4 2 Beds[?]

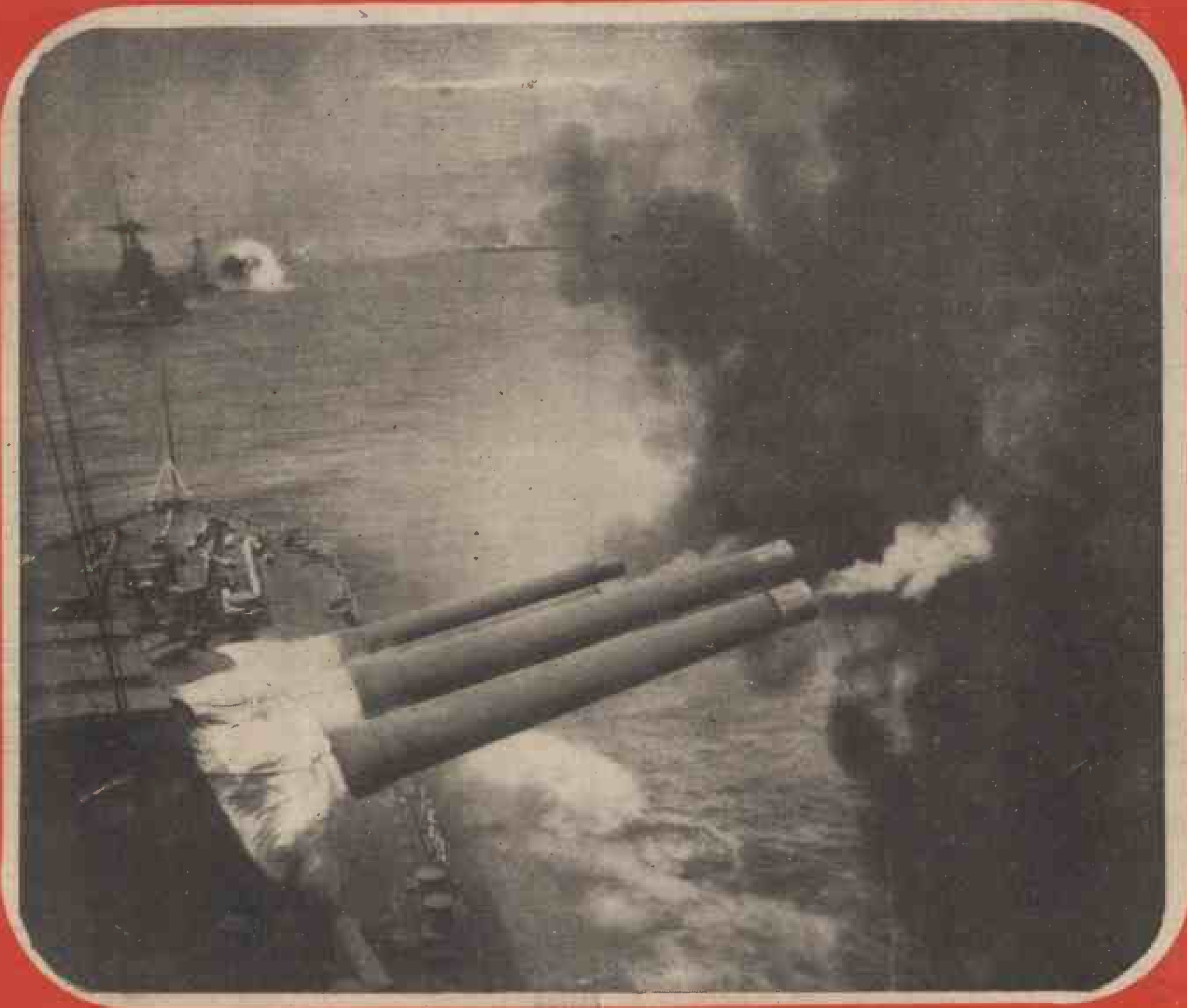
NAVAL BOMBARDMENT

NEWNES

PRACTICAL MECHANICS

9D.

SEPTEMBER 1944



SUBSCRIPTION RATES
(including postage)
Inland - - - 10s. 6d. per annum.
Abroad - - - 10s. per annum.
Canada - - - 10s. per annum.
Editorial and Advertisement Office: "Practical Mechanics," George Newnes, Ltd.
Tower House, Southampton Street, Strand, W.C.2
'Phone: Temple Bar 4363
Telegrams: Newnes, Rand, London.
Registered at the G.P.O. for transmission by Canadian Magazine Post.

PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. XI. SEPTEMBER, 1944 No. 132

FAIR COMMENT——BY THE EDITOR

Stereoscopic and Colour Television

A GREAT stride has been made in the development of television during the war. Mr. Baird's latest invention—the Telechrome—eliminates the revolving disc and lenses previously necessary for colour and stereoscopic television. The colour and stereoscopic pictures now appear directly upon the screen of the cathode-ray tube, so that colour and stereo television can now be received on apparatus as silent and efficient as the pre-war black-and-white receivers. The Telechrome differs from the black-and-white cathode-ray tube in having two cathode-ray beams and a transparent double-sided screen. The front of the screen being coloured blue-green, and the back red, one cathode-ray beam produces a blue-green picture on the front surface, and the other a red picture on the back surface, the two blending to give a picture in natural colours.

For stereoscopic viewing coloured glasses are used, the left and right eye pictures corresponding to the left and right eye images, a principle well known in the cinemas.

Stereo television without the use of glass has been demonstrated by Mr. Baird, but it has not yet arrived at the practicable stage.

Britain is well ahead in the field of colour and stereoscopic television. Both are British inventions, and were shown for the first time by Baird in 1928. Stereoscopic television is unique to this country, and has never been demonstrated abroad, while the only coloured demonstrations staged in the U.S.A. employ Baird's original revolving disc system.

The Telechrome

Television in colour has previously been accomplished by three methods. In the first demonstration of colour television revolving discs were used by Mr. Baird to accomplish the scanning and also supply the colour component. In his second method the scanning was done by the cathode-ray tube and the colour supplied by a revolving colour disc. In his third method images produced side by side on the face of a cathode-ray tube were coloured by stationary colour filters and superimposed by projection upon a viewing screen.

Of these methods the first two come within the category of mechanical systems.

The third, which requires no moving parts, might be best described as an electro-optical system as the colour is added to the image by optical means. This system has the very considerable disadvantage that the fluorescent screen cannot be viewed directly; the coloured image being obtained by projection which involves a substantial loss of light.

The present system is entirely electronic, the coloured image appearing directly upon the fluorescent screen, two cathode-ray beams being required for a two-colour system and three for a three-colour system. These cathode-ray beams are modulated by the incoming signals corresponding to the primary colour picture and impinge upon superimposed screens coated with fluorescent powders of the appropriate colours. For example, in a two-colour system the two cathode-ray beams scan the opposite sides of a thin plate of transparent mica one side of which has been coated with orange-red fluorescent powder and the other with blue-green fluorescent powder. Thus the screen has formed upon its front face an image containing the orange-red colour components and on its back face an image containing the blue-green components. These images are superimposed and thus give a picture in natural colour.

Where three colours are to be used the back screen is ridged and a third cathode-ray beam added, the front face of the screen giving the red component, one side of the back ridges giving the green components, and the other sides of the ridges the blue component.

A two-sided tube has been developed and has been shown receiving a picture from a 600-line triple interlaced moving spot transmitter using a cathode-ray tube in combination with a revolving disc with orange-red and blue-green filters. The screen is a 10in. diameter disc of thin mica coated on one side with blue-green fluorescent powder and on the other with orange-red fluorescent powder. (The colour may alternatively be provided for the back screen by using a white powder and colouring the mica itself.)

The tube may be viewed from both back and front, but if used in this way one set of viewers see a mirror image, also coloured mica must not be used, and a filter has to be inserted between the back viewers and the tube to keep the colour values correct and compensate for the light lost in the mica and fluorescent powder when the direction of viewing is reversed.

The tube can only be viewed from the front, but having one cathode-ray beam perpendicular to the screen simplifies the set-up of the apparatus. The tubes give a very bright picture due to the absence of colour filters and the fact that special powders are used giving only the desired colours, which are seen additively.

The tubes give excellent stereoscopic television images when used with a stereoscopic transmitter, the blue-green and orange-red images forming a stereoscopic pair and are viewed through colour glasses.

New Form of Scanning

In the present form of scanning all the lines in successive frames are of the same colour, the colour changing with each successive frame.

In the new form of scanning now being developed successive lines are of different colour and the number of lines is made a non-multiple of the number of colours, so that every line of the complete colour picture has successively shown each of the primary colours.

The object of this is to reduce colour flicker. Where frame by frame colour alteration is used, flicker becomes prominent in any large area of a single colour; for example, if the picture is showing a large blue area, this blue appears in the blue frame only. While the red and green frames are appearing it is not shown, so that the frequency of the repetition is reduced and flicker accentuated. With line by line colour alteration each colour appears in every frame.

This form of scanning does not lend itself to the revolving disc system.

Pilotless Aircraft

WE have received a number of letters from readers in connection with our article on this subject on page 366 of last month's issue. Several readers have misread the figure given for fuel consumption, which was correctly given as .95 miles per gall. Several readers overlooked that small, but important, decimal point! Obviously if it had a fuel consumption of 95 miles per gallon its thermal efficiency would be high, not low, and with a fuel capacity of, say, 150 gallons, such a craft could encompass the earth.

The Astronautical Development Society has made independent investigations which confirm our own views. There is an interesting article in their Bulletin, and we express our thanks to them for the information they supplied.

One small misprint occurred in the article: it was stated that the rate of combustion was 40 explosions per minute. This, of course, should have read 40 explosions *per second*.

The secretary of the Astronautical Society congratulates us upon being the first of the technical press to print a concise exposition of the matter.

There would appear to be at least three types of these pilotless aircraft, and we confirm that up to the present there is nothing to support the view that these craft are radio controlled, or possess any other device which enables the enemy to establish the point of impact after launching. Neither is it possible to change the direction of the bomb after launching.

Naval Bombardment

How the Co-operation of Heavy Naval Guns Play an Important Part in Modern Warfare

By J. A. SPAR

The battleship H.M.S. " Nelson," firing a broadside from her 16in. guns.

THE Allied landings on the coast of Normandy have seen the greatest naval bombardments in the whole history of war. The Germans did not like it. Here is how the " Militarische Correspondenz aus Deutschland."—official newspaper for German forces abroad—described the ordeal which they had to undergo.

" The fire curtain provided by the guns of the Navy has so far proved to be one of the best trump cards of the Anglo-American invasion armies. It may be that the part played by the Fleet has been more decisive than that of the Air Forces, because its fire was better aimed, and, unlike the bomber formations, it did not have to confine itself to ' short bursts of fire.'

Fire-power

" It would be utterly wrong to underestimate the fire power of warships, even of smaller vessels. A torpedo boat, for instance, has the firing power of approximately a howitzer battery, a destroyer that of a battery of artillery. With regard to its armament a cruiser may be compared to a regiment of artillery. Battleships carrying 14in. to 16in. guns have a firing power which is difficult to achieve in land warfare, and only possible by an unusual concentration of very heavy batteries.

" Of particular advantage to the invasion troops, which employed strong formations of warships as floating batteries, was the great mobility of the vessels by which artillery concentrations could be achieved at any point of the coast and made to change place according to the exigencies of the fighting situation. The attackers had made the best possible use of this opportunity.

" It is no exaggeration to say that the co-operation of the heavy naval guns played a decisive part in enabling the Allies to establish a bridgehead in Normandy. This had already been in evidence at Salerno and Nettuno. For several days fighting in Normandy took place at the periphery of the range of the heavy and very heavy naval guns. Once out of range of the guns of the Navy, with their colossal concentration, the German troops frustrated all attempts to widen the bridgehead—the fighting on land having entered a phase in which the Naval Powers lacked the logical initial advantage—conditions henceforward being equal for both sides."

" Floating Forts "

Thus said the Germans, and how right they were! The fact is that the modern battleship is a floating fort, just as the aircraft carrier is a floating aerodrome. No steel and concrete Atlantic wall can stand up to a concentration of these floating forts, which can turn up unexpectedly at any point along a coastline of approaching 2,000 miles. The German heavy guns, in their concrete emplacements, protecting particularly vulnerable points, cannot be moved, whereas the great guns of the battleships can be shuttled hundreds of miles in the course of a single night.

Air attack is bad enough, but it is soon over, giving the defenders time to get their second wind. But once the battleship comes on the scene, he just sits there, correcting his range with ruthless efficiency. To paraphrase a well-known advertisement, he won't be happy till he gets you. And get you he does, before swinging his guns for the systematic destruction of another target. What Hitler and his admirals failed to realise was that the development of aircraft, far from

A front view of H.M.S. " Nelson " travelling at speed. Note the triple gun turrets on the quarter deck.

rendering the battleship obsolete, made it ten times more deadly. Sea power, *plus* air power, is the most deadly combination in all history. And Nazi Germany lacks both!

Protected by air cover, the modern battleship is a floating battery of immense fire power. It can bring up close to the front line a great weight of armament representing the equivalent of a very powerful force of land artillery.

Again and again reports from the Allied Armies in Sicily and Italy spoke with gratitude and high praise of the magnificent artillery support given to them by the Royal Navy.

This is by no means a novel employment of naval might. Bombardment from the sea has been used repeatedly. But at no time has the use of naval fire-power been so highly developed as it is to-day, nor have the three fighting Services ever been so closely co-ordinated. To-day, combined operations do not mean the simultaneous employment of land, sea and air forces for the purposes of an assault; all three have become closely linked in waging continuous warfare.

A 6in. quick-firing Elswick gun, designed for separate loading.

One of the giant 10in. German railroad guns, mounted on a circular track, and having a firing radius of 360 deg., which were used by the Germans against shipping in the Channel, and also against U.S. troops as they advanced in Normandy. The Air Corps soon put a stop to the use of these guns before they could do any more damage.

Operational Phases

Operations may be divided roughly into three phases—(1) the preliminary bombardment to soften up the enemy's defences; (2) the initial assault; (3) the subsequent full-scale advance from the point of assault. The Navy plays a vital part in all three phases, and continued support of the land forces long after the second phase is successfully accomplished is an integral part of the strategical planning of operations ashore, so long as the fighting remains within range of the warships' guns.

In the case of Italy, which consists largely of a long chain of rugged mountains with a narrow stretch of coastal plain on either side, the use of the Navy was planned to continue until the whole sea-board, East and West, is firmly in Allied hands. In other words, it devolved on the Royal Navy to play a leading part in the conquest of almost the whole of Italy.

Fire-power

Here is a consideration of the actual fire-power possessed by the various classes of various ships, which shows how large a part can be played by the Fleet in these operations.

With her 14in. (355.6 mm.) guns, such a vessel as *H.M.S. King George V* or *H.M.S. Howe* can fire 15 shells a minute, each shell weighing over 707 kilogrammes. Thus, her target can be pounded with a total weight of over 10,000 kilos, every minute of the bombardment. If her secondary armament is also engaged, she can hurl 160 rounds, weighing about 32 kilos each, a total of 5,120 kilos a minute from her 16 5.25in. (133.35 mm.) guns.

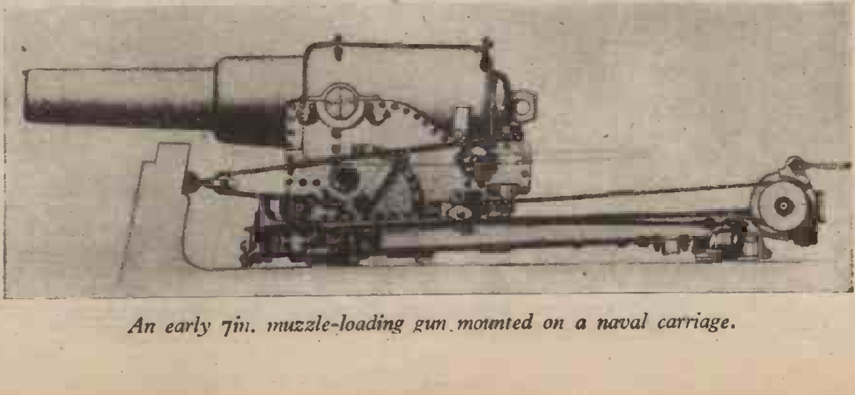
Not only that. She carries with her a vast store of ammunition, and complete servicing equipment of every kind. She is not merely a floating battery, she is a floating arsenal, barracks, repair shop, and everything else. Among her crew, numbering over 1,500 men, are experts in every branch of engineering for the care and maintenance of her guns, her machinery, and the instruments on which the accuracy of her fire depends. She carries also powerful anti-aircraft batteries and defences, and has her own aircraft for spotting the target and the fall of shot.

Self-contained Artillery Unit

The modern battleship is thus a self-contained and self-sufficient artillery unit, complete in every detail. She can be brought right up into action on the front line at a speed of well over 30 knots (55 kilometres an hour). The extreme range of her heavy guns may be as much as 40 miles (about 64 kilometres); at half that distance her gunfire can be surprisingly accurate. Imagine the effort necessary to bring up to the scene of action a comparable concentration of land artillery!

Remember that in the case of sea-borne invasion, as in Normandy, before we gained possession of a properly equipped seaport, such as Cherbourg, and had put its port installations in running order, it would be all but impossible to put ashore land artillery in any way comparable to the big guns of a battleship.

The 14in. gun is the most modern and the most efficient of heavy naval guns. Earlier classes of battleships mounted even heavier guns, but considerable improvements have given the 14in. gun greater hitting power than either the 15in. or the 16in. In other words, the difference between the wide-

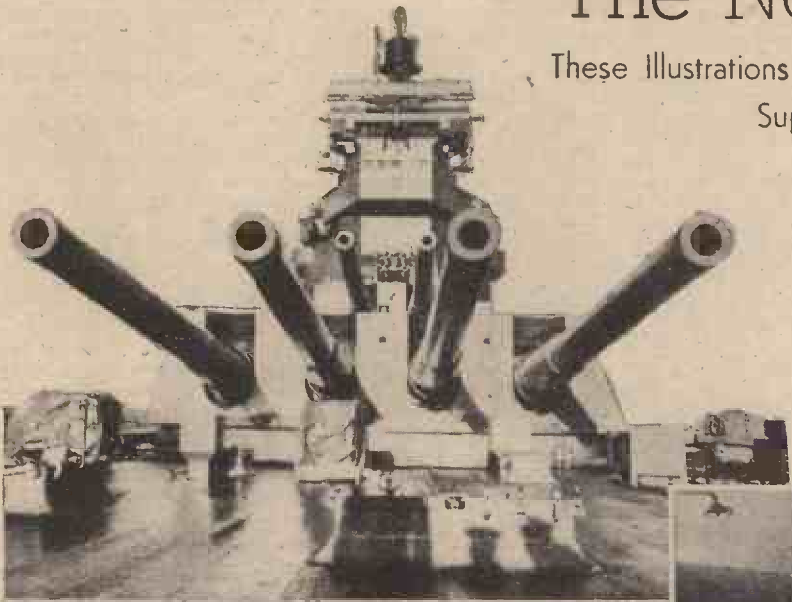


An early 7in. muzzle-loading gun mounted on a naval carriage.

The Navy's Big Guns

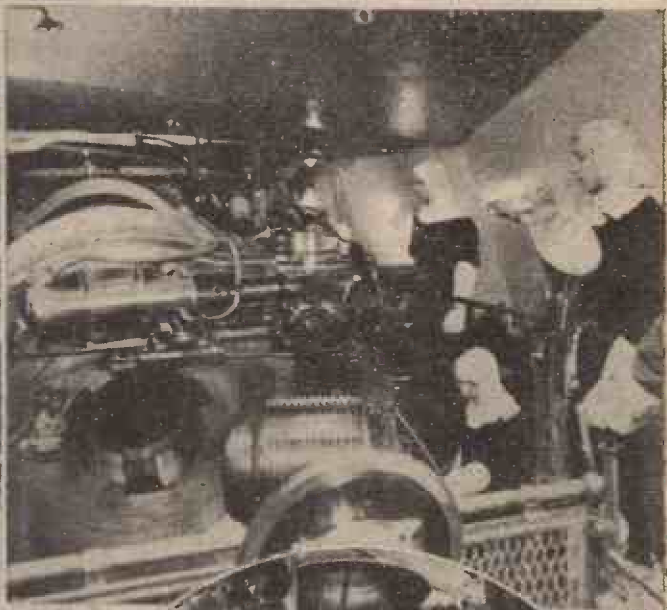
These Illustrations Show How They are Manned and Supplied With Ammunition

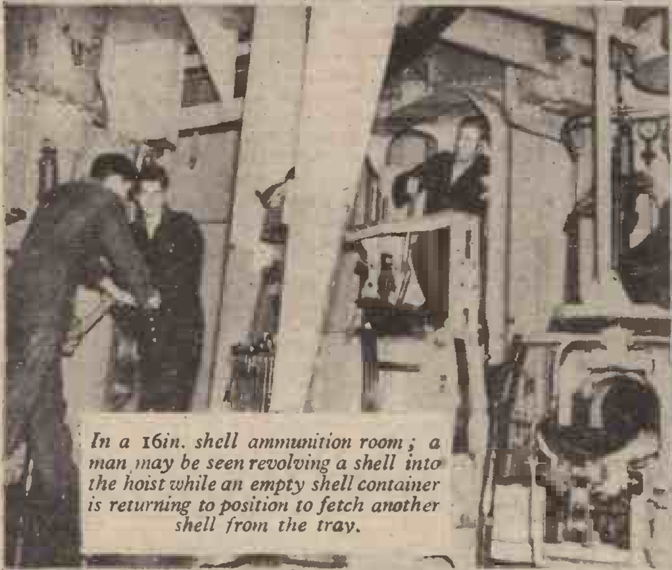
Much has been said in the daily press lately concerning the vital support the British Navy has given to the Allied Armies during the landings in Normandy and the south of France. The present article, and illustrations, help to explain how this is brought about, and compares the terrific bombardment of present-day warships with those of Nelson's time.



(Left) Looking towards the forward gun turrets of H.M.S. "Duke of York."

(Below) A 15in. gun and its crew in one of the turrets of H.M.S. "Malaya."





In a 16in. shell ammunition room; a man may be seen revolving a shell into the hoist while an empty shell container is returning to position to fetch another shell from the tray.

(Above) In the shell room of a British destroyer on escort duty.

(Left) How the Navy's big guns support the Army. The weight of shells hurled at the enemy by Royal Marines manning X -turret can be gauged by the study of X-gun deck. The shell cases massed here number more than 2,000.

mouthed blunderbuss and the modern sniper's telescopic rifle. The larger the gun the larger the turret to contain it, and therefore the larger the ship, and the slower the speed. Moreover, a smaller ship with 14in. guns can carry more guns, and steam faster.

The heaviest armament in the Royal Navy is the 16in. (406 mm.) mounted in three triple turrets. The projectile weighs 952.5 kilos, and the muzzle velocity is 808 metres per second. Rate of fire is 1.2 rounds per minute, giving a total fire power of 11 rounds a minute, or a total weight of about 10,500 kilos of projectiles.

The 15in. (381 mm.) gun is mounted in battleships carrying only eight guns in their main armament. The projectile weighs 885 kilos, and the muzzle velocity is 760 metres per second. Rate of fire is only slightly higher than with the 16in., so that the total amount of high explosive which such a ship can pump into a target at extreme range is about 9,000 kilos per minute.

A limiting factor in naval bombardment of shore targets is, of course, the wear and tear on guns. This has been considerably reduced by the employment of "bombardment charges," which are designed to give a higher trajectory, and therefore greater accuracy. But the life of a gun barrel, or rather, of its rifling, must be allowed for when planning continuous naval support to land forces.

(Left) Gun drill with a carronade on a light non-recoiling carriage. This form of carriage began to come into use some years before 1800, and its lightness and hardiness specially fitted it for use on the upper decks.

Air-spotting

In the first phase of co-ordinated land, sea and air invasion, the softening-up process is carried out by the Fleet, with the aid of air-spotting. This is done either by the ship's own aircraft or by carrier-borne aircraft where enemy air opposition is not too intense. Otherwise, it is carried out by the faster aircraft of the Allied Air Forces. In the second phase, specially trained observation officers are put ashore to direct the bombardment, with bombardment liaison officers carried in the ship. The forward observation officers continue their work into the third phase, and, owing to the high mobility of the Fleet, can ensure gun support of the land forces wherever it may be needed.

But the battleship does not sail alone. She has her screen of destroyers, and her bombardments are usually carried out in conjunction with bombardments by cruisers as well.

Cruisers' Heavy Armament

The more powerfully armed cruisers may mount 8 guns of 8in. (203 mm.) calibre, with a secondary armament of 8 of 4in. (101.6 mm.) calibre. The main armament can thus hurl into enemy shore defences, gun emplacements, tank and troop concentrations, and other targets 48 rounds per minute, totalling 5,568 kilos, while her secondary armament, when within range, fires 144 rounds a minute, totalling 2,024 kilos.

Ships of the Leander class mount 8 6in. (152 mm.) guns, but the more modern Southampton class have 12 in. four triple turrets, as well as 8 4in. anti-aircraft guns, and 6 torpedo tubes. The 6in. projectile weighs 45.36 kilos, and has a muzzle velocity of 915 metres per second, and a rate of fire of 10 rounds a minute. The most powerfully armed of the 6in. gun cruisers mounts 12 6in. and 12 4in. guns, which give her a fire power of 120 rounds of 6in. (5,443 kilos) and 216 rounds of 4in. (3,037 kilos) per minute.

Destroyers vary in size and design more than any other class of warship, from the little "Hunts" to the big powerful Tribal class, which might almost be considered light cruisers. The Tribal class are of 1,870 tons, with a crew of 190, and a service speed of over 36 knots (60 kilometres per hour). They mount 8 4.7in. (120 mm.) guns, 7 smaller guns and 4 21in. torpedo tubes. The 4.7in. gun fires a projectile weighing 22.68 kilos, at a rate of 12 rounds per minute, thus allowing these ships to fire 96 rounds a minute, totalling 2,177 kilos.

The destroyer, with its very high speed and the small target which it presents to the enemy, has proved of the greatest service in bombarding enemy shore batteries from close range. In addition to a very large number of organised bombardments there have been innumerable engagements of shore targets whenever opportunity presented itself.

Mediterranean Operations

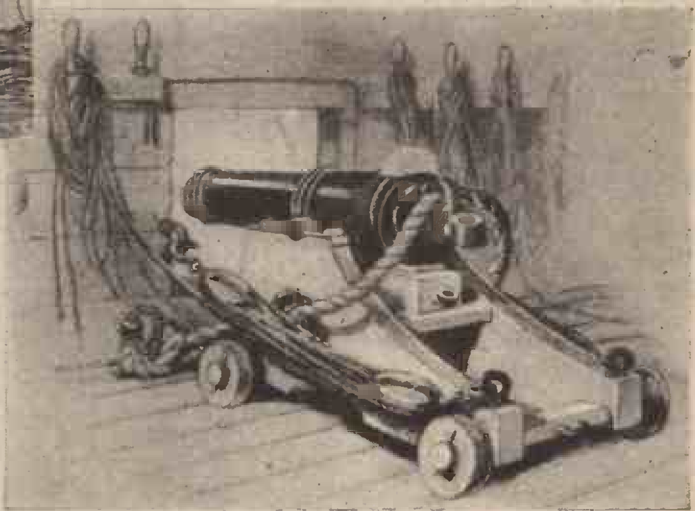
It will thus be seen that the fire power of a naval force brought to bear upon the enemy in preparation for or in support of landings, and in support on an advance along the coast, can be a decisive factor. As soon as it became evident that the Italian fleet need no longer be considered a serious threat to British naval operations in the Mediterranean, the supreme command was able to deploy this vast fire power in direct support of military operations. The results were spectacular. The Germans themselves had to admit that, but for the guns of the Navy, they would have smashed the beachhead at Salerno. They gave the credit for the success of this invasion of Italy entirely to the warships.

Indeed, at one time in the earlier Sicilian campaign, fire from the ships saved a dangerous situation. At Gela German tanks actually broke through on to the beaches, and it looked as if the Allied troops would be driven into the sea. The 6in. cruisers, appearing in support of the land forces, steamed in and immedately opened fire in a terrific bombardment at close range. The panzers were stopped and routed in short order by this great hail of shells pouring in from the sea.

Again, Mussolini's "impregnable" fortress of Pantellaria, and the island of Lampedusa, both hoisted a white flag to the Royal Navy after sampling a naval bombardment by the ships which steamed close inshore.

At Gela, in Southern Sicily, the defences were completely destroyed by fire from destroyers and gunboats operating close inshore, and from the heavier ships standing off and firing over the heads of the infantry in their assault craft.

In the earlier stages of the campaign a diversion was caused by the heavy bombardment of Trapani, on the West Coast, by the battleships *H.M.S. King George V* and *H.M.S. Howe*. This had the effect of confusing the enemy as to the Allied plans, and played a considerable part in dispersing the strength of the defences.



(Right) A carronade of Nelson's time, as originally mounted.

At the height of the battle for Augusta, a heavy bombardment was opened from the sea. The Greek destroyer *Kanaris* steamed right into the bay to support it, engaging the enemy batteries at close range. Other ships followed her in, the batteries were silenced, and the town gave in.

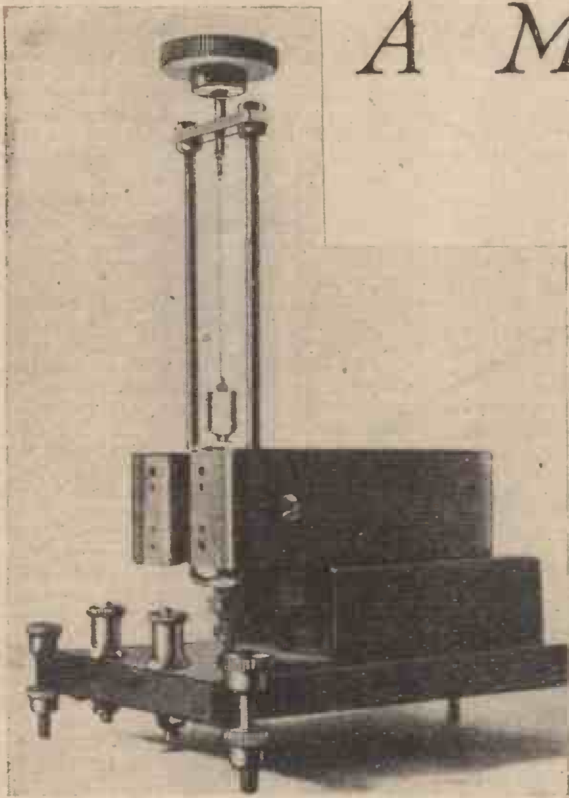
As long ago as July 18th, 1943, within 40 miles of the Italian coast, 60 tons of shells were hurled into a military barracks by British capital ships at five miles range. The shore batteries were silenced by the destroyer screen, which went in close to engage them. The enemy aircraft which came over to engage them took one look at the battleships' powerful anti-aircraft batteries and cleared off, thinking that discretion was the better part of valour.

(To be continued)

A Moving-coil Galvanometer

Constructional Details of a Useful Unit

By J. W. COLE



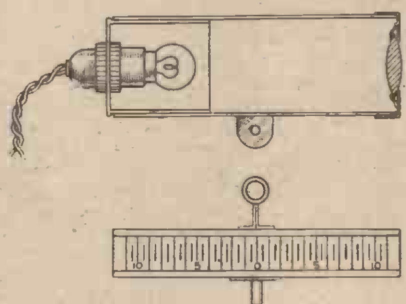
General view of the completed galvanometer.

THIS type of current-measuring instrument has wide applications; it can measure a very wide range of currents by using different shunt resistances, while series resistances give it a correspondingly wide voltage range. If the copper damping frame is omitted, it gives ballistic readings and is then suitable for measuring magnetic field strengths, permeability of magnetic alloys, etc. The amateur can make it a most useful universal meter, while its light-spot scale is very convenient for demonstration work in a classroom.

The construction will naturally depend upon the size of magnet obtainable; it should have soft iron pole pieces and a cylindrical soft iron core, leaving about ⅛in. clearance for the coil. The core must have a *brass* support arranged as shown; this has a flange which is screwed to the wooden base. The latter is built so that the pole pieces overhang, to leave a space for the moving coil. A fixed leg at the rear, and two adjustable ones at the front, follow the usual practice. Terminals are easily adaptable for this purpose.

