometimes met with. These two tables—I and II—enable the core dimensions and the turns per coil to be quickly arrived at in order to suit any specified output. For example, if it is desired to select a suitable size of core for a transformer to develop 50 volts 6 amperes on the secondary output, when supplied with an input of 230 volts 50 cycles, and to ascertain how many turns of wire there must be in each of the coils, turn first to Table I. Find the loading in watts by multiplying together the secondary volts and amperes; this is 50 x 6 — 300 watts. At fifty cycles frequency, Table No. I shows that core No. 4 is suitable for this rating. Next refer to Table II and this at once gives the turns per volt as 2.6. The primary coil turns must, therefore, contain 230 x 2.6 = 598 turns, while the secondary will require 50 x 2.6 = 130 turns.

Gauges of Coil Windings

The next step is to decide upon suitable gauges of wire for the two coils, and Table II

Core No.	Turns per Volt for various Frequencies						
	25 cycles	33 cycles	40 cycles	50 cycles	60 cycles	83 cycles	100 cycles
1	16	12	10	8	6.7	4.8	4
2	10.2	7.7	6.4	5.1	4.2	3.1	2.6
3	7	5.3	4.4	3.5	2.9	2.1	1.8
4	5.2	3.9	3.3	2.6	2.2	1.6	1.3
5	4	3	2.5	2	1.7	1.2	1

Table II. Transformer coil specifications.

must be consulted, after first ascertaining the approximate value of current in each coil. The secondary current is, of course, already known by the specification as 6 amperes, and to find the primary current the loading in watts is divided by the primary volts, namely 300 watts ÷ 230 = 1.3 amperes approximately. As a matter of fact, the input current will be slightly greater than this to allow for the inevitable copper and iron losses and a 10 per cent. increase will safely cover the requirements in this range of small sizes, so that the figure of 1.3 becomes 1.3 plus 0.13—that is, 1.43 amperes for the primary current. Reference to Table III now indicates suitable gauges of wire for each of these current values, namely No. 20 for the primary and No. 15 for the secondary.

S.W.G.	Diameter inches	Safe current in amperes	Ohms per lb.	Yards per lb.	Turns per linear inch		
					Enamel covering	Single cotton	Double cotton
14	.080	7.54	.082	16.7	—	11.3	10.6
15	.072	6.10	.140	21.2	—	12.6	11.9
16	.064	4.82	.202	24.8	—	14.0	13.1
17	.056	3.69	.420	35.1	17.1	15.8	14.7
18	.048	2.71	.639	45.0	19.8	18.5	17.2
19	.040	1.88	1.32	68.8	23.7	21.7	20.0
20	.036	1.52	2.01	80.0	26.1	23.8	21.7
21	.032	1.20	3.23	107.4	29.4	26.3	23.8
22	.028	0.92	5.52	129.4	33.3	29.4	26.3
23	.024	0.67	10.22	191.0	38.8	33.3	29.4
24	.022	0.57	14.48	215.3	42.1	35.4	31.2
25	.020	0.47	21.19	275.2	46.0	38.5	33.3
26	.018	0.381	32.21	340.0	50.6	41.7	35.7
27	.0164	0.316	46.55	410.0	55.9	44.6	37.9
28	.0148	0.258	70.12	503.0	61.4	48.1	40.2

Table III. Winding tables for small transformers.

The complete specification can now be stated as follows:—

Rating.—Input, 230 volts 50 cycles single phase. Output, 50 volts 6 amperes, continuous rating.

Iron Core.—No. 4, Table I. Stalloy Strips.

Secondary Coil.—130 turns of No. 15 SWG d.c.c. copper.

Primary Coil.—598 turns of No. 20 SWG d.c.c. copper.

If great accuracy is required in the voltage ratios a few additional turns should be allowed for on the secondary coil to compensate for drop of volts due to internal resistance when full load current is passing.

Workshop Hints

In conclusion, a few workshop hints may be useful as regards handling the various stages in general assembly. The first step consists in building up three sides of the iron core, leaving the fourth side open for the time being, so that the coils can be mounted in position before putting in the bridge piece. The long studs used for bolting up the corners are fixed in an upright position at appropriate centre distances in a wood base, and the stampings threaded on them in layers, the joints coming alternately right and left as in Fig. 15. When the stampings have been piled up to the required depth allowing for compression, the nuts on the studs are tightened up and the partly built U-shaped core set aside while the coils are prepared.

Except for the very smallest coils, it is best to use cotton covered wire, as enamel coverings are so easily damaged by inexpert handling, and the slightest defect in the covering may lead to internal short-circuits and a general burn-out. One circular "former" does for winding both the secondary and the primary coils. This is a fairly easy job in the lathe, the former being shaped as in Fig. 17, the body and one flange being in one piece, the opposite flange being loose, and the whole held together by a long bolt through the centre.

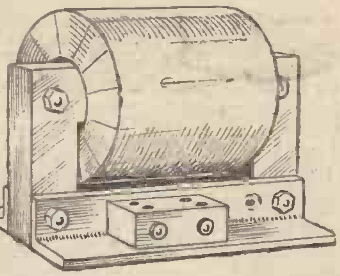

Fig. 16. Stampings and coil assembled, showing air spaces at the sides.

Note the shallow grooves running along the body, corresponding with sawcuts made radially in each flange. This enables fine string to be threaded through the coil and tied securely in four places before removing the coil from its former, and prevents it from collapsing and losing its shape. Remember to wind the secondary on first, following this by the primary, placing at least two layers of 10-mil leatheroid sheet between them as insulation. Keep the turns even and closely wound; any turns that slip down at the ends in contact with the lower layers will have a tendency to break down owing to the increasing difference of potential which exists between layers as the coils build up.

Counting Turns of Wire

The most important detail is to keep an accurate count of the turns, and the best way to avoid mistakes is to use a "Veeder" counter attached to the lathe head, which will indicate the exact number of revolutions made. When both coils have been wound, tie them securely with fine twine, remove the loose flange and slide them carefully off the former body. A little french chalk applied to the latter before starting facilitates this. The coils must be thoroughly dried in an oven to expel any moisture, and while still hot immersed bodily in a tin of suitable insulating varnish. Shellac is not advised, being often acid, and special insulating varnishes such as "Ohmaline" are preferable. After all air bubbles have ceased to rise, lift the coil out and let it drain well, then return it to the oven and bake out for several hours at about 180 or 200 deg. F. It is important that this is done before the coil is put to work, as "wet" varnish is a frequent cause of breakdown. Remember when drying out that the varnish gives off a highly inflammable vapour and guard against naked lights near it.

The final treatment consists of wrapping the coil radially with cotton tape, half-lapped and brushing the surface over with one or two coats of air-drying oil-proof varnish such as Pakyderm. "Dry" coils (that is, unvarnished) will never stand up long without trouble, but the above doping process is well repaid in making a permanent job.

Finishing and Mounting

The finished coil after taping is then ready to assemble over one of the long limbs of the iron core, which should be first wrapped with two complete turns of 10-mil leatheroid. Finally, the bridge piece can be put in and the stampings clamped up by the studs and nuts, tapping them into line, if necessary, with a light wood mallet until flush on all sides and well squared up. Do not forget to insulate the corner studs by wrapping one turn of leatheroid round them as they are pushed through the holes.

For mounting the finished transformer, angle iron strips can be attached to the bottom of the core to form a foot, as in the

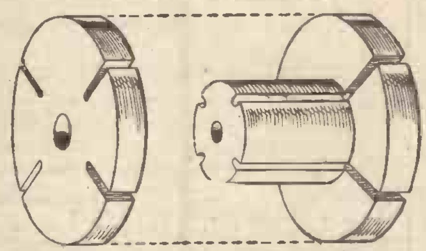

Fig. 17. Details of the coil former.

accompanying drawing of the finished job (Fig. 16). The two-way standard moulded terminal blocks make a satisfactory means of attaching the coil ends, and at the same time providing means for connection to the outer circuit.

How the Eagles Sharpened their Talons

PILOTS of "Eagle" Squadron, the first all-American Squadron of the Royal Air Force, which recently took its place as a fully fledged unit of Fighter Command, had the experience, unique under present-day conditions, of undergoing their "operational training" as a complete squadron under their own squadron commander. Normally, pilots in the R.A.F. go through the famous "four stage" training system—Initial Training Wing; Elementary Flying School; Service Flying School; Operational Training Unit. This system is designed to transform the completely untrained young man into the highly skilled service pilot ready to take his part in a squadron on active service.

But when "Eagle" Squadron was formed last October, all its members could already fly. Some had seen service with French or British squadrons; others were pilots with American civil air lines: some student fliers at their Universities in the States.

For the past few months "Eagle" Squadron has been sharpening its talons, going through all the tactical training and exercises which ordinarily is given at an operational training unit. In a comparatively quiet sector they have been hard at work, learning all the "tricks of the trade" under instructors with first-hand experience of modern air fighting.

Films taken with cine-camera guns fitted to their Hurricane fighters and operated by a touch on the firing button recorded the "interceptions" and "attacks" made during practice flights which closely resemble the real thing.

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A Famous Model Railway

By W. J. Bassett Lowke, M.I.Loco.E.

The late Capt. Lockhart (right) examining the boiler of one of his locomotives, with Mr. John Braunston, the maker

Some Interesting Notes about the late Captain Anthony Lockhart, D.S.C., R.N., and his Outdoor and Indoor Model Railway

MODEL railway enthusiasts, and naval men alike, will learn with regret of the death of Captain Anthony Lockhart, D.S.C., R.N., at the early age of forty-eight.

Captain Lockhart had carved for himself a career, which any boy would wish to emulate. One reads of the olden days and the stirring deeds of our fighting men, but here was a hero of modern times—a man whose whole family was steeped in the tradition of the services. His only brother served in the Great War in the Army, and was killed at Gallipoli—Captain Lockhart served in the Navy throughout 1914-1918, and was on active service in North Britain for several weeks of the present struggle.

His speciality was the submarine—with the rank of lieutenant in 1911 he turned his energies in this direction, and in these craft he served through the Great War. After the Armistice was signed he was for three years Senior Instructional Officer of the Submarine service. He graduated at the Naval Staff College in 1923, and in 1924 commanded K.26, the largest steam-driven submarine in the world, which was over 3,000 tons register. He has served on the staff of H.M.S. *Nelson*, and also commanded the Fourth Submarine Flotilla in China seas. Certainly a career of variety and activity.

With his marriage in 1927, Captain Lockhart sought service nearer home, and in 1932 became Chief of Staff to the Admiral commanding the coast of Scotland. This position he held until his retirement from the Navy in 1936. Captain Lockhart then decided to go into business, and centre his activities on his lifelong hobby of model railways, which he had not developed as much as he had wished in the stress and strain and travel involved in naval service. He therefore took an interest in the model-making company of Bassett-Lowke, Ltd., and went to live at Northampton. He joined the board of the company early in 1937, and took over the office of Works Director, where his wide knowledge of ships was extremely valuable.

The Duston Model Railway

Early in 1939 he planned for himself at Duston an outdoor and indoor model railway, which promised to be one of the best designed gauge 1 steam railways in the country. The track has a circular formation, and is mounted on trestles built of cedar wood, which will stand any weather. It is an ideal formation for testing every type of gauge 1 steam locomotive, and the Captain had in mind the making of experments with different forms of steam traction.

This railway was being built throughout 1939, and by September the scale permanent way—of German silver rail and correctly ballasted—was in position.

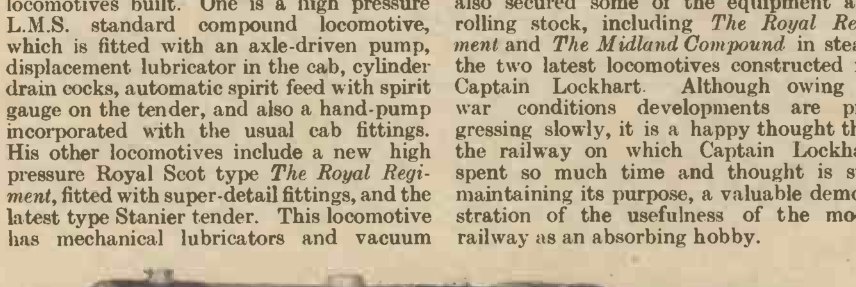
High-Class Models

Even in pre-war days Captain Lockhart had been interested in gauge 1 locomotives, though he had so little opportunity of trying out his purchases. As soon as he came to Northampton, however, he had several new locomotives built. One is a high pressure L.M.S. standard compound locomotive, which is fitted with an axle-driven pump, displacement lubricator in the cab, cylinder drain cocks, automatic spirit feed with spirit gauge on the tender, and also a hand-pump incorporated with the usual cab fittings. His other locomotives include a new high pressure Royal Scot type *The Royal Regiment*, fitted with super-detail fittings, and the latest type Stanier tender. This locomotive has mechanical lubricators and vacuum ejectors. Another prize model is his L.M.S. Fowler 0-8-0 high pressure locomotive in the same highly detailed finish, and two others which must be mentioned are his D.C. electric Johnson Single in old Midland style, and his D.C. 0-10-0 model as used on the Lickey incline. Both these are masterpieces of detail, and the latter has the tender fitted with cab as on the prototype. Another D.C. model is his L.M.S. 0-6-0 tank locomotive.

The same detail and finish characterise his rolling stock. His wagons are realistically loaded with wire netting, engine frames, castings, tube, cable drums, and so forth, and include gunpowder van, L.M.S. furniture removal wagon, timber trucks, Portland cement wagon, crocodile wagon, and stores' and engineers' department wagons. There is some tinplate passenger stock, but here again most are vacuum-fitted, and one or two vehicles have dummy brake cylinders, gas cylinders, lamp brackets, steps, and altogether they are first-class models.

This splendid railway, when war broke out last September, was almost completed. Painters were at work on railway buildings in the peaceful Duston garden as Hitler's armies marched into Poland. We were at war, and before one could realise it Captain Lockhart had rejoined the Navy, and was up in the North of Britain on special Admiralty work. A few weeks and he was taken ill—the recurring weakness of his heart—and at the beginning of December, 1939, was invalided out of the service. Nothing daunted he planned to return to his duties as Works Director at Northampton in the New Year, but this was not to be, for after a week's convalescence at Northampton, he passed away quite suddenly.

The railway has now been purchased by Mr. C. Sutton and re-erected in the grounds of his home at Benham, Newbury. He has also secured some of the equipment and rolling stock, including *The Royal Regiment* and *The Midland Compound* in steam the two latest locomotives constructed for Captain Lockhart. Although owing to war conditions developments are progressing slowly, it is a happy thought that the railway on which Captain Lockhart spent so much time and thought is still maintaining its purpose, a valuable demonstration of the usefulness of the model railway as an absorbing hobby.



Unpainted model of " The Royal Regiment "—an L.M.S. Royal Scot type locomotive, with the latest type Eranier tender

"MOTILUS" PEEPS INTO

Some of the uses of

Two scale model ships made by Mr. Charles P. Wade, of Snowshill Manor, Nr. Broadway, Worcs.

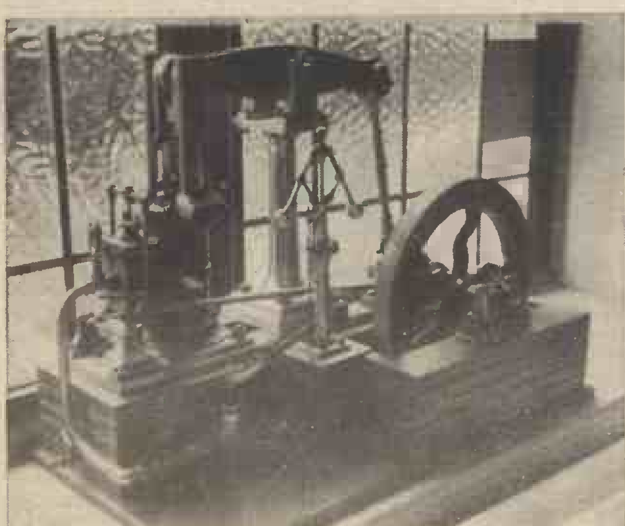
"WHAT is the ideal layout for a model railway station?" This is a query often raised by men who wish to have a really representative station on their railway system. So here, I am told, is the "ideal design," incorporating all essential features of railway practice, yet, at the same time, simple in layout and not occupying too much space. The track is easy to lay, and actually all the features which are enumerated here are standard productions, so it is possible to complete this through station with all its supplies and buildings at a very reasonable price.

Here is the key. 1. Covered Goods Shed. 2. Cattle Pen. 3. Coal Office. 4. Platelayers' Hut. 5. Signal Box. 6. Water Crane. 7. Circular Water Tower. 8. Passenger Rolling Stock. 9. Platelayers' Truck. 10. Stack of Coal. 11. Engine Shed.

The main station buildings can either be standard or built up to suit the owner's taste in the style which appeals to him. There are many other accessories such as nameboards, time table indicators, automatic weighing machines, bookstalls, etc., to make the platform lifelike, and a sketch like this is very helpful to the model railway owner in getting his station layout correct.