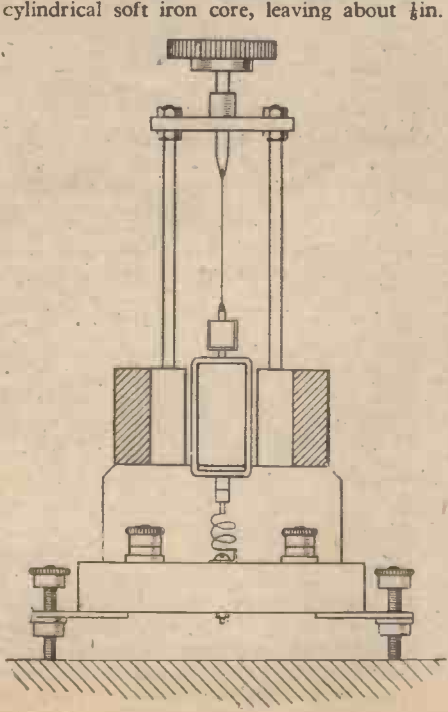
Coil Former

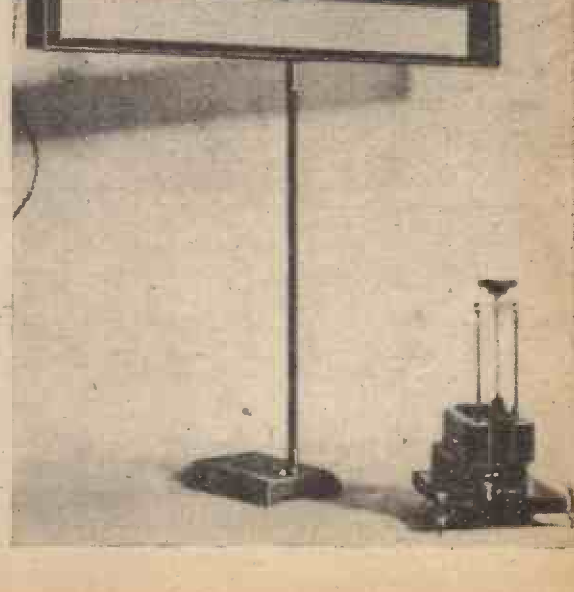
A coil former is built up of very thin copper of U-section. A strip soldered to the top of this carries a mirror ⅛ inch square in a copper frame. The strip tapers to a point and has a small hole for the suspension wire. At the bottom of the coil former is soldered a second strip, which carries an insulated copper pin. The wire is 40 SWG. enamelled. One end is soldered down, and the coil is wound on top of a strip of silk. About 20 turns were used, but this will vary according to the sensitivity required. The end of the coil goes to the insulated pin.



Section of lamp tube and lens, and a front view of scale.

The torsion head is supported on 3-16in. brass rod, screwed into the pole pieces. A short rod, equipped with an old wireless condenser knob, turns in a sleeve which is slit so as to grip it. The rod ends in a tapered flat (just like a lathe half-centre) and has a hole for the suspension wire. The length of this wire is such that the coil may be lowered on to the soft-iron core when carrying the instrument about. No. 48 SWG. enamelled wire can be used, or phosphor-bronze strip from a scientific supply house. The lower connection is via a coil of similar wire to an adjustable tag, thence to a terminal. The other terminal goes to the frame.

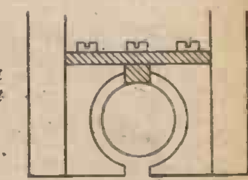




(Left) Front elevation of the galvanometer. (Right) The stand which supports the scale and lamp. A view of the finished galvanometer is also shown.

Lamp and Lens

The lamp used had a 6v. 3w. bulb, with a *straight* filament. The lens forms an image of this on the transparent scale, after reflection on the galvanometer mirror. The lamp is built up from a small tin can such as is used for spice or pepper. By moving the bulb, the lamp may be focused; the length of tube required is found by preliminary experiment with the bulb and lens, the latter being about 3in. focal length. Mark the scale with a central zero, on grease-proof paper, and sandwich it between strips of celluloid fastened to the wooden frame. This also carries the lamp, which swivels vertically, and the whole swings on a tube which fits the vertical rod of a retort stand.



Details of magnet pole pieces and soft iron core.

To standardise the instrument, a known resistance and a standard cell were used, the scale being 1 metre from the mirror. Finally, the resistance of the coil is measured so that shunt and series resistances may be calculated as required.

Instruments for Motor-cars and Aircraft

(Continued from page 392, August issue)

The Principle of the Venturi and Carburettor

By JEREMY MARTIN

THE Venturi Principle is incorporated in several instruments, and in action gives the same result as a vacuum pump. The same principle is incorporated in the carburettor.

In construction the venturi represents a pipe, as in Fig. 16, with a constriction, and at any point around the constricted area a lead-off pipe is fitted. In operation the passage of air enters at A, and, travelling in the direction B, passes through the constriction. As the air moves into the constriction its velocity increases, and in consequence its molecules are not long enough in contact with the sides of the tube to develop full atmospheric pressure; it therefore follows that the pressure in the constriction is less than the normal atmospheric pressure. The faster the stream of air travels, the lower the pressure in the constriction. The lead-off tube is attached to the instrument chamber and results in a difference of pressure between this tube and the normal atmospheric pressure at the inlet air jet. The operation is now quite clear, and it will be seen that the venturi principle is used in many instances for creating a difference in pressure. One common example is in the construction of dust-extractor and smoke-extractor shafts, and in the design of carburettors.

The Carburettor

This is the mechanical means of supplying the correct mixture of petrol and air to internal combustion engines. The most simple type of carburettor is shown in Fig. 17, and consists of a casting incorporating a float chamber, in which is contained a metal or cork float. Petrol from the tank is supplied to the float chamber, and the buoyant float, being attached to a needle valve, operates that valve by its movement upon the surface of the fluid. When a definite level has been attained, the cam attached to the float arm causes the needle valve to close, thus shutting off the petrol. Conversely, as the petrol in the float chamber is used up, the float drops, thus moving the needle valve through the cam into a position which opens the valve. It is essential to maintain the level in the float chamber, for the action of the carburettor in supplying a correct mixture is dependent upon this. The jet, connected to the float chamber, determines the amount of petrol supplied to the engine. The jet tube is enclosed in a choke tube, working on the venturi principle, which draws petrol from the jet into the stream of air passing to the cylinders. As the engine turns over, the piston on the induction stroke sucks air speedily through the choke tube, and at the constriction a drop in pressure results. The pressure of the petrol is the same as the air entering the tube, but, due to the restriction, a difference in pressure is given, and the petrol is drawn through from the tube and, issuing in the form of vapour, mixes with the air, so forming a combustible mixture which is drawn into the cylinder on the induction stroke. The depression afforded must be sufficient to supply all the air required for combustibility at the greatest speed of the engine.

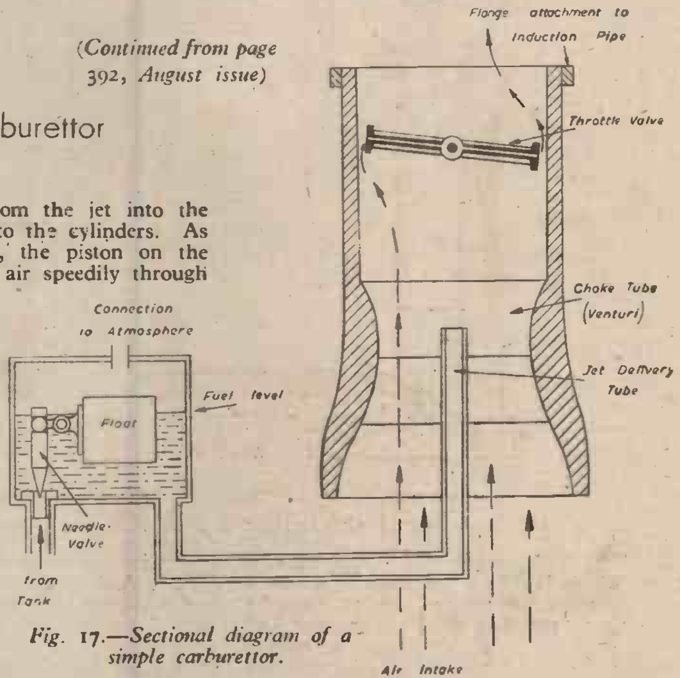


Fig. 17.—Sectional diagram of a simple carburettor.

Throttle Valve

The throttle valve is fitted at the engine side of the depressed area, and its purpose is to control the quantity of mixture which can be drawn into the induction system of the engine. This valve is in the form of a disc pivoted at right angles to the walls of the tube, and so constructed as to permit movement through 90 deg., thus almost completely closing off the tube, or conversely to give the minimum restriction. The "closed" position is for "slow running," and the fully open position for "full throttle." It might be pointed out that the size of the disc is smaller than the diameter of the tube, and in consequence there can always be free passage between the periphery of the disc and the wall of the tube.

At the slow-running position the amount of air drawn through the choke is so small that the choke cannot create a depression, but when the throttle valve is closed there exists at the lip high depression, due to the suction from the piston on induction stroke, and the depression so afforded is utilised to draw petrol from what is called the "slow-running system."

The mixture supplied to the engine must be maintained at a ratio within certain limits to ensure that efficient combustion is obtained. With a simple fixed jet the increase in engine speed would cause a greater increase in petrol to the increase in air and the mixture would become progressively rich. For cruising speeds a weak mixture is used of a fuel/air weight ratio greater than 1 : 15. This gives fuel economy, but to obtain the full power output from the engine a considerably rich mixture is necessary. In either case the atomisation of the fuel/air is essential. As the aircraft rises its increase in height results in a drop in atmospheric pressure, and the mixtures if set to work at normal atmospheric pressure at sea level will become richer as the height increases. The simple jet carburettor will not give efficient working under these conditions, and it has been found necessary to design a carburettor possessing all the characteristics for efficient working.

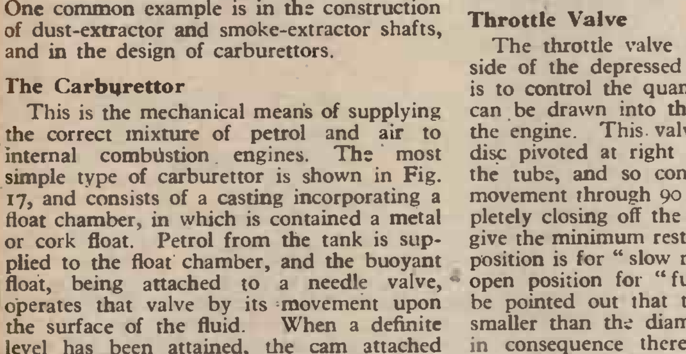


Fig. 16.—Diagram illustrating the principle of the venturi.

Modern Aircraft Carburettor

Present-day high-duty engines call for very efficient carburettors. Pressure balance and adequate air intake to minimise any change in mixture with the varying speeds have been incorporated in the modern carburettor. The adoption of the power jet principle has afforded economical consumption at cruising speeds and yet gives full power with the throttle opened.

The delayed-action acceleration pump enables the engine to be accelerated on weak mixtures for cruising.

Additional Power for Take-off

To overcome the difficulty met with in highly supercharged engines on take-off, an extra jet is incorporated which is actuated synchronomously with the over-ride of the boost control of the supercharger; this permits the availability of extra power for take-off, without causing detonation or overheating. Slow-running large induction systems fitted with superchargers call for special consideration in slow running to avoid build-up or flat spots when idling. This is allowed for in the slow-running system, providing a 3-point spray to minimise build-up difficulties, and preventing a flat spot by incorporating a passage in the throttle.

The carburettor described herein is the Claudel-Hobson, a well-designed and most efficient type used in many aero engines. The main points can be seen from the diagram, Fig. 18

The Diffuser Set

This is fitted to this type of carburettor, and, besides supplying a correctly proportioned mixture of petrol and air it forms an emulsion prior to supply to the choke tube.

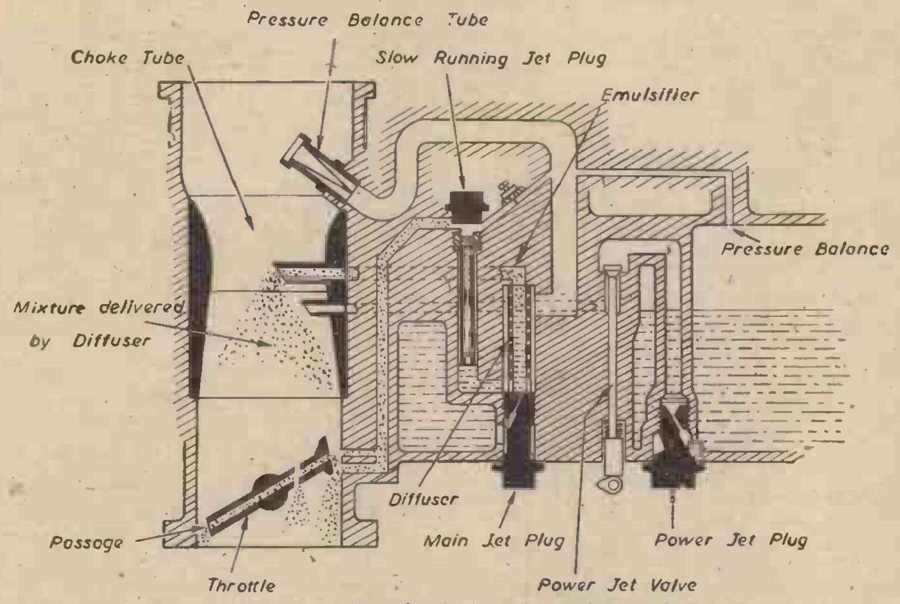


Fig. 18.—Diagrammatic sectional view of a Hobson carburettor.

This is in the form of a "U"-tube, and the petrol enters this tube from the float chamber, and when the engine is not running the level of the petrol is the same in each half of the "U"-tube. With the engine started and the throttle opened, air is drawn through into the "U"-tube at the limb nearest to the choke tube, and this, mixing with the petrol, forms the required emulsion. The depression caused by the restriction in the choke tube causes a difference in pressure between the two ends of the pipe line, being less at the end inserted in the choke tube than that at the end with outlet to atmosphere; as already explained, this will cause the required suction. With this action the level of the petrol in one side of the tube will fall, due to the atmospheric pressure and the restriction of supply from the small-bore main jet. The level of the petrol in the limbs will vary with the varying depression in the choke tube, which, in turn, alters with the changes in engine speed. At slow running the levels will be almost the same, that is, the same level as the fuel in the float chamber; but as the engine speeds up this level will fall, until at the maximum the level will be at the bottom of the tube close to the main jet.

When this condition has been obtained, it can be seen that the main jet is passing its maximum amount of fuel.

Construction

The diffuser consists of a brass tube with a series of holes drilled along the length of the tube. This is suspended in the well formed inside the carburettor. The well and the diffuser are analogous to the "U"-tube mentioned in the outline of principle employed. Fitted to the casting is a small nipple which gives the air inlet to the diffuser, and as the engine revolutions increase the depression created within the choke tube draws air through this jet along the inlet passage and into the diffuser, where it combines with the petrol, forming a highly explosive mixture. As the engine speed increases, the air-holes in the diffuser are uncovered until at full speed all are free, and at this stage (as "U"-tube analogy) the main jet is supplying its maximum. In similar conditions in a simple carburettor a rich mixture would result. The diffuser principle, however, obviates this, for as each hole is uncovered and the petrol supply increases, so does the uncovering of the holes give additional air inlet, and thus the petrol/air ratio is maintained constant at all speeds. It can be seen that when the engine is running the depression is insufficient to suck the mixture from the diffuser, and during this period the fuel is supplied by the slow-running jet, for there is considerable depression at the slow-running nozzles, due to the small opening around the throttle valve.

The Power Jet

This is a hollow plug with two small calibrated orifices drilled diagonally from one end to break into the waisted portion of the plug. This is sealed by fitting a washer behind the flange on the head. Fuel enters the jet through a spring-loaded power jet valve, which is depressed by the cam attached to the accelerator pump spindle when the throttle lever is advanced to the predetermined value required. The fuel enters the valve chamber through an orifice in the wall of the float chamber, passing through a channel serving the main delivery nozzle in the choke tube by way of the calibrated orifice. The power jet is arranged to supply fuel at a set position, approximately 50 deg. from the closed position of the throttle valve. This is effected by positioning the cam on the operating lever spindle.

Power Jet Valve

This governs the supply of fuel to the power jet, and consists of a spindle and valve head supported in two sleeves. The power jet valve carries a small calibrated hole in its head; this counteracts the tendency of the diffuser to over-compensate the supply of fuel from the main jet by feeding through the bleed hole fuel, which assists in maintaining the falling performance of the diffuser, and thus maintains the proper fuel/air ratio and the power jet comes into operation.

The slow-running jet is similar in construction to the power jet, and is fed from a duct delivering into another duct in the upper part of the carburettor body.

Enrichment Jet

This serves to enrich the mixture when the over-ride (this raises the boost pressure to 2½lb. per sq. in.) is brought into play. The valve is of similar construction to the power jet valve with the exception of the bleed hole. The valve is operated by a cam (Fig. 19).

Inverted Flying Plug

This takes the place of the jet which is fitted when the aircraft is flying in the inverted position, and by this means the fuel is fed to the choke tube when the engines are in that position. The needle valve is closed by the weight of the float. A pipeline is connected to a special reservoir, and this feeds fuel to the jet when in the inverted position.

Boost Control Over-ride Valve

This valve, operated by a cam controlled by the lever in the pilot's cockpit, works in conjunction with the enrichment valve. This valve is the means of controlling the air bleed from the boost control aneroid chamber. The duct from the over-ride valve leads from the suction side of the induction system.

The Boost Control

In the event of applying excessive boost, over-supercharging, damage may be caused to the engine, which might result in failure of that control. To obviate this it is necessary to incorporate some device which will automatically prevent such an occurrence. This is done by controlling the opening of the carburettor throttle to within certain limits. This device is known as the Variable Datum Automatic Boost Control, and it may be set to give either maximum take-off boost or climbing boost.

The variable datum device fitted to the automatic boost control ensures a power output directly proportional to the movement of the throttle lever. It represents an aneroid chamber at right angles to a servo piston cylinder operated by oil pressure from the main pump. The aneroid is similar to that used in other aircraft instruments, and consists of a number of evacuated capsules sealed and attached to each other. A threaded rod is attached to one end of the aneroid, the position of the sleeve being adjustable. The sleeve is actuated by a cam (see Fig. 19) which is connected to the throttle operating lever. The opposite end of the aneroid is attached to a piston valve, which is permitted free movement within a sleeve containing various ports admitting pressure oil to either side of the servo piston, depending upon the direction which it is moved by the expansion and contraction of the aneroid (caused by the chamber). The spring at the furthest end assures that the aneroid returns to its normal position at ground level, and also acts as a damping medium. At one side of the aneroid chamber there is a calibrated port connected to the pressure side of the supercharger, and at the opposite side a similar port connected to the venturi in the carburettor, but intercepted by the boost over-ride valve. The action of the variable datum boost control is briefly as follows: Variations in the boost

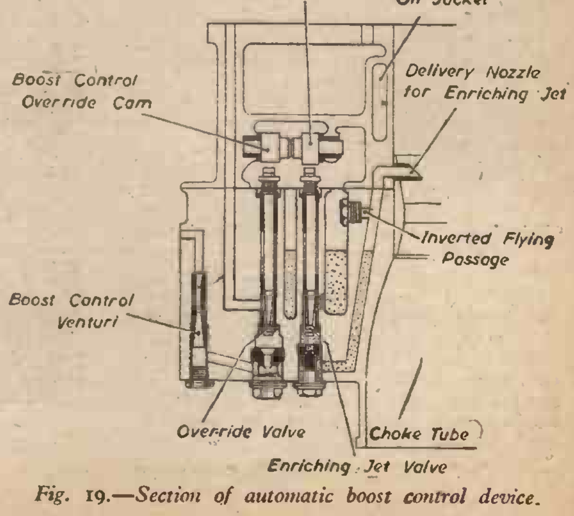


Fig. 19.—Section of automatic boost control device.

pressure are transmitted through the pipe to the aneroid chamber. This causes the aneroid to either expand or contract, with resulting movement of the piston. This allows oil under pressure from the main system to travel to one or the other side of the servo piston, thereby developing sufficient pressure to control the toggle link-work attached to the carburettor throttle valve. With increased height and the resultant drop in atmospheric pressure, consequential movement of the aneroid operates the piston until the throttle is opened to maintain induction pressure.

With "take-off" additional boost is required, and this is allowed for by the insertion in the system of an over-ride valve, which not only allows for take-off boost, but also enriches the mixture (through the cam-operated enrichment jet) sufficiently to prevent detonation. The over-ride device consists of a venturi in the side of the aneroid chamber connected to the suction side of the induction system. Movement of the mixture control lever opens the over-ride valve between the aneroid and the induction system. This permits the pressure in the chamber to be relieved, for, as the venturi is larger than the calibrated orifice, a certain amount of air from the aneroid chamber is ejected. This gives a decrease in pressure in the chamber, and the aneroid expands accordingly, causing further opening of the throttle by the servo piston and giving higher boost pressure. The movement of the mixture control valve lever also opens the enrichment valve.

The variable datum cam operates against a shoulder on the spring-loaded cap carrying the aneroid adjusting screw, and the movement of the screw varies the reaction or datum point of the aneroid. Adjustment of the boost pressure to take off boost can be carried out by adjusting the size of the orifice in that pipe opposite the venturi, for by selection of a suitable size the pressure in the aneroid chamber can be lowered to give the expansion in the capsule to raise the boost pressure.

Automatic Mixture Control

This is linked to the mixture control valve cock on the carburettor, and effects the necessary change or correction for atmospheric density upon the carburettor during climb. As shown in Fig. 20, the aneroid is connected to the piston rod so that an upward movement of the servo piston gives a reduced movement of the aneroid capsules and the piston valve. This continues until the pressure inlet port is closed, and the servo piston no longer travels upward unless further expansion of the aneroid takes place, due to further reduction in atmospheric pressure at an even higher altitude.

The piston valve sleeve is fitted with two sets of ports, one set being positioned farther up in the sleeve than the other. The sleeve can rotate through 90 degs. by means of levers connected to the cockpit mixture control lever in order that either set can be brought into action. When the lower set of ports is in play, the zero position of the servo position at ground level on a day of normal barometric pressure is at the bottom of the cylinder and the mixture control valve is closed. This position is known as "automatic rich" when, by rotating the sleeve, the upper set of ports are brought into play; under the same conditions the zero setting must be reset, for, owing to the changed positions of the ports, oil is admitted to the underside of the servo piston, thereby forcing that piston upwards until in its upward travel it draws up the aneroid and piston valve, shutting off the oil flow. This movement opens the mixture control valve to a predetermined position which weakens the mixture, and this is known as "automatic weak position."

It will be seen from Fig. 20 that the aneroid is surrounded by two brass containers, each container being machined with three slots and fitting into each opposite number. Around these containers is fitted a spring giving the following action: Under normal conditions the containers are held apart by the expansion of the aneroid, but in the event of the piston valve becoming stuck in the lower position, thereby permitting oil to pass to the underside of the piston, this would rise unchecked in its movement, for the piston valve would not cover the holes in the sleeve. In the upward movement the piston carries with it the upper brass container and the spring is compressed, at which point the lower container is also drawn upward, thus freeing the piston valve in the sleeve by exerting on it the force of the servo piston.

(To be continued)

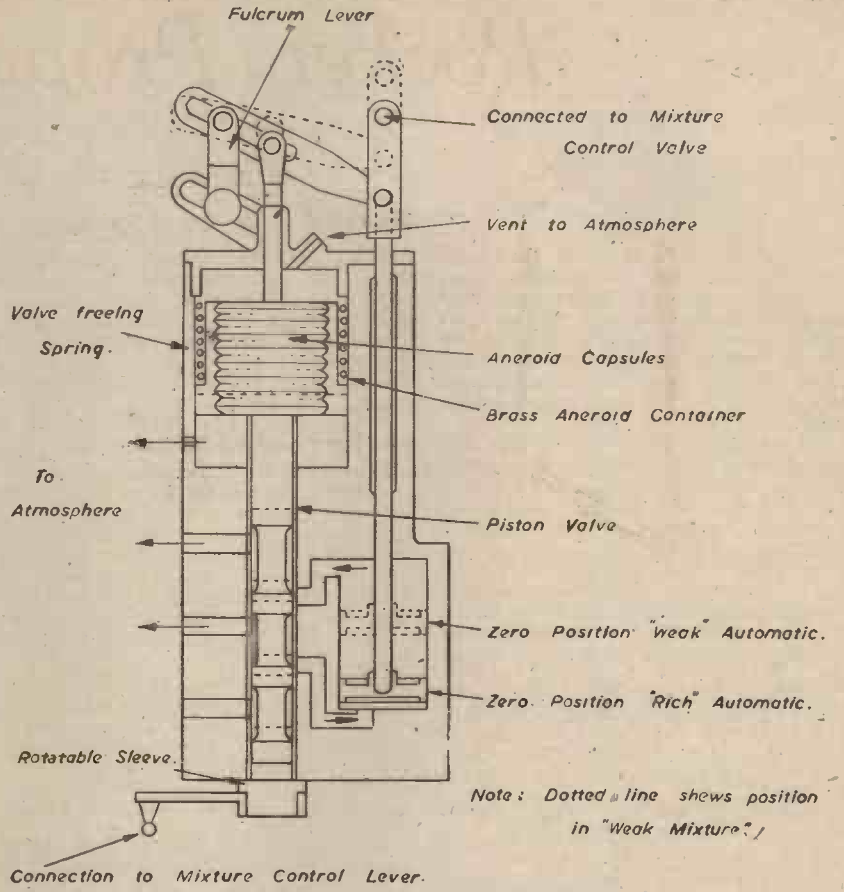


Fig. 20.—Automatic mixture control unit.

Typhoons in the Making

A corner of a Hawker factory where Typhoons are assembled. The Typhoon has a top speed of over 400 m.p.h. and is powered by the new 2,200 h.p. Napier Sabre engine. The illustration shows one of these engines being fitted in place.

Rocket Propulsion

Its History and Development

By K. W. GATLAND

(Continued from page 375, August issue)

THE war of 1914-18 found the signal and illumination rocket (the latter ejected a parachute flare at the peak of trajectory) used extensively on the fighting fronts, and towards the end of the conflict a special message-carrying rocket projectile was developed, which found its greatest use for maintaining communication between advanced troop elements.

Rockets projected from aircraft were also employed during the war for destroying observation balloons and airships. The projectile, which was of the conventional "stick" balanced type, consisted of a simple tubular case containing gunpowder propellant compound, and incorporated at the "head" a number of barbs which enabled the missile to cling to the fabric of the target, the rocket exhaust being sufficient to fire the highly inflammable hydrogen gas contained.

The first operational aircraft to employ rocket projectiles as offensive armament appeared in 1915. This machine, a Henry Farman, carried ten rockets, these being electrically fired from small tubes situated on the outermost interplane struts, five either side. Several Newport Scouts were later fitted to carry eight rocket missiles mounted and fired in similar manner.

In 1917, the Vickers aircraft group developed a special single-seat, pusher type, rocket-firing aircraft (the Vickers F.B.25), designed as a defence machine intended to counter Zeppelin attack. However, this 'plane did not realise operational service, due to the introduction of incendiary ammunition for use in the ordinary aircraft machine-gun.

An interesting suggestion aimed at the increase of the flight efficiency of shells, particularly rocket shells, was put forward by Chilowsky in 1915. In order to reduce drag at high speed, he advocated the projection of a flame ahead of the projectile in order to raise the temperature of the air locally at the nose, the heated air thereby becoming less dense. For instance, it has been estimated that by means of the combustion of 10 gm. of phosphorus, it is possible to halve the resistance of the standard 75 mm. F.N. projectile.

The "Thrust Augmenter"

A French engineer, Henri F. Mélot, whose work, although being concerned solely with the development of thermal-jet power units, produced in 1917 an interesting design (Fig. 8) incorporating a multi-nozzle device of progressively increasing dimensions emulating from around the nozzle of a combustion chamber, the motor employing inducted air, with petrol as fuel. This "stage" nozzle served to induct air to augment the thrust of the propulsive jet, and was tested under the auspices of the French military authorities during the latter stages of the last war, though with no definite success. The principle upon which the device functioned was that air was sucked into the unit by virtue of an area of negative pressure created by the exhaust flow from the producing plant being expanded through a venturi "diffuser" tube, which thereby increased the mass flow of the efflux. Since the war, the "thrust-augmenter," as the device was later termed, was further developed by Mélot and others. In 1927 the Mélot "augmenter" system was tested at the Langley Memorial Aeronautical Laboratory, U.S.A., the results of which proved conclusively the efficiency of the device. It is quite probable that, by careful design, the "thrust-augmenter" may in later development provide the means for operating the "true-rocket" system in atmosphere at a practical efficiency.

Further Goddard Research

Mention of Dr. Robert H. Goddard's early researches has already been made, and in 1919 the findings of these initial investigations and experiments were published in the form of a report to the Smithsonian Institute —"A Method of Reaching Extreme Altitudes" (Smithsonian Miscellaneous Collections, Vol. 71, No. 2). Investigations at the Clarke University were maintained during 1919 and for some years following, the immediate aim being the establishment of a firm foundation from which it would be possible to base the design of a practical sounding rocket, capable of penetrating to heights prohibitive to the balloon and the aeroplane, for the purpose of providing much-needed data of atmospheric conditions at extreme altitudes.

Dr. Goddard is reputed to have conducted preliminary research concerning liquid fuels (which are capable of being throttled to the combustion chamber under direct control, thereby maintaining a constant chamber volume throughout the entire firing period), in 1922, when he first put forward the suggestion of employing petrol as fuel, burnt in a medium of oxygen, this latter element being contained in concentrated *liquid* form. It should not, however, be concluded that liquid propellant owes its origin to Goddard alone, for Professor Oberth, as early as 1914, is held to have proposed liquid oxygen and liquid hydrogen as a plausible rocket fuel.

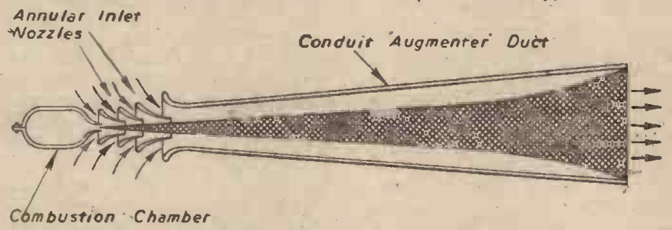


Fig. 8.—Mélot type thrust augmenter. Air is sucked in at the sides by virtue of negative pressure created within the conduit duct by the fast-moving exhaust efflux.

The process concerned in the reduction of a gaseous element, such as oxygen, to the liquid involves the gas first being highly compressed. Once a sufficient pressure has been attained, the gas is suddenly allowed to expand, thereby reducing the temperature, and by means of a series of such processes the gas finally assumes liquid form, in the case of oxygen at 182.9° C. Special vacuum containers, of the Dewar or "thermos" type, are required for storage as vaporation quickly takes effect, acting to return the liquid to its original form at normal atmospheric temperatures.

Two more pioneers of modern rocket development were an Austrian, Dr. Hermann Oberth, and Dr. Walter Hohmann, of Germany, whose early theoretical researches, unlike Goddard's, dealt almost entirely with the rocket in space. After extensive investigation, a treatise was finally developed in 1923 in which Oberth set out a technical observation of the rocket as a means for interplanetary communication. This work was later published as a book entitled "Die Rakete zu den Planetenräumen" (92 pp.).

Reverting once more to the French rocket pioneer, Esnault-Pelterie, a lecture was delivered by him to the main assembly of the French Astronomical Society on June 8, 1927, the subject-matter concerning both the aspect of altitude sounding by rocket, leading to the possibilities of the interplanetary space-vessel. A year later the lecture was published as a book entitled "L'Exploration par Fusées de la Très Haute Atmosphère et la Possibilité des Voyages Interplanétaires," and in 1930 this work, considerably expanded to include in addition to its original matter an extensive mathematical investigation covering rocket performance and trajectories, was published under the title of "L'Astronautique" (249 pp.). The work remains to this day the greatest theoretical treatise of rocket propulsion yet produced.

In June, 1927, the world's first successfully organised rocket research group, the "Verein für Raumschiffahrt, E.V." (Society for Space Navigation), was formed in Breslau, Germany, due mainly to the endeavours of Max Valier and Ing. Johanes Winkler, and it was not long after inauguration that the society listed amongst its members such renowned names as Professor Oberts, Dr. Hohmann and Willy Ley.

Rocket-car Trials

The society commenced active experimentation a year after its formation, the first series of tests concerning the propulsion of road vehicles, and although the experiments concerned can hardly be said to have contributed greatly toward the technical advancement of rocket propulsion, considerable public interest was nevertheless aroused.

This early work was sponsored by a notable German car manufacturer, Fritz von Opel, probably with the view in mind that the sensational nature of the experiments would serve as a good advertisement for his more conventional products. At all events, the first rocket car to be developed by the society was tested on March 12, 1928, at the Ruessilsheim racing circuit, and a month later a similar test took place as a public demonstration. The car itself, designed by Max Valier, was of light construction, and powered by twenty-four individual gunpowder charges, each weighing twenty-six pounds. These charges, specially manufactured for the test by Ing. F. W. Sander, were arranged in "block" form behind the single driving seat, firing taking place in sequence. Ignition was either accomplished electrically or by means of a clockwork timing device.

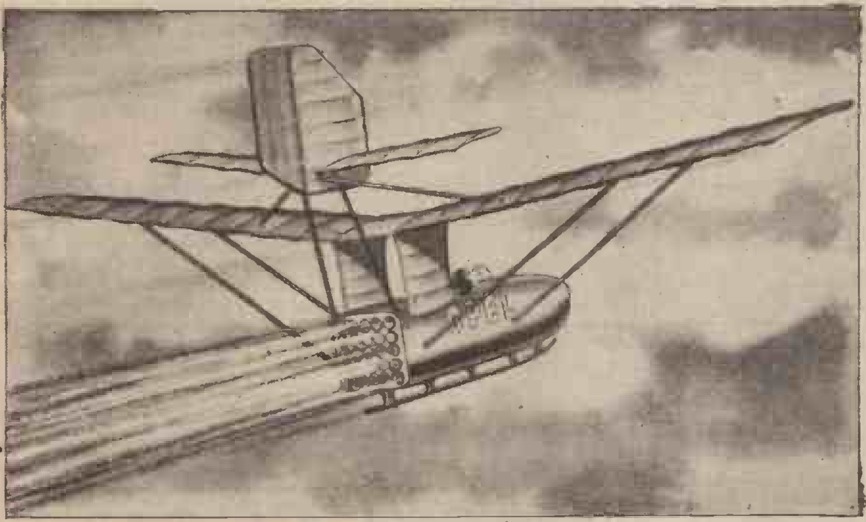
Von Opel's Experiments

On May 23, 1928, with von Opel himself at the wheel, a further public demonstration took place, on this occasion at the Avus

Speedway, Berlin. From a standing start, the car is recorded to have accelerated to a velocity of 60 m.p.h. in five seconds, attaining a maximum speed of 131 m.p.h.