Scale Models for "Wolf's Cove"

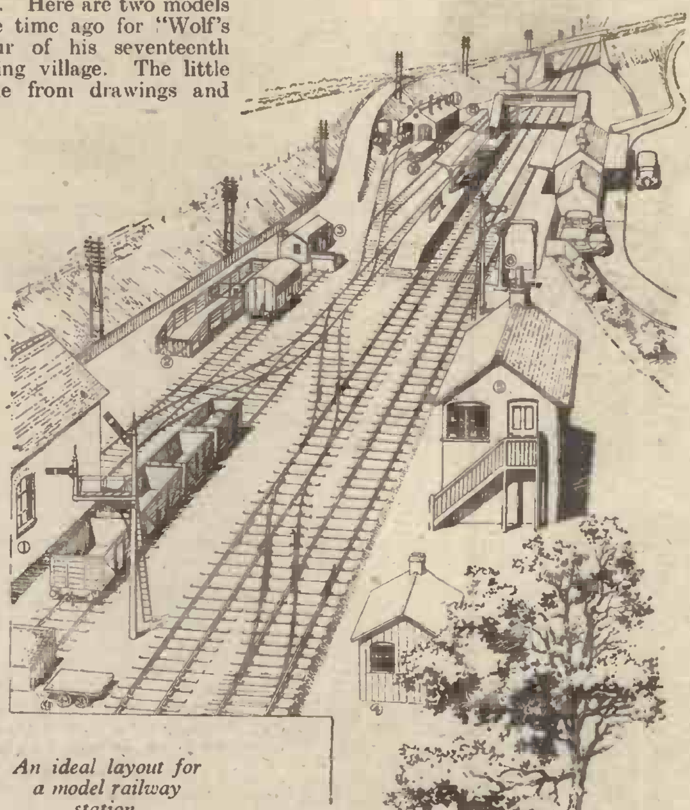
Mr. Charles P. Wade, whose beautiful scale models are known to many visitors who have had the privilege of calling at his delightful Cotswold Manor House at Snowshill—not far from Broadway, in Worcestershire—has decided regretfully that he cannot put his model display out in his old-world garden this summer. Here are two models that he made some time ago for "Wolf's Cove," the harbour of his seventeenth century model fishing village. The little coal barge is made from drawings and details obtained from a Droitwich derelict canal barge, but the model is shorter than the original for reasons of balance. The lugger is Mr. Charles Wade's own design, and is the imaginary type of local fishing boat suited to the atmosphere of Wolf's "Cove." There are no actual prototypes afloat like this, but those who are students of the fishing lugger I am sure will be interested to study this design.



An early working model of a beam engine—the property of Colonel C. M. Croft, Chief Engineer of the Wandsworth and District Gas Company.

A Fine Model Beam Engine

Visiting a friend of mine recently, Colonel C. M. Croft, D.L., J.P., M.Inst.C.E., M.I.Mech.E., Chief Engineer and General Manager of the Wandsworth and District Gas Company, I was interested to find that he has a very fine collection of historic models in his private office there. Among them is an early working model of a beam engine, which he purchased for a few shillings at an auction sale of a collection of the late Sir Henry Wellcome. Like most models built in this period, the chief metal used is brass—the crank itself being of this metal. As will be seen from the photo, the engine, which is non-condensing, consists of a balanced beam, and is fitted with a "D" slide valve operated by slide rods and rocking levers directly connected with ordinary sheave eccentric. Engine speed is regulated



An ideal layout for a model railway station.

by a Watts Governor working directly on to the steam admission valve and driven by a belt. The drive for the governor is somewhat complicated, and consists of fixed and variable jockey pulleys, and is actuated by a round leather belt. The cylinder has a blown-down cock fitted at the bottom of the cylinder, and the cylinder lubricator is fitted on the inlet steam pipe. The remainder of the lubrication is carried out by ordinary brass cups. If you study the photograph carefully you will notice that the eccentric rod connection to the rocker arm has a superimposed lever, but parts of this control gear are missing and it seems difficult to understand for what purpose

THE MODEL WORLD

model making in War-time

this was originally intended, as it neither has the effect of reversing the engine or affecting the steam admission. The dimensions are : cylinder bore 2¼ in., stroke 4 in., beam 14 in. between centres, height from base, approximately, 20½ in., total width 14½ in.

Despite the fact that this model beam engine has seen some rough treatment, and also has been neglected during its life, it is still in excellent working order.

An Early Model Locomotive

Another model which particularly fascinated me was his model locomotive, called the "Flying Dutchman," probably made between 40 and 50 years ago in London or Birmingham, and typical of the products of those early days; sold for the most part in showrooms of opticians. Actually, Colonel Croft picked up this model from a stall in the Caledonian Market five years ago. You will see it has outside cylinders—the gauge is 3¼ in.—and the boiler is constructed of brass tubing, the end plates being solid. The heating is obtained from a methylated lamp of the old type, having four wicks. The cylinders are cast brass, and the single strap eccentrics are also of brass. The boiler end at the footplate is fitted with high and low level te cocks, and simple regulator. Colonel Croft has had the engine under steam and it propelled itself quite satisfactorily along a level floor at a scale speed of twenty miles per hour. The wheels are of very light design, and are turned from brass castings. The buffers are of solid brass without springs. The exhaust from the cylinders is conducted into the chimney by means of direct outlet pipes. The whole chassis frame appears to be one casting, and the footplate is roughly chequered by hand chiselling. I examined this model very carefully, and it shows little signs of being used, and is in fact in a very good state of preservation.

A model picked up by Colonel Croft five years ago in the Caledonian Market—the "Flying Dutchman" of fifty years ago.

Colonel Croft also has some very fine models of famous ships—one of a modern coastal collier of the type designed and built specially for bringing coal direct from the North-East coast up the Thames to Wandsworth.

I find that many owners of model railway layouts all over the country are putting their railways to useful purpose in wartime. Knowing that there are many model enthusiasts in the Forces to-day, these model men are throwing open their railways to visitors "in uniforms" in their districts.

Mr. D. Glasspool, of Yarmouth, Isle of Wight, is the owner of quite a comprehensive "OO" gauge layout. The main equipment is Hornby Dublo, but he has added some scale working locomotives and rolling stock by various makers. Mr. Glasspool is one of those model railway owners, however, who prefers the modest creation of his own hands to the skilled craftsmanship of someone else, and wherever possible he has pursued this principle, so that in the main the layout is "home made." He keeps his railway in the loft at the top of the house, where space available measures 14 feet by 7 feet, and the railway follows Southern Railway practice, as this railway company is the most familiar to him.

The controls of Mr. D. Glasspool's fine "00" gauge model railway at Yarmouth, Isle of Wight.

The line is single throughout, but has fairly extensive facilities at each terminus, which are situated one on each of the longer sides of the baseboards raised on trestles 3 ft. 6 in. above the floor. There are three levels—one being 1¼ in. and the other 3 in. above datum. One station is on the high-level baseboard, while the other station is on the low-level baseboard. The main line joining these two stations is at the intermediate level, this easing the gradients approaching either station.

Let us take an imaginary journey from the high-level station, which has two platforms with four roads and over-bridge approach. Moving out of the station a small goods yard is passed on the right hand, while to the left lies the loco. depot and turntable. Passing over a level crossing, the train then crosses a bridge and descends a bank of 1 in 40 to the intermediate level, where it joins the main line (which encircles the layout); immediately after it enters a tunnel which occupies the whole of the east side of the layout, and in which is situated a passing loop, capable of holding a four-coach train and locomotive. Emerging from the tunnel at the north-east corner, the train may continue to circle the layout indefinitely or complete its journey by being diverted at the junction in the north-west corner, thence to pass under the road and railway bridges to enter the other station. This station, while smaller than the other one (only one platform and two roads) has a more commodious goods yard and carriage sidings together with a loco. depot to accommodate four engines.

Mr. Glasspool has five locomotives in his stud, and also has three train sets of four coaches each, two standard Southern and one Pullman set, and a fair assortment of goods wagons, open and covered, including a well-wagon built up from rail.

At the extreme eastern end of the layout is the dock, approached by a bridge from the goods yard. Though this is not yet complete, a waterline model of a typical coaster has been constructed for the basin or lock.

Members of the Forces in the district of Yarmouth, Isle of Wight, here's your chance to see a splendid little railway.

Buildings and accessories of the "00" gauge model railway.

HOME MOVIES

Notes by G. P. KENDALL, B.Sc.

NEWS AND COMMENTS

Spring-Cleaning the Camera

SPRING is the time when many cinematographers get an urge to do something to their cameras in the way of oiling, cleaning and adjustment, in hopes of ensuring perfect running in the season to come. The intention is no doubt praiseworthy, but the way it is carried out sometimes does much more harm than good. For example, a camera which has been laid away since the previous autumn may be found to run sluggishly, and some rash owners then proceed to douse every bearing they can see with oil. The result of that may be that some bearing which was packed with grease by the maker has its proper lubricant washed out and is left to run on a much thinner one. It then runs noisily, wear sets in, and the next thing is an indignant letter to the makers.

A well designed and well made camera really needs very little more attention than careful cleaning, even after a period of disuse. Oiling, in particular, is a thing to be done with great restraint. The instruction book is a sure guide to what is really necessary; too much oil generally causes more harm than too little.

The first thing to do when the camera is brought out for a new season is to clean it properly, and that is simply a matter of painstaking brushing, dusting and blowing. The outside should be spotlessly clean *before the instrument is opened*, and then the interior should be tackled. Here there should be little to do if the camera was put away in a normally well-cared-for state, but, of course, the gate and pressure plate should be inspected closely for any specks or "corns" of adhering emulsion or dirt. If any of these are found they should be removed with a sharpened matchstick (*not* a metal tool), and then all the surfaces in the film track can be well polished with a soft rag.

The next step is to see how the camera runs. First, the spring should be fully wound and the camera run right down with the speed control at the 8-frames setting. By the end of the run the mechanism should have limbered up, but if it still seems sluggish, the camera should be left in a warm room for a few hours and the treatment repeated. A really obstinate case can usually be cured by a short run at 64 frames, but if this seems necessary, the camera should be loaded with a few yards of waste film. (The mechanism may in some types be subjected to undesirable strains by running at high speed without film). Many cameras, of course, will emerge from their winter hibernation and run perfectly at the first pressure on the button, if they have been properly stored; it is not by any means to be assumed that the limbering-up process will be essential.

It remains only to clean the lens, but that is a process which has often been described. A reminder may be added, though, that the view-finder lenses need their share of attention.

Tests With the Odd Inches

THIS summer most of us will not be hoping to shoot much footage, and it seems in order to consider how the maximum value can be got from every inch of film that goes through the camera. Now, a very profitable use for a small part of a roll would be to carry out some experiments on (*a*) filters, and (*b*) speed ratings. Both questions could be settled once and for all at the cost of a very few feet of film.

If the inexpensive gelatine type of filter is used, a representative group of, say, four filters could be tried out at a cost of a few shillings, and a very interesting time could be had in doing it. A good selection would be a green, a medium yellow, orange, and red, and in a suitable scene with both blue sky and a fair range of natural colours can be found, these will give some most instructive results. Only a few inches of film need be exposed through each, since the shots can be examined with the projector stopped, but to make sure of conclusive results, it is important to repeat each shot with slightly varying exposures, to make sure of hitting the correct factor for each filter. The best exposure with, say, the green filter, can then be compared with the best from the orange, and so on. A very good idea of the real effect of each type can be obtained in this way.

Finally, a series of graduated exposures either side of the one indicated by the exposure meter will settle conclusively any doubts about the speed rating of the film, and safeguard you against waste footage.

Shutter Openings

THE usual way of expressing the shutter opening time of a cine camera is as an angle; if (as is usual) this angle is 180 degrees, that means the shutter is open for half each complete revolution, for, of course, a revolution is 360 degrees. For any given running speed of the camera it is, therefore, easy to work out the exposure time of each frame of film, bearing in mind that the shutter must open and close once for every frame. Since it is (if of the 180 degree type) open and closed for equal times, it follows that at 61 frames per second running speed the shutter will be open for 1/32 of a second.

This leads us to the rule that to find the opening time for a shutter of the 180 degree kind, we have only to double the running speed (in frames per second), and then turn this into a fraction. Thus, at eight frames the shutter opening time is 1/16 second, at 64 frames it is 1/128 second, and so on.

It is sometimes asked why shutters are not made to give a longer opening than that provided by the 180-degree design. Admittedly, this would allow more light to reach the film and so enable sufficient exposure to be given at smaller lens apertures, but this obvious advantage has offsetting drawbacks. Longer exposure times than those given by the customary shutter opening tend to undue blurring of moving images, and in addition the shorter the "closed" period of the shutter cycle, the faster the film must be moved on and brought to rest on the next frame. That means greater difficulties for the designer of the mechanism, and increased wear on moving parts in all probability, also greater strain on the film itself.

More often, therefore, when designers depart from the conventional 180 degrees they go a little the other way, to make things easier both for themselves and the mechanism. Again, when (as in some advanced cameras) they provide a "variable opening" shutter, the maximum is not likely to be much (if anything) in excess of 180 degrees; the adjustment is a matter of *reducing* the opening to smaller values. The power to use a *smaller* opening is often of value when filming fast-moving objects, or when it is desired to work the lens at a large aperture in order to make the principal subject stand out in sharp focus against a well-blurred background. The variable shutter also permits a proper fade-out, down to complete blackness, to be made in any light, and without upsetting the range of sharp focus as so often occurs when a diaphragm fade is used.

QUESTIONS ANSWERED

Titling By Daylight

Is there any reason why I should not shoot my titles by daylight, and so get over the black-out difficulties I have in using my ordinary titler with its double row of 100-watt bulbs?

Good titles can be made by daylight, and many people use no other kind of illumination. The principal objection is found in the varying quality of natural light, which renders it a matter of some difficulty to secure the perfect constancy of exposure so necessary for good titling. A simpler solution of the problem is to use the ordinary titler in the daytime, drawing the curtains of the room to exclude the varying effects of daylight.

Photoflood Efficiency

When comparing the amount of light to be had from ordinary lamps and from Photofloods, should I take the latter as being of 275 watts?

No, they give much more light than a normal 275-watt bulb. A better basis for reckoning is to regard them as equivalent to 750 watts.

Good and Bad Fades

The fades I made at the end of artificial light shots were good. Why is it that I cannot make equally good ones outdoors?

A successful diaphragm fade—one which ends up properly with a completely dark screen—can only be made if the normal exposure for the shot is a fairly wide aperture. There is then a sufficient margin in reserve for stopping down, and so darkening the scene by under-exposure. As a rough rule it can be taken that a good fade is impossible unless the normal exposure calls for a stop at least as wide as f/4; if it is something of the order of f/8 or f/11 there is no hope of getting a full fade-out, since the lens is already so far closed down that there is insufficient "closure" in reserve. This explains the difference often observed between fades made by artificial light and those done out of doors.

The Lower Camera Speeds

If the 8-frame camera speed is used, as I understand, when the light is too weak for proper exposure at 16 frames, what is the object of the 12-frame speed?

These lower speeds have many uses in addition to the obvious one of giving increased exposure at a given stop. By way of example, suppose we wish to make a sequence of a train approaching from a distance: the first shot, if it is to give any real sense of distance, will show the train so far away that at 16 frames it would appear to move so slowly that it might not be noticed. The use of a below-normal camera speed would accelerate the train's apparent movement to a degree which would force it upon the attention of the audience, without making it seem unnatural. Care must, of course be taken when arranging such shots to see that there are no moving objects in the foreground to reveal the abnormal taking speed. (It would, in any case, be bad practice to have movement in the foreground of such a shot, since it would distract attention from the distant train.)

The two lower speeds in question are commonly provided on the more elaborate cameras, and it is to be understood that one or the other will be used according to the degree of acceleration of movement required. In either case a tripod is practically essential if a sharp shot is desired.

Trouble with Rights and Lefts

This winter I have been using a translucent screen, with the projector behind it, but am puzzled to know what to do about titles. They always appear reversed from right to left, so that they cannot be read.

This is the natural result of rear projection. The usual remedy is to thread the film into the machine the other way round, but when this is difficult or impossible, as in the case of certain types of 9.5-mm. reels, the projector should be placed at right angles to the screen and the beam directed thereon with the aid of a small piece of surface-silvered mirror. This reverses the image laterally as required.

Standard Aperture Dimensions

Is there an accepted standard for the size of frame in 16-mm. sound film?

The S.M.P.E. standard is now generally accepted, and this is as follows: Camera aperture, .410 in. wide, .294 in. high; projector aperture, .380 in. wide, .284 in. high; sound track, .065 in. wide.

This scene from the making of one of Gene Autry's films was obviously posed specially for the "stills" cameraman: observe that although the players are speaking, the camera is an unblimped silent model which would not be used for sound shooting. (Observe also cord hanging round cameraman's neck—his photo-electric exposure meter is on the end of that.)

QUERIES and ENQUIRIES

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

Converting D.C. Motor to A.C.

I HAVE a ¼ h.p. 200-220 volts compound type motor which I wish to use, if possible, on my present 220 volts A.C. supply. I should appreciate information on type of rectifier, and approximate cost of same to enable me to do this. Alternatively, is it possible to have this motor adapted to run on A.C.?—J. W. Baxter (Ruddington).

WHETHER this motor can be successfully converted for running on A.C. instead of D.C. depends very largely on the field construction. If it has a solid field casting it will not make a satisfactory A.C. motor, as it will overheat badly. If, however, the fields are laminated, both poles and yoke ring, the conversion is practicable. Since no details have been supplied as to the dimensions of the armature, number of slots, number of commutator bars, it is difficult to give a precise winding specification. It must be assumed that the armature is about 3½ in. diameter by 2 in. long with 19 slots, and has a commutator with 39 bars, running in two-pole fields, as this would be an average size of armature for a ¼ h.p. motor running at 2,000 r.p.m. Should the armature and commutator be more or less sub-divided into sections, the winding given below must be altered proportionately in order to maintain the same number of conductors on the armature.

Armature winding.—Thirty-eight coils, former-wound, each containing 38 turns of No. 28 SWG d.c.c. copper. Coil span from slot 1 to slot 9 inclusive. Lap-connected.

Field winding.—Two poles, each coil containing 400 turns of No. 21 SWG d.c.c. copper, coils in series with armature.

Making Chloracetophenone

CAN you tell me the chemical formula of chloracetophenone? I understand that this is a white crystalline solid. Is it possible for me to produce a small quantity of this substance?—C. S. (Bromley, Kent).