So pleased was von Opel by the success of the Avus Speedway trial that he sponsored three more rocket cars, these being constructed before August of the same year. Unfortunately, due to an accidental explosion, the fourth car was seriously damaged shortly after its completion, but the remaining two satisfactorily completed their respective trials, although the results obtained did not in any way compare with those achieved on May 23. Further types were run on rails, and in one particular instance a speed of 62.5 m.p.h. was attained within 5 seconds from a standing start.

A particularly interesting point was that "retaining planes," emulating stub wings, were fitted to a later Opel rocket car. These projected outwards from a point behind the front wheels, and were set at a negative incidence, the object being that, as the car gained speed, air pressure would act upon the planes and so restrict any lifting tendency.



The Opel rocket-propelled aircraft (1929).

The First Rocket Aircraft

On June 11, 1928, the first man-carrying rocket aircraft flight was made, the machine employed being a light tail-first type Rhön-Rossittengesellschaft glider, powered by two large powder charges, and piloted by Friedrich Stahmer. The flight in question was commenced from a point in the Rhön mountains, the 'plane travelling for nearly a mile before descending. Later a further and much sturdier machine of tailless form was constructed which incorporated four propellant tubes.

Rocket Mails

In July of the same year an Austrian engineer, Ing. F. Schmiedle, conducted experiments aimed at the development of a rocket mail-carrier. Six experimental rockets were constructed, and subsequently tested in free flight, delicate registering instruments being housed within special nose compartments. Unfortunately, the sixth rocket exploded, destroying every item of its valuable load.

As the direct result of these preliminary experiments, Schmiedle established in 1931 the first officially recognised rocket mail service, projecting his mail-carriers for a distance of two miles over mountainous country connecting the two Austrian towns of Schöckel and Radegund with a high degree of accuracy. In fact, so confident were the authorities in this rocket postal service that even registered letters were entrusted to the Schmiedle service for delivery.

A parachute enabled the projectile, which contained the mail in a nose compartment, to reach the ground without damage, being automatically released as the rocket ceased firing.

Further German Experiments

On July 18, 1928, Max Valier himself tested a specially built all-wooden car of his own design, attaining a speed of 112 m.p.h., using gunpowder as propellant. Two further tests were made later, and during the latter he achieved a velocity of just over 130 m.p.h. before disaster overtook him, the car overturning at speed and ending as a complete wreck. Happily, no serious injury was sustained.

Undaunted by the car mishap, Max Valier continued his experiments, and on February 3, 1929, conducted trials of a rocket-propelled sleigh on the ice-covered Lake Starnberg, Germany. In this test a maximum velocity of 235 m.p.h. was attained, and Valier, highly pleased with the success of this latest venture, next resolved to take the air in a rocket 'plane. His plans involved the actual design of a special machine capable of spanning the Channel, which he hoped to fly, from Calais to Dover, but for a variety of reasons the project was never developed into reality.

On September 30, 1929, Fritz von Opel himself piloted a rocket glider, specially designed by Ernest Hatry, powered by some twenty Sander gunpowder charges. In this craft von Opel attained a maximum speed of 85 m.p.h., the machine flying for a distance of one and a half miles at a more or less constant altitude of 50 feet. Unfortunately the 'plane was rather severely damaged on landing, but fortunately the pilot escaped without serious injury.

However, although widespread interest was attracted by these full-scale tests of powder-driven rocket vehicles and aircraft, the Verein für Raumschiffahrt E.V. engineers soon began to realise that nothing of real technical value was being gained. Nevertheless, it had to be admitted that the experiments did act to emphasise one very important point, namely, that the degree of control attainable using powder fuel was practically negligible, as once the propellant charge was fired the reactive thrust of any one charge could not be increased or diminished at will. Thus it is probable that these experiments considerably hastened the inevitable introduction of *controllable* liquid fuels; but we must turn to America for the first practical demonstration of this unique fuel form.

Fuel Liquids

Dr. R. H. Goddard is credited with the initial application of fuel liquids, the particular experiment concerning the firing of a rocket projectile nine feet in length and twenty-eight inches in diameter, employing liquid oxygen, with petrol as propellant. The projectile, which contained special light meteorological instruments, was fired from a 40-foot high steel tower, the test being carried out on the outskirts of Worcester, Mass., on July 17, 1929. Although the projectile exploded after reaching an altitude of nearly 900 feet, the test was considered to have been highly successful, so much so that Goddard received a donation equivalent to the sum of £20,000 from the late Daniel Guggenheim for the continuance of liquid propellant research, although only after extensive investigation of his claims.

After assisting in the preparation of another technical rocket work, "Die Möglichkeit der Weltraumfahrt; Allgemeinverstandliche Beiträge zum Raumschiffartsproblem" (344 pp.), Professor Oberth greatly expanded his first treatise, "Die Rakete zu den Planetenräumen," and in 1929 a new 431-page edition was published.

Also, in 1929, the REP-Hirsch award, a fund originated by Esnault-Pelterie and a wealthy banker, André Hirsch, was established, which aimed to encourage the development of the newly born science of *astronautics* (space-flight) by the annual award of a sum of 10,000 francs, to either the author of a most original technical literature or in recognition of an especially significant experimental work. A committee, comprising many eminent scientists of the French Astronomical Society, was formed to assist in the selection, and in its initial sitting of June, 1929, this body was unanimous in recording the first award to Professor Hermann Oberth.

Research in the U.S.S.R.

In Russia, as indeed in many other countries, the developments of European and American rocket research workers were being followed with ever-increasing interest, and finally, in 1929, two U.S.S.R. rocket research groups were formed—one the Moscow G.I.R.D., founded by Ing. I. Petrovitch, and the other the Leningrad G.I.R.D., founded by Professor N. Rynin and Dr. Jakow I. Perlmann. Professor Rynin later contributed a comprehensive work entitled "Interplanetary Traffic" (9 vols.), which did much to promote Russian interest in the possibilities of space-flight. The Russian engineer, K. E. Ziolowsky, too, had not been idle since his preliminary work of 1903, and many more original papers by him were published concerning both the application of the rocket principle for rapid terrestrial transport, and also as a means for achieving interplanetary communication.

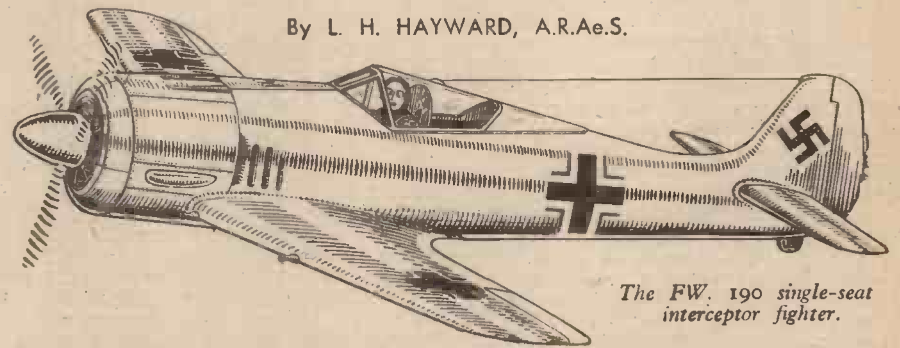
Liquid Fuel Rocket Car

It is of interest to recall yet another German rocket car development, this time the propellant employed being liquid oxygen, with denatured methylated spirit as fuel, in accordance with Professor Oberth's investigations. The reaction motor, into which the propellant mediums were pressure fed, was designed by Dr. Paul Heylandt and scaled barely seven pounds. Tests proved it capable of developing a maximum of 50 h.p. In April, 1930, an initial trial was held at the Tempelhof Aerodrome, Berlin, in which the car accelerated to a maximum speed of 60 m.p.h., and although the velocity attained was not half that reached by the earlier powder fuel vehicles, in consideration of the fact that the constant volume combustion chamber was then in its most embryonic stage, the test was concluded to have been highly successful.

AIRCRAFT ON ACTIVE SERVICE

7.—The Focke-Wulf FW. 190

By L. H. HAYWARD, A.R.Ae.S.



The FW. 190 single-seat interceptor fighter.

ONE of the most outstanding aircraft that the Germans have produced to date is the FW.190 low-wing monoplane, manufactured by the parent firm at Bremen and Johannisthal, near Berlin, and extensively "shadow" produced throughout Germany. Officially classed as a single-seat interceptor fighter, it has now been adapted for fighter-bombing, ground strafing, and tip-and-run day and night raids.

A cleverly designed low-drag engine cowling and an engine-driven fan, which ensures positive cooling, are two of the many ingenious design features embodied in this aircraft. Many developments have been made, and several different types are now known to be operating. The general leading particulars of Germany's only radial-engined air-cooled fighter now on active service are given in the table on the right.

Construction

A single main spar runs the complete length of the wing, and it is on this spar and a subsidiary one that the entire wing is built up as an individual unit. Aluminium alloy, flush riveted stressed skin covering is used throughout with the exception of the ailerons, which are fabric covered. Electrically operated split trailing edge flaps to assist take off and landing are fitted between the wing roots and the control surfaces. Wells are provided to receive the undercarriage legs, and cameras are usually carried in each wing.

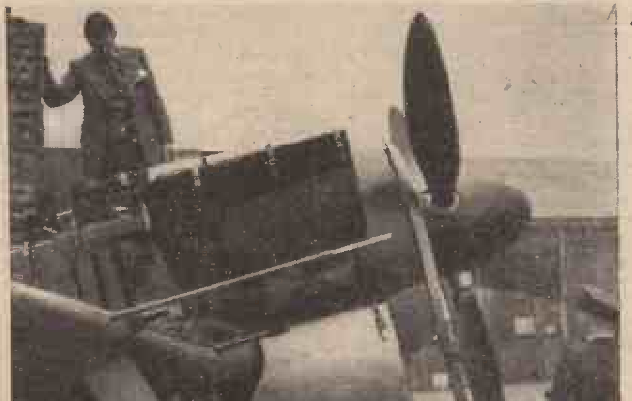
The all-metal light alloy monocoque fuselage, with flush riveted stressed skin covering, houses the undercarriage wheels when retracted, and two self-sealing fuel tanks. Flaps attached to the underside of the fuselage seal off the retracted undercarriage.

An interesting feature of the FW.190 is that the angle of incidence of the tailplane can be altered in flight to correct the trim of the aircraft and improve stability under all conditions of flight. Controls in the cockpit allow the pilot to vary the angle of incidence between -3 to $+5$ degrees, and an indicator is provided to show at a glance the tailplane position.

Engine

Early FW.190 aircraft were fitted with the B.M.W.801A engine, and with this installation the amount of cooling air flowing over the engine was not controllable. The more recent machines have been fitted with the B.M.W.801D, 1,600 horse-power, 14-cylinder, air-cooled, double-bank, radial, direct-injection engine which the Germans have developed from the Pratt and Whitney Twin Wasp.

Span	Length	Height	Weight	Max. Speed	Motor Type	Motor Power
34ft. 5in.	29ft. 4in.	11ft.	8,580 lb.	375 m.p.h.	B.M.W. 801.D. 14 cyl. Radial	1,600 h.p.



Side view of the front of a FW. 190 brought down by a Spitfire on the south coast. The illustration shows the clean lines of engine cowling and two of the 20 mm. cannon guns. On the top of the engine fairing, under the engine cowling, are the two 7.92 mm. machine guns.

A 12-bladed fan, revolving at about one and a half times engine speed, is fitted immediately behind the cowl opening. This fan blows cooling air through baffles fitted around the cylinders and cylinder heads, and the three apertures which can be seen in the illustration allow the air to leave the power unit. The amount of air flowing over the engine can be controlled by opening or closing these apertures at the discretion of the pilot. Ducts fitted at the rear of the fan convey air to the supercharger, and thereby delete the usual type of air intake fitted outside the cowling on British radial air-cooled engines.

A clever and ingenious control system has been devised to ease the pilot's task. The correct fuel-mixture strength and supercharger gear are automatically selected by a hydraulic unit, which also controls the airscrew pitch, boost pressure and throttle position.

Armament

As with most operational aircraft, several different types of armament have been used on the FW.190. The most recent version to be put in service mounts four 20 mm. cannons in the wings and two 7.92 mm. machine-guns installed above the engine in the nose of the aircraft and synchronised with the two inboard cannons to fire through the airscrew arc. It is possible for the pilot to fire any pair of guns individually or collectively.

On most FW.190 aircraft provision is made for bombs to be carried below the fuselage. The FW.190 A4 fighter-bomber usually carries one 250-kg. bomb. For long-range flights auxiliary fuel tanks are fitted beneath the wings, but when tip-and-run raids are being made on this country from bases in France and Holland the long-range tanks are replaced by two small bombs carried under each wing and the 250-kg. bomb is replaced by a 500-kg. bomb.

Cockpit

Neatness of design and simplicity of control have been successfully attained in the layout of the pilot's cockpit, which has been very carefully sealed to prevent ingress of petrol fumes from the engine. The sliding hood, formed from a single sheet of Perspex material, can be easily jettisoned. Bullet-proof glass is fitted in the front windscreen, and armour plating is fitted for the protection of the pilot and engine. To enable the aircraft to operate at high altitude oxygen equipment is fitted.

In Service

The FW.190 was first encountered by our fighter pilots during September, 1941, and it is believed that all fighter squadrons of the Third and Fifth Air Fleets of the German Air Force are now equipped with these machines. It has been used extensively in the Italian campaign, and most of the day raids on this country have been made by F.W.190 aircraft.

Precision Clockmaking—3

Reviewed from the Aspect of Scientific Craftsmanship, With Special Reference to Self-contained Electric Clocks

By the Late GEORGE B. BOWELL

(*Continued from page 389, August issue*)

"Siemen's H" Armature

FIG. 6 shows the "Siemen's H" armature, which is similar to the Ritchie (Fig. 5), though the actual formation is very much improved; the commutator used was merely two segments, similar to Fig. 5.

In the Ritchie motor the "field" was provided by a permanent magnet, and, indeed, this was thought to be necessary in the very early days; but the Siemen's machine, except for very small sizes, had the field excited by coils as an electro-magnet. Fields are taken for granted in the accompanying sketches, which only show their pole faces.

It will, of course, be understood that any of these machines may either be used as *motors* or as "*dynamos*" (see Fig. 3), transforming an electric current to a mechanical motion, or vice versa.

Ring Armature

In 1860, Gramme, a French instrument-maker, devised the ring armature which yielded a steady current, for the pronounced undulations due to the use of only two commutators' segments was superseded by merely an almost imperceptible ripple. In Gramme's machine the armature core is an iron ring, and the winding forms a continuous coil around the iron (see Fig. 7). Thus the commutator may have a relatively high number of segments or "bars," each of which may be connected to the armature winding at uniform intervals. Fig. 8 shows a commutator. In Fig. 7, for the sake of clearness, the brushes are shown merely diagrammatically, as if they made contact direct against the winding. This Gramme machine, with its smoothly sustained action, may be regarded as one of the big stepping-stones in the development of motors and dynamos.

Constructionally the *ring* armature has the disadvantage that the winding must be threaded through the inside of the ring, so the "drum" type was evolved to obviate this.

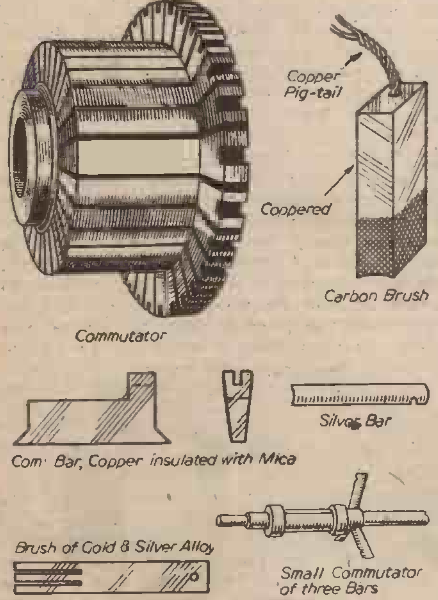


Fig. 8.—A commutator and details of the various parts.

Drum Armature

In the *drum* armature the windings are wholly on the outside of the core and provide for the same essential, namely, that current shall flow in opposite direction only where it may traverse a magnetic field of opposite polarity; thus in both places the same relationship as between current, field and motion (see Fig. 3) is preserved.

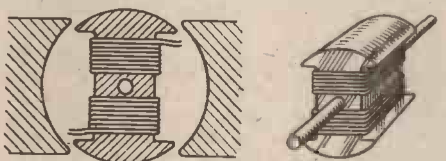


Fig. 6.—"Siemen's H" armature.

There are various forms of drum winding, all of which provide for this; one is shown in Fig. 9, the only four sections are shown so that the connections may more readily be traced.

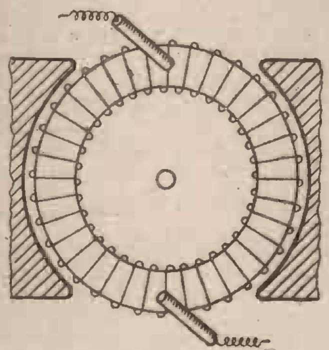


Fig. 7.—Gramme ring armature.

A very usual construction is by the employment of a number of *former-wound* coils, which are placed in slots, thus providing good anchorage and protection.

Eddy Current Losses

Field magnets may be solid, but armature cores are built up of thin stampings, because, in rotation, the magnetic flux through the core undergoes rapid reversals and occasions a loss called *hysteresis*, which is greatly minimised by the laminated construction. Also, these laminations are separately varnished, or papered and varnished, in order to prevent a low electrical resistance in a direction at right angles to the magnetic flux; because otherwise the metal of the core itself would act as an additional, and quite unwanted, armature turn in which a large current would be included, but to no useful purpose. Such loss is called the "eddy current" loss.

Motor for Small Mechanisms

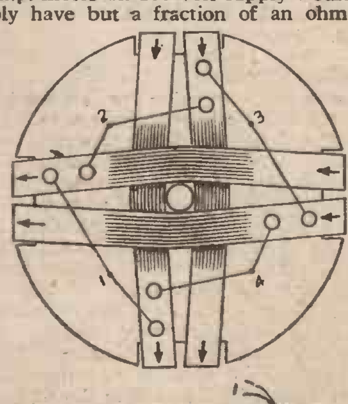
Apart from the usual form of electric motor, mention must be made also of a different construction which has been found preferable for such special purposes as "small mechanisms" where the actual power required is extremely small. Here the importance of "no-load" efficiency is paramount, and thus one benefits to a large extent by the adoption of a type which needs no iron core in the armature, so eliminating *hysteresis* losses. In addition to this, the armature coils are built up in a non-metallic casing (bakelite) so as to avoid *eddy current* losses as far as the armature itself is concerned. Such a motor is shown in Fig. 10. It has an armature 3¼in. in diameter, and its speed is about 275 r.p.m. and affords a liberal drive to a seconds house clock. A single dry cell maintains its action for a prolonged period, as the normal motor input is only about 1.5 milliwatts.

Fields: Shunt and Series

Before leaving the subject of D.C. motors it would be well to recount the circumstances controlling their behaviour. First let it be assumed that field strength remains constant irrespective of load. The armature will then in rotation generate its own e.m.f., which is proportional to speed of rotation. If this e.m.f. were equal to that of the battery, or some other source of supply assumed to be of constant e.m.f., then no current would flow into the motor; thus, devoid of input, it would reduce its speed and with that its own e.m.f., which can now be called a "back e.m.f.," until there results sufficient *difference* between the applied e.m.f. and the back e.m.f. to provide sufficient current to maintain its rotation. Hence (i) the motor will always take as much current as it needs to balance the required torque, but (ii) it will never take more than this, since if it did so the speed would rise and thus oppose any increase.

Thus the current in the circuit follows Ohm's law, but, in applying this, one must take the difference between supply voltage and back e.m.f., and this divided by the resistance of the armature = the current. Therefore, the extent to which the motor's speed will drop as load increases depends on the armature resistance, which accordingly one always aims at making as small as possible. The motor speed and its back e.m.f. being proportional, the extent to which the armature's resistance will cause speed to vary with load can be ascertained by multiplying the current by the resistance and deducting this result from the supply voltage.

The lowness of armature resistance is, of course, a relative matter. For instance, a 1 h.p. motor on 100-volt supply would probably have but a fraction of an ohm; or a



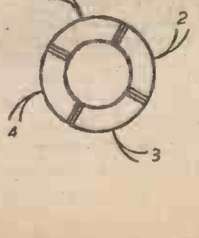
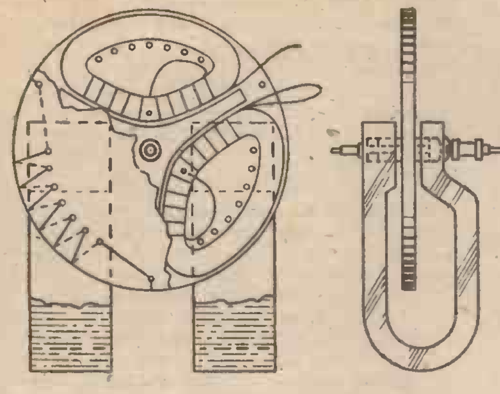


Fig. 9.—Four sections of a drum winding, showing connections.



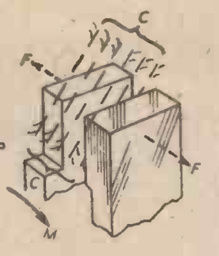


Fig. 10.—Motor for small mechanisms.

motor (such as Fig. 10) taking merely 1 m/a at 1.5 volts might have over 100 ohms armature resistance.

The several methods of arranging field excitation are shown in Fig. 11. The *shunt* winding preserves a constant field because it is supplied by a small current irrespective of load.

Compound Winding

The *compound* winding is a modification by which a little alteration of field is made by passing the main current through a few turns of thick wire, the purpose being to secure for differing loads more perfect uniformity of speed in a motor or of volts in a dynamo. A dynamo may be over-compounded to compensate not only for drop in volts occasioned by armature resistance but also by resistance of a long cable through which it may have to supply a varying load.

The *series* wound motor is altogether different in its speed characteristics—the field varies as the load; consequently when load is reduced the speed rises greatly—it may, in fact, race dangerously if load is completely thrown off. Nevertheless, it is for appropriate purposes of great merit, because of the powerful starting torque it provides. This, by the way, is the particular advantage of a compound winding rather than a plain shunt *machine* for motors.

A reversal of supply current does not change direction of rotation of a motor, but reversals of current will do so in the case of separate excitation, of which the simplest example, of course, is the permanent magnet field. Hence, if it is required to reverse rotation of an ordinary motor one may do so by reversing either the leads to armature or those to fields, but not both. However, should the intention be to provide for habitual reversing in use (such as for some machine tools), the reversing switch should always act on the armature circuit, not on the fields.

Alternating Currents

A few matters relating to *alternating current* ("A.C."), and particularly as to A.C. motors, should be added before concluding these notes concerning electrical apparatus.

Fig. 12 is just a sort of demonstration model or toy which closely resembles Fig. 5 (Ritchie machine), except that in Fig. 12 the rotating part is the permanent magnet and the fixed part the wound iron core, also that the commutator of Fig. 5 is omitted. In consequence of this omission, upon rotating the permanent magnet an *alternating* current is obtainable from T.T. This current would flow in one direction during one half revolution and in the reverse direction during the other half. Rotated at 50 turns per second (3,000 r.p.m.) the alternating current would have a frequency of 50 cycles per second. Such a current would be quite as convenient as a D.C. current for lighting an incandescent lamp. The little machine would in fact be a primitive form of "alternator."

Function of a Transformer

It will be noticed that the work done by rotating the magnet is that of magnetising the fixed iron core in an alternating manner, so if some other A.C. supply were available one could discard the rotating element altogether and set in its place another wound iron core (Fig. 12, in dotted lines). An alternating current passing through one coil would thus induce an alternating e.m.f. in the other, from which a circuit, such as the lamp shown, could be supplied. And this would be a primitive "transformer."

Fig. 13 shows a more reasonable way of making a transformer, which is a highly efficient device, quite ordinary sizes in commercial use having about 95 per cent. efficiency. On a light load proportionately less input is needed to maintain a given flux intensity, and, by it, the back e.m.f. which checks input. The input winding is called the "primary" and the output winding the "secondary," and their voltage ratio is proportional to their respective number of turns.

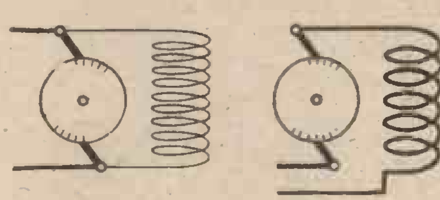


Fig. 11.—Shunt and series fields.

These facts, and particularly the absence of moving parts, give rise to advantages of such importance in the planning of an efficient electric supply system that the "A.C." is now in almost general use. For ordinary electric lighting purposes, such as in houses, etc., it is, of course, necessary to use a voltage sufficiently low to be reasonably considered safe to have about the place, and the Board of Trade regulations limit this to below 250 volts as a possible maximum source of "shock" to any person accidentally touching any of the wires or fittings; on the other hand, if there are many houses aggregating to a large "load," it would mean large currents to be sent through probably long cables, and this by Ohm's law obviously means considerable voltage drop along the cables when carrying a big load. Hence inefficiencies and difficulties in preserving the proper voltage at the distant parts. But the A.C. *transformer* allows of feeding the load from a convenient number of relatively near transforming points which can themselves be readily supplied, by less amperes at more volts, at any convenient higher voltage. All this no doubt is painfully obvious, but it emphasises the convenience and flexibility of an A.C. system as compared with a D.C. It is, of course, not impossible to transform D.C. by suitable sub-stations, but the necessary machinery and its costs, etc., are far greater than a simple A.C. system.

In the early days, however, a strong preference for D.C. supply existed largely because there were no sufficiently satisfactory A.C. motors, particularly of the smaller sizes. This does not apply nowadays, and practically every purpose to which small motors are put can be just as well met by an A.C. motor of suitable type as by a D.C. motor.

Types of A.C. Motor

The commonly used forms of A.C. motor are: (i) the "*Repulsion*" or "*Universal*," (ii) the "*Induction*," (iii) the "Repulsion-*start*" Induction motor, commonly called the "*Repulsion-induction*."

The first named, illustrated diagrammatically in Fig. 14, is merely a series-wound D.C. type, but has laminated construction for the field magnet, in consequence of which both armature and field can respond to the reversals of the A.C., and thus in both "half waves" the torsional effort is in the same direction. The action of the commutator preserves across the armature a more or less definite position of polar axis irrespective of time of revolution. So this motor has the same characteristics as a D.C. series motor, viz., a very good starting torque but an absence of speed regulation, for the speed is only limited by the load, and thus for some purposes the "universal" motor is not suitable.

The *Induction* motor is shown diagrammatically in Fig. 15, and its action is certainly very intriguing. In A.C. motors one calls the fixed portion the "stator" and the other part the "rotor." When in action the current from the supply is passed through the windings of the *stator*, and (transformer like) this also induces a current in the *rotor*, which thus need not even have brushes, etc. A common form of rotor "winding," illustrated in the sketches, is the "squirrel cage," and this consists merely of a number of copper bars placed lengthwise on the rotor and connected together by a plain copper ring at each end. This constitutes a short-circuited winding, though any other similar arrangement would suffice for the purpose. So much for the construction, and now as to the action. If the rotor be supposed to be turning at "synchronous speed" it would make half a turn (Fig. 15) for a reversal of magnetic field: consequently at any given moment the inductive effect on any opposite bars would be neutralised; this would be an impossible state of affairs, because with no current in rotor windings there would be, so to speak, nothing for the stator's magnetic field to catch hold of, or, to be more exact, there would be no torque, because torque and

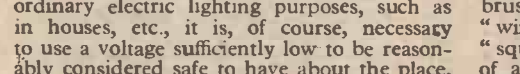


Fig. 12.—A simple form of "alternator."

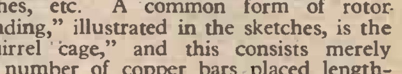


Fig. 13.—A transformer.

current in a motor are always proportional. Hence the rotor assumes a speed somewhat *below* synchronous speed; the difference is called the "slip," and the precise extent of this slip is therefore just that by means of which a current proportional to the load is provided.

The actual speed variation between no load and full load is very small in these motors, probably under 5 per cent., and, as in a transformer, the watts of input must at all times be proportional to the work done.

Repulsion Induction Motor

The only point over which the simple induction motor fails to merit commendation is its high starting current and poor starting torque, and these defects aggravate each other. There are, however, various modes of reducing such troubles, but the most direct and complete solution appears to lie in the *Repulsion-Induction* motor, which at starting acts as a "universal" motor, but is then changed over automatically to a plain induction motor.

Fig. 16 shows the scheme; there is no

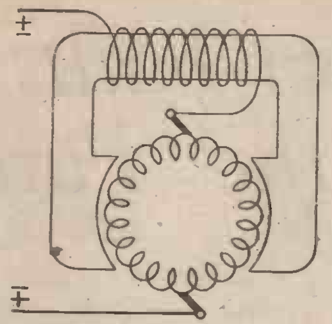


Fig. 14.—Repulsion or "Universal" motor.

tioned the 10,000-volt generating station at Deptford, which supplied its output to a transformer station in the City, and another in the West End; the full load at Deptford was represented by about 80 amperes—about 400 k.v.a. load at each of the two centres supplied, which seems trivial in comparison with present-day loads. This was just a single-phase system, and the "consumers" were supplied at 100 volts. At times this

voltage strictly limited to 230. Fig. 17 shows geometrically the e.m.f. relationship between these two kinds of connections, often known as "star" and "delta," and their exact relationship is always as $1 : \sqrt{3}$, which may be taken as 1.7321, so if a 240-volt single-phase service is to be effected the voltage for a three-phase connection, where that is required, will be 416.

Synchronous Clock Motors

Of other motors there are various types, used either for special textile or other industrial purposes or for very large machines; but, with the exception of the little motors, relatively mere toys, that are so popularly used to drive timepieces showing "time from the mains," other synchronous motors are not of general interest nor suitable for the conditions required with small motors for their hundred-and-one purposes.

These little synchronous "clock" motors consist only of a stator excited from the mains supply and acting on a rotor which is just a piece of magnetic material (either soft iron or preferably magnetised steel), the

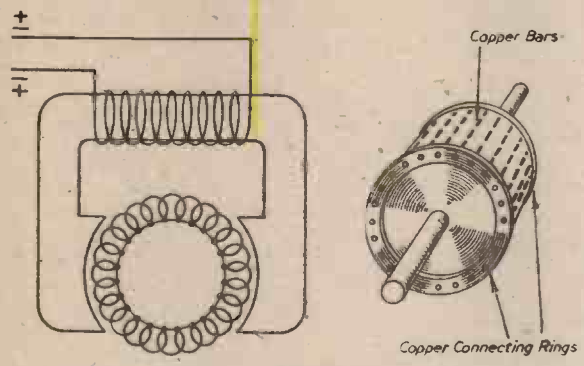


Fig. 15.—Diagram of induction motor and squirrel cage rotor "winding."

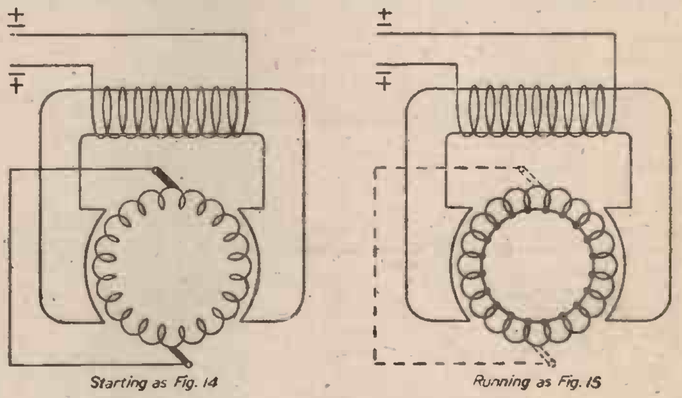


Fig. 16.—Diagrams of repulsion start induction motor.

occasion to connect the rotor with the stator circuit (as in Fig. 14), since its current is forthcoming simply by induction, so the brushes are bridged together and the commutator acts to define the rotor's polar axis, and the whole arrangement therefore works just as the "universal" motor already referred to. Then, upon attaining reasonable speed, a centrifugally actuated device acts to short-circuit all the commutator bars, thus reducing the rotor winding to a plain form appropriate to an induction motor, at which it continues to work.

Three-Phase System

Larger motors, such as for industrial purposes, are often supplied by a "three-phase" A.C. service. This is brought to the motor by three wires, between each two of which there is a *single-phase* e.m.f., and the three are acting in strict sequence. Such a service can therefore be connected to three windings in the stator of a motor in such a way as to produce a *rotating magnetic field.*

This three-phase method therefore comes to the aid of the simple induction motor in a very effective manner and is often so used; but it is not available for small motors, such as have to work from the simple single-phase supply, because the voltage accompanying the three-phase service is considerably in excess of that used for ordinary installations such as houses.