THERE are several compounds of the name you mention, but we think you refer to the chloracetophenone which is more correctly named dichlorethylbenzene and which possesses the chemical formula: C-H-Cl-(C-H-). This is produced by the action of ethylene gas on dichlorbenzene in the presence of anhydrous aluminium chloride. The ethylene gas is bubbled through the dichlorbenzene (containing about one quarter of its weight of anhydrous aluminium chloride), the flask containing the mixture being provided with an upright "reflux" condenser and being gently heated on an oil bath.

This is a preparation which you are not likely to succeed in. Moreover, you should not attempt it, since the dichlorethylbenzene is lactrymatory and its production is definitely fraught with danger.

Quick-setting Wax

CAN you please tell me how to make a strong and quick-setting wax, as I wish to give tautness to linen and such-like materials by applying hot wax?—C. Munro (Wimbledon).

A STRONG and quick-setting wax can be prepared by dissolving shreds of bleached Carnauba wax in Ether. This solution, which is very highly inflammable, must be painted on to the linen and it will immediately set hard. A similar solution made by dissolving the wax in benzine has the same properties, but is slower drying.

By dissolving celluloid in a mixture of amyl acetate and acetone (equal parts) you can make a preparation which, when painted on to fabrics, will dry fairly rapidly, and which will set dead hard so that it can readily be cut. This, in our opinion, is better than either of the wax preparations for the purpose you name.

Melting Aluminium

FOR some time now I have been trying to melt aluminium to enable me to make my own castings. The quantity to be melted is very small, and I have tried this by directing two blow-lamps on the scrape in an iron ladle. This only softens the scrape into a rough mass. I have no gas, and no facilities for a coal furnace. Can you advise me what to do to get enough heat to make the metal run? Also, can you give me the name and address of suppliers of ebonite rod?—A. P. Frame (Lerwick).

WE do not know of any way in which this small amount of aluminium can be cast except by remelting under proper conditions, and these depend largely on the type of aluminium.

For ebonite rod, the following firms are suppliers, but whether under war conditions they will execute a small order we cannot say: British Tyre & Rubber. Co. Ltd., Leyland. Dunlop Rubber Co. Ltd., Castle Bromwich, Nr. Birmingham. Greengate & Irwell Rubber Co. Ltd., Greengate, Manchester, 3. India Rubber, Gutta Percha & Telegraph Works Co. Ltd., Silvertown, London, E.16. North British Rubber Co. Ltd., Castle Mills, Edinburgh, 3. Vulcanized Fibre Ltd., Shalford, Guildford.

Automatic Cut-out

I WOULD like information on making a cutout 30 volt, 25 amp. at 40 amp., without using mercury, so that the dynamo can be fitted to shafting with varying speeds which alter very rapidly.—T. E. Wood (Durham).

IT is by no means clear what is meant by "a cutout 30 volts 25 amp. at 40 amp.," but assuming this is intended for the protection of a 30-volt battery, where charging may vary between the limits of 25 and 40 amperes, it may be stated at once that any cutout of the "dry contact" type is likely to be unsatisfactory. Recourse must be had to the mercury-cup type, such as the standard "Record" or "Neville" type. It is not an appliance that can be recommended for amateur construction, but quotations for the complete article can be obtained from The General Electrical Co. Ltd., Magnet House, Kingsway, London, W.C.2.

Valves and Joints on Compressor Plant

I SHALL be glad if you will inform me as to the correct method of grinding in new flapper valves on a compressor using CH3CL. The valves are flat pieces of metal, and are opened and closed by the pressure and vacuum created by the pistons.

What is smeared on the gaskets and washer between cylinder head and crank case prior to screwing together? Also, is anything smeared on the flared joints on copper tubing as used on a refrigerator? Will you please state also, what is used as jointing material on the screwed and tapered brass connections?—G. Carozzi (New Tredegar).

TAKING your questions in order:—The correct method of grinding in valves depends largely on their condition. If the new flapper valve is to be fitted to existing valve plate the scratches on the old seat should be removed first by fine carborundum paste, and then finished off with metal polish. If there are scratches on the new valve which is to be fitted, these can be removed by rubbing on a flat piece of glass, using metal polish. The flapper valve should be finally finished off by rubbing it on the valve seat with metal polish.

(2) A large number of gaskets used on small compressors consist of compressed asbestos fibre, usually referred to as C.A.F. jointing. The most satisfactory way is to smear both sides of the joint with ordinary

compressor lubricating oil. An alternative is to use gold size or shellac.

(3) No substance is used when taper brass connectors are screwed in except a little shellac, and in the case of flared copper joints no lubricant or other substance is used at all. The flared copper pipe when screwed hard up on to its brass connector makes a very satisfactory joint, provided that the brass connector and copper pipe have no dents nor other marks on the flare. Sometimes a little oil is smeared on to the flare tool while the flare is being made.

Electric Clock

COULD you let me have particulars of the winding of an electric clock for 4 volts? Also details of the winding of a relay for 230 volts—50 cycles.—R. A. Manley (Pontypool).

IT is quite impossible to give winding specifications for either a 4-volt clock or a 230 volt relay in the absence of all details as to type or size of either apparatus. It is not even stated whether the clock is to be battery driven, or supplied with A.C. transformed down from the mains. A sketch should be supplied with the enquiry, illustrating the type of clock and method of operation. The same applies to the relay, giving the bobbin dimensions on which the relay coils are to be wound and, if possible, the purpose for which it is to be employed.

Drilling Vitrolite

I WISH to drill holes in vitrolite, and shall be glad if you can inform me if this is possible with a brace, and if so, what kind of drill would I need? Also can you give me the name of the firm that takes small orders for vitrolite.

(2) Where can I obtain small *plain* head chromium-plated nuts and bolts?—C. V. Jones (Reading).

VITROLITE can be drilled with an ordinary brace and bit, using a standard high-speed steel (18 per cent. tungsten) twist drill. Dip the drill in turpentine before use and as required later. If no success is achieved, the only remedy is to drill with a tungsten carbide drill, in a proper drilling machine. These drills are, however, costly, and it is doubtful if at the present time reasonable delivery could be obtained.

Vitrolite is made and supplied by Messrs. Pilkington Bros. Ltd., Doncaster, but whether they will accept small orders can only be decided by direct application, stating quantities and sizes required.

In regard to nuts and bolts (chromium-plated), there are numerous firms making "bright" bolts, e.g., Messrs. T. Bradley Ltd., Birmingham; Auto Machinery Co. Ltd., Coventry; Nuts & Bolts Ltd., Darlaston. We cannot say if these firms supply chromium-plated bolts and nuts of the type desired, but if not, no doubt they could be chromium-plated by one of the plating firms. You might try Messrs. W. Canning & Co. Ltd., Birmingham.

Expansion of Antimony: Copper Bellows

WILL you please oblige by answering the following questions;—

1. What would be the linear expansion of a rod of antimony ½ in. diameter by 24 inches long heated to 150 degrees Fahrenheit?

2. Where can I purchase copper bellows as used on damper regulators on hot water boilers?

3. What is the composition of the fluid used in the bellows?—Geo. Thompson (Newcastle-on-Tyne).

THE coefficient of linear expansion of antimony per deg. F. at room temperature is 6.27×10^{-6}.

2. Try Bennis Combustion Ltd., Bolton; Alldays & Onions Ltd., Great Western Works, Sparkbrook, Birmingham, or Vaughans (Hope Works) Ltd., Hope Street, Dudley. The Cooper Development Association will probably be able to give you a precise recommendation. Their address is Thames House, Millbank, London, S.W.1.

3. We do not know the composition of the fluid, except that it is of volatile type. It is probably a trade secret.

New L.N.E.R. Locomotives

THREE new locomotives, two steam and the other electric, the designs for which were prepared before the outbreak of war, have just been completed by the L.N.E.R. at its Doncaster Works.

The new steam locomotives, the first of which is named "Bantam Cock," are the direct result of the success obtained with the "Green Arrow" 2-6-2 Mixed Traffic type of engine. "Bantam Cock" is, in fact, a light version of the "Green Arrow" design, weighing with its tender 113 tons 3 cwts., as against the 145 tons 2 cwts. of the "Green Arrow" type of loco,

The various methods adopted to effect this reduction in weight include the use of 2 per cent. nickel steel for the boiler barrel, the extensive substitution of fabricated construction in the case of steel castings for such parts as main frame stays and boiler supports, and lighter construction of the footplate and its supports.

As a result, the "Bantam Cock" locomotive will be able to travel on secondary lines, over which the heavier "Green Arrow" and "Pacific" locomotives cannot be run owing to their weight. In fact, whereas the two latter types of engines are restricted to 2,752 route miles of the L.N.E.R., the "Bantam Cock" design can work over 5,000 route miles of the system.

The "Bantam Cock" design, together with the "Green Arrow" type of locomotive, will greatly facilitate the standardisation of locomotive design on the L.N.E.R., as their all-round usefulness will dispense with the need for the construction of any further tender locomotives of 0-6-0 and 2-6-0. wheel arrangements.