It is interesting to recall the difficulties, many of which seemed then almost insurmountable, that attended the development of electrical engineering matters even barely 50 years ago: the bold schemes tried and the often perplexing effects. Of one of the most stout-hearted, upon what was then almost as uncharted seas, might be men-

pioneer "high-tension" line set very urgent problems to its bold instigators, and long stories might be cut short by mention of a peculiar weapon like an ebonite oar or paddle kept handy below a high-tension switch, which itself had a blade about a yard long.

A.C. in Long Cables

Much was learned about the behaviour of A.C. in long cables, but the assiduousness of the pioneers duly tamed such things; and now far more immense power plants "go like clockwork," and probably the early excitements have long since been forgotten.

The usual modern plant works on a three-phase plan throughout; it has many advantages both as to economy and facility over a single-phase, and so it comes that ordinarily the distributing cables consist of three "phase" wires together with one "neutral." From this cable a connection may be made for power purposes as a three-phase supply at, say, 400 volts, whilst by connecting from only one of the phase wires and the neutral a single-phase service is effected, and at a

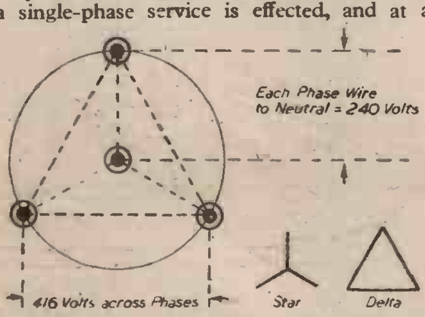


Fig. 17.—Diagrams illustrating the relationship of "star" and "delta" connections.

ends of which rotate past the stator poles and assume synchronous speed at which they derive a succession of little impulses to maintain their motion. If the stator and the rotor each has only one pair of poles, rotation will be 3,000 r.p.m., assuming that 50 cycles per second is the supply frequency. In many popular forms the motor is arranged to give a lower speed, such as 200 r.p.m. This is obtained by the use of multiple poles for the stator or for the rotor.

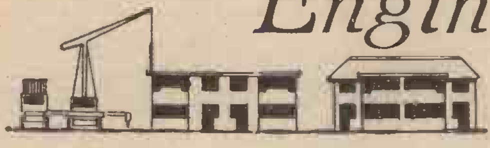
In one very neatly arranged type the stator is in the form of a ring around the rotor tunnel, the construction of which is like a pot magnet with air gap on inner surface, but the air gap is formed by a series of interlacing teeth alternately projecting from each end of the gap, so that they form a ring of alternate poles of the required number to give the speed intended.

To provide a considerable number of stator poles in a circle of limited diameter of course restricts the width of the individual poles, but there is nothing to prevent making up for this by having at least several limbs or polar faces to the rotor, and this is almost invariably done and avoids a needlessly high reluctance of the magnetic circuit. Somewhat similar procedure is adopted also where the rotor is the multiplied part instead of the stator.

(To be continued.)

A Correction

In the second article of this series, referring to the Board of Trade unit, on page 288 (August issue), it is stated that an appliance "taking 2,000 watts will work for five hours on an expenditure of 1 unit." This, of course, should read 200 watts.



Engineer-built Houses of the Future—18

(Concluded from page 378, August issue.)

Services Equipment, Drains, and Fences

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

THE services equipment of pre-built houses is receiving very good attention by those engineers who specialise in heating installations, cold and hot water, sanitary and plumbing services, and domestic and utility equipment.

Since the commencement of this series, about 18 months ago, several different and good systems of pre-building houses have obtained publicity by the erection of experimental types and by other means, and they all appear to provide evidence that for many years past services equipment has been one of the main subjects uppermost in the minds of the designers of engineer-built houses.

It is only necessary to examine and explain one type each of a pre-built bungalow and a house to make it clear as to the great difference between the pre-war traditional methods of services equipment and what may be expected in post-war housing. Fig. 120 is a plan of the M.O.W. emergency factory-made bungalow, and it will be noted that the services equipment is very compactly grouped together in one storey and comprises the following items: (1) Stove-boiler which directly heats the living-room and also other rooms by means of hot-air ducts: it is also, as its name implies, a boiler which provides the hot-water installation, the hot-water cylinder being behind the stove-boiler as shown; (2) a drying cupboard adjoining the stove-boiler and cylinder compartment; (3) cooker; (4) washing copper; (5) sink with draining board; (6) refrigerator; (7) an electrical immersion water heater which comes into operation when the stove-boiler is not in use; (8) bath; (9) lavatory basin; (10) various utilitarian items, such as towel rail, cupboards, etc., and (11) all cold and hot water supplies and wastes to the various fittings and equipment are scientifically and practically arranged and grouped together to ensure the maximum efficiency and economy.

Fig. 121 depicts the ground and first-storey plans of the Tarran pre-built house, the first type of which has recently been erected and has caused a considerable amount of attention as it is a good example of a factory and machine produced house. The services equipment is arranged compactly in the two storeys, that in first storey being over that

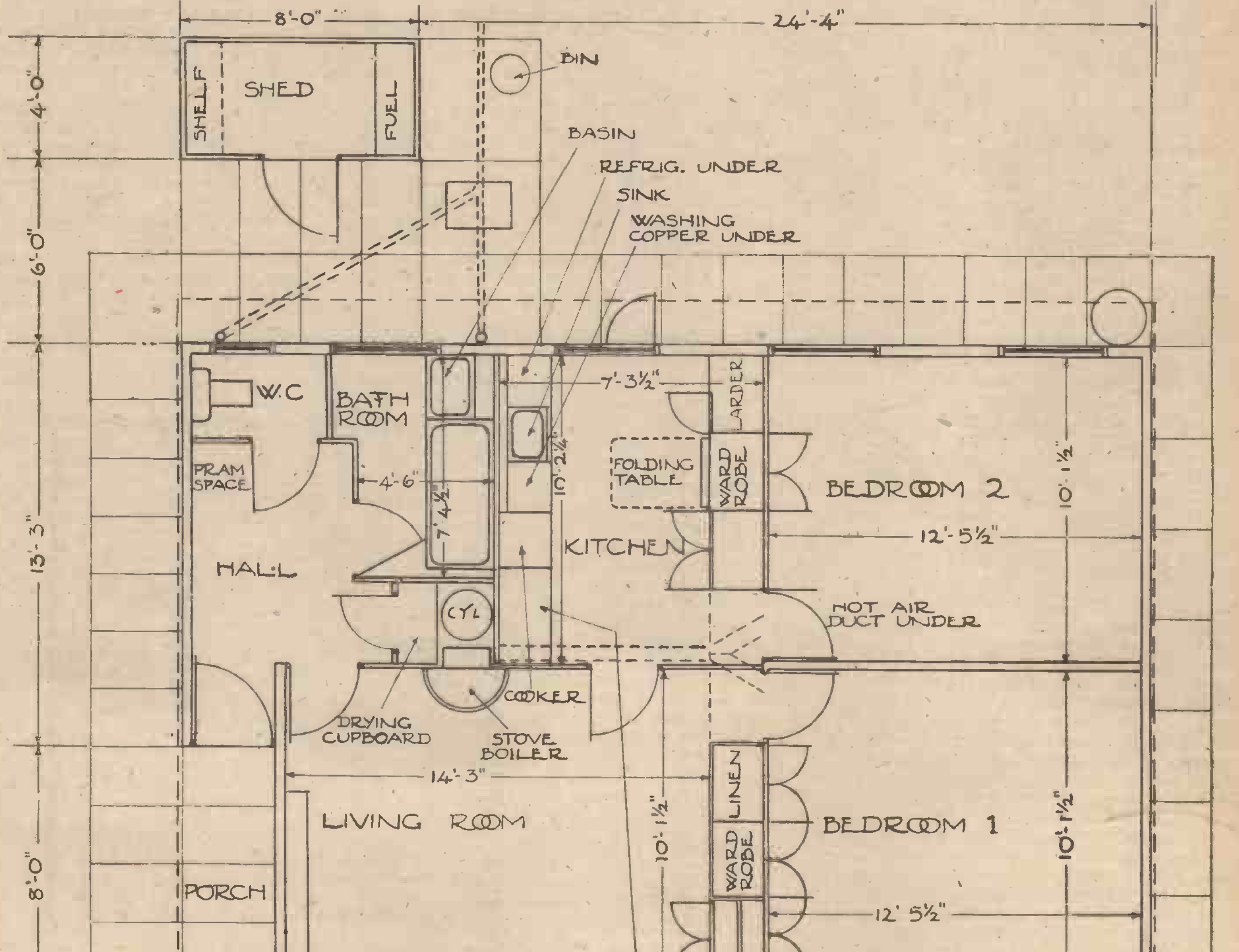


Fig. 120.—The M.O.W. emergency factory-made bungalow.

in the ground storey, and comprises the following: (1) Stove-boiler in the kitchen which heats the hot-water installation by means of a well-designed system consisting of a cylinder in the linen cupboard in first storey and circulating pipes feeding the sinks, bath, lavatory basin and towel airer; (2) cooker; (3) sink and draining board in kitchen and another sink in the utility room; (4) refrigerator; (5) bath; (6) lavatory basin; (7) linen and airing cupboard; and (8) various utilitarian items, such as towel airer, mirror over lavatory basin, etc.

Drains

The drainage system for houses and other types of property are still mostly governed by by-laws framed long ago, and while it must be admitted that they have maintained a high standard of good hygienic conditions, it may also be granted that modern sanitary science and engineering has, and is, pointing the way to improvements. Drainage in this country is usually either of the combined system which allows soil matter and surface water to run into one main sewer, or the separate system where the soil matter is connected to the soil sewer and the surface water to the surface water sewer. Both systems are governed by main sewerage disposal principles. As far as each house is concerned, it is more economical to adopt the combined system, as only one instead of two main drains is required on the site of the house. The plumbing work, which consists of the various soil and waste pipes which lead to the drains, is still controlled by by-laws that require separate soil pipe and branch drain leading from w.c.s to an inspection chamber; and a separate waste pipe or pipes, taking singly or combinedly the wastes from a bath, lavatory basin and sink, and leading to a gully which in its turn must have a separate drain leading to the inspection chamber or an approved junction on the drain; rain pipes must be separate and discharge over a gully or other fitting which is connected to the drain. In effect the above means at least three separate pipe systems, and this makes it essential for designers of engineer-built houses to consider the more economical one-pipe drainage system which has proved entirely satisfactory in the United States and on the Continent. It allows for all soil, waste and rain to be conveyed in one pipe and avoids open gullies; proper trapping, ventilation, connections and jointing are essentials with the system. With the grouping of services equipment, as shown by Figs. 120 and 121, drainage and plumbing work may be exceptionally efficient and economical.

The underground drains and inspection chambers, or manholes as they are often called, may in the near future be subject to different methods of designing than those to which tradition has fettered us so long. The old 2ft. long stoneware pipes, with their jointing every 2ft. and concrete bed and sundry fittings, may be superseded by simpler methods with long-length pipes and fewer joints and no continuous concrete beds. Inspection chambers may not be of the traditional type which comprise excavating, a concrete bed, brick walls which are rendered internally, channel pipes and benching and manhole cover and frame. Instead they may comprise a very few pre-built units which will be set in reasonably small excavated pits of proper depth to suit the falls of the drains.

Fencing

It would not be right to conclude this series without a reference to fencing. One of the most astounding final or semi-final acts of the jerry-builder is the provision of fencing. This is usually supplied and erected by fencing sub-contractors, who are usually so bound by low prices that they are unable to supply fencing which may comply with some reasonably good codes of practice. A typical jerry-builder's fence to the rear garden of houses consists of 4in. x 5in. fir posts, 9ft. or 10ft. apart, with their ends let about 2ft. in the ground, such ends being sometimes treated with a preservative, such as tar, which is either brushed on or applied by dipping. Two triangular fir arris rails are usually connected with either a good or bad joint to the posts. A fir gravel board runs along the bottom of the fence. Fir feather-edged pales nailed to the arris rails, with usually too short and cheap nails, complete the structural part of the fence, and it is finally treated by spray or brush with a so-called preservative. The ends of the posts which are in the ground usually rot after a few years, and wood or concrete "spurs" are bought and fixed to prevent the fence failing almost completely.

After a few high winds it is quite possible that the fence will be blown over—or, in other words, its top will be awash the owner's or neighbour's lawn, flowers or cabbages. These states of affairs are caused not only by burying dead timber in the ground, but by the fact that there are no laws of the mechanics or structures which may be applied to prove that a panel of fencing about 9ft. long and, say, 5ft. 6in. high—an area of about 50ft.—is capable of standing up to even a moderate wind with posts tailed only 2ft. into what is usually comparatively soft ground.

A fence which was constructed originally with concrete posts with the ends in the ground surrounded with a proper quantity of concrete would have been a much more sensible proposition; but it would have cost the jerry-builder a little more money, which would have broken his heart.

The fencing of the future will be designed by structural engineers. It will consist of reinforced concrete or metal posts, with proper bases correctly tailed into the ground, probably reinforced concrete or metal gravel boards which will not quickly rot; the "arris rails" or horizontal rails will be of reinforced concrete, metal or timber. The covering to the fence will be of timber pales, latticed slats or strips, which will provide that charm which timber imparts to a fence and which permits the gardener to fix his climbing flowers.

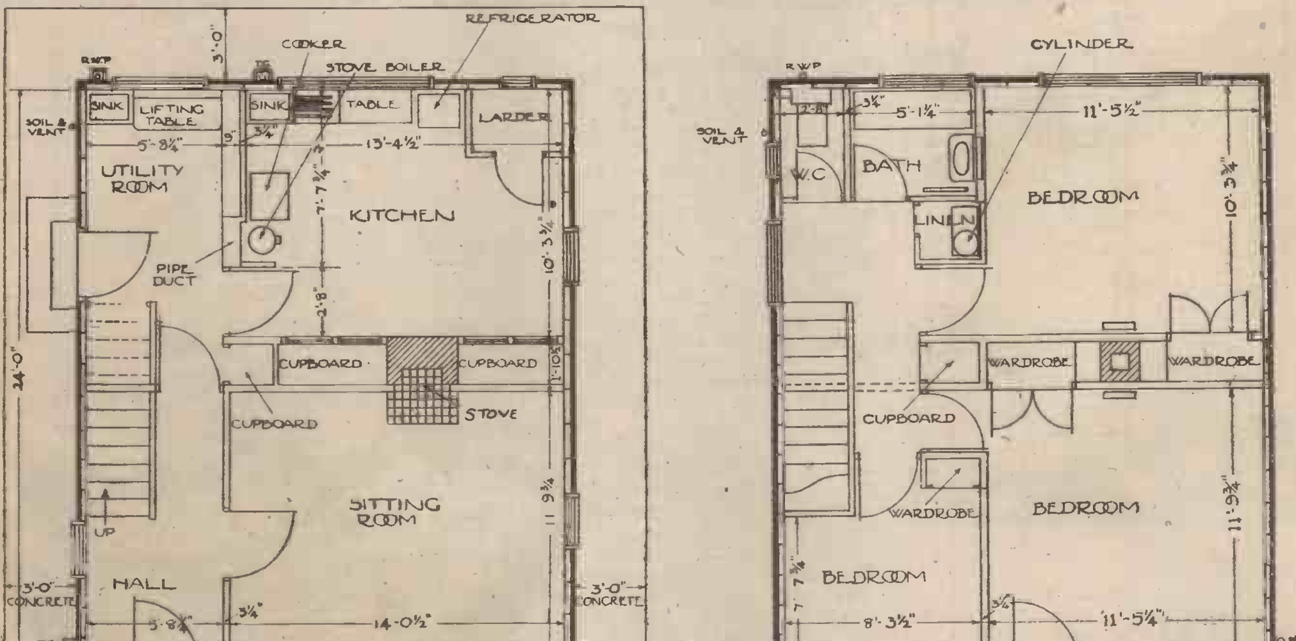


Fig. 121.—The Tarran pre-built house.

Masters of Mechanics—98

A Pioneer of Horology

Thomas Earnshaw, and His Perfection of the Chronometer

IT was only with the coming of commerce and the consequent opening up of overseas trade routes that the necessity of accurate timetelling forced itself upon mankind.

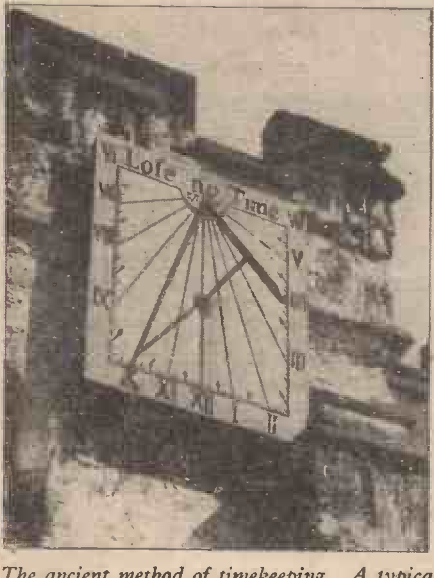
Previously, when nations formed self-sufficient and even isolated and detached units, accurate timekeeping was a matter of more or less secondary importance. The workaday world in those days rose with the sun and retired early. The village sundial served as the communal timepiece, its accuracy, in these non-Summer Time days, being sufficient for all.

It was not until the seventeenth century that clocks and watches began to be made in any quantities. First came the "lantern" clock, a semi-portable device cut from heavy brass, and, after it, the long case or "grandfather" clock. Reasonably accurate timetellers these old "grandfathers" were and still are; but they were anything but portable clocks, and, owing to their pendulum construction, it was quite impossible to use them at sea.

The early watches and spring-driven clocks were anything but accurate. Yet they were the only mechanical timetellers available for seagoing vessels, and for this reason, as the number of ocean ships began to increase, the invention of a portable form of clock which would keep accurate time over a reasonable period quickly became a dire necessity.

Let us realise just why this was the case.

In order for a vessel to be steered on an



The ancient method of timekeeping. A typical village sundial situated high up on a church wall.

accurate and a safe course out at sea, the captain must know her daily longitude, or position east or west of Greenwich. The quick determination of a ship's position of longitude necessitates an accurate knowledge of Greenwich time. By means of a sextant, an instrument simple enough in itself to use, a mariner at sea, by making observations on the apparent altitude of the sun in the sky, may determine with great accuracy the local time of the place, and by comparing this local time with Greenwich time, the longitude, or distance east or west of Greenwich, may readily be worked out.

The necessity of having a timepiece which would keep accurate Greenwich time will now be apparent. If the ship's clock varied appreciably during the voyage from its initial correct setting (or, at any rate, if its constant

Thomas Earnshaw.

rate of variation were not accurately known), the ship's longitude could not be determined with precision. Hence, in such circumstances, the skipper of the vessel would never know his exact whereabouts.

The "Board of Longitude"

So urgent and pressing did this problem of accurate longitude determination become that, in 1713, the British Government offered a prize of £30,000 to anyone who could devise a means of longitude determination within an accuracy of one degree during a voyage to the West Indies and back. A "Board of Longitude," of which the Astronomer Royal was the chairman, was constituted, and it was given the duty of investigating the claims of inventors who sought the Government award.

The obvious solution of the problem was to make a portable clock which would keep accurate time or which would only gain or lose at a known rate over a reasonable period. A hundred years previously the famous Cardinal Richelieu, speaking on the possibility of constructing clocks which would keep accurate time, is supposed to have exclaimed: "I know not what such an undertaking would be to the Devil himself, but to Man it would undoubtedly be the height of folly!"

The words of this rich prelate seemed as though they had indeed an element of truth in them. Try as they would, clockmakers could not get their instruments to measure out time in accurate steps. A new principle in the art of clockmaking was called for; and a mechanical genius was required for its elucidation.

Harrison's Chronometer

At last, however, the problem was partially solved by James Harrison, a Yorkshireman, who, in 1761, made a "chronometer" (or "time-measurer") which passed the Government tests with flying colours. The problem of longitude determination thus became solved, in theory at least. But in practice this was not always the case, for Harrison's chronometer took about three years to make and cost £400. Moreover, Harrison's chronometers were far too complicated to come into general use. What was still required was a cheaper and a more simplified instrument which could be used by all and sundry.

To this problem three contemporary mechanicians and clockmakers, Thomas Mudge, John Arnold and Thomas Earnshaw, gave their respective attentions. They all aided the solution of this practical problem, but it was Thomas Earnshaw who produced the first really satisfactory, reasonably cheap, and truly portable chronometer. Indeed, the marine chronometer as we now know it is substantially Earnshaw's invention, for it is the Earnshaw escapement which governs its functioning that has rendered it so consistently accurate and satisfactory the world over.

Thomas Earnshaw was one of the true heralds of modern horology. Yet, like many another pioneer, much of his life-history and the memory of his personal traits have been allowed to vanish. Although Earnshaw died as comparatively late as 1829, it has been found impossible to trace anything concern-

The elaborately ornamented movement of a watch of Earnshaw's day. It was from his efforts to improve the timekeeping of the everyday watch that Earnshaw invented the principle of his chronometer.

ing his earlier history. To this task several serious inquirers in the town of his birth have addressed themselves over many years, but with a complete lack of success.

Ashton-under-Lyne

That Thomas Earnshaw was born in the then diminutive Lancashire town of Ashton-under-Lyne on February 4th, 1749, is certain. But little is known about his parentage and his early upbringing. All we know definitely is that at the age of 14 he was apprenticed to a local watchmaker, and that, after serving his time under his master, he immediately went to London, in which city he lived the whole of his successful life, eventually dying there at the age of 80 on March 1st, 1829.

There is a sort of semi-tradition which ascribes to Earnshaw the characteristics of honesty combined with roughness, if not actual uncouthness. Despite the considerable financial success which he had in life, he seems to have been a somewhat soured man, probably in consequence of the vexations and disappointments which he experienced in connection with his claim to invention priorities.

For many years Thomas Earnshaw presided over his well-known clockmaking shop at 119, High Holborn, London. It was here that he carried out all his original work, the greater part of which was done under conditions of much secrecy.

Earnshaw had to build up his London business by degrees. On first arriving in the metropolis he seems to have worked as a "finisher" of watches, adjusting them, timing their movements and generally getting them into condition for sale. He quickly acquired the art of escapement making and watch jewelling, occupations which were of much assistance to him, since, having married early in life and being faced with a family to bring up, he discovered that regular "bread and butter" earnings were essential to him.

It was only after Earnshaw had got out of his earlier family difficulties, and had established himself in High Holborn, that he was enabled to give a freer rein to the inborn mechanical and constructive genius which he possessed in so high a degree.

The Vital Escapement

Earnshaw's contribution to the chronometer problem came in 1781. Basically, it comprised his invention of a new form of chronometer escapement—the spring detent escapement—which at once put the chronometer upon a new plane of utility.

Often enough Fate seems to have a trick of bringing to several minds similar notions at about the same time. Such was the position as regards Thomas Earnshaw's chronometer escapement. Louis Berthoud, a Frenchman, has been stated to have anticipated Earnshaw's escapement invention, and in 1783 John Arnold, a contemporary clockmaker of fame, obtained a patent for a similar invention.

The movement of a modern chronometer of the type originally introduced by Thomas Earnshaw.

It is very difficult to penetrate thoroughly into the tangle of technical history which has resulted in this matter. It does seem, however, that Earnshaw was the true and original inventor of his form of chronometer and that to him the laurels of inventive fame in this respect should be applied.

The facts of the case seem to be these: Earnshaw, in 1781, after devising his chronometer escapement, showed it to one of his customers, John Brockbank. He then revealed the invention to a Thomas Wright, another customer, and there was some agreement to the effect that when a watch carrying this escapement had been completed and tested, Wright should advance the money to patent the invention, and, indeed, actually carry out the work of applying for the patent.

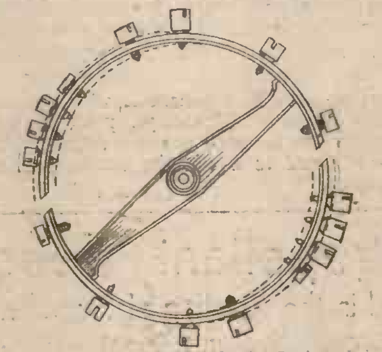


Diagram illustrating the principle of the compensation balance wheel, which, in its original form, was the invention of Thomas Earnshaw.

The man Wright does not seem to have been very quick on the uptake, for he kept the finished chronometer watch in his possession for more than a year, and he did not apply for the patent until the year 1783. In the interim, John Arnold, another clockmaker, applied for a patent, claiming a similar device as his own invention.

Earnshaw ever afterwards firmly maintained that he had been very badly let down by Brockbank, who, he averred, had revealed his invention to Arnold. Whether such was the case there is now no knowing. Certain is it, however, that Earnshaw, for all his roughness and lack of grace, was a sincere man, and, for this reason alone, one can hardly imagine that he would have stooped sufficiently low to purloin the inventive work of a brother clockmaker.

In spite of the non-validity of Earnshaw's patent (taken out in Wright's name), a number of watchmakers began to construct watches to the Earnshaw specification. None of them was successful, however. Perhaps Earnshaw had not revealed *all* the working details in his patent specification. At any rate, Thomas Earnshaw, when he subsequently began to make the new watches, constructed them to better proportions, with the result that they became a brilliant success.

Earnshaw's Success

Maskelyne, the Astronomer Royal of the period, advised Earnshaw, in 1789, to apply to the still-existing Board of Longitude to conduct official tests on his chronometer movements. The Board sent five of his watches to Greenwich for trial, the eventual result being that Earnshaw received a Government order for two of his specially made chronometers to be supplied to the Observatory at Greenwich.

Ultimately, Earnshaw was, in 1801, awarded £500 by the Board of Longitude for his invention of the chronometer escapement, and, a couple of years later, he received an official grant of £2,500 for the same thing. Even this financial windfall seemed not to satisfy Earnshaw. He had now become a man with a grievance, an individual with a bee in his bonnet, and, to the end of his life, he considered himself badly done by in respect of his chronometer invention.

In 1808 he published a pamphlet entitled *Longitude: An Appeal to the Public*, in which he gave a summary of his claims to be the true and original inventor of the basic improvement of the escapement mechanism which had resulted in the popularisation of the chronometer as an instrument of universal usage and application.

What Earnshaw objected to was the coupling of his name with that of his contemporary, John Arnold, in connection with the chronometer business. Perhaps, also, in the background of his mind lurked the knowledge of the fact that Arnold had been awarded £3,000 in respect of *his* claims to the chronometer improvement.

Earnshaw made a considerable number of ordinary pendulum clocks and also special clocks to specified requirements. One of these was supplied to the Archbishop of Armagh. It cost that worthy £150, and, in addition, Earnshaw charged a fee of £100 for travelling to Armagh in order to fix and adjust it.

A marine chronometer of the present day. It is mounted on gimbals and enclosed in a brass-bound case for protection.

"Compensation Balance"

What is known as the "compensation balance" was another of Thomas Earnshaw's horological inventions. This balance, which is now incorporated into all high-class chronometer mechanisms, comprised in Earnshaw's day a divided-balance-wheel rim made of steel and brass fused together, the more expansible metal, brass, being placed outwards. Heat expands the balance-wheel rim and so produces a slower oscillation of the wheel. Thus the chronometer mechanism would tend to slow. Opposing this effect, however, is the fact that the inner steel portion of the balance-wheel run is not as expansible as the brass. Thus the free end of the rim tends to be drawn into the centre of the wheel as the brass portion tends to expand the rim outwards. Such a contraction, by making the diameter of the wheel smaller, tends to quicken its rate of oscillation and thus to increase the rate of the clock. These two opposing effects cancel each other out very satisfactorily and so produce virtually a wheel which has one constant rate of oscillation within any reasonable temperature-range.

At lower temperatures the opposite to the above effects take place, the brass outer rim tending to contract and the free end of the rim tending to be drawn outwards. Here, again, however, the wheel still retains very satisfactorily a constant rate of oscillation.

Earnshaw put various adjusting screws into the rim of his balance-wheel and thereby brought into existence a valuable form of compensatory construction which, with one or two modifications, has persisted to the present day.

The Transit Clock

A lesser-known triumph of Earnshaw's was his improvement and simplification of the great "transit" clock at Greenwich Observatory. This mechanism had originally been made by George Graham, another inventive clockmaking genius, at a much earlier date, but it had become cumbrous and not a little old-fashioned, so much so that it called for the hands and brain of a later horological genius to launch it again on a new and a very much extended lease of practical life.

The chronometer is, perhaps, the most perfect piece of mechanism which has ever been devised. Nowadays, marine chronometers can by various compensating devices be adjusted to a working accuracy of 1 in 500,000.

It is curious, perhaps, that the present age, which witnesses this truly astonishing triumph of horological precision, should also see the chronometer as an everyday time-keeping instrument decreasing in importance. Yet such is a fact, for nowadays a ship need not necessarily carry a chronometer provided that it possesses a reliable radio installation, by which latter means it can obtain the necessary time signals from any land installation.

Nevertheless, seagoing vessels carry at least two portable and independently adjusted chronometers of great accuracy which are maintained as standbys in case of any failure on the part of the radio, and, in general, it would seem that this efficient instrument will long remain in marine use in view of the complete independence of land-station communication which it confers upon a seagoing vessel.

Reaction Motor Propellant Feed

A Summary of the Problems Entailed in the Feeding of Propellant, in "True-rocket" Aircraft Systems.

By K. W. GATLAND

THE problems relating to the feeding of propellant to the reaction chamber, especially in connection with the volatile "supporting" element, liquid oxygen, are numerous and complex, and feed systems, apart from being dependable in action and simple to service, must provide injection of large quantities of fuel, in correctly metered proportion, at high pressure, and within wide temperature extremes.

Liquid Injector Methods

The use of liquid oxygen, or any of the gaseous elements reduced to the liquid, present such difficulties as the freezing of the priming lines, backfiring and overheating, as the result of incorrectly metered fuel delivery, and the problems of vapour lock (due to the reducing atmospheric pressure with altitude, in rapid ascent), owing to an increased rate of vaporation of the fuel.

There are two general forms of liquid feed, the *pressure* type, in which the fuel is force fed by the action of an inert gas, such as nitrogen or carbon dioxide, while the other feed method functions with the fuel tanks at atmospheric pressure, employing some form of *mechanical pump*.

The simplest form is the *pressure* feed type, where the "supporter" (i.e., liquid oxygen) is expanded into the reaction chamber by its own pressure, the petrol, or other suitable fuel, being force fed by a gas charger. Despite the simplicity of this system, however, due to the different pressures within each tank, severe disproportion of the fuel impulse may quickly arise, and in the case of liquid oxygen, the tank may be subjected to wide pressure extremes, due to the boiling of the liquid. This is more noticeable when the pressure difference between the tank and the reaction chamber is small, since it is this difference which determines the rate of fuel delivery. Should an increase of oxygen develop against constant flow of fuel, oxidation of the reaction chamber, in which the oxygen clings to the wall surface, consuming the material as fuel, will often result in motor burn-out, with combustion temperatures as high as 3,000 degrees Centigrade. The method employed to ensure constant delivery is to use a nitrogen (or CO^2) charger tank, and introduce the high-pressure gas through check valves in both oxygen and petrol tanks.

One of the main drawbacks to the use of *pressure* feeds is the weight of the tanks due to their having to withstand the full reaction chamber pressure. Difficulties in handling and charging up, due to the high pressures, and the possibilities of leakages in the tanks, valves and in feed line connections, are also problems of some significance.

In view of these considerations, the *mechanical pump*, although, of course adding

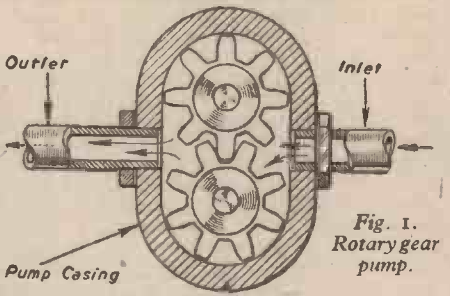


Fig. 1. Rotary gear pump.

complication, would appear to offer some solution, the main advantage being safety, with constant and high-delivery pressures. Perhaps the most effective type is the gear-pump (see Fig. 1), which consists of two meshed gears, revolving in a casing, operated by auxiliary drive. This pump adequately fulfils the requirements of a steady, continuously acting unit, permitting high-pressure delivery at a controllable rate, the fuel entering the pump, being carried round between the gear teeth.

Auxiliary Drive

The exhaust-driven turbine would appear to offer the most promising type of prime mover for the operation of the mechanical pump. Petrol reciprocating engines would require supercharging at high altitude and would consume a proportion of the fuel-load. It is possible that engines employing compressed gases operated by combustion-chamber pressure may be used. Superheated steam units might find their place, either operating a reciprocating engine or multi-stage turbine. Such plants would be in the form of flash-steam units, with heating pipes encompassing the reaction chamber "throat."

Problems entailed in the starting of the exhaust turbine, and the compressed-air gas motor, would naturally arise, but it is considered that pressure chargers for initial priming would suffice.

The Centrifugal Fuel Injector

The centrifugal injector (similar in principle to the centrifugal pump), developed provisionally by the "Astronautical Development Society" and the "Manchester Astronautical Association," is an example of a self feed unit, and apart from initial priming of propellant, the unit is completely automatic in operation. The rotary portion of the injector (see Fig. 2) consists basically of a centrifugal feed unit around which are equally spaced a number (three or more) of reaction chambers axially offset. Operation is as follows: Fuel and oxygen are initially primed to the reaction chambers by means of auxiliary pressure chargers, contained in the conical fairing. Upon ignition, thrust developed acts to rotate the unit, pressurising the fuel tank, and automatically releasing the oxygen feed valve, permitting the fuel and oxygen to pass to the centrifugal feed unit, where delivery is made to the reaction chambers in correctly metered proportion and at constant and high pressure.

The diagram shows an installation intended for petrol as fuel, with oxygen, but the working principle remains similar when other forms of fuel liquids are considered.

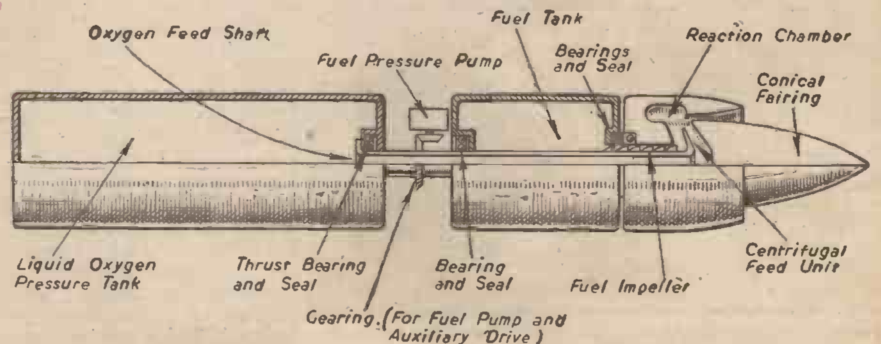


Fig. 2.—Sectional view giving details of the centrifugal fuel injector and oxygen and fuel tanks.

An Electric Table Lamp

Constructional Details of an Attractive Lamp Made Chiefly of Wood.

By G. SMITH

The completed electric table lamp.

FROM a few odds and ends of apparently useless wood a very useful table-lamp stand, suitable for use in a bedroom, can be constructed, particularly if candle type lamps are used. The stand, as described and illustrated, was constructed with five pieces of teak.

Having selected suitable material the stand (Fig. 1) is constructed in the following manner. The base consists of two parts screwed together, the lower base (A) being bored from the side to the centre, where another hole of larger diameter is bored at right angles to meet it. The double arm (C) is marked out on the wood with the aid of a template, and is cut roughly to shape with a bow-saw and finally finished with chisel, file, and sandpaper. Each of the arms carries a small base (D) to which the lampholders are screwed.

The boring of the side arms which carry the concealed wires should be carried out with considerable caution, otherwise the wood is apt to split, due to the short grain. It is advantageous to bore from either end. A hole is also bored through the centre of the base (B) and a small reciprocating press switch let into the chamfered side.

To avoid difficulties all corners of the bases are rounded before chamfering.

Wiring of the lamps should not present undue difficulty. It is easier to wire the pieces before final assembly. It should be pointed out that, unless specifically stated, the small tubular or candle lamps are usually supplied to be wired in parallel. If this is ignored, maximum candle power will not be obtained. The wiring connections are shown in Fig. 2.

Owing to the difficulty of glueing teak, all the parts of the stand were simply screwed together, but a touch of glue might be used if one of the more commoner woods is employed. A small finishing bush is screwed into the wood where the lighting flex enters the base (A).

The wood is finished in an appropriate manner, i.e., oiled or french polished, or even painted. If it is polished, this should be carried out before assembly.

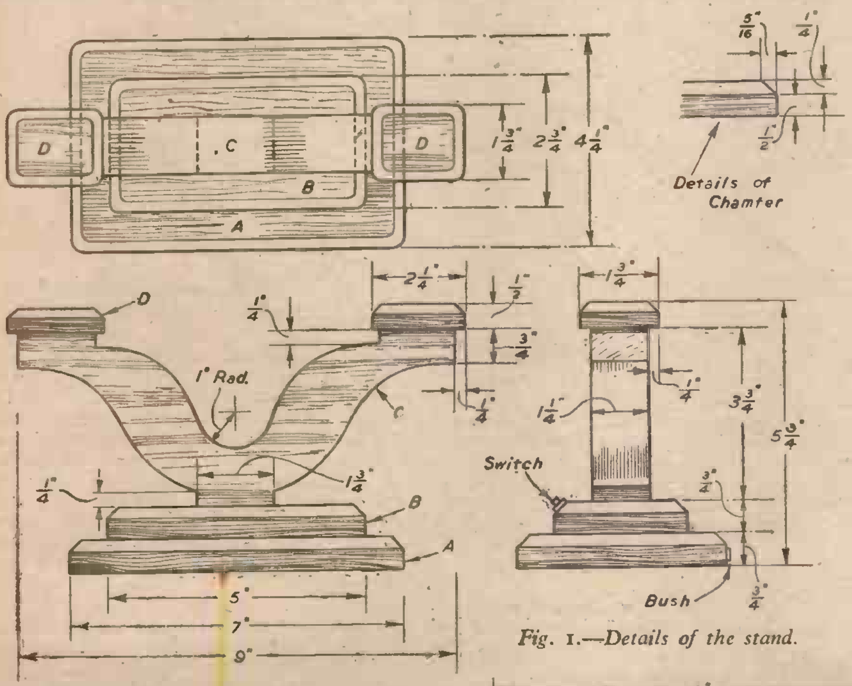


Fig. 1.—Details of the stand.

Making the Shades

Shades, suitable for the lamp described, may be constructed from a few short lengths of thin, but strong wire, and a small quantity of "natural" parchment. Wire as used for packing cases is admirable. The parchment is obtainable from any art stores (Fig. 3).

The top and base of the wire frames are bent to shape, and the ends allowed to overlap for convenience of soldering. Short lengths of wire forming the corners of the frames are simply bent around the corners of the top and base with the aid of a pair of pliers.

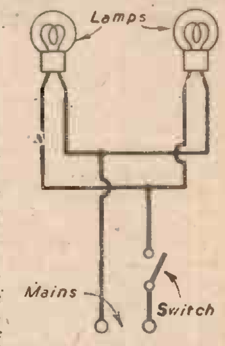


Fig. 2.—Wiring diagram.

Next, two short pieces of wire are soldered to curtain rings, ¾in. diameter, which will enable them to be fitted over the S.B.C. lampholders. The other ends of these wires are attached to opposite corners of the frame base. A spot of solder is applied to all joints to ensure rigidity.

A piece of parchment previously cut to size is folded around the wire frame, and the join, which is arranged to coincide with one of the corners, is secured by stitching with thread.

MATERIALS REQUIRED.

1 piece of wood 7in. × 4¼in. × ¾in.	2 Tubuar or candle lamps (wattage to suit) S.B.C.
1 piece of wood 5in. × 2¾in. × ¾in.	1 Finishing bush.
1 piece of wood 9in. × 3¾in. × 1¼in.	Length of lighting flex.
2 pieces of wood 2¼in. × 1¾in. × ¼in.	Small quantity of parchment (For shades)
2 Back plates.	Small quantity of wire (For shades)
2 Reducing bushes.	Small quantity of gymp (For shades)
2 S.B.C. lampholders.	2 Curtain rings, ¾in. diameter (For shades)

Finally, lengths of gymp of a suitable shade, obtainable from drapers, are glued to the parchment around the top, base, and corners of the frame.

If candle-type lamps are used the finished effect is quite pleasing without shades, but some attempt should be made to cover the metal lampholders. For example, a short length of tubular cardboard, lacquered white, could be used.

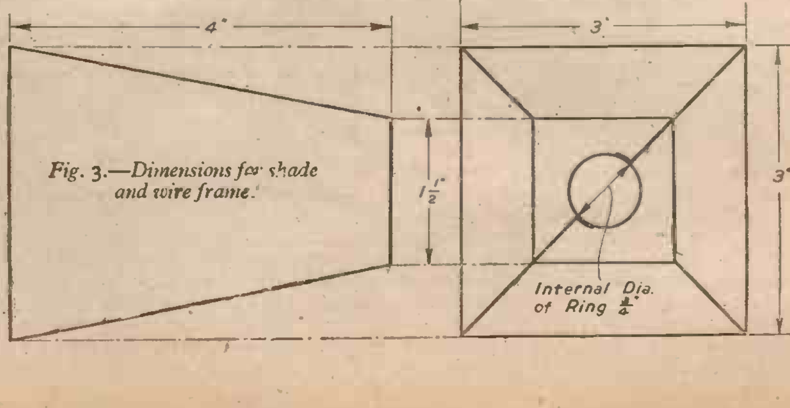


Fig. 3.—Dimensions for shade and wire frame.

Modern Developments in Life-saving at Sea

Steel Fireproof Lifeboats, and Self-releasing Rafts

(Concluded from page 371, August issue.)

EACH man is provided with a lifejacket and lifesaving waistcoat, so designed as to support the chin, so that, in the event of becoming unconscious while in the water, the head will not fall forward and the mouth and nose dip below the surface. Each lifejacket is fitted with a little red electric light which has become the seaman's safety lamp. Hundreds of lives have been saved because men in the water at night could be readily located. Each man is also issued with a whistle on a lanyard, again for attracting attention. Every officer and supervising deck rating carries a jack-knife fitted with a tin-opener.

Improved Designs

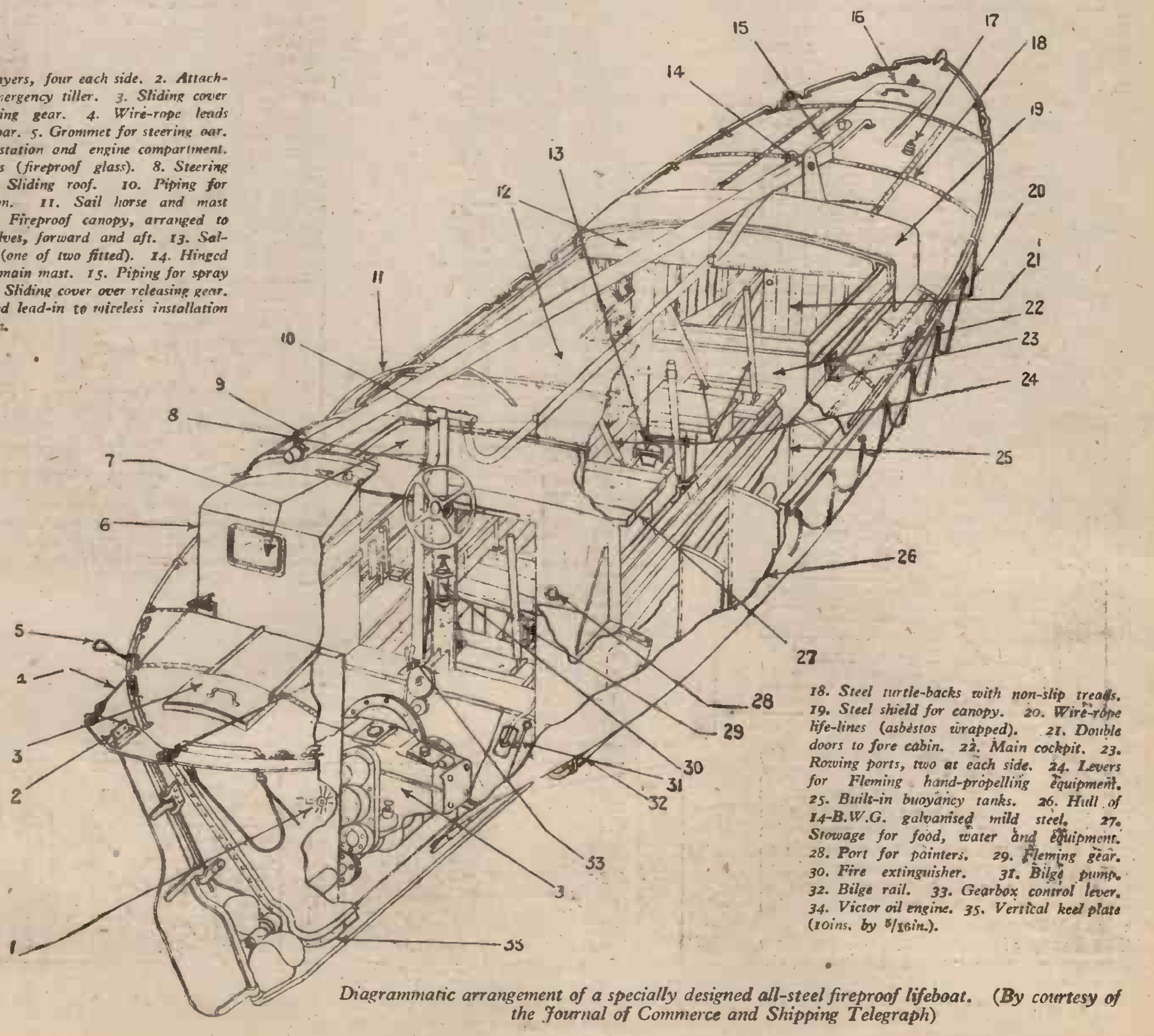
But it is in the design of the lifeboat itself that the most notable progress has been made during the course of the war. The lifeboat designed by Mr. F. H. Lowe, managing director of the Lamport and Holt Line, Ltd., has been adopted by the Ministry of War Transport, and is now being installed in all new ships built for Government account. It is as nearly self-righting as possible, and provides extra cover for the occupants of a more permanent character than canvas side-screens or hoods.

Stability and lowering trials have shown conclusively that this boat can be lowered into smooth water by one fall only—either forward or aft—without shipping any water. The test was carried out by lowering the boat, first by means of the forward fall, so that the stern entered the water at an angle of about 70 degrees, and, second, with the boat suspended by the after-fall.

In each case the unsupported end of the boat floated long before there was any possibility of water entering. The normal lifeboat, if subjected to such treatment, would have shipped a large quantity of water and would probably have lost its stability. Incidentally, one of the features of this new type of lifeboat is the cork-filled fender around the gunwale, which provides extra buoyancy and additional stability.

Including experiments were also made when the boat was rotated by means of ropes passed under the keelson. It was proved that the boat floated when listed to an angle of 100 degrees from the horizontal. In other words, when the turning moment was released the boat at once returned to a level keel. An ordinary boat would capsize after reaching an angle of 80 degrees from the horizontal.

When the boat was righted, and consequently was full of water, it still had several inches of freeboard. It had sufficient buoyancy to support the weight of two men standing on the port gunwale. Experts considered that the boat, even in this condition,



1. Hull sprayers, four each side. 2. Attachment for emergency tiller. 3. Sliding cover over releasing gear. 4. Wire-rope leads to steering oar. 5. Grommet for steering oar. 6. Control station and engine compartment. 7. Windows (fireproof glass). 8. Steering wheel. 9. Sliding roof. 10. Piping for spray system. 11. Sail horse and mast crutch. 12. Fireproof canopy, arranged to open in halves, forward and aft. 13. Salvage pump (one of two fitted). 14. Hinged support for main mast. 15. Piping for spray system. 16. Sliding cover over releasing gear. 17. Insulated lead-in to wireless installation in ore-cabin.

18. Steel turtle-backs with non-slip treads. 19. Steel shield for canopy. 20. Wire-rope life-lines (asbestos wrapped). 21. Double doors to fore cabin. 22. Main cockpit. 23. Rowing ports, two at each side. 24. Levers for Fleming hand-propelling equipment. 25. Built-in buoyancy tanks. 26. Hull of 14-B.W.G. galvanised mild steel. 27. Stowage for food, water and equipment. 28. Port for painters. 29. Fleming gear. 30. Fire extinguisher. 31. Bilge pump. 32. Bilge rail. 33. Gearbox control lever. 34. Victor oil engine. 35. Vertical keel plate (10ins. by 5/16in.).

Diagrammatic arrangement of a specially designed all-steel fireproof lifeboat. (By courtesy of the Journal of Commerce and Shipping Telegraph) was "stiff" enough to support six men on the gunwale.

One of the worst ordeals that seamen have been called upon to face was when they had to abandon ship with the sea covered with burning oil. Much thought was devoted to designing a fireproof lifeboat for installation on board tankers.

Three types of lifeboat were designed by the Tanker Tonnage Committee, of which Mr. John Lamb, technical manager of the Anglo-Saxon Petroleum Co., Ltd., is chairman. These were a new steel lifeboat, a converted steel boat, and a converted wooden boat.

Steel Lifeboat

By last October arrangements had been made for the mass production of the new type of steel lifeboat for use on tankers, and initial orders for 500 had already been placed.

The chief characteristics of this boat are: Length, B.O.T., 28ft.; length on water-line, 26ft.; breadth, moulded, 9ft. 6in.; depth, moulded, 3ft. 9in.; seating capacity, 33 persons; propelling gear, 10 h.p. oil engine or alternatively Fleming hand-gear. The total weight on the davits, fully equipped and manned, is approximately 7¼ tons.

The new lifeboat has several novel features, including raised turtle deck forward and aft, fireproof sliding canopy over the cockpit, built-in buoyancy tanks, considerable protection from fire and weather, and water sprayers all over.

The principal details of the specification are: Keel, stem, and stern frame of 5-16in. plate; hull, bulkheads, deck, etc., 14 B.W.G. plate metallised; canopy of asbestos cloth, double thickness; two hand pumps for water sprayers, each capable of discharging about 30 gallons per minute.

Propulsion tests in a fully loaded condition resulted in a speed of 5.5 knots with the engine and 3.3 knots with the Fleming hand-gear. The boat is also fitted with lug sail, jib and mizzen.

The most important test was that which required the boat to be subjected to intense fire and smoke for a period of at least four minutes, in which time it was estimated that the boat could be propelled at least ¼ mile up wind (either by power or hand-gear), a distance which would generally be beyond the limit of blazing oil on the sea.

In none of the tests was the seaworthiness of the boat impaired, though the boat at times was lost to sight in smoke and flames reaching to a height of 40ft. The quenching and cooling effect of the water-sprays, on which the safety of the boat and its crew depends, was entirely satisfactory. The occupants of the boat showed no signs of distress after their ordeal, and said that conditions never became unpleasant even when this test, which took place in a static water tank, was extended to five minutes.

The Ministry placed orders for a supply of gravity davits to enable the boats to be launched quickly from the inboard position and to be lowered fully loaded with this equipment and complement of men. The davits are fitted with flexible steel wire falls attached to the boats through quick-acting releasing gear.

Converted Wooden Boats

The advantages of converting existing wood or steel lifeboats is that it can be done in four or five days. Furthermore, existing davits can handle them, whereas special and stronger davits must be fitted for the new type, all of which takes time.

Wooden lifeboats are converted by means of shielding the woodwork above the waterline with thin metal plates, adding metal coamings extending 12 ins. above the gunwale, and providing metal turtle-backs fore and aft. There is a canopy or hood made of asbestos-treated canvas of three sections, each of which can be operated independently. When all these sections are closed the boat is completely enclosed. The lowering hooks are reached through hatches in the turtle-backs, and Mills patent releasing gear is provided.

The most important addition to the normal boat is the provision of spray pipes

(Top left) Unsinkable Chipchase Patent Lifecraft under sail. (Top right and bottom left) Raft in launching position on board ship. (Bottom right) The lifecraft with awning erected for protection against the weather.

to port and starboard and thwartship fore and aft. The object of these is to keep the canvas hood, the turtle-backs and the whole of the exposed part of the boat covered with a water spray to prevent flames overheating the fabric of the boat or making the air inside too hot to sustain life.

These spray pipes are fed with water by means of two semi-rotatory hand pumps, drawing water from sea-cocks in the bottom of the boat. One pump at the after end feeds the aft thwartship, also the starboard spray pipe, while the forward pump takes care of the forward and port sprays. When both pumps are going, the whole of the top of the hood is protected by water jets from the thwartship sprays, while the port and starboard jets protect their respective sides. There is also a ballast pump to deal with any water which may find its way inboard.

To provide extra buoyancy and stability "blisters" are fitted to port and starboard; they are made of metal and filled with expanded rubber which is protected with sheet asbestos. Steering is effected from within the boat by means of a wheel with wire rope connections to the rudder head.

This type of converted wooden lifeboat was given a gruelling test in a tank of burning oil. The semi-rotary pumps were operated by a crew of volunteers, and every endeavour was made to simulate as nearly as possible actual conditions at sea. It was definitely proved that the lifeboat is unburnable as long as the water spray gear is working.

Every tanker lifeboat carries an asbestos blanket 8ft. by 6ft., and each member of the crew wears a sort of asbestos boiler suit with zip fasteners.

In all ocean-going ships at least one of the lifeboats must be a motor lifeboat with enough fuel to make a voyage of at least 160 miles. Where more than 30 passengers are carried, there must be two such motor-boats. One of the chief functions of the motor-boat is to keep the other boats together

These illustrations show tests being carried out on a self-righting lifeboat designed by Mr. E. H. Lowe, of the Lamport and Holt Line.

instead of dispersing over a wide area of ocean and so making the work of searching rescue vessels appreciably more difficult. When the sinking occurs near land, they can also take the other boats in tow.

Self-releasing Rafts

Quite often torpedoed ships sink so quickly that there is little or no time to lower the boats. To meet these emergencies all ships are fitted with rafts which release themselves. They are of many designs, and can float either way up so that the survivors have still a cockpit in which to sit, and can get at the water, provisions and flares. These rafts can be sailed, though naturally they are slow and clumsy to handle. A great many lives have been saved by their use. One man was rescued after spending over 100 days on one of these craft, illustrations of which appear on page 423.

The details given in this article are just a sketch, and by no means a complete one, of the thought and effort which have gone to improving the methods of life-saving at sea. And the merchant seamen deserve all this and more. But for their increasing heroism, returning to sea time and again after being torpedoed, there would be no second front. Not an aircraft could leave the ground. Not a tank or even an omnibus could move on land. Even if the Germans had not invaded us, the population of these islands would be starving to-day. It is true to-day, as it has been true for centuries, that Britain lives, and only can live, by the sea.

Items of Interest

Men of the Little Ships

ALTHOUGH the majority of ratings on coastal craft are for "duration" service, there is still a large number of regular Navy men aboard them.

Of the three types of boats which constitute coastal force craft, the motor torpedo boat is essentially an offensive ship which, despite its lack of size, will attack anything. These craft can attain a speed of over 45 knots, can make themselves an almost impossible target at sea, and have attacked such formidable ships as *Scharnhorst* and *Gneisenau*. Motor gun boats, on the other hand, were originally designed to combat the E-boat. They will readily go after enemy merchantmen and trawlers, however. Enemy coastal convoys and their escorts are sometimes an easy prey for these swift, heavily armed boats, manned by fearless men who will stop at nothing.

Motor launches are larger, slower craft than either the M.T.B. or the motor gun boat—almost sedate by comparison. They were originally designed as patrol craft with the idea of combating enemy submarines near the British coast. Their operations now include convoy and rescue work, and they have become the "odd job" craft of the Royal Navy. Motor launches have been used with great success in commando raids, and rendered distinguished service at St. Nazaire.

These three craft which comprise our coastal defence forces are out looking for trouble all the time. They not only render valuable service at sea, but have released larger craft—such as destroyers—for work farther from the coast.

A gunner aboard a motor gun-boat takes a sight, and is strapped to the gun for this purpose.

Mosquito Aircraft Made in Australia

FIRST deliveries of Australian-built Mosquito wood and metal fighter-bombers have now been made to the R.A.A.F. in Australia. In announcing this, the Australian Minister for Aircraft Production, Senator Cameron, said development of the Australian manufacture of the Mosquitos had been proceeding for many months.

The Mosquitos, claimed to be the fastest fighter-bombers in the world, are being built by De Havilland Aircraft Pty. Ltd., Australian branch of the British company which developed the design that has proved so successful in all types of operational flights in Europe. Australian woods were used to a great extent in its construction.

Warplanes of Australian manufacture operating in the Pacific area now include the Beaufighter, the Beaufort, and the Boomerang. Other warplanes in service in Australia, but not made there, include the Spitfire, Kittyhawk, Boston, Hudson, Catalina, Ventura, Vengeance, Sunderland, Liberator, Mitchell, and Walrus.

Inventions of Interest

By "Dynamo"

Durable Hearth Brush

IT is appropriate that a lady should be the applicant for a patent relating to a brush for keeping the hearth clean.

Hitherto this kind of brush has consisted of a handle and bristle-carrying body shaped from one piece of wood.

That form, it is maintained, is not economical. The bristles at or near the nose are worn away more rapidly than those in the neighbourhood of the handle. Obviously a cluster of projecting bristles at the front is necessary for inserting in corners, while a good spread of hair is required in the flat surface. Yet the rate of wear has not been uniform, and the brush has lost its general usefulness before the majority of the bristles have been worn down.

The inventress proposes a movable handle. This, it appears, is not an absolute novelty. But she has devoted her attention to the improvement of such an attribute.

According to her idea, a reversible hearth brush includes a body or stock provided with a separable handle, and at each end with handle-affixing means. The body is hollowed out above, so that at each end a lengthwise-holed upwardly inclined portion can carry a friction-held handle, the stem of which projects into the hollow.

Being slightly tapered, the handle is forced into a round hole. When it is desired to change it from one end to the other, it can be knocked out by tapping the end which projects into the hollow of the body.

"Clocking in" Cards

A NEW invention concerning workmen's time or wages cards has made its appearance. The aim of this "clocking-in" device is the effective dealing with these cards on an address printing machine for registering workmen's identifications.

The top portion of the card is increased in width by outwardly inclining one or both side edges. The top of the card is blank, in order that the address may be printed thereon. The lower portion receives time records and wage entries. Extra matter can be printed on the top, thus avoiding the need of an additional card.

The shaped head also ensures that all the cards are arranged in the same way. It assists in the handling of them and in their insertion in the address printing machine.

A Close Shave

A DRY shaver, for which a patent in this country has been applied, has a novel and improved cutting head. As a consequence, it is affirmed that the morning facial operation is more effective.

The characteristic of the invention is a comb structure of a shape which we are told makes for closer and more uniform shaving. An elongated comb is curved both lengthwise and crosswise. The two-way curvature of this comparatively long and narrow cutting area, it is contended, is particularly beneficial in promoting close shaving.

The comb and cutter are so arranged as efficiently to cut long and short hairs, thereby avoiding a residue of isolated long hairs after shaving.

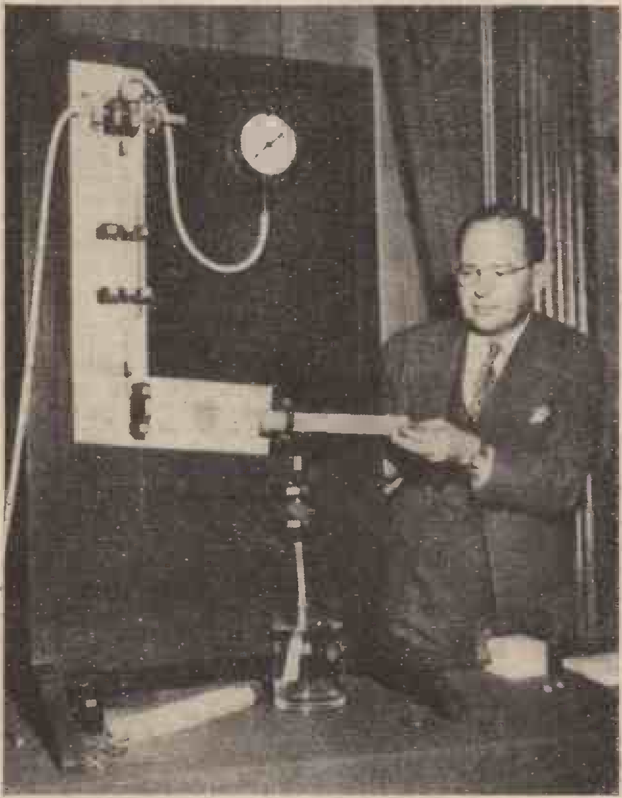
It is stated that this implement has greater strength and can be manufactured with more uniformity than its predecessors, and also that it will retain its shape more satisfactorily than prior comb structures.

A movable cutter reciprocates behind a perforated metal plate through the interstices of which the hair projects. There is included as comb a sheet-metal element arched convexly both lengthwise and crosswise. This has hair-receiving openings within its longitudinally arched portion. The sheet-metal element is secured to a truss structure while maintaining the element in its form, in which it is arched in both directions.

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

Circular Atlas

A GLOBE with a spherical map of the earth on its surface has been a feature of many schoolrooms. This method of teaching geography is strikingly developed by an inventor. He has devised a series of maps which can be pieced together to form a globe-shaped atlas.



A new chemical treatment which makes wood nearly as hard as steel was announced recently in New York City by the Du Pont company. In the illustration Dr. J. F. T. Berliner demonstrates the initial step in the transmutation process by placing strips of wood in the impregnating machine.

The putting together of this educational jig-saw puzzle may be made to impart to the scholar and student a good idea of the relation of the continents and oceans of our planet. However, the assembling may be facilitated by having the edges of the several map sections numbered.

The sectional maps may consist of suitable material such as stout paper, thin board, or even plywood, and they are so shaped that when assembled they form a complete sphere.

The edges of the several sections are fitted with strips which can be folded inwardly or outwardly and secured together either temporarily or permanently. In the former case the sections can be taken to pieces, and the maps may be flattened, thus occupying a minimum of space for storage.

Earth and Sky Map

A FURTHER advantage of the above-mentioned invention is that there is furnished a complete atlas. If the maps are laid side by side instead of being built up into a globe, they will give a true idea of the sizes of the various countries. This, the inventor maintains, is unattainable in any other way, since the atlases at present in use show different parts of the globe on different scales.

The principle of this device can be utilised to form also a celestial globe displaying the constellations. And if a celestial globe of a size larger than a terrestrial one be provided, the latter can be inserted within the desired hemisphere of the former. It may then be rotated to demonstrate the position of the stars at different hours of the day and night in various parts of the earth.

The sections in a celestial globe may be printed on transparent material and on both sides of such material.

Repairing Rubber Heels

FOOTWEAR, such as Wellingtons, gum-boots, and rubber bootees, is usually discarded when the heels are badly worn. As a consequence, there is a considerable waste of rubber.

To prevent this loss of material is the object of an invention which provides pads by which the heels in question can be repaired, with a minimum of waste.

The method consists in smoothing the worn surface of the heel by scraping or filing. A cut in the heel inclining slightly forward is made by a saw or other suitable tool from about the point at which the worn part meets the unworn portion. Engaged with the cut is the lip of a pad of rubber or rubber composition This has a flat outer and an inclined inner surface conforming with the worn surface. The lip is tapered and its inner surface forms a continuation of the inner surface of the pad, while the outer surface is inclined from the outer surface of the pad to the tip of the lip. And the pad is secured to the heel by an adhesive or one or more brads, screws, or rivets.

THE WORLD OF MODELS

By "MOTILUS"

How Model-makers Have Helped in the "Salute the Soldier" Campaign

Army vehicles modelled to the scale of ½in. to the foot—made by Bassett-Lowke, Ltd., in connection with an exhibition being sent to Canada to demonstrate this Dominion's war effort.

OF the various campaigns for raising money for the war effort, probably the recent "Salute the Soldier" weeks have made a special impression, because the campaign synchronised remarkably with the invasion period and the opening of the Second Front

In most campaigns—I remember it so with the Merchant Navy, Wings for Victory and Warship weeks—the exhibition of models has contributed considerably to the public interest. Models have been displayed in exhibitions and in shop windows, and competitions have been run among local youthful talent, producing valuable propaganda for the cause.

Northampton has long been known as a home of fine models, and its tradition in this respect has been well continued into the coming generation, judging from the entries in the model competition which was held among local schools in connection with the Borough's "Salute the Soldier" week in June.

In the competition entrants have to model any one of a number of weapons from designs supplied by the "Salute" committee, and the prizes were three, two and one savings certificates respectively.

Model Tanks

The first prize-winner, Malcolm S. Cooke, aged 14½, has produced a model of a Valentine tank which would not disgrace a professional firm in point of its exactitudes and realism, and little less creditable is the work of the second prize-winner, John J. Wright, aged 15, embodied in a smaller model of the same tank. Third prize went to G. Chadwick, aged 13¾, for a striking and topical model of the Dukw amphibian, and the entries of Michael Reed (14), infantry landing craft, and R. Daniels (13), Army reconnaissance 'plane, were very highly commended.

I had a chat with four of these boys—lads who have none of the advantages of peacetime "prepared" model parts—and gained an insight into the ingenuity and skill apparent to-day from this "cross section" of typical young modellers.

They had all worked from the drawings issued by the National Savings Committee, and in two cases had increased the models to double size, making the requisite drawings themselves. The time allotted for making the models was one month, and 5 per cent. of the work was allowed to be undertaken by some other person. Over 90 per cent. of the material used in the models was wood, the remainder being accounted for by paint, transfers, wire and small improvised metal fitments.

The winner, Malcolm Cooke, started building models when he was eight years old—he had an elder brother to encourage him. His first effort was a Bristol Blenheim Mark 1, and the majority of his models were of aeroplanes, both flying models and static ones. He said (and two of the other prize-winners made this point also) that details and drawings of aeroplanes were much easier to get and more cheaply obtained than those of ships or Army weapons and vehicles. He was keenest of all on modelling ships—particularly old-time vessels—but mentioned that parts and information were scarce at the moment.

His Valentine tank model was 11¾ins. overall with a width of 6ins., and was mostly "rushed together" in the last week, and he dashed down at the last minute with the model just before entries closed. Nevertheless, the model appeared to be a very polished effort, with the gun turret made to swivel and the two-pounder gun arranged to elevate. Also details like the tank periscopes, petrol tank, spare tracks, camouflage netting and Besa machine-gun modelled carefully to scale.

John Wright, who gained second prize, supplied a few more details about the prototype—the Valentine medium tank is about 18ft. long, weighing approximately 17 tons, as against the 28-ton Shermans and Matildas, and was used in the North African campaign. It has a crew of three men, the driver, commander and gunner.