Electric Locomotive for Mixed Traffic

The new electric locomotive is the first of seventy mixed traffic engines planned for the Manchester-Sheffield Electrification Scheme, upon which work was well in hand before the war. In September 1939 it was decided that only the first of the electric locomotives should be proceeded with so that work of national importance could be taken in hand.

The new engine is designed to handle main line passenger and express goods trains up to speeds of 65 m.p.h., to haul 1,000 ton mineral trains across the Pennines, and to carry out local passenger and goods train duties.

It is carried on two bogies measuring 50 ft. 4 ins. in length over buffers, and picks up electric current of 1,500 volts D.C. from an overhead wire by means of either of two pantographs (collectors) mounted on the roof.

THE Cyclist

Editor: F. J. CAMM

All letters should be addressed to the Editor, "THE CYCLIST," George Newnes Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

'Phone: Temple Bar 4363

Telegrams: Newnes, Rand, London

VOL. IX MAY, 1941 No. 231

Comments of the Month

By F. J. C.

Budget and Cycle Tax

ONCE again a budget passes without the imposition of a tax on cyclists. It is needless for us to reiterate the good reasons which have guided successive Chancellors of the Exchequer to reject the usual pre-Budget plea for a tax on pedal bicycles.

Here is a typical example of the latter which appears in a well-known weekly journal: "One thing which always baffles me is why they don't put a tax on cycles—with perhaps exceptions in special circumstances. There are to-day supposed to be about 30,000,000 cyclists in the United Kingdom. A ten bob tax would yield (with the aforesaid exceptions taken into account) about £12,000,000. A couple of years ago the writer suggested a cycle tax of five shillings per machine, and the Editor expected a vast post of protest. He got a shock, for by a very large majority, cyclists heartily supported a tax on themselves."

The writer of this paragraph is misinformed. There are not 30,000,000 cyclists in this country out of a total population of between 40,000,000 and 50,000,000. At most there are between 10,000,000 and 12,000,000. Cyclists know they have no need to protest against the suggestion of a tax, for they know that the national organisations have already represented their point of view. It is certainly amusing to read that cyclists want to be taxed, for taxes are always unpopular, even if necessary.

Cyclists and Accident Claims

IT was this journal which first pointed out that the rise in accident figures was not due to a rise in the carelessness of private motorists, but to the carelessness of the drivers of military vehicles. This point of view, supported by facts, we represented to the Minister of Transport, and also to the Manufacturers Union, at a time when it was said that accidents were due to increased carelessness on the part of the private motorist. "Never was the standard of driving lower," it was said. The Minister of Transport, however, heeded our remarks and investigated the matter. He found that the vast majority of vehicles involved in accidents were military vehicles.

The rights of cyclists and other road users, whose vehicles are involved in an accident with a military or Government-owned vehicle were recently raised in the House of Commons, and it was stated that where a person was killed or injured by the wrongful act of an officer of the Crown in the course of his official duties, he or his dependants has the right of action against that officer, and it is the invariable practice of the Crown in such cases to pay any damages or costs which were awarded by the court.

The Minister of Transport, replying to questions in the House of Commons, dealt with the number of accidents caused by the drivers of military vehicles. Army lorries were responsible for no fewer than 300 accidents a day. That statement is sufficient justification for the attitude we took when certain critics misread the accident figures.

The Mass Storing of Bicycles

SHOULD not some arrangement be made, during the war, for the mass storing of bicycles? The accommodation of large numbers of bicycles, where cyclists are employed or congregate, is a difficult problem. Most of the usual parking facilities have gone. Another problem concerns the large numbers of cyclists who have joined the Army. There is room here for wise business people to undertake the mass storing of bicycles owned by those who are in the Army and the other Forces.

War Transport Council

THE Minister of Transport has decided to set up a War Transport Council, whose function it will be to advise the Minister on questions of transport policy. In addition to examining all matters which the Minister may refer to them, members will be invited to put forward any proposals which, in their view, would increase the contribution that transport is making to the war effort. This marks a new stage in the process of adapting our transport system to the needs of war, and the Council embodies the changed conception of the purpose of transport in war. No longer a mass of independent organisations, catering for peace-time activities, whether business or pleasure, the transport industry is emerging as a single great instrument of total war.

It is well known that the transport system of this country has been laid out for economic and social purposes, and not on strategic lines. While in Germany, military considerations have always governed the lay-out of railways and, more recently, the roads, we in this country have been extending the London tubes to relieve the pressure of rush-hour traffic, building commercial arteries, such as the Liverpool-East Lancashire Road, or roads to facilitate the week-end holiday to Brighton.

After Dunkirk and the transfer of the battle-front to Great Britain, transport began to experience new and increased difficulties. Black-out, one of the great handicaps with which transport has to contend, has existed from the outset, but the last summer witnessed the beginning of air raids on a large scale. From this moment the predominant movement of traffic ceased to flow in the traditional north to south direction, and a new movement across established lines started from east to west. With the production of war material still expanding, there were few opportunities, either to redesign our established routes or to extend the number of operating vehicles. The machinery operated by the Railway Executive Committee has been tightened up.

The Transport Industry

THE transport industry employs more workers than any other single industry in Great Britain. In 1931 at the time of the last census the total was over 1,500,000. The mileage of canals and inland waterways in Great Britain is about 3,000, of which 2,500 are in constant use. Traffic originating on the principal waterways in 1938 amounted to 13,000,000 tons. There are forty-eight principal ports in Great Britain.

British railways cover 20,000 route miles and employ a staff of 580,000. Steam locomotives number 20,000. and freight-carrying vehicles about 1,250,000.

With a total mileage of 180,000, Great Britain has a greater length of road to the square mile than any other country in the world. Classified roads alone cover 45,000 miles. The total number of motor vehicles licensed in this country before the war was upwards of 3,000,000. Goods vehicles numbered over 500,000 in the hands of 220,000 operators. The road haulage industry was carried on under "A" and "B" licenses, by some 60,000 hauliers, who owned between them about 150,000 vehicles. Buses and coaches numbered 50,000.

Bath Road Smith

AS mentioned elsewhere in the issue, C. A. (Bath Road) Smith has been made the first Hon. Life Member of the Bath Road Club. The rules of the club were specially amended to make this possible. The 1890 Bath Road "100" was an event. The start was fixed for 9.30, but torrents of rain delayed the race until 10.4 a.m., when eighteen safeties, four tricycles, and six ordinaries were despatched at five-minute intervals. The pneumatic and cushion-tyred safeties soon left the solid-tyred machines on the muddy roads, and evens were maintained for the first four miles. Before Henlow Crossing was reached, Tommy Edge's pneumatic-tyred safety shed its chain, and C. A. Smith was the next to suffer misfortune, the connecting pin of his chain breaking 12 miles from the start. At Cross Hall, P. C. Wilson was leading the field by 150 yards, when James collided with Bates' back-wheel, placing S. F. Edge and James *hors de combat*.

Our congratulations to Bath Road Smith on the honour which has been conferred upon him. We are certain that the members of the club are delighted that one so prominently associated with it and with the sport, should have his name reappear in the club handbook.

Make your money go further—there is no better value than Firestone

MADE IN ENGLAND

When you get a Firestone you really are getting the best tyre for your money—thanks to the skill and experience of British Tyre Engineers who are spending their life designing and producing the world's finest tyres. Look into these specifications and prices—they're extraordinary road value as many cyclists have proved.

OLDFIELD

This deep rugged tyre is renowned for its substantial saving in first cost, yet giving wonderful mileage and safety. Sizes 28 x $1\frac{1}{2}$, 26 x $1\frac{1}{2}$, 28 x $1\frac{3}{8}$, 26 x $1\frac{1}{4}$.

Tube 1/10. Cover 4/5

SPORTS

The Firestone Sports tyre is designed for speed with extra safety. Its light weight is achieved by extra fine quality—ensuring flexibility and liveliness and great strength. Sizes 26 x $1\frac{3}{8}$, 26 x $1\frac{1}{4}$, red or black.

Tube 2/4. Cover 6/1

SPORTS TANDEM

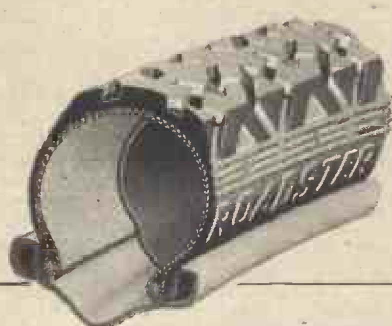
With a deep tread of Sports tyre design and cord fabric impregnated with extra rubber the Firestone 26 x $1\frac{3}{8}$ Tandem tyre has extra strength and liveliness perfectly balanced.

Tube 2/7. Cover 6/1

SENTINEL

High quality at a wonderfully low price, only made possible by the experience and skill of Firestone Tyre engineers. Sizes 28 x $1\frac{1}{2}$, 26 x $1\frac{1}{2}$, black only. 26 x $1\frac{3}{8}$, 26 x $1\frac{1}{4}$, red or black.

Tube 1/7. Cover 3/6



ROADSTER

The deep rugged tread of the Firestone Roadster gives greater safety and mileage. Underneath are cords of the finest quality, giving extra strength and flexibility. Sizes 28 x $1\frac{1}{2}$, 26 x $1\frac{1}{2}$, 26 x $1\frac{3}{8}$.

Tube 2/7. Cover 7/2

C.3

FIRESTONE TYRE & RUBBER CO., LTD., GREAT WEST RD., BRENTFORD, MIDDX.

Waltham St Lawrence. Berks.
A lovely unspoilt little village near Twyford. The beautiful church and the village pound surrounded by some very old trees. The 16th cent. Bell Inn is just round to the right . .

AROUND THE WHEELWORLD—By Icarus

Bath Road Smith—Life Member

MY congratulations to "Bath Road" Smith on being made first Hon. Life Member of the Bath Road Club, probably the most famous of all cycling clubs. The rules of the club were specially amended to make this possible. "Bath Road" Smith, who was breaking records and winning innumerable trophies in the 'nineties, was at first Secretary and then President, for many years, of the Bath Road Club, which has done as much as, and probably more than, any other to foster club life and promote the best interests of the sport. It is, indeed, a model on which most other clubs are based. Entirely democratic, its famous "100" is looked upon as the Blue Riband of the road. It has produced more famous cyclists than any other club, and its members, in opens, have always brought credit to it. Frank Southall, of course, is a member of it. So C. A. Smith once again graces the list of members of the club for which he did so much. As announced in the last issue, he has given back to the club the trophy which he won outright in 1891/2. He had insisted that the matter be kept a secret until the Annual Dinner (this year a lunch), and so no one outside the club was aware, until the function, that the cup was to be presented. Only two persons knew that he was to be present at the function. One of those was the Editor of this journal, and the Secretary had kept the secret so well that it did not leak out.

Rear Lights

OUR contributor "Wayfarer" writes: "I have read with great interest F. J. C.'s 'Comments of the Month' (April), especially those in relation to rear lights. F. J. C. thinks that there is 'bound to be a struggle' to secure their abolition. It may be so, and we shall have congenital idiots crying aloud in the market-place that this emergency legislation must not be cancelled. I, however, pin my faith to the commonsense of the British people as a whole, and to the Prime Minister's statement in the House of Commons recently—an underlining, I think, of a previous assertion. In speaking of the surrenders of liberties which we have all made, Mr. Churchill went on to say that Parliament's 'most sacred duty' will be to restore those liberties when victory has been achieved. That is good enough for me."

Lancashire Cyclist Honoured

I WANT to congratulate C. H. Crompton, who has been selected as the latest recipient of the Sir Alfred Bird Memorial Prize, which is a silver medallion provided annually by Sir Robert Bird, Bart., M.P., in memory of his father, and awarded for the most signal service rendered to the club each year. As Mr. Crompton has taken up an important Government appointment in South Africa for the duration of the war, it was not found possible to present him with it at the club's Annual General Meeting at Leeds on April 26th. Had he been in this country, my old friend Percy Brazendale, a fellow-Lancastrian, would have handed it to him. Mr. Crompton, who was a frequent contributor to "The Cyclist," has been a member of the C.T.C. since 1917. In 1921, he began to take an active interest in cycling in Bolton, and he became press secretary of the Bolton section of the Manchester D.A. during the time of the National Bicycle Week in 1923. In September, 1923, he founded the Lancashire Road Club, and then the Bolton D.A., in connection with which he founded the *Boltonian.* He was elected president and four years later, when he left Bolton for London, he became, and remains, the vice-president. He was elected to a seat on the C.T.C. Council in 1926, and is now the member for a division in the Home Counties. In all, he served nine years on the D.A. Committees, eight years on the General Purposes Committees, two years on the Rights and Privileges Committee, and two years on the Finance Committee. He was chairman of the Finance Committee. He received, in 1938, the club Certificate of Merit, in recognition of his D.A. work in Lancashire. He kept up an average of 10,000 miles a year from 1920 to 1937, and had not fallen below 5,000 until 1940. He has toured extensively in Great Britain, France, Germany, Italy, and Switzerland. News of the latest honour was cabled to him at Pretoria by Mr. G. Herbert Stancer, secretary of the C.T.C.

Girls and the Clubs

MANY clubs with mixed membership, had delegated official positions to the lady members when the males were called to the Services. I understand that Mr. Bevin's new call-up will affect many of these officials, and the clubs are now in a worse position than before. Let us hope that it does not mean that many clubs will be moribund. It is one thing to repeat the parrot cry of "Carry on," but quite another thing to give effect to it. Several of the clubs which decided to do so now find that they cannot. Evacuees have taken command of all the available accommodation within reasonable distance of the start. Riders are finding it difficult to find the time to train. Others are working weekends. Things are not going to be easy.

N.C.U. Hotel Lists

LISTS of recommended stopping places in county form, similar to those issued by the N.C.U. last season, are now being brought up to date. They are being dealt with in county alphabetical order, and those falling in the early letters are now ready. These lists are supplied free to Private Members, and sold at 3d. per County List to Club Members and Associates of the Union. Applications should be made to N.C.U. offices (temporary war-time address), 35 Balliol Avenue, E.4., and should be accompanied by N.C.U. membership card or certificate for the current year.

No Award of C.T.C. Plaque for 1940

THE Committee of independent cycling experts whose duty it is to nominate a worthy recipient of the silver plaque offered each year by the Cyclists' Touring Club for the "greatest improvement in cycle design, construction, or equipment," have decided that no award should be made for the year 1940.

Repair of Bicycles

CYCLISTS have experienced difficulty in getting their bicycles repaired, not because of the shortage of labour, but because of shortage of spares. The Government has apparently realised that it is essential to maintain bicycles in a good state of repair, for millions of them are used by munition workers. The Manufacturers' Union has made an arrangement with the Board of Trade for a special allocation of material for this purpose.

Is Accuracy "Bunk"?

I WAS astonished to read in a contemporary an article suggesting that accurate watches were unnecessary in timing road trials, because the courses themselves were inaccurate. With this latter statement I, of course, concur. I do not believe that any course is so accurate as it is made out to be. Many of them are a considerable number of yards out, and no surveyor would be prepared to measure, say, a 25-mile course and guarantee it to be within 50 yards. But that is no reason why we should abolish accuracy in timing riders over those courses, no matter how inaccurate they may be. The important point which is missed by this contributor is, that the courses are standard for all riders, and therefore no one is penalised. If, however, a poor grade of watch is used for timing, it will certainly be lacking in isochronism, which means that at the start of the race it will gain perhaps 8 seconds in the first hour, and then gradually lose; thus, the timing conditions for the riders would not be standard. You must have a watch with a reasonably constant rate to give a fair result. I agree that in matters of competition record we require a more accurate system of measurement. I do not think that there is one record course in the country that has been really accurately measured. We do not need to draw the red herring of inaccurate course measurement across the scent of accurate timing, for two blacks do not make a white.

WAYSIDE THOUGHTS

By F. J. URRY

Easter

BY the time you read these lines Easter will be in the offing, and I wonder what it will contain for us in the way of a short release from work. Ever since last Whitsun, most of us have been closely concerned with factory or office, and have not enjoyed as many free days as the soldier lads we know: so I for one hope the conditions will be such that they will allow us to stretch our limbs for a day or so, and go out to meet the spring. The question is where to go—but does that matter much so long as you are in the country, and the warm west winds are combing your hair? If the fates are kind, I shall go down on a farm in the heart of Salop, and make that comely old house a centre from which to take my daily excursions. Farms are good places of harbourage in these days, for they can usually provide homely fare from the bake-house, the hen-roost, and the rafters, if it so be you are an old acquaintance, and are prepared to properly praise the provenders provided. For the jolly old farmer is like most mortal men, he loves a compliment paid to the goods he provides, even though he may seem a trifle grim when the encomium is passing. This farm is on the telephone, an advantage to-day if a sudden call home is needful; for, say what we will of our desire for freedom, most of us still have a kind of sneaking regard for the welfare of the place where we get our living. Ever since the days began to present us with an evening, I have been thinking of these few hours among the Salop lanes, of seeing the Severn where it sweeps round the cliffs of the Brieddens, topped with the Rodney Stone in remembrance of the old Admiral who planted the oaks, which in due time he expected to be built into the wooden walls of England. I shall go to the valley of the Vyrnwy too, to Meiford, and Pont Robert, and Dolanog, where the Vyrwny leaps the rocks, and recover something of those youthful adventures when we camped by that stream in its mountain fastnesses more than thirty years ago. That will be good, a rest and refreshment amid these epic days—if!