He started the hobby of model making when he was seven, and now has a young brother about this age but of a destructive

Winner and runner-up—the two sizes of Valentine tanks made by Malcolm Cooke and John Wright respectively.

rather than constructive turn of mind, and therefore he now keeps his models under lock and key!

Of all the models he has made, his favourite was a frigate copied from the local museum. It is a scale model and was not fitted with sails, but will float on an even keel and stay steady in a strong breeze.

Constructional Details

His Valentine tank was 6ins. long and was made of deal, with aluminium casing to certain of the parts, such as the reduction cover plate on the driving sprocket and the tank headlights. These were a very effective part of the model, and each one was made in this rather ingenious manner. A piece of wood was shaped and hollowed out and then lined with aluminium to act as a reflector, and finished off at the front with a circle of celluloid.

The tank springs were made of $\frac{1}{8}$in. dowel wood shaved down at each end and wound with 15 amp. fuse wire.

By the way, the aluminium used did not in any way impede the war effort; it was obtained from the tops of milk bottles—full marks here for an original idea.

A Model "Duck"

Third prize-winner, G. Chadwick, had taken the famous American amphibian vehicle, popularly termed the "Duck." His model was made in pine—a wood favoured by professional model-makers because of its reliable qualities—and he had become interested in models through his father, who was able to supply most of the materials needed to make the model. He had started modelling at 10 years of age, and the Dukw amphibian was the best and most ambitious model he had yet tackled.

The steps on the "body" of the "Duck" were made of balsa wood glued on, and the propeller and rudder of aluminium.

"Dukw" amphibian model made by G. Chadwick, which gained third prize.

The model was certainly a very creditable effort for a boy of 13$\frac{3}{4}$, made without the aid of any photographs and finished off with neatly machined canvas canopy.

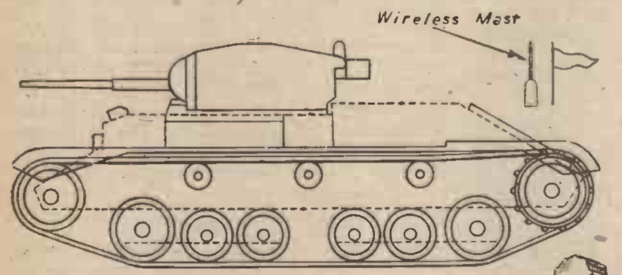
Model "Auster" Spotting 'Plane

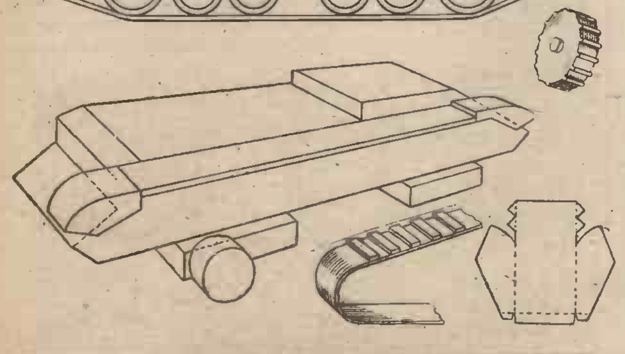
The youngest member of the party was R. Daniels, whose model of the "Auster" artillery spotting aircraft was 1-72nd actual size. He estimated the model had taken him 13 hours altogether, and the 5 per cent. assistance he had received had come from his handicrafts master, an expert model-maker and the tutor of three of the boys, Cooke, Chadwick and Daniels, who all attend the Kettering Road Senior Boys' School. Wright is a pupil of the Northampton Town and County School.

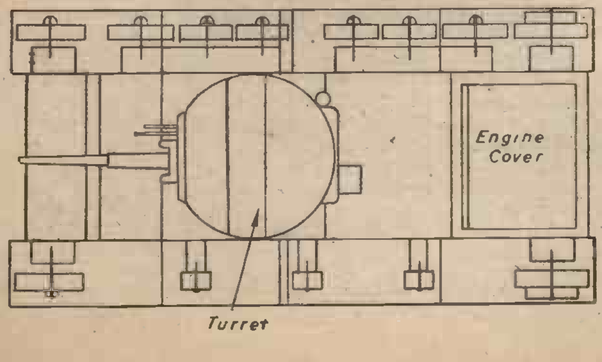
Daniels is a keen aero modeller and has made many as presents, including 15 for an aunt of his, who has a blue ceiling, against which the aeroplanes are fixed as if flying in the sky. His best model was a large Short Sunderland. He has a six-year-old brother, who already assists him in the "rough" work of chopping the wood!

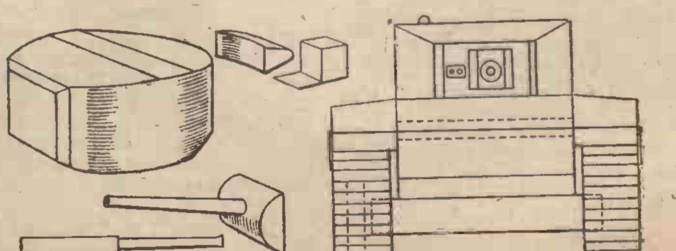
His Army reconnaissance 'plane was a neat little job, fitted with bamboo struts and a celluloid cockpit, and camouflaged (as were the other models) in the Army colours of olive-green and khaki, with transferred markings.

Each model showed promise, and no doubt the boys will derive encouragement from the fact that they received their prizes from the hand of the High Sheriff of Northamptonshire, Major-General Sir Hereward Wake.









War Savings Campaign drawings of the Valentine medium tank, used by the 1st and 2nd prize-winners.

Professional Model Work

While on the subject of Army models, it is an opportune moment to make a reference to some of the high-class professional model work now being done in connection with Government publicity on the war effort. On page 426 is a picture of 12 models of various types of Army vehicles, the prototypes of which have all been constructed in

Model "Auster" artillery spotting aircraft, the work of R. Daniels—(1/72nd actual size).

Canada. They are modelled to the scale of $\frac{1}{8}$in. to the foot, and therefore none of them exceed much more than 2ins. in length, which calls for very fine, delicate model-making. They have been made specially by Bassett-Lowke, Ltd., to the order of the Ministry of Information in connection with an exhibition being sent to Canada to show this Dominion's fine war effort. The vehicles include 15-cwt. water tank, 3-ton general service armoured car, 15-cwt. truck, 3-ton ambulance, Bren gun carrier and recovery lorry and trailer, scout car and utility car.

Popularity of Model Work

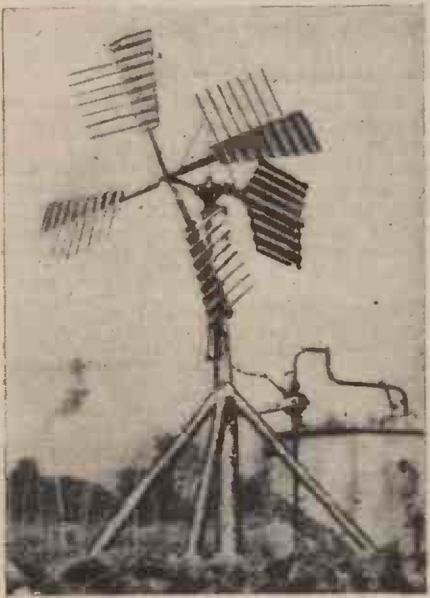
Going about the country as I do I marvel at the amount of model work that is being carried out by old and young, and I wonder whether this is merely because the making of models gives relaxation to counteract bouts of war weariness or because professional models are no longer available and people must perforce construct their own simpler models. It will be interesting to see which way the tide will flow when hostilities cease and commercial model firms are in full production again on peacetime work.

Letters from Readers

A Windmill Pump

SIR,—Using some scrap barrel, an old Austin 7 back axle, and some corrugated iron, I have made a small windmill, which has exceeded all expectations, as it keeps a 400-gallon tank filled with water on my 20-rod allotment.

Although it has only been erected three months, it has proved invaluable to many of us for obtaining water when needed. The windmill was made at home in the winter



A small windmill pumping plant

months, and only took about two hours to erect. Many people have praised its performance, including Captain Williams, secretary for the allotments, and I thought perhaps a short description of the appliance may be of interest to other readers.

The propeller is made of 3ft. 6in. lengths of 1ft. by 2in. oak, with the galvanised iron bolted to it, making a 7ft. span. The whole is then easily bolted to the drive on the universal joint end of the back axle.

The wheel housing is placed vertically, and the end which projects is cut off and the shaft removed. The planetary gears (6) are also removed, and the two remaining bevel gears give a ratio of 5-1.

An extension downwards to the remaining axle shaft is provided with a piece of ½in. gas barrel, to the free or lower end of which is screwed a crank. This crank (horizontal) is connected to the handle of a semi-rotary pump.

In order to keep the pump primed a non-return valve (rubber sheeting) stretched over the outlet end is fitted, and the end immersed in a water-can, the spout of which in turn fills the storage tank.

ARTHUR P. CARTER (Walton-on-Thames).

Electrified Fencing

SIR,—With reference to your reply in PRACTICAL MECHANICS, of June, to W. E. Ambrose (Oswestry), I would like to pass on the following.

All the "electric fence units" work on the "shocking coil" principle. The arrangement is generally a 6v. 50 AH accumulator energising the primary of an induction coil, through a pair of contacts that open and close 40 to 60 times per minute, in a similar manner to a battery operated electric clock. One end of the secondary winding is earthed, the other is taken to either one or two strands of barbed wire, which in turn is secured to posts on "reel" type insulators. It is usual to place one wire only, at approximately shoulder height of the animals to be fenced.

The 60 impulses per minute principle saves current, also preventing animals "freezing" to the wire. The HT voltage is sufficient to sting the animals, but not to cause injury or undue pain.

I greatly appreciated W. H. Sutherland's articles on wind-driven dynamos, and myself have experimented during the last five years on these plants.

One snag readers may have is the rewinding of the dynamotor. In my plant is incorporated a "Rotax" dynamo Type AT91, without alteration to same.

I give here a list of "Rotax" dynamos with a low cut-in speed, suitable for direct drive; possibly some readers may have one or other of these machines stored away.

Type	Output Volts.	Output Amps.	Cut-in R.P.M.
At 90	12	11	440
At 91	12	10	350
At 94	12	10	350
At 92	12	11	440
At 113	12	11	440
At 114	12	11	440

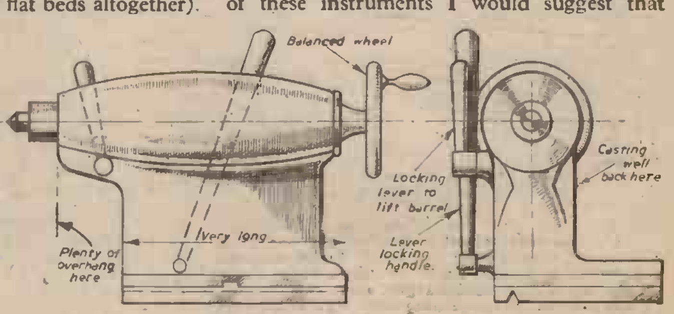
R. D. P. CLIPSTONE (Mansfield).

An Improved Lathe Tailstock

SIR,—As a turner who has spent the last forty years in various tool rooms all over the country on various makes of centre lathes, may I put forward that one of our chief difficulties is keeping our work dead parallel. Now I think that the chief trouble in this is the design of the tailstock. Even in modern lathes the amount of overhang of the casting is not enough and the locking device is the wrong way.

When one is continually working on a lathe all the year, and is constantly up against this slightly taper turning, I think it is high time it was looked into. In order to help matters I suggest the following idea for an improved tailstock. The casting should be long, and fit well down on the bed, and be relieved in the centre; it should bed on one Vee only (cut out flat beds altogether). This additional length of the casting will provide also a long guide for the barrel. It should stand well back in front to allow the top slide to get close against centres, and barrel end to stand well out to support it (the length of this could be nearly half the width of cross slide). The locking device should not throw the barrel horizontally, but definitely lift it. This will help to keep the work dead parallel. If the locking device causes the barrel to tighten horizontally (which the majority do) there is a danger that when the barrel gets slightly worn, a slight variation of centres is noticeable when the barrel is tightened; therefore, when this happens one is *never* sure that the lathe is going to cut parallel, and this is a bugbear to turners, especially on precision work. Now if the locking device is made to lift the barrel, and if there is any movement at all it will not affect the centre so much, and this is a great help. The best means of obtaining this is two locking collars, one threaded and one clearance for a rod handle bolt situated one quarter down the length of barrel, concaved out to suit diameter of barrel about ⅛ of the diameter. There should be a rod handle, with cam action for locking the tailstock on bed, which saves the necessity for hunting for a spanner. The cam underneath should be situated one third down the length of the casting. The top casting should sit on the bottom casting by a *tight* fitting tongue and groove in a central position for taper turning, etc., moved by a tight fitting screw so that there is very little slack. An internal phosphor-bronze square thread bush is pressed in the barrel and secured by a grub screw. A balanced hand-wheel should be fitted, and if this is not balanced there is a danger of the work flying out of the centres if the operator ever forgets to tighten the barrel and the knob of the hand-wheel happens to be in the wrong position. The screw should be long enough to knock the centre and drills out well before the barrel is right back.

W. J. STEVENS (Northolt).



An improved lathe tailstock.

Sunlight Recording Instruments

SIR,—With reference to your reply to a querist in the June issue regarding sunlight recording instruments, I would like to point out the existence of a rather more scientific device than the one mentioned.

This consists of a paper-covered drum and recording device similar to the one forming part of the familiar recording barometer with the drum electrically driven. The other part of the instrument consists of a photo-electric cell-operated switch, which functions in a similar but reverse way to the automatic lighting street lamps. When light of a certain intensity strikes the cell the drum is set in motion, and when the light fades below a certain point the drum is stopped.

The drum is suitably graded in hours and minutes, and a direct reading is obtained, no calculation being necessary.

If your correspondent intends to make one of these instruments I would suggest that a motor from an electric clock, with the drum mounted direct on to the minute hand spindle, would form an admirable basis for construction.

The motor would, of course, have to be of the self-starting type.

If querist would like to communicate with me c/o The Editor, I would be glad to supply him with sketches and any further information he may need.

E. S. GREEN (A.P.O., England).

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.

Moulding Graphite

I HAVE in my possession a quantity of graphite powder and I should be glad if you could tell me how I can mix this into a paste so that I can press it into honeycomb plates resembling accumulator plates. Should there be any special process in the drying?—R. M. Steer (Swansea).

WE hardly think that you will be successful in compressing your graphite powder in order to form the articles you require, since this is a process which necessitates the employment of a hydraulic press capable of attaining a pressure of at least 1½ tons per sq. in. In commercial working, the graphite is intimately mixed with a suitable binder and it is subjected to compressions varying from 1½ to 3 tons per sq. in. The "binder" usually consists of china clay (up to 6 per cent. admixture). Sometimes a little sodium silicate is also admixed, but usually a soft, semi-colloidal clay, such as high-grade china clay, suffices amply for all such binding purposes.

It is impossible to make any mouldings of graphite, for the moulded material would not hold together. Strong compression is absolutely essential, and since hydraulic presses are very expensive devices (and, incidentally, absolutely unobtainable at the present time), we very much fear that you will not be able to treat your graphite powder in the manner you desire.

Radio Detection of Metals

CAN you tell me if it is possible to detect the presence of metals by means of a sort of wireless apparatus—and is such an apparatus worked upon the principle that different metals have their own "wavelength"?

Would it be possible for me to detect the presence of metal particles in, for example, solution requiring purification from such metal dust? Such a question presupposes that the apparatus will detect from a distance, i.e. not, be in actual electrical contact with the metal to be detected, but working on the same principle as the radio receiving station.—D. A. Layton (Norwich).

IT is possible to detect the presence of metals by radio means. Essentially, all such metal detectors consist of a delicately adjusted radio oscillating circuit, any disturbance or alteration in the capacity of which will cause the circuit to break into oscillation.

Now, since the proximity of metal will cause such a circuit to oscillate, it is thereby possible to detect the presence of such metal.

Such a circuit would also work as regards the detection of metal particles suspended in a liquid, provided always that the metal particles were present in sufficient quantity to form a considerable mass of metal in the aggregate. Otherwise the circuit would not operate for such a purpose, it being impossible to detect the presence of very fine and stray particles of metal in a large volume of solution.

For the above purpose you can experiment with almost any delicately balanced valve oscillating circuit. The circuit should contain a "capacity plate" comprising a sheet of metal some 6in. square, which, when it is placed in proximity to the metal to be detected, will give rise to capacity effects. The increased amount of capacity in the circuit will thus disturb its electrical "balance" and the valve will be set into oscillation.

Re-winding a "Startamotor"

IN a recent issue of "Practical Mechanics" there was described a method of re-winding a Morris "startamotor" or Lucas A900C dynamo to give 12 volts and up to 20 amps. from a low cut-in speed for windcharger unit.

Am I correct in assuming that such a dynamo could be wound to give 120 volts at 1 amp. by winding on 10 times the number of turns per coil of a much smaller gauge wire? If so, could you tell me what gauge wire, and also what is the total weight of wire required (in either high- or low-voltage winding, as I take it this would be approximately the same in either case) to wind the armature and field coils?—W. H. Spoor (Saltash).

ASSUMING the field windings are designed to give the normal field strength, the voltage obtained rom a dynamo is almost directly proportional to the number of armature conductors and to the speed. Therefore, in order to obtain 10 times the normal voltage at the normal speed, you would need to wind the armature with 10 times the original number of conductors. Smaller wire would have to be used and this would reduce the safe full-load current, which is proportional to the cross-sectional area of the armature conductors. For instance, if the armature is re-wound with wire of 0.315 times the original diameter the safe full-load current will be about one-tenth of the original value. It is advisable to use the largest size of wire which can be accommodated in the slots. For 1 amp. full-load current you could use 27 s.w.g. for the armature.

If the magnetic field strength is reduced, the generated voltage at a given speed will be proportional to the field strength. It is advisable to retain the original field strength, and to do this the number of ampere turns on the field coils must be the same. Therefore if the armature is re-wound to give a higher voltage the field coils must also be re-wound, and the new field coils must satisfy two conditions. The product of the field current and the number of turns in each coil must be the same as before; the coils will have more turns of thinner wire. The size of wire used for the field coils must be adequate to carry the current without over-heating and the product of the field current and the resistance of the field circuit must equal the voltage. Due to the fact that the resistance of a coil having 10 times as many turns of wire of one-tenth the original cross-sectional area is likely to be more than 100 times the original resistance, we suggest that to obtain 10 times the normal value of generated voltage you wind the armature with 11 times the original number of turns and connect a variable resistance in the field circuit to provide a means of controlling the voltage.

Direction of Rotation of a Motor

COULD you please tell me if there is a way of fixing, apart from actual experiment, the direction of rotation a certain arrangement of field and armature connections will give to a direct current motor?—J. O. N. Burrows (Weymouth).

THE direction of rotation of a motor depends on the relative magnetic polarity of the field magnets and armature. The armature current will give the armature a certain polarity with poles which are approximately midway between the field magnet poles. The conditions may be as indicated in the sketch. With the magnetic polarities shown the N pole of the field

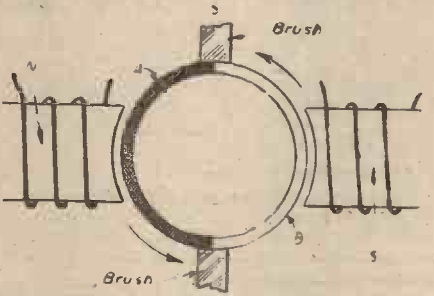


Diagram illustrating how the direction of a motor armature may be determined.

system will repel the N pole of the armature and attract the S pole of the armature, thus causing the armature to rotate in a counterclockwise direction. Reversal of the relative polarity of fields and armature will reverse the rotation.

If you can trace the direction of winding of the field coils the magnetic polarity can be determined by the corkscrew rule. If a corkscrew is turned in the direction in which the current flows through a coil the point of the screw moves in the direction of the magnetic lines of force, and the point of the screw leaves the coil at the N pole. You may be able to trace the armature winding in the same way. The armature conductors between one set of brushes carry current in the opposite direction relative to the shaft than do those between the next set of brushes. For example, in the sketch the conductors at A carry current away from the observer and at B carry current towards the observer. The corkscrew rule gives the armature polarity as shown. Alternatively, you could find the polarity of the armature and field windings by passing current through each separately and using a compass needle.

Model Generator

I AM constructing a model generator of similar dimensions to the 10 watt motor described in "Practical Mechanics" for December, 1943. The field magnet is exactly the same, i.e., 2in. wide by 3in. high by 1½in. thick. The armature is 1½in. diam. by 1½in. long, the main difference being that it is 8-pole with a 4-part commutator. I do not know how to wind the armature or how to connect up the field winding, so if you could supply me with these instructions I should be grateful. What output could be expected from this generator? Also, what would be its current consumption and output run as a motor?—R. Rumble (Swindon).

MOST small motors of this type are series connected so that the same current passes through the field windings and armature. The current taken by the motor will depend largely on the load which it drives and, when operated on 6 volts, it could be worked at about 2.5 amps full load current and might develop 1/150th h.p. For use on 6 volts you could wind the field coil with 4 ozs. of 22 s.w.g. d.s.c. wire. The 8-slot armature should have an 8-part commutator, and could have 8 coils each of 30 turns of 22 s.w.g. d.s.c. wire. Placing the armature so that slots 1 and 5 are equidistant from the centre of one pole face, number the commutator segments which then lie under the nearest brush, numbers 1 and 2. Connect the start of the coil in slots 1 and 5 to commutator segment No. 1, and the finish of the coil to segment 2. Connect the start of the coil in slots 2 and 6 to segment 2 and the finish to segment 3, and so on.

If the machine is to be used as a generator it will only build up voltage when the external circuit is closed, and the voltage will vary considerably with the load current. To use the machine as a shunt dynamo, the field would have to have a larger number of turns of comparatively fine wire connected across the armature. In order to suggest a suitable shunt field winding, we should have to know the voltage output required and the speed at which you intend to run the machine, this would have to be a high speed. You might have a certain amount of difficulty in getting the machine to build up as a self-exciting dymano.

Smoke Bomb Formula

I SHALL be very grateful if you could let me have the following information:

1. One or two formulæ for making smoke bombs. If possible with chemicals that can be got nowadays?

2. A method for detonating such bombs when they are thrown?

They are for H.G. and Cadet demonstrations so they must be harmless.

3. Is there any other method for converting red phosphorus to yellow phorphorus besides heating it to 200 deg. C. in an inert gas and collecting the vapour?—O. Bowen (London, W.).

THERE are quite a number of admirable "smoke mixtures," but these can only be made up in grenade form provided that the grenades are equipped with detonators, and since you would be unable to provide such means of igniting we do not think that any of these chemical smokes would serve your purpose. However, for your information, we give below two formulæ which have been well tried:

(a)	Potassium nitrate (saltpetre)	45 per cent. (by weight).
	Sulphur	12 ,, ,,
	Pitch	30 ,, ,,
	Borax	9 ,, ,,
	Gluepowder	4 ,, ,,
(b)	Zinc dust	28 per cent.
	Hexachlorethane	50 ,,
	Zinc oxide	22 ,,

The above must be ignited by means of a priming charge which is fired by the detonator. A suitable priming charge consists of:

Antimony powder	76 per cent.
Zinc dust	11 ,,
Potassium perchlorate	11 ,,

You will no doubt be aware of the fact that ordinary yellow phosphorus will ignite on being thrown in easily broken containers.

The following liquids, singly or in admixture, when thrown in the air, give rise to dense white fumes. They are, however, expensive and not readily obtainable:

Tin tetrachloride	$SnCl_4$.
Titanium tetrachloride	$TiCl_4$.
Silicon tetrachloride	$SiCl_4$.

The only practical way of converting red into yellow phosphorus is by the process you mention, i.e., by the heat-treatment and distillation of the red phosphorus in vacuo or in an inert gas. All other methods are very complicated and quite impracticable for your purpose.

Electric Welding

I WISH to do some electrical welding repairs, and additions to light gauge sheet metal (18 and 20 g.). Will you please give me the following information :

What pressure and current is necessary for the above, and what are the constructional details of a transformer to provide the current on a supply of 230 v. single phase A.C. ?

I should also be obliged to know the appropriate size of electrodes required and where they, and the transformer stampings, could be obtained.—B. Dawson (West Kirby).

FOR your purpose you would require to use 1/16in. diameter electrodes, and a transformer having an output of about 25 amps at 80 to 100 volts. We suggest you first ascertain if the supply authority will permit a welding transformer to be connected to the single phase supply. Welding rods can be obtained from Murex Welding Processes, Ltd., Hertford Road, Waltham Cross, Herts, and Stalloy transformer laminations from Joseph Sankey and Sons, Ltd., of Bilston, Staffs. We suggest a transformer having 6 square inches cross sectional area of core. The primary winding could have 260 turns of 14 S.W.G. D.C.C. wire and the secondary 122 turns of 10 S.W.G. D.C.C. wire, bringing out a tapping at the 98th turn to give 80 volts.

You will need a choke coil connected in series between the secondary winding, and the arc, to reduce the voltage when the arc has been struck.

Electric Blanket

COULD you kindly give me some details for making an electric blanket about 2ft. by 3ft. 6in. My main difficulty is in the wiring, and I wondered whether it would be suitable to run the blanket off 230 volts A.C. mains, or whether the voltage should be reduced. Also what length and gauge of wire should be used and how is it best wired ?—R. Eldridge (London, S.W.).

IT should be quite satisfactory to operate the electric blanket direct from the 230 volt A.C. mains. We suggest you use about 66 yards of 36 S.W.G. nichrome resistance wire, this first being formed into coils by winding the wire on a rod about 3/32in. in diameter. You could then sew the loose spiral of wire between two sheets of asbestos cloth, the wire being run zig-zag fashion from one side of the blanket to the other.

Phase-shifting Transformer

WOULD you please explain the theory of the Phase Shifter, as used with the Drysdale A.C. potentiometer ?—P. T. Jones (Gillingham).

THE phase-shifting transformer consists of a stator and rotor, very similar to those of an induction motor. The stator current produces a varying magnetic field, and thus induces a voltage in the rotor windings. On single-phase systems the two-phase shifter is used, one of the windings being connected in series with a condenser which is shunted by a resistance. The voltage induced in the rotor windings by the rotating field is constant in magnitude for all positions of the rotor. The change of phase between primary and secondary is proportional to the angle through which the rotor is turned, and if the primary current has a sine wave form the secondary will also approximate closely to a sine wave. The phase of the secondary current in any part of the windings depends on the phase of the magnetic flux acting on it, this of course being changed by turning round the rotor.

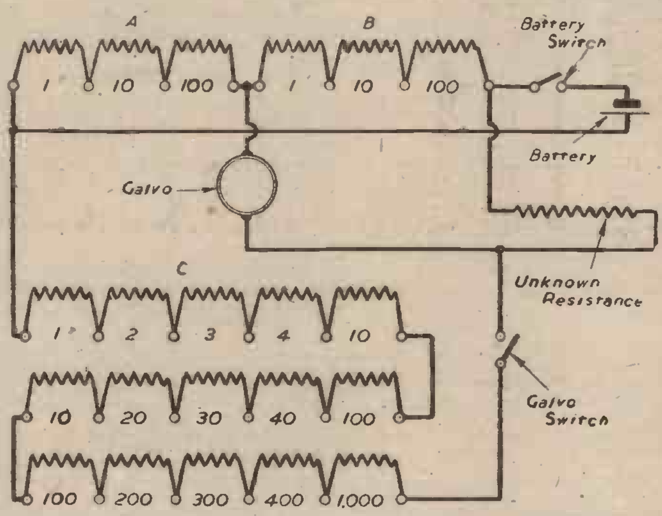


Diagram showing arrangement of resistances in a P.O. bridge.

P.O. Bridge Details

CAN you please give me details of P.O. bridge construction, and also where I may be able to obtain the necessary wire, etc., for building same ?—F. J. C. Maiden (Saltburn-on-Sea).

THE P.O. bridge comprises three variable resistances, A, B and C, connected as shown. A and B may each comprise two or three units having resistances of 1, 10 and 100 ohms which can be plugged out of circuit as required, each resistance being connected across two brass plates, between which a well-fitting brass key can be plugged. C comprises three sets of resistance units, the first having resistances of 1, 2, 3, 4 and 10, the second having resistances of 10, 20, 30, 40 and 100 ohms, and the third having resistances of 100, 200, 300, 400 and 1,000 ohms. The resistance coils are usually wound non-inductively, the wire being doubled back upon itself before being wound on its bobbin.

A galvanometer is mounted on the wooden or ebonite panel, together with the plug contacts and a switch in circuit with the galvanometer and a second switch in series with the battery. The resistance units and battery can be placed below the panel.

You could probably obtain the wire from London Electric Wire Co. and Smiths, Ltd., of Church Road, Leyton, 10.

Calcium Carbide

I HAVE read various books on industrial gases and have noted a reference to the manufacture of calcium carbide. The raw materials of lime and coke, or lime and anthracite coal, are united in an electric furnace. How are they united and in what proportions ?—P. O'Neill, (Ennistymon).

CALCIUM carbide manufacture is ordinarily undertaken in a high-temperature electric furnace. Essentially, the process consists in heating 55 parts by weight of quicklime and 36 parts of coke to a temperature of 3,000 deg. C. in an electric furnace so constructed that the carbide, as it is formed, is pushed away from the sphere of the electric arcs.

Sometimes about 20 per cent. of high-grade anthracite is mixed with the coke in order to give greater "body" to the mass.

ELECTRADIX

BUTTON MICROPHONES!

Thousands use these wonderfully ingenious solid-back SOUND TRANSMITTER UNITS. A marvel of acoustic engineering design, as used by G.P.O., invaluable to radio experimenters and others for amplification and detection of sound for all purposes. Make your own outside listener.

EVERY BUTTON TRANSMITTER WE SUPPLY IS GUARANTEED.

The 1in. dia. brass body is of solid brass, forming the granule chamber, and the diaphragm is thin mica. Radio is not essential, as with only a pocket battery 4½ volts and a high-ratio transformer, speech may be transmitted to phone receiver. Experimental uses for the Buttons: Home Broadcasting, Detectors of Sound for Air Raid, Baby Alarm, Detectors of sound from leaky water mains, Electrical Stethoscopes or Vibration detectors, etc.

PRICE ONLY 2/6 (Postage 6d.).
High-ratio Transformer, 4/6.

CONTROL BY LIGHT and Invisible Rays. Raycraft sets with selenium bridge. 10,000 ohms tele-type Relay, fittings and booklet, 42/-

TRANSFORMER PARTS. We offer a few shrouded carcases ready for rewinding. 250 watt size, 35/-. First class make. If you can cut your own lams. out of 6in. Stalloy sheet, we can supply in 38in. lengths at 1/3 each.

SMALL SWITCHGEAR. Automatic Circuit Breakers, 10 amps upwards, open or ironclad, triple pole, thermal trip, from 25/-. Battery cut-outs and Remote control D.C. contractors 6/12 volts 8 amps, type L, 10/6. 10 volts, 240 volts and 230 volts, 10 to 40 amps., 35/-. Rotary Instrument Switches, 7-way by R.I., ebonite panel, 7 studs on teak box, 7/6 only. Low voltage Switchgear. Lucas 8-way Aero enclosed, change-over and fuses, R.A.F. surplus, 3/6. 6-way R.A.F. push-button, 2/9. G.P.O. single c/o, 7/6. 3-way rocker switches, 3/6.

METAL CABINETS AND COVERS. Boxes with hinged lid; inside 8¼ x 4¾ x 5¼in., for oscillators, etc., 10/-. Covers. Light metal, ventilated special arch shape to contain 6½ x 5in. with terminal cover extension, 3/6.

G.P.O. RESISTANCE BOXES. 2 switches, 3 plugs, 4,000 or 8,000 ohms by 10 ohms steps. Type 142M, £3 10s. Low resistance. Wheatstone Bridges, 100 ohms to sub-divided ohm, £5 10s.

DYNAMOS—MOTORS—ROTARIES.

For essential work, experimental work, permit free. Fine modern quarter-horse D.C. motors, 200 to 250 volts, enclosed, drip-proof, silent bearings, flange fixing, double end shaft, ½in. dia., 1,450 revs.; size 7½in. x 7in.; weight, 35 lbs. Compound. We fully guarantee. 1/5th h.p., £3 10s. ¼ h.p., £4. Larger powers in stock. state wants.

BUZZERS, ETC. Midget Townsend high note buzzers, 10/-. Light practice buzzer, 3/6. Heavy bakelite L.M., 5/6. All 4½ volts. W36 on wood base, 6 volts, 7/6. A.C. Buzzers for bell type transformer, 6 volts, 5/-.

TAPPING KEYS, Bakelite, 5/-. Wood base B2, 9/6. Operators, plated on mahogany, 9/6. American type swan neck, 8/6. Galvo Keys, Gambrell, single, 10/-.

MAGNETS. We have a large range of permanent magnets all sizes from 2 ozs. to 4 lbs.
Stamped envelope for illus. leaflet. Electro-magnet solenoids for 12 volts D.C. with 2in. free plunger, ¼in. dia., compound wound, 6/6.

Please include postage for mail orders.

ELECTRADIX RADIOS,
214, Queenstown Road, Battersea, London, S.W.8
Telephone: MACaulay 2159

TOK SWITCHES

ROTARY QUICK MAKE & BREAK

BRITISH MADE THROUGHOUT

For all purposes — fully tested Switches to customers' requirements.