A Good Habit

ONE week-end when March was not very old, a great nephew was staying with me while his parents were on a short visit, and a beautiful Sunday morning came along, when the day emerged from the mist to send long golden streamers along the hedgerow, and wake to music these "Care ruined choirs" of yestermonth. "How would you like to go out on the tandem, Bob?" I asked, and the response was a whoop, a scatter for the cycle shed, and a brisk pumping of tyres. Fortunately, the seat pillar would drop sufficiently to comfortably accommodate the young legs, so in ten minutes we were mounted, and when the lad had become convinced I was quite capable of doing the steering, we made a respectable tandem crew with confidence to take the descents as fast as the machine would travel. We rode easily, for I am no believer in pushing the eager spirit of feckless youth into the opinion that speed is the only thing worth while, and we stayed here and there to gaze into wide valleys mellowed in the sun-shot mist, to listen to the bird song in the copses, and watch the flood gates of a normally gentle stream roaring with a flurry of water from the drowned meadows. What a fascination there is in running water; and what a joy it is to show a lively lad the things that thrilled me more than forty years ago. On this occasion these things were Maxstoke Castle and Priory, deep in the Forest of Arden still, though their Norman builders would not know the ordered fields between the woodlands if they could walk again their ancient paths. Under these hanging woods is a cottage where there is always a cup of tea, a bottle of pop, and if a lad is lucky—as on this occasion—a packet of rock, and there we rested awhile ere we swooped to the lower lands, and over the rough lanes between two great and noble domains. After the thirtieth mile of that morning's ride, the kick of pressure from the rear bracket was not quite so fierce: but that did not matter because we had a fifty-one gear to temper the slopes. Some folk appear to consider they are conferring a privilege on youth when they join forces, but I confess to thinking it is entirely the other way round, and am thankful to occasionally find a willing youngster.

The Old Days

I HAVE lived so long in the cycling world as an active daily cyclist, that now and again I get a shock to find how long ago it is. The years do not seem any burden to me (although they are now beyond the three score) except when I happen to be "out of sorts," as the printers say, which is not very often, mainly because I keep on riding. I was out with a few of the lads a Sunday or so ago, and during a stop for the mid-morn cup of tea heard one say to the other when I was out of sight: "The old man rides well considering his years and weight," to which his companion of the moment replied: "Well, he's at it every day, you know, and if there's half a chance of a holiday, he's off." True enough, I suppose, but somehow or other I never think of myself as old or elderly, though a glance in the mirror is proof enough that the passage of the years have left their marks. While the yarning was going forward under that hospitable roof, the conversation turned on tyres, and particularly on the introduction of the Dunlop; and once more the skipper turned to the main enquirer and said: "Ask the old man." I don't like that qualifying adjective even though there is a modicum of truth in it. And these lads did ask me, and found it difficult to believe the dainty cycle tyre of to-day called the Sprite is the direct descendant of the 2½ in. old pudding Dunlop lashed to a flat steel rim by mummy bands of canvas. We talked tyres for nearly an hour, the Clincher Bartlett beaded edge detachable, the Welch wired-on, and the marvellous simplicity of the Woods valve. It was remarkable how interested these lads were, and as one of them said, "it must have been exciting to live through those days." It was: too exciting on occasions when tyres blew off the rim, or shed their rubber treads in the hot weather. I prefer the comfort and security of to-day: which maybe is another pointer to the fact of the years. Yet I shall not grow old in the sense of decay so long as I can ride a bicycle and enjoy it; and I see no reason why that desideratum should not continue for a long while yet, as long as you and I keep on keeping on.

Our Makers

TOWARDS the end of this jolly month of April I shall be one of a company of nearly fifty cyclists on a long week-end. The occasion is the spring run of the Centenary Club, the cycling organisation of the cycle manufacturers, and a jolly lot of fellows they are, as merry as schoolboys once they are away from their offices. The organisation grew out of a week-end run I induced the manufacturers to take in 1938 to celebrate the centenary of the birth of the bicycle, and so thoroughly did they enjoy that trip (even though the weather was April in a temper), that they formed the Centenary Club then and there, the members of which have now grown to the full allowance of fifty, and half a hundred bright lads they are. The number wanting to come on this week-end is over forty, and at the moment of writing, I do not know if accommodation can be found for them; but those of us dealing with the matter are doing our best because it seems a shame that when a cycle maker wants to enjoy the results of the pastime from which he makes his fortune, he should not be fully encouraged. This week-end trip is not just a place-to-place crawl. Thirty miles from Shrewsbury to Llangollen on the Friday afternoon, followed by the A.G.M. in the evening (in the best tradition of war-time club life); and then on Saturday a sixty miles round trip including the climbs of the Horse-Shoe Pass and the Sportsman's Pass, and a quiet ride home on the Sunday. As the average age of these Directors must be nearly fifty, a week-end of some 120 miles riding is not bad going, nor is the little holiday looked on as one of life's ironies, but with the greatest possible enthusiasm.

Satisfaction

A SMALL niece of mine recently unburdened her young mind to me on the question of owning a bicycle. It seems that the trouble was Mother, who did not think it was safe for her daughter to ride to school, or go scooting round the country lanes with her companions when there was leisure time on hand. "I have saved," she told me very confidentially, "just over a pound towards the cost of a bicycle, and thought you might help me to get one and to overcome Mother's objection." And then the lassie became comically critical: "She is so old-fashioned you know!" The result was that one evening Miss Pigtails and I went to interview Mother, and pointed out to her the saving of time and money on bus fares, the fact that the girl could easily get home for lunch, and the important one (from my point of view), that I had survived through fifty years of road roaming, much of which was in town areas. Anyhow, between us we broke down the objections, and now one of the happiest damsels in Warwickshire is "in possession." My friends supplied me with a dainty little machine at the right price, but the shock of paying nearly 25/- Purchase Tax was a real one, for it is the first time I had been involved in the impost. But the gift of that machine was almost as pleasurable as the receipt of a new one for myself.

At the summit of the famous Bwlch-y-Groes (Pass of the Cross).

SCOTTISH EVENTS

THE first open time trial of 1941 in Ayrshire, the Ayrshire and Dumfriesshire C.A. open ten miles event, was run off in wintry weather at the end of March. There was an encouraging entry of 21, and 19 riders started and finished. The winner was James Tudhope, Crawick Wheelers, a Dumfriesshire miner, whose fast times in the past have tended to be overshadowed by those put up by Will Scott, his clubmate, now in the R.E.'s. Tudhope's time of 27 mins. 25 secs. was faster by 44 seconds than that of David Scott, second man.

When the Clydeside cycling season opened at the end of March with the West of Scotland Clarion C. & A.C. medium gear 25, conditions on the course were arctic. Nevertheless, J. Conner, St. Christopher's C.C., a seventeen-year-old Glasgow lad, clocked 1 hr. 10 mins. 36 secs. for first place. Of the 27 entrants, only 13 started, and 12 finished.

When the King and Queen were in Aberdeen, they opened the new George VI bridge over the Dee. The bridge is 75 feet wide, with two footways and two carriageways. It is made of reinforced concrete with a facing of granite, and cost £150,000.

P. K. Dolan, Glasgow Eastern C.C. speed star, rode in the opening event of the Clydeside season, the West of Scotland Clarion medium gear 25, and came in third with 1 hr. 15 mins. 23 secs. Dolan was on leave from the Army. Shortly before the event, he took part in the British raid on the Lofoten Island.

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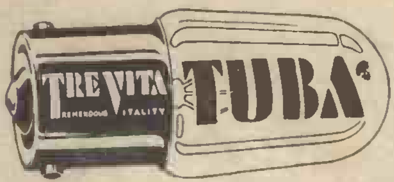

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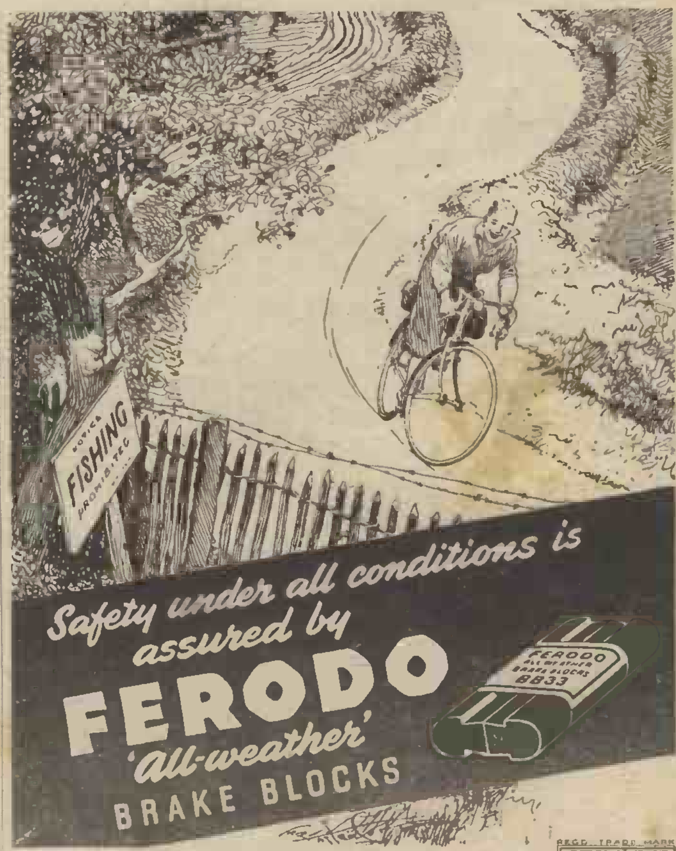

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