Let us use our long experience to solve your Switching problems

TOK SWITCHES LTD.,
CAMBRIDGE ROW, BURRAGE ROAD, WOOLWICH, S.E.18

YOU CAN TIN ANY METAL QUICKLY AND EASILY *with*

HOYT'S TINNING COMPOUND

consisting of powdered metal combined with an active flux

NO SEPARATE APPLICATION OF FLUX, SOLDER OR TIN REQUIRED
JUST CLEAN THE JOB AND FOLLOW DIRECTIONS

Heat the work and just sprinkle the powder evenly upon surface to be tinned. The flux should "boil" and its cleansing action will be assisted if the surface is scrubbed with a wire brush at this stage. When flux has all melted and the surface is tinned evenly all over, remove from heat and wipe with a clean rag.

Price 6/3 per lb. nett carr. paid.

HOYT METAL CO. of GT. BRITAIN, Dept. PM, DEODAR RD., PUTNEY, LONDON, S.W.15

CHEMICALS

REAGENTS, FINE CHEMICALS

SCIENTIFIC APPARATUS

STUDENTS' MATERIALS A SPECIALITY

Write for quotations

CONSOLIDATED INDUSTRIAL RESEARCH LABORATORIES, LTD.
295, REGENTS PARK ROAD, FINCHLEY, LONDON, N.3

YOU can become a first-class RADIO ENGINEER

Post coupon now for free booklet and learn how you can qualify for well-paid employment or profitable spare-time work.

We are specialists in Home-Study Courses in Radio Reception, Servicing, Transmission, Television, Mathematics and Radio Calculations.

T. & C. RADIO COLLEGE,
2, The Mall, Ealing, W.5

(Post coupon in unsealed envelope —1d. stamp.)

Please send me free details of your Home-Study Courses in Mathematics and Radio.

Name..

Address..

M.14..

A PELMAN TRAINED MIND

WHY, amongst the brainiest and most successful men and women in England to-day, are there so many Pelmanists?

Why does being a Pelmanist lift you right out of the rut?

The answer to these and to many other questions relative to *Your Success* and its assurance through Pelmanism will be found in "*The Science of Success.*" In this book you will read accounts by Pelmanists themselves of how whole lives have been changed for the better by Pelmanism.

What Pelmanism Does

Pelmanism brings out the mind's latent powers and develops them to the highest point of efficiency.

It eliminates such defects as:—

Depression	Pessimism
Forgetfulness	Timidity
Shyness	Procrastination
Indefiniteness	Indecision
Morbid Thoughts	Unnecessary Fears

which interfere with the effective working power of the mind, and it develops such valuable qualities as:—

—Optimism	—Confidence
—Perception	—Self-Control
—Judgment	—Ambition
—Courage	—Initiative
—Will-Power	—Reliability

Half fees for serving members of His Majesty's Forces (Apply for Services Enrolment Form)

Your Unsuspected Self

Pelmanism teaches you to rely on yourself. Every man and every woman has within himself and herself a mine of abilities that lie dormant, ready to be brought into service through the proper training of the mind. This is the time to bring them forth and to use them for the benefit of yourself, your dependants and your associates.

Remember—Everything you do is preceded by your attitude of mind.

The Pelman Course is taught by correspondence only. There are no classes to attend. The problems of each Pelmanist are considered separately by highly trained, sympathetic instructors. Under this understanding system, even the most timid student gains self-confidence immediately.

The Pelman Course is fully described in "*The Science of Success.*" The Course is simple and interesting and takes up very little time; you can enrol on the most convenient terms. The book will be sent you, gratis and post free, on application to:—

Pelman Institute
(Established over 40 years.)
130 Albion House, New Oxford St., London, W.C.1

PELMAN (OVERSEAS) INSTITUTES: NEW YORK, 271, North Avenue, New Rochelle. MELBOURNE, 396, Flinders Lane. JOHANNESBURG, P.O. Box 4928. DURBAN, Natal Bank Chambers (P.O. Box 1489). DELHI, 10, Alipore Road. CALCUTTA, 102, Clive Street.

THE Cyclist

Editor: F. J. CAMM

VOL. XII. SEPTEMBER, 1944 No. 271

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

Comments of the Month. By F. J. C.

The Paid Advocates

ONE of our contemporaries, in criticising the Memorandum submitted to the Ministry of War Transport, deplores the recommendation contained in it for the control of pedestrians and says "no similar exhortation aimed at car drivers" was made. We hope this is not indicative of the critical faculties of our contemporary, for it exhibits an appalling lack of knowledge of the subject. Motorists *are* controlled, and over 2,000 regulations, with hefty penalties, control the construction and use of their vehicles. We do not for one moment suggest that there are not careless motorists, and many of the regulations are doubtless very necessary. To suggest, however, that they are always to blame, and that cyclists are always the innocent parties is just fatuous nonsense—the sort of nonsense which has done the cycling movement so much harm, and reveals them to the official eye as illogical and unreasoning individuals who oppose everything.

The criticism to which we have referred also reveals the danger of snatching a paragraph from the context, and not giving the whole of the context so that the reader may judge for himself. It is the old trick of the debater who has not an argument which will hold water, of erecting a bogy to knock it down—with the distinction that in this case our contemporary does not knock it down, but trembles before it.

To refer, as the journal does, to accidents as "murder" is just extravagant tosh. It is estimated that there are at least 10,000,000 cyclists on the road, although no one really does know the exact figure because cyclists are not registered, and there are no taxation figures upon which an accurate assessment can be made.

As far as drivers of mechanically-propelled vehicles are concerned we do know that there are approximately 3,000,000 of them, and it is reasonable to assume that there are careless cyclists as there are careless motorists. Accepting the 10,000,000 figure there are thus over three times as many careless cyclists as motorists.

Our contemporary is equally wrong when it states that most accidents on the road are due to speed. Official statistics do not support this, for the majority of accidents occur on roads subject to the speed limit where the average speed is eight miles an hour! Accidents on roads not subject to a speed limit have shown a noticeable decline. If any evidence were necessary to support the statement of the Roadfarers' Club that accidents are caused by the negligence of all road users, not motorists only, it is only necessary to refer to the fact that quite a number of accidents occur each year where pedestrians walk into stationary cars. There are a number of incidents where racing cyclists taking part in time trials have ridden into the backs of stationary lorries because they have been riding with heads well down.

Whilst on this question of speed, too, it is amusingly interesting to note that a writer in another contemporary, who is also associated with the C.T.C. and the R.R.A., in writing of post-war record prospects refers to a new course which he has discovered which lends itself to speed. The first contemporary quoted refers to the Memorandum as "partial," because apparently it does not represent cyclists as the saints of the road. On this line of reasoning every one of our judges is partial, because they give verdicts in favour of one litigant against another. The only opinions we observe which can be labelled as partial are the views of our contemporary which, briefly, are that the cyclist is always right and everyone else is wrong.

Impartiality

THE Roadfarers' Club is, of course, quite impartial, and the writer of the article concerned would do well to look up the meaning of that word in the dictionary, for he seems to be under the impression that impartiality is neutrality. Our judges give impartial views as the Roadfarers' Club has done, but these views are not necessarily neutral.

Impartiality means "not favouring one side more than another." Certainly the Roadfarers' Club is well represented by cyclists, for the writer of that particular article serves on its committee. It really is high time that this attitude so long promoted by the C.T.C., that the cyclist can commit no wrong, was changed, and we commend the matter to the Agenda of the next C.T.C. Council meeting.

We realise that if one pays an advocate one expects to have one's cause pleaded, but that does not mean that the advocate necessarily believes in the innocence of his client or the justice of his cause. The paid advocates, and that is what our cycling leaders are, must inevitably become *advocatus diabolæ*, even though they may lack dialectal skill. We certainly do not subscribe to the view that cyclists are always the innocent victims of accidents, and we do not support the views so often expressed that they are never in the wrong. For every culpable motorist there are at least three culpable cyclists, and probably six culpable pedestrians. These facts must be realised.

The C.T.C. and the N.C.U. still have their heads well in the past, and are not modifying their views to coincide with changing conditions. They have opposed the progressive as well as the bad. They have opposed the desires of a new, but properly constituted body to run mass-start races on the road. Their opposition is ineffectual, for these mass-start races are being run very successfully without opposition from the police; often with their assistance, without accident, and are obtaining an excellent amount of publicity in the daily press. This seems to annoy one contemporary which regards it as adverse publicity for cycling—which really means adverse publicity for the N.C.U. and the C.T.C. An article recently published attacks our cycling leaders in the following terms:

"The tiny handful of obstructionists, self styled 'leaders,' continued to ignore Sunday sport for some 20 years after its general adoption, eventually slinking into line, still proclaiming their spurious claim to be the 'guardians of the sport.'"

"Sour Grapes"

THE C.T.C. not many years ago endeavoured to alter its Articles of Association to include as members the motorists they now so much despise. It is true that the motion was defeated, but it does indicate that the C.T.C. membership does not entirely support the views expressed by its spokesmen concerning motorists. In fact the present attitude of the C.T.C. rather savours of sour grapes. We fear that neither the C.T.C. nor the N.C.U. will be taken seriously, either by the public, the cycling public nor the Government until their membership really becomes representative and until their policy is changed. The N.C.U. has a most fantastic history of opposition to almost everything which is at present accepted. It opposed time trials on the road, yet now has as a bedfellow the R.T.T.C.; it opposed Sunday time trials which are now practically standard throughout clubdom. It has been the apostle of lost causes. What reliance, therefore, can be placed upon the present views of these two bodies when they have been so consistently wrong? The C.T.C., with its quaint opposition some years ago to Sunday riding, recently organised a Sunday ride which received publicity.

More Rational Outlook

NO wonder the cry is heard loud in the land for new leaders and a more rational outlook. It is very apparent from the remarks of Mr. Noel Baker that, in the post-war period, cyclists and pedestrians will have to submit as motorists have already submitted, to some measure of control and be made to bear their share of the responsibilities at present thrown upon one section of road user.

Certainly the constitution of the C.T.C. is in drastic need of overhaul. At present it is not a democratic body, for it expresses views without consulting its members, and has the power to set aside any resolutions passed at its annual general meetings. Its council, therefore, is constituted as a dictatorship, and the members have no means of imposing their will upon the council. In this fantastic state of affairs it is difficult to see how the C.T.C. *can* change its constitution, for any resolution to that effect could be vetoed by the council.

The C.T.C. does not take a referendum of its membership on vital points from time to time, to sound the members as to whether their views on particular points have changed. Therefore it is wise for cyclists to remember when they read C.T.C. "views" in the press that these are not necessarily the views of the 30,000 members of the C.T.C. They are the views of the council, which virtually manufactures its members' views.

Paragrams

Stratford St. Mary, Suffolk.

U.S. Soldier's Win

M. C. HOLZAPFEL, a member of the U.S. Army, who has joined the Polytechnic C.C. and who is a familiar figure on roads out of London, won a N.C.U. "Medal" final at Paddington against strong opposition.

South African Wheelers

SERVING cyclists in South Africa have formed a cycling unit under the leadership of Cpl. H. Suddaby, pre-war active Hull clubman.

Broad Oak Loss

C. SMITH (Royal Fusiliers), a member of the Broad Oak C.C., has been killed in action in Italy.

Leeds Christopher Casualties

FIVE members of the Leeds Christopher C.C. have made the supreme sacrifice, the latest being Sergeant Navigator D. McCormack and Sergeant Pilot L. Scott.

Cyclist's New Role

L. CALDERWOOD, Wingate C.C., has returned to this country after some exciting experiences in the Balkans. While working as a N.A.A.F.I. man in Crete he was captured, escaped and then joined some Greek patriots.

A Small Place . . .

TWO members of the Wearside Wheelers found themselves within 500 yards of each other during some heavy fighting in Normandy. They were B. Blakey and N. Grieveson, who had not previously met for some time.

In Japanese Hands

NEWS is to hand that Eric Drake, Bournemouth Arrow C.C., is a prisoner of war in Japanese hands. He states he is reasonably fit and well.

New "25-Mile" Record

BY clocking 59 minutes 18 seconds in the Manchester Clarion "25," C. Cartwright, of Manchester, lowered R. Dougherty's 25-mile record, put up in 1939.

50-Mile Champion

A. C. HARDING, Middlesex Road Club, won the R.T.T.C. 50-mile Championship of England by clocking 2.6.35 in the Yorkshire Cycling Federation "50."

East Anglian News

J. FITT, East Anglian C.C., and holder of a number of local records, has reached the Allied lines in Italy after an eventful dash from a prisoner-of-war camp. Originally captured in Tobruk, he was taken to Italy, and then, months after the Armistice, managed to get through to the British lines.

L. A. R. Lawrence Captured

CRACK 25-miler of the Norwich A.B.C. a decade ago, L. A. R. Lawrence is now a prisoner of war. He was serving with the Special Air Force.

Bournemouth Arrow Losses

ARTHUR HAMBLETON, Bournemouth Arrow C.C., has been killed in action in Italy, and his clubmate, Harry Vince, has been reported lost at sea. Two other members, F. Mason and G. Lynn, are prisoners of war in Germany.

R.A.F. Club Established

ANOTHER R.A.F. cycling club, the Lindholme Wheelers, has been established in South Yorkshire. Many prominent cyclists are included in its ranks.

G. Poole's New Role

GEOF. POOLE, well-known pre-war massed start rider, is now a petty officer in the Royal Navy, and is serving in Freetown.

J. Birss Decorated

FLIGHT SERGEANT J. BIRSS, Jesmond C.C., has been decorated with the British Empire Medal.

Alnwick R.C. Record

NO fewer than 32 members of the Alnwick Road Club are with H.M. Forces; one of them, W. S. Thompson, a Royal Marine "commando," has been reported missing in North-West Europe.

Shillito's Role

ARTHUR SHILLITO, former hon. secretary of the Road Racing Council, is now hon. secretary of the North London District of the R.T.T.C.

Midland Families Bereaved

TWO well-known Midland cycling personalities have been bereaved by the loss of sons on active service. They are M. P. McCormack, whose 22-year-old boy William died of wounds sustained in Normandy, and B. Bashford, whose son Eric was buried at sea after having previously been reported missing from air operations.

Road Events Cancelled

CERTAIN prominent road events have been cancelled in the London area owing to shortness of accommodation.

Toni Merkens

GERMAN news agencies report the death of Toni Merkens, 32-year-old sprinter of international repute, who was, perhaps, the most popular German rider ever to visit this country. In addition to winning British sprint championships, he also rode, as a professional, in two six-day races at Wembley.

Another Overseas Club

CYCLISTS in Italy have formed the Central Mediterranean C.C. Membership includes three famous Italian riders.

Welcome in Manchester

J. A. MOKWA, a member of the U.S.A. forces, has joined the Manchester Wheelers.

H. E. J. Cann Killed

CPRL. H. E. J. CANN, well-known London clubman, and prominent in the cycle retail trade, has been killed in action in Italy. He won the Military Medal at El Alamein.

Edinburgh's Activities

ONLY one active time-trialing club has survived the war in Edinburgh. It is the Edinburgh United C.C.

Ernie Stapley Missing

E. E. STAPLEY, Finsbury Park C.C., and initial secretary of the R.T.T.C., is reported missing following an operational sortie over Paris. He was a rear-gunner in the R.A.F. Another of the club's members, J. Cakebread, also with an R.A.F. air crew, is similarly posted.

Bristol's Loss

FORMER captain of East Bristol Wheelers and one-mile N.C.U. Bristol champion in 1938, George Stabbins has been killed in action in Italy.

West Scotland T.T.A. Chairman

JAMES CLIMIE, Douglas C.C., has been appointed chairman of the West Scotland Time Trials Association.

"25" Record for Cartwright

CYRIL CARTWRIGHT, Manchester Clarions, broke the British "25" record in his club's open event by 11 seconds when he clocked 59 minutes 18 seconds.

Eleanor Collins Best in Scotland

ELEANOR COLLINS, White Heather C.C., is the fastest girl in Scotland, with an average of 20.88 m.p.h. over distances of 10 and 25 miles.

Ian Duncan Missing

IAN DUNCAN, 1939 club champion of the Douglas C.C., has been reported missing from R.A.F. operations over Normandy.

Veteran Woman Tourist

MRS. H. W. SHEARD, of Bartley, Yorkshire, is in her 63rd year and still tours alone by cycle. She averages 60 miles a day, and this year toured Galloway and Southern Scotland.

Northern Revival

THE most northerly cycling club in Britain has been revived. It is the Thurso Social C.C., which suffered a partial eclipse during the four years of war. The new secretary is Mr. J. B. Gair, Castle Lodge, Thurso.

Youthful Tandemists

JESSIE and Mary Fordyce, seven- and five-year-old daughters of Timekeeper J. Fordyce, are now riding a juvenile tandem together, and have travelled to Glencoe on it for their holidays.

Forty Years a Cyclist

DAN QUINN, Douglas C.C., has just celebrated his fortieth year as a cyclist by a tour in the Lake District.

Hostel Warden

RONNIE CUNNINGHAM, Douglas C.C., is now the warden at Kyle of Lochalsh youth hostel.

Commandos in high spirits assembled ready for embarkation at a coast port, prior to landing in Normandy. Some of them have cycles for special jobs.

Around the Wheelworld

By ICARUS

Bartleet's Collection—Facts Wanted

MY comments on Bartleet's so-called collection of antique bicycles has brought me a large volume of correspondence from people who were apparently aware of Bartleet's inaccuracies, and who, moreover, assert that Bartleet knew they were inaccurate, for the inaccuracies were pointed out to him many times, *but he failed to rectify the labels.* I invite further letters from anyone able to supply evidence concerning any item or items in Bartleet's collection. Such letters will be treated in the strictest confidence. My only concern is to see that posterity is not misled by a collection which, as it now transpires, failed to mislead a few people, but evidently has misled a good many.

I have no doubt that some items in this collection are accurately described, but I am equally certain that a number of items which were claimed as the gems of the collection are spurious—notably the insupportable claim of Bartleet's to possess Hume's bicycle, equipped with the first pneumatic tyre. The location of the real Hume's bicycle is known; it is in the Belfast Museum. Dunlop's first tyre is in the Edinburgh Museum. It is a surprising fact that the Dunlop Rubber Company, which really ought to know better, sponsored the publication of Bartleet's book, in which is shown, on plate 55, the photograph of the machine which Bartleet claimed to be Hume's, with the alleged Dunlop tyre attached.

Unfortunately, the late H. H. Griffin, who really was a cycling historian, did not live long enough to correct Bartleet, and no one else seemed sufficiently interested to take the matter up. Those who now say that they knew all the time are guilty of grave remissness by their silence, helping to perpetuate something in the nature of a hoax—not to use too harsh a word.

The Old Timers

AND so it came to pass, the 27th Summer Meet of the—er—Fellowship of Timeworn Cyclists took place last month on a Sunday. The luncheon was at the "Royal" Hotel, Woburn Place, and about forty were present. Perhaps the most important item on the programme was Mr. G. Reynolds's suggestion that the Fellowship should have a sort of dictionary of all the members so that one could look up all the interesting points in a member's career! This suggestion was acclaimed with applause. Mr. Raybould, aged 95, was referred to by Mr. Reynolds, who proceeded to state how much Mr. Raybould regretted that he was unable to be present. Mr. Harold Johnson was made President in place of Mr. S. T. Capener, who was duly presented with the past president's wartime badge. Mr. Summers was reappointed hon. sec. and the old committee continued in office. In a few remarks Mr. Summers announced that there were 490 members and that since the last meeting 32 had passed away. A lot of the old faces are missing and one must not forget that in time the Fellowship will disappear. Thanks were accorded to Mr. Summers for all the work done on behalf of the club. And so the meeting terminated with thanks to the new President, Mr. Harold Johnson.

But has *every* member of this—er—Fellowship really qualified for membership?

N.C.U. National Championships for Manchester

HEADQUARTERS of the National Cyclists' Union have allocated the 1,000 metres and the 5 miles National Championships to the Manchester Athletic Club, for their race meeting.

N.C.U. Announcement

THE National Cyclists' Union announce that owing to unforeseen circumstances they have transferred their office to, First Floor, King William Street House, Arthur Street, E.C.4. Office hours are from 9.30 a.m. to 5.30 p.m. inclusive.

Road Accidents—June, 1944

ROAD casualties in June numbered 497 killed and 10,441 injured. There were 135 fewer deaths than in May, but 117 more than in June, 1943 (which was a relatively good month). Fatalities to pedestrians 15 years of age and over totalled 106, an increase of 50 per cent. on the total in June last year.

The following table shows the number of road deaths analysed according to the types of vehicles primarily involved:

Type of Vehicle	Number of Persons Killed.
Service (British, Dominion, and Allied of the three Services)	227
Civil Defence and N.F.S.	3
Public Service and Hackney	55
Goods	89
Private cars	34
Motor cycles	17
Pedal cycles	65
Others	7
Total	497

There is no implication that the driver of the vehicle primarily involved was culpable or responsible for the accident. C.T.C., N.C.U., and cycling contemporaries, please note!

The B.S.A. Folding Bicycle

IT was in the autumn of 1941 that the War Office made an enquiry for a folding bicycle for the use of parachutists. Specification: Weight not more than 23 lb. Guarantee: For a distance of at least 50 miles. Capable of standing being dropped by a parachute (the equivalent of an ordinary drop of about 20ft.).

The standard diamond frame type of bicycle was considered too heavy. As a result of experiments B.S.A. succeeded in evolving an unorthodox machine for the purpose: the eliptical bicycle. The result was the curved tube frame bicycle illustrated—the perfect balance between strength and weight. For obvious reasons, we cannot describe its specification in detail, the theory of stresses and strains or the metallurgical developments it embodies, but it is significant that B.S.A. technicians successfully accomplished one of the most difficult problems ever put before the bicycle industry—a great promise for the future. The frame of this bicycle was equal in strength to the diamond type, but its weight only 3 lb. with hinges, as compared with 8 lb. without hinges of the diamond type. This B.S.A. folding bicycle was accepted by the War Office.

For the purpose of test the B.S.A. motor-cycling test track consisting of loose ashes, and a test hill with a gradient of one in four, were used. A 15½ stone rider did 18 miles round the track on the first day, riding over railway sleepers, scrap dumps, and applying fierce braking when going down the test hill.

In spring, 1942, the War Office made their own tests on Salisbury Plain. Groups of three bicycles were dropped by parachute and then ridden 50 miles. No containers were used on the parachutes.

The first 50 B.S.A. folders were despatched to a French-Canadian force in Burma. Several thousand of them were used later in the invasion of North Africa. Many thousand B.S.A. folders have been made since then.

The machine is illustrated below.

R.T.T.C. Hill Climb Rules

THE regulations laid down for the conduct of road time trials shall be applicable to hill climbs, except that Regulations 5 and 38 shall not apply, and the following additional regulations shall apply:

Competitors shall wear, as a minimum, vests and dark coloured knickers reaching at least half-way to the knee. No competitor who, in the opinion of the responsible promoting official, is not suitably attired shall be allowed to start.

Competitors' numbers may be worn.

Competitors may be held up, but shall not receive a pushed start.

A Curious Letter

I HAVE received from Mr. S. C. Ticknell, Vicar of Latton-cum-Eysey, Wilts, the following letter:

"Motorist, pedestrian and dog protection associations should use their funds and influence to initiate a crusade against dogs being allowed on motor roads without a sufficiently strong lead in a sufficiently strong hand.

"They can always be exercised elsewhere.

"Only dog owners who are not also dog lovers will object to this."

This strikes me as a curious letter from one who signs himself "Hon. Promoter, 'Movement for Free and Natural Evolution of all Creatures Human and Non-human.'" Is a dog on a lead enjoying free and natural evolution? Cyclists want motorists on leads, and vice versa. We are all in favour of freedom, provided it is the other man we shackle to enable us to enjoy it!

Cycling 100,000 Miles

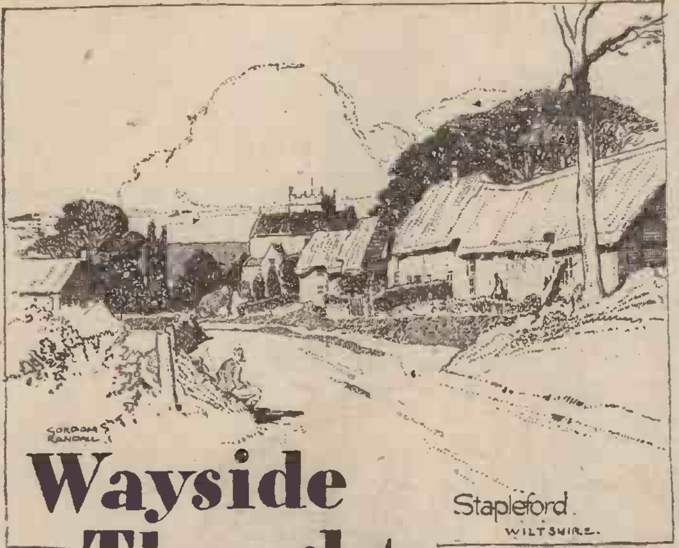
AN unusual cycling-to-work "record" is held by Mr. Frank Wood, of the Dunlop Rim and Wheel Dispatch Department, at Foleshill, Coventry.

Since 1913 he has covered more than 100,000 miles in this way and still does his 12 miles a day between Barnacle and Coventry.

Mr. Wood began work with Dunlop as long ago as November 3rd, 1896, splicing tyre wire at the Alma Street works. After two years in the Dispatch Department, he was for three years the only operator on making up solution.

After the 1914-1918 war Mr. Wood was transferred to the Dunlop Rim and Wheel Co. in the Artillery Steel Wheel Department, from which he came on to his present job.

The new B.S.A. folding bicycle ready for the road, and folded ready for transport.



Wayside Thoughts

by F. J. URRY

Touring To-day

I HAVE been trying to arrange a ten-days' tour for three people, and by good luck, some knowledge and a little persistence have managed the job, but it has taken me over three weeks of occasional time and more than 30 letters. The district was Wales, and because I know the Principality fairly well the job was eased on that account. I did not expect to meet quite so much difficulty, for I only wanted to book at five places, spending two nights at each; yet the accommodation question was not easy even in the remote villages well away from the seaboard. So after my experience I made numerous inquiries among my touring friends and discovered that several of them had given up the notion of place to place touring, and others had met similar disappointments in the old friendly accommodations at well-known spots, as had fallen to my lot. Therefore I think it right to pass on this knowledge, with the advice to get busy if you want to take a touring holiday late in the season, for from many of my old haunts comes the information that they are booked up until the end of October. I am sure the best way of touring to-day is to make a centre, or two centres, from which to radiate, for then you are sure of a bed and some food. A soloist may be lucky and find a place in which to rest his head on day-to-day journeys, but a party, even a small party, is taking a risk, and if that risk proves to be uncomfortable all the fun and joy of roaming is cancelled. Touring can still be undertaken if you are prepared to take the trouble to make arrangements, so we cyclists are better off in that respect than was the case in 1914-18, when conditions were almost impossible despite the fact that we had no restricted areas then. The delightful freedom of cycle touring is still possible, but to make it comfortable you must be prepared to take a little prior trouble in the matter of booking.

Smoking!

I HAD a query put to me the other day which may interest some of my friends. The questioner asked me if I considered smoking was harmful to cycling. My personal answer is "No," but then I ought to qualify that by stating the reply is largely dictated by my liking for the habit. I have never found smoking any inconvenience to cycling, and I hope I never shall, being too fond of both to allow either to dictate terms to the other. Actually, I seldom smoke while riding: firstly, because I think a real smoke demands a rest, and if possible the pleasure of a grand view, and secondly because the habit has been dictated by dentistry, for I can't hold a pipe comfortably enough to enjoy it. On the other hand, I admit all of us might be better if the nicotine habit were discarded, though I confess I'm not going to lead or join any non-smoking league. People say smoking "shortens your wind," and if this is a fact I am bound to say I haven't noticed it when comparing my hill-climbing powers with those of other non-smoking friends near my age. From the strenuous athletic point of view no doubt the non-smoker scores, but being long past that period I have no personal knowledge. When I was young and the competitive spirit was in me, I certainly gave up smoking during training time, but I cannot affirm that the self-sacrifice added anything to my speed. It was a fact, however, that I invariably carried a loaded pipe and a few matches in my racing kit, so that in case anything untoward occurred I could sit on the road verge, enjoy a long-denied pleasure while cheering on my erstwhile opponents. Smoking is one of the minor joys still left to us; I should hate to give it up, for it does me little, if any, harm, and is certainly a boon to that ever-hungry man the Chancellor of the Exchequer.

On Design

ONE of my trade friends, Mr. Walter W. Hackett, C.B.E., of Accles and Pollock, Ltd., tells me that the bicycle has altered very little since he first rode one, some 50 years ago, and that the modern one is too heavy, particularly remembering the enormous advances made in the science of metals. W. W. H., being a clever steel tube maker with many special manipulation devices to his name, deserves attention. Wheels and cranks ought to be lightened, he says, and fittings like brakes and guards can be made reasonably strong in alloy metals. And he has a word to say on cycle design. In his view it is about the only piece of machinery that has not altered out of all recognition during the last four decades. On this question of design the trade did try to make alterations at the beginning of this century, many cross frames and girder frames being introduced. But they found little favour with the cycling public, mainly because they did not add anything to strength, rigidity or running qualities of the bicycle. Actually it is probably true that our early designers did their job so well when they made the diamond frame that they cut the margin for improvement to very fine limits, and it has only been possible since then to introduce minor alterations that have justified acceptance by improving the breed. As far as weight is concerned, we may have added something on that account by the fitment of guards, brakes and speed gears. In my young days if you sported mudguards on a bicycle you were considered a "pansy," while brakes were taboo, free-wheels unknown, and speed gears still awaiting invention. We can do something, I think, about alloy fittings in the form of brakes, bars, seat pillars, and possibly lamps, while rims ought to be less weighty and can be made in steel far lighter than at present. I know this because I have owned rims of steel under 1 lb. each. Cranks are a different proposition, for a crank must be sturdy since every bit of give means wasted effort. If, however, we really want these things, then we must pay the price, for obviously the special article is more costly, though in the long run it is a great saver of energy—your energy.

Many Punctures

DURING the last six months I have had more punctures than ever I remember over a similar period. Some of these perforations are due to the fact that, like most other cyclists, I am wearing my covers to the last gasp, for the old habit of changing them when they begin to show signs of disintegration has perforce had to give way to the added risks that worn tyres engender. But the main trouble is broken glass and steel swarf, and in my area these handicaps to the healthiness of tyres seem to be as bad as ever. I do not know if anything can be done about it in the present state of affairs, beyond a chit to the people concerned with bottles and swarf—a direct Government chit—to be a little more careful in the handling of these articles, and clearing away the debris when an accident does occur. Certainly lorries on the job of swarf removal are overloaded and shed part of the overload along their route scattering trouble for the next comer. And, unfortunately, my daily journey is along these steel spattered ways, and my tyres suffer accordingly. Punctures and the repair of them do not worry me; it is the tyre destruction that makes me feel annoyed, particularly when a notice faces me imploring the public to take care of rubber. Years ago we could buy "thorn-catchers," a small chain or wire tangling on the tread of the cover for the purpose of extracting foreign matter before it became embedded by the constant pressure of many wheel revolutions. I never thought they were very efficient in the early days of the pneumatic, but they might be useful now because it is seldom swarf penetrates far into the tread when first picked up by the tyre. The right cure, of course, is to keep the roads clear of these destructives, but my official friends tell me that is impossible to-day, owing to labour shortage. As we have to grin and bear it for the moment, wisdom suggests we should look carefully over our tyres at regular intervals, yet even then we shall miss some of the tiny bits of puncture material that finally let us down at disconcerting moments.

Good Work

HERE is a case where cycling has been of inestimable service to an unfortunate. Four years ago a young lady acquaintance lost her right leg in the Birmingham blitz. She fully recovered some 12 months ago, and wondered if she could cycle again with the service of one leg only, and found she could providing the right bicycle was available. So the right machine—as far as present conditions permit—is now in the making, with a 57in. gear, and, of course, a fixed wheel. What we need, and are trying to obtain, for her is a 2-speed hub, which, with a low in the region of 42in., would give the lassie the leverage to ride most of the hills on ordinary roads. The 2-speed hub would also allow a free-wheel at will in the neutral position between the gears, and the change quadrant could be notched to give this neutral position. I mention this matter in case the idea may be of interest to other people, for the notion appeals to me because it gives the chance of a certain measure of activity to people who have had the misfortune to strike trouble as a direct result of war conditions.

Road Accidents

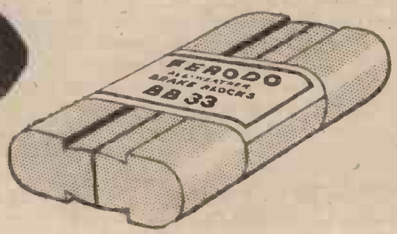
ROAD accidents are enormously increasing in ratio to the number of vehicles on the road, a deplorable fact, and one we should do well to face and conquer now, instead of waiting until the war ends and the crush of traffic returns. How we are going to cure the present carelessness, which is the cause of most accidents, I do not know, for I should hate to suggest imposing on other road users restrictive conditions which I should resent myself. But something—if necessary some drastic thing—must be done to improve road manners; for, in my opinion, it is a lack of ordinary decent behaviour, such as that we expect and get in our homes that is the main cause of the trouble. Being a daily rider, I am quite certain that behaviour on the road had deteriorated during the war years to a point needing a salutary corrective. Road accidents have been a national scandal for years, they are increasing, and will increase unless the corrective is applied without fear or favour. If the magistrates agree with this dictum let them act accordingly; they have the corrective power. If they refuse to use it, then replace them with men and women who will realise their duty to the road travelling public.

The Old Bell Inn, and the Parish Church, Thetford, Norfolk.

AWHEEL . . .
IN SAFETY

When you obey the 'call of the open road' be sure that you can rely on your brakes. Wet or fine, on steep hill, dangerous cross-roads or treacherous curve you can rely on Ferodo All-weather Brake Blocks. In all emergencies they grip firmly and noiselessly giving confidence and safety along every mile you ride. Be sure to fit

FERODO



ALL-WEATHER BRAKE BLOCKS

REGD. TRADE MARK FERODO

FERODO LIMITED, CHAPEL-EN-LE-FRITH

CYCLORAMA

By H. W. ELEY


The lovely little Essex village of Finchingfield.

Smiling in the Rain

CYCLISTS are usually happy folk, and I was interested to see the smiling faces of cyclists when the rains came . . . after such a prolonged drought. It is always rather a mystery to me why people—in the dry spells—long for rain, and then when it comes indulge in "grouses" and talk as if we never had any sunshine! Rain is just one of the ingredients of our varied weather, and, personally, I like nothing better than a ride in the rain. One must be suitably clad, of course, but providing the "garb" is right, then a bike ride through the gentle rain can be grand indeed. What a pleasant smell from the drenched fields! What a gorgeous twittering from the green hedgerows! Few people on the roads . . . the rain in one's face, and the joy of knowing that at the end of the road there is the warm welcome from the inn! And sometimes, if one is lucky, there is the grandeur of the rainbow! The good cyclist does not grumble at the rain!

Wooden Pedal Blocks

I MET a rider the other day whose mount was equipped with wooden pedal blocks . . . another indication of the rubber shortage! I was interested in examining these blocks, and found that they were manufactured from beech. They seemed fairly satisfactory, but, I fancied, an unwelcome substitute for the rubber. But rubber is still a precious commodity, and in spite of all we hear about synthetic, the rubber problem is still with us, and the utmost economy is still essential.

Cycle Manufacturers' Publicity

THERE may be manufacturing difficulties; supplies may be short; trading presents many problems . . . but in spite of all these things, the British cycle manufacturers are alive, and are wisely keeping up their advertising. One has only to look through the pages of a cycle trade journal, to realise that the manufacturers have a progressive policy, and are alive to the fact that to stop advertising is to court future disaster. "Keep the name going," is good advice in these wartime days, and it is to the credit of the British cycle industry that its members have had the wisdom and foresight to realise that good advertising is . . . good business.

Thinking of the Future

A WELL-KNOWN writer on cycling topics has been taking a peep into the future, and the vision he sees is a rosy one. His view is that the war has brought to the ranks of cyclists large numbers of middle-class folk who, previously, were ardent motorists. Petrol restrictions, and the cutting down of motoring, has converted them to the joys of cycling . . . and it may well be that, once having tasted these joys, they will not be disposed to give them up even when cars are available again. And, in addition, there are the large numbers of retired folk who, seeking a pastime for their days of leisure, will turn to cycling. It is, I fancy, a sane view of the future, and one which should give encouragement to the men in the cycle business.

The Essential Bike

BUSINESS took me recently to a large Midlands munition works, and I happened to be there at the moment when thousands of workers were leaving the plant . . . and tremendous numbers of them were on bikes. I saw these men and women taking their machines from the cycle sheds, and could not help thinking what an essential thing the bike has been in the nation's war effort! Trams and buses were near to the works exits in plenty, but they would have been sadly overtaxed had it not been for those trusty bikes! The riders streamed out of the gates, and I thought how convenient the bike is . . . no trouble, no waiting, just a pleasant ride home. Just one little fly in the ointment: so many of the tyres were under-inflated!

The Old Cleric . . . and the Old Bike

QUITE often one sees ancient cycles, and ancient cyclists, but the other day I saw an exceptionally old man, a parson, and he was riding a very old cycle. I chatted with this veteran rider, and found that the machine was a "Coventry Eagle," of very ancient vintage. My clerical friend had possessed it for over twenty-five years, and had ridden it hard . . . all over his scattered parish. It was obviously an old friend, indispensable to this country shepherd-of-souls. We talked of bikes, and rural rides, and adjacent villages, and I found that the old man had, in his youth, done some quite remarkable rides around the country. He told me of old-time customs in the villages; of farming in the years before mechanisation came; of village "characters"; of ancient superstitions and weird beliefs, and I left him prepared to believe that for years yet he would be pedalling that old mount around his parish, and finding joy in doing so. Salute to veterans!

"Monty" Holbein Passes On

SO a grand old man of cycling . . . and of swimming . . . has passed on; and his passing will bring regrets and memories to many. Holbein was a great athlete, and a man of iron will and endurance. His swimming feats are legendary, although he never achieved his life's ambition to swim the English Channel. In the cycling world he won the North Road Twenty-Four Hours for four successive years. A great figure, who proved that "old age" is not the signal to give up cycling, or other pursuits.

The Wartime "Derby"

THE restrictions on rail and car travelling did not prevent racing enthusiasts from attending the wartime "Derby"—but the interesting thing is that so many went by cycle; never before, I imagine, have so many folks travelled to a race meeting on cycles, and the great procession constituted just one more proof of the utility of the cycle, which has, during this mighty war, come very definitely into its own.

The Nomads

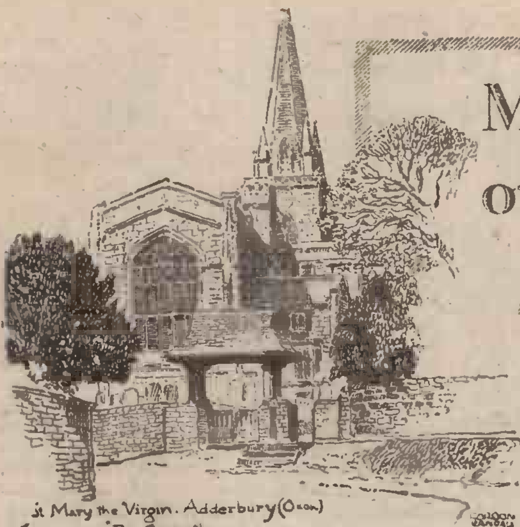
I HAVE always been interested in gipsies, and in peacetime, whenever I came across a little company of them I endeavoured to have a chat and learn something of the ways of these nomadic folk, so picturesque, so "different," and so stubborn in their determination to cling to their wandering existence. Recently there has been published a book about the Romany, written by the editor of *The Field*; and a wonderful book it is, giving the story of the gipsies in graphic form, and dealing with fortune-telling, camp-fires, horse-dealing, funeral rites and all the other things we associate with the wanderers and their ways. It is evident that the author of the book loves gipsies—and that is an essential to any intelligent understanding of them; it is only by mixing with them that one may learn . . . and what a lot there is to learn! Of their origins, one can only say that there seems good evidence that the true Romany came from the Balkans, and the men and women I have talked with, in the lanes and on the commons of southern England, were descendants, I fancy, of tribes which came from Hungary and Bulgaria; but one cannot be dogmatic on the matter—sufficient that the gipsies are an enchanting people, with all kinds of secrets locked in their hearts.

Suffolk

BROWSING among old maps and note-books recently, I came across some jottings I made of a cycle tour in Suffolk . . . quiet, lovely Suffolk, where one may still see villages and streams and old mills just as Constable saw them in his day, when he painted such masterpieces as *The Hay Wain*. Suffolk has preserved its beauty to a remarkable degree; of course there is no coal beneath its peaceful surface, and that accounts for much! How lovely are such villages as Kersey and Long Melford! How full of interest such little coast towns as Southwold and Aldeburgh! To the tourist who always "goes west" and will have none of East Anglia I would say "go to Suffolk," and see an unforgettable English scene.

My Point of View

BY "WAYFARER"



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

Naïve

IN being introduced the other day to a lady, with the information that I was a prominent cyclist, she at once asked me whether I preferred cycling to motoring. This naïve—indeed, silly—question immediately wound me up, and I replied vigorously that you couldn't compare non-comparable things, and that, in any case, I hadn't the slightest use for motoring, which I found usually did me more harm than good.

Travel Harvest

ONE of the men in the factory which I adorn with my presence daily (Sundays excepted) came to me last year, on the eve of his holidays, with the news that he had booked rooms for a week at Kilpeck, and would I tell him where the place was and how to get there? Thanks to my being a cyclist, I was able readily to locate the spot for him, and, as I had recently visited the district, I knew the name of the railway station where his outward journey would finish. History repeats itself! The man has just been to me again on a similar quest. This year he is going to Llanafan. All he knows about the place is that it is "somewhere near Aberystwyth." So the map is consulted and the village located, together with the name of the nearest railway station, and I again pose as a Public Benefactor—thanks to my experience as a cyclist. My friend was good enough to say that he did not know anybody else who could help him, which may—or may not—be true. Anyhow, I was glad to let him have the use of my travel harvest.

Evening Trail

THERE came an occasion recently when, fed up with devoting every evening to work, the decision was reached to break away and go for a ride. Quickly changing into my glad rags, I was soon on the road, in full enjoyment of the exercise and the fairly quick passage through the air, and viewing with eagerness the prospect of obtaining an extra look at the countryside when once suburbia had been pushed astern. And what a countryside! There was no superabundance of sunshine, but the air was very clear and the foliage was rich in colour. From two separate points I gazed across broad acres to intensely green belts of trees, over which it was a joy to see grey hills showing from a distance . . . hills in Worcestershire, Shropshire, and Oxfordshire. At a wayside cottage I sat for an hour, drinking tea and yarning, and then I did the return journey. That evening trail of 34 miles occupied, in all, four hours, and it seemed to me like a half-day holiday. Anyhow, I resumed my job with new energy and a fresh outlook, feeling all the better for a short period stolen from the tyrant work.

This evening trail idea is an excellent one. It is not easy to keep it going as a regular feature of one's life, as was once the case, but I never lose an opportunity of indulging in a mid-week "training spin." It makes a pleasant break in the everlasting programme of work, work, work.

High Perch

TWO young men overtook me the other Sunday evening—I am easily overtaken nowadays!—and I tucked in behind them for a while. I noticed that one of the lads (who both rode well) occupied a high perch on his bicycle—so high, indeed, that his legs had to be fully stretched with each pedal revolution. Coming alongside when the opportunity offered, I inquired whether he would resent a word of advice from one old enough to be his father. As no objection was raised, I suggested that his saddle was far too high, and that he should drop it at least one inch, possibly two inches. The reward was immediate, for the lad replied that one of his knees was giving him trouble, and he wondered what was wrong. I said that he now knew the probable cause, and that, if he lowered his saddle, as suggested, the trouble would be cured. So his attention was promised to this important point, and the lads passed out of my life. I hope that, by now, the saddle has been pushed down; I hope, too, that other cyclists, with or without knee trouble, will look into their saddle position and make sure that they are not too highly perched. In that way is cycling developed into hard work!

Misconception

ONE evening in July, at the end of a day's ride which had included four hours of steady rain, a lady said to me: "But aren't you afraid of skidding?" The question struck me as being so ridiculous that I replied, with perhaps more force than was really necessary: "No! you can't skid when the roads are swimming-wet." I believe that statement to be true. The skidding (or side-slip) danger nowadays arises—if it arises at all—during the road-drying process. In practice, however, experienced cyclists do not "take it lying down," if I may quote an old political tag. The possibility is there when, in abnormal circumstances and given the "right" road conditions, sudden braking is necessary, or an awkward crossing of tramlines is unavoidable. But, by and large, we remain upright.

The Better Plan

PEOPLE often talk about the desirability of "starting as you mean to go on"—a policy which, normally, is no doubt quite sound. An exception, however, should occur in respect of the commencement of a cycle journey, which emphatically should not be made at anything like the pace at which "you mean to go on." You see inexperienced wheelfolk starting off at full speed, to find themselves in difficulties at the end of a few miles. My own plan, adopted long years ago—and I am convinced that it is the better plan—is to "go slow" to start with and gradually to work up to normal speed. Then I can "stay put" for hours, and at the end of the day's journey I find myself still riding strongly, and still with something "up my sleeve" in case it is required. "Play yourself in" should be the motto. Avoid starting out at top speed.

The Price

A REMARK recently made by an eminent medico in the person of Lord Horder seems to me to be worthy of the widest publicity: "Every man is not prepared to pay the price of possessing a healthy body." As I see it, a healthy body demands exercise—regular exercise—in the open air, and one of the easiest methods of obtaining that exercise is through the medium of cycling. The population of this country will be immeasurably enriched when many more men—and women—are "prepared to pay the price of possessing a healthy body," preferably through the medium of cycling.

Benefactor!

ON my way home from business the other evening I overtook a youth, of the University-student type, whose tyres were flabby. My friendly suggestion that he should "shove some air into them"—for I hate to see tyres being abused—provoked the retort: "I would if I had a pump." I replied: "If that's all you want try this," handing him my pump, and in a minute or so I had the satisfaction of seeing him ride board-hard tyres, thus adding to their life and to his own comfort. It was easy!

Notes of a Highwayman

By LEONARD ELLIS

The Lure of the Map

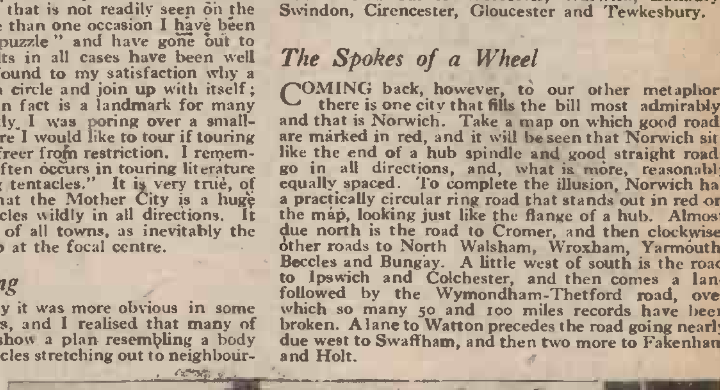
THERE is endless enjoyment in the study of maps, if only to appreciate their beauty and the skill of the cartographers. Most cyclists can browse contentedly over a plan of their favourite touring grounds; many are able, after long practice, to conjure up a fairly accurate picture of unknown territory complete with trees, hills, valleys, rivers, churches and the like. Frequently also the map shows up a curious combination of natural features that is not readily seen on the ground itself. On more than one occasion I have been intrigued by a "map puzzle" and have gone out to investigate. The results in all cases have been well worth while. I have found to my satisfaction why a river seems to flow in a circle and join up with itself; that an isolated knoll in fact is a landmark for many miles around. Recently I was poring over a small-scale map deciding where I would like to tour if touring were a little easier and freer from restriction. I remembered the phrase that often occurs in touring literature—"London's sprawling tentacles." It is very true, of course, and suggests that the Mother City is a huge octopus throwing tentacles wildly in all directions. It is true to some extent of all towns, as inevitably the road links must join up at the focal centre.

Early Roadbuilding

IDLY I speculated why it was more obvious in some cases than in others, and I realised that many of the old Roman towns show a plan resembling a body with eight or more tentacles stretching out to neighbouring towns. I noticed that these old Roman towns, broadly speaking, had straighter arms than the newer towns. It did not require a great mental effort to realise that the roadbuilders in those days had little to contend with in the way of private estates, and their ideas of roadmaking were like Euclid's definition of a straight line—the shortest distance between two points. I imagine that cyclists, in their search for a more apt metaphor, often use the expression the "spokes of a wheel." On the map the picture of London as an octopus is somewhat marred by the amazing conglomeration of roads weaving or intersecting the main radiations in all directions. Coast towns like Sunderland and Liverpool show an octopus on the beach with all his legs landward, but York, Salisbury, Canterbury, Chelmsford, Carlisle and Shrewsbury are all fairly good animals with no such one-sided preferences. Among the newer towns Northampton and Leicester are good examples of road-centres. Stow-on-the-Wold is another place that is a remarkable road-centre, particularly when one remembers its small size and relative lack of importance. From here seven great arms stretch out to Worcester, Warwick, Banbury, Swindon, Cirencester, Gloucester and Tewkesbury.

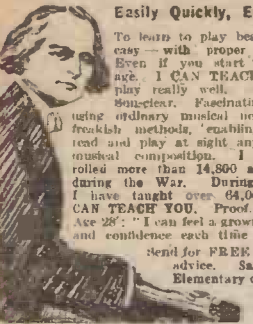
The Spokes of a Wheel

COMING back, however, to our other metaphor, there is one city that fills the bill most admirably, and that is Norwich. Take a map on which good roads are marked in red, and it will be seen that Norwich sits like the end of a hub spindle and good straight roads go in all directions, and, what is more, reasonably equally spaced. To complete the illusion, Norwich has a practically circular ring road that stands out in red on the map, looking just like the flange of a hub. Almost due north is the road to Cromer, and then clockwise, other roads to North Walsham, Wroxham, Yarmouth, Beccles and Bungay. A little west of south is the road to Ipswich and Colchester, and then comes a lane followed by the Wymondham-Thetford road, over which so many 50 and 100 miles records have been broken. A lane to Watton precedes the road going nearly due west to Swaffham, and then two more to Fakenham and Holt.



Old houses in Mill Street, Warwick.

MASTER THE PIANO



Easily Quickly, Enjoyably.

To learn to play beautifully is easy — with proper teaching! Even if you start at middle age. I CAN TEACH YOU to play really well. By POST. Sun-clear. Fascinating Lessons using ordinary musical notation, no freakish methods, enabling you to read and play at sight any standard musical composition. I have enrolled more than 14,800 adult pupils during the War. During 39 years I have taught over 64,000, and I CAN TEACH YOU. Proof. Beginner Age 28: "I can feel a growing mastery and confidence each time I play."

Send for FREE BOOK and advice. Say Moderate. Elementary or Beginner.

Mr. H. BECKER

(Dept. 258). 69, Fleet St., London, E.C.4

HELP TO MAKE A BRAVE NEW WORLD

It is our duty to contribute towards the building of a better world of international friendship. Join the great band of Esperantists who have pen-friends all over the globe and find a welcome wherever they go. Esperanto is the international auxiliary language, which has been in use for over fifty years.

A complete correspondence course costs only 5/-.

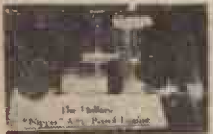
Write for full particulars to the

BRITISH ESPERANTO ASSOCIATION, INC., Dept. P.M.10, Heronsgate, Rickmansworth, Herts.

MATRICULATION

brings Success & Security

Whatever your age, you can now study for the all-important Matriculation Examination at home on "NO PASS—NO FEE" terms. "MATRIC" is the accepted passport to all careers, and opens up opportunities which would otherwise be completely closed to you. Ensure the success and security of you and yours through post-war difficulties by writing for our valuable **"Guide to Matriculation"** immediately—**FREE** and without obligation. **B.T.I. (Dept. 160), 356, Oxford Street, London, W.1.**



Easily made From Our Castings.

J. HALLAM & SON, Upton, Poole, Dorset.

MINIATURE PETROL ENGINES for Aeroplanes and Speed Boats.

Send 3d. for particulars

LINESIDE FEATURES:	"00"	"0"
PLATELAYERS' HUTS	3/-	3/6 & 5/6
COAL OFFICES	3/- & 3/9	6/6 & 9/9
WEIGHBRIDGE AND OFFICE	5/- & 7/6	9/-
BUNGALOWS	7/6	—
WATER TANKS	16/9	—
OIL TANKS	15/6	24/9
CONTRACTORS' HUTS	3/-	6/6

BOOKS:

"Our Railway History." Part I. By R. Bucknall. 3/-, by post 3/3.

"Scale Railway Modelling To-day" (2nd Edition). By Edward Beal. 12/6, by post 13/-.
CASH FOR YOUR USED MODELS, MAGAZINES and BOOKS.

Tyldesley & Holbrook, 109, Deansgate, Manchester, 3. 'Phone: Bla. 7312

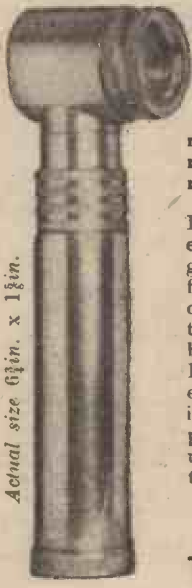
Ideas Wanted!

They may mean money for you!

We are open to consider any ideas or patents of practical worth with a view to making and marketing them. Write in confidence to:

Edron Industrial Group, 7 Park Lane, London, W.1

THE ULTRA LENS AIDS PRODUCTION



Actual size 6⅞in. x 1⅝in.

This patented Electric-Magnifying Lens of the most modern design has stood the test for the past few years and has proved to countless industrial Firms its extreme and sustained usefulness for minute surface examinations of every conceivable object, metals, tools, fabrics, fibres, raw materials.

It is very useful in Tool Rooms for examination of freshly hardened tools, gauges, etc. It will detect hidden fractures and will prevent tools with ordinarily undetectable cracks—cracks that occur in the hardening process—being placed in service.

Revealing every detail with startling exactness, highly magnified and brilliantly illuminated in natural colourings, it presents in many instances hitherto unsuspected data which can be used to advantage.

Full particulars on request

THE ULTRA LENS COMPANY

RICHARD BOCK

BRITISH MADE

75, Finsbury Court, FINSBURY PAVEMENT, LONDON, E.C.2

DATA SHEETS

ELECTRIC GUITAR UNITS. No. GU. 1.—This revised edition deals with the principle and operation of electro-magnetic units, and gives full constructional details with blueprint of three highly efficient designs. Price 5/-.
ELECTRIC ONE-STRING FIDDLE. No. ESF. 5. This instrument must not be compared with the old fashioned type, as its quality and rich tone is that of a good violin or viola. Complete constructional details and blueprint, 5/-.
TRANSVERSE CURRENT MICROPHONE, No. TMC. 1.—A high efficiency instrument, simple to make, and capable of giving first-class results on speech and music. Complete details with blueprint, 2/6.
OHM'S LAW. No. OL. 1.—This simple but vital formula is dealt with in a clear and concise manner and worked examples are given. Price 1/2½.
AUTOMATIC GRID BIAS CIRCUITS. No. AGB. 1.—Complete details and circuits of methods of obtaining grid-bias without batteries. Price 1/2½.
Send S.A.E. for complete list of Data Sheets, stating any particular requirement.

L. ORMOND SPARKS, 9, PHOEBETH ROAD, BROCKLEY, S.E.4.

B.A. thread screws and nuts, 1 gross assorted useful sizes, 2/6; ditto brass washers, 1/6 gross; fibre washers, 1/6 gross; assorted solder tags, 2/- gross; assorted small eyelets and rivets, 1/3 gross. Rubber-covered stranded copper wire, 1d. yard; heavier quality, 1½d. yard; very heavy quality, 2½d. yard; ideal for aerials, earths, etc. Tinned copper connecting wire, 20ft. coil, 6d.; ditto rubber covered, 10ft. coil, 6d. Braided twin electric cable, 6d. yard. Finest quality resin-cored solder, ¼lb., 2/-. Wood's metal stick, 2½in. by ¼in., 1/-. Cotton covered copper instrument wire, ¼lb. reels, 18, 20, 22, 24 gauges, 1/6; 26 gauge, 1/9; 42 gauge double silk-covered, 2oz. reel, 2/-; 36 gauge ditto, 1/9. Sensitive permanent crystal detectors. Tellurium-zincite combination, complete on base, guaranteed efficient, 2/6; reliable crystal with silver cats-whisker, 6d. Reconditioned headphones, complete, 4,000 ohms, 12/6. All postage extra.—**POST RADIO SUPPLIES, 33, Bourne Gardens, London, E.4.**

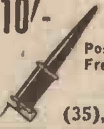
SILVER PLATING SETS

as supplied to Electroplaters, but in miniature, for small parts, etc., instructive small sets, 19/- inc. post. Send 2½d. stamp for printed folder.

MERCURY WANTED URGENTLY high price paid, write for quotation.

ARGENTA PRODUCTS, Dept. C, 40, Harrogate Road, LONDON, E.9.

"VIBRO-ARC" Engraving Pen



10/- Post Free

For rapid engraving any metal—hard or soft. Operates from 4-6v. Battery or A.C. Transformer.

HOLBOROW, (35), Boroughbridge, Yorks.

ELECTRIC ENGRAVERS.—Powerful instruments in cylindrical case, on stand with spring attachment and switch. Suitable for dog collars, tool marking, etc., 4-6 volt model, price 55/-; A.C. Mains model, 200-240 volts, 75/-, postage 1/-.
PHOTO-ELECTRIC CELLS.—For all sound films, high fidelity production, speech and music. Large tube, 4-pin base, 2¼in. x 1in. Price 28/6. Small tube, 2 terminal base, 1¼in. x ⅞in. Price 26/6.
COMPLETE OPTICAL SYSTEM for 35 or 16 mm. sound film, 2in. long, ⅜in. diam., projects, 0.001in. light image. Price £2/17/6.
BATTERY CHARGERS FOR A.C. MAINS. FOR CHARGING 2-volt accumulators at ½ amp. Parts with diagram, 12/6. Complete, 21/6. Postage 10d.
FOR TRICKLE CHARGING CAR CELLS, parts with diagram. Output 1¼ amps. for 6v. cells, 30/- set. For 12v. cells 35/- set. Larger sizes quoted for.
MICROPHONE BUTTONS, 2/3.
TELEPHONE WATCH RECEIVERS, 9/6 each.
MORSE TAPPERS, Good Quality, 2/6 each.
MORSE BUZZER, Tunable, 6/6 each.

ECONOMIC ELECTRIC CO.,

64, London Road, Twickenham, Middlesex.
Tel.: POPesgrove 1318.

WE WILL PURCHASE

Models and Machines of every description. Railways and parts from gauge 00 to 15. Boilers, Engines, Boats, Meccano, etc., etc. State fullest particulars and price required in first letter to save unnecessary correspondence.
We also have FOR SALE fair stocks of the above. Stamp with requirements.

BOTTERILLS, Models, Department, **HIGH STREET, CANVEY, ESSEX**

LARGE DEPT. FOR TECHNICAL BOOKS

FOYLES

★ **BOOKSELLERS TO THE WORLD** ★

New and secondhand Books on Engineering and all other subjects.

119-125, Charing X Rd., London, W.C.2

Open 9 a.m.-6 p.m. including Saturday.

Telephone: Gerrard 5660 (16 lines)

W. & G. Foyle, Ltd.

RATCHET & REVOLUTION COUNTERS

Ask for Leaflet No. 18/3

Speed up to 6,000 r.p.m.

B. & F. CARTER & CO LTD., BOLTON 5

A.C./D.C. FOUR VALVE M.W. RECEIVER. Build the "WIZARD" in an evening. Set of instructions, clear wiring diagram, component layout, theoretical circuit, parts list and prices—5/- post free. Uses British valves, obtainable from us. Many equivalents. Components sold separately. Your queries answered free S.A.E. No callers. BATTERY VERSION READY OCTOBER.—**Franklin Developments, "Weldona," The Avenue, Finchley, London, N.3.**

Build your own

TOY or MODEL MAKER'S LATHE

from easily obtainable materials, costing 50/- to 60/-. Set of diagrams (6) and clear instructions for making all parts, including two types of Headstock and Chuck—Price 3/9. No castings or machining needed.

P. M. BARHAM, "Hilltop," Bradmore Green, Coulsdon, Surrey

(Parts stocked.)

"Practical Mechanics" Advice Bureau

COUPON

This coupon is available until September 20th, 1944, and must be attached to all letters containing queries, together with 3 penny stamps. *A stamped, addressed envelope must also be enclosed.*

Practical Mechanics. September, 1944.

CLASSIFIED ADVERTISEMENT RATES

5d. per word, minimum charge 5s. per paragraph of 12 words or less. Cash with order.

TOYS, MODELS and NOVELTIES. Send for range of popular designs with full instructions. 2/6 only post free.—Harrod, 10, Beaconsfield Road, Maidstone.

LIGHTER Wheels, 1/-; Lighter Cases 2/3; Pkt. 8 Ass. Lighter Replacements 2/6; Bargain Parcel Lighter Spares and Accessories 10/-. Post free.—BCM/Cleaveland, W.C.1.

ALARM Clock Mainsprings, 6 ass., 18/- post free.—BCM/Cleaveland, W.C.1.

MODELS made by engineer who specialises in all Patent Work, Design, Drawings, and marketing of patents.—BBJY, London, W.C.1.

NEW MACHINERY. *For essential work only.* Electric Motors, Band Saws, Drilling Machines, Pumps, Grinders, Welders, etc.—John P. Steel, Bingley.

Free Guide—"Success in Engineering"

One of the following Courses taken at home in your spare time can definitely be the means of securing substantial promotion in your present calling, or entry into a more congenial career with better prospects.

ENGINEERING, ETC.

Radio — Telegraphy — Telephony — Welding — Aerodynamics — Electrical Engineering — Television — Electric Wiring—Talking Picture Work—Generation and Supply — Works Management — Metallurgy—Refrigeration — Planning, Estimating, Rate-fixing — Time and Motion Study—Aero Inspection—Automobile Engineering—Sheet-metal Work—Engineering Draughtsmanship—Aero Draughtsmanship—Jig and Tool Draughtsmanship—Press Tool and Die Draughtsmanship — Structural or R/F Concrete Draughtsmanship — Sanitary Engineering — R.A.F. AND R.N. PILOTS AND OBSERVERS.

GENERAL

Matriculation — College of Preceptors — Chartered Institute of Secretaries — Aircraft Apprentice — Salesmanship—LONDON MATRICULATION.

MUNICIPAL SERVICE

School Attendance Officer—Handicraft Teacher—Registrar—Relieving Officer—Sanitary Inspector—Weights and Measures Inspector—Inst. of Mun. and Cy. Engineers—P.A.S.I.

"PRACTICAL ENGINEERING" said—

We recommend all readers interested in improving their position to apply for a copy of this valuable book. "Success in Engineering" is not a pamphlet. It is a 124-page book, containing valuable and vital information on all branches of engineering . . . There are many engaged in engineering who owe their success to The National Institute of Engineering.

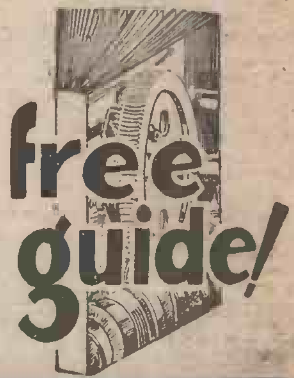
The FREE GUIDE explains:

- Openings, prospects, salaries, etc., in Draughtsmanship, Inspection, and opportunities in all other branches of Engineering and Building.
- How to obtain money-making technical qualifications through special RAPID FULLY-GUARANTEED COURSES.

Write now for your copy of this remarkable publication.

A.M.I.E.E., A.M.I.Mech.E., A.M.Brit.I.R.E., A.M.I.P.E., A.M.I.C.E., A.M.I.Struct.E., A.M.I.A.E., A.F.R.Ae.S., A.M.I.S.E., M.R.San.I., London B.Sc., Degrees.

Fully guaranteed postal courses for all the above and many other examinations. Fully described in the Free Guide.

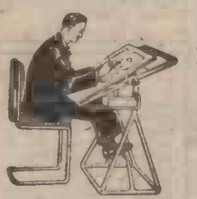


THE BUILDING BOOM— SECURE YOUR SHARE!

The Free Guide also gives particulars of our extensive range of modern Building and Structural Courses, Surveying and Levelling, Quantities, Costing, Building Draughtsmanship, etc. The great post-war Building programme offers unlimited prospects to technically trained men.

—BECOME A DRAUGHTSMAN— or AERO INSPECTOR AND EARN BIG MONEY

Men and Youths urgently wanted for reserved occupations as Draughtsmen, Inspectors, etc., in **Aero, Jig and Tool, Press Tool, Electrical, Mechanical** and other Branches of **Engineering.** Practical experience is unnecessary for those who are willing to learn—**our Guaranteed "Home Study" courses will get you in.** Those already engaged in the General Drawing Office should study some specialised Branch such as Jig and Tool or Press Tool Work and so considerably increase their scope and earning capacity.



THE ACID TEST OF TUTORIAL EFFICIENCY

SUCCESS—OR NO FEE

We definitely guarantee that if you fail to pass the examination for which you are preparing under our guidance, or if you are not satisfied in every way with our tutorial service—**then your Tuition Fee will be returned in full and without question.** This is surely the acid test of tutorial efficiency.

If you have ambition you must investigate the Tutorial and Employment services we are able to offer. Founded in 1885, our success record is unapproachable.

Why not fill in and post the attached coupon NOW for further details and Free Authoritative Guide to openings in Engineering and Building? This book contains a mine of valuable and exclusive information and may well prove to be the turning point in your career.

PROMPT TUTORIAL SERVICE GUARANTEED

NATIONAL INSTITUTE OF ENGINEERING

(Dept. 29)

148, HOLBORN, LONDON, E.C.1

NEARLY SIXTY YEARS OF CONTINUOUS SUCCESS

SOUTH AFRICA BRANCH: E.C.S.A. P.O. BOX 8417 JOHANNESBURG.

FOUNDED 1885—FOREMOST TODAY—OVER 100,000 SUCCESSES

FREE COUPON

To NATIONAL INSTITUTE OF ENGINEERING (Dept. 29), 148, Holborn, London, E.C.1.

Please forward your FREE Guide to

NAME ....

ADDRESS.......................................

....

My general interest is in: (1) ENGINEERING (2) BUILDING (3) MUNICIPAL WORK *(Place a cross against the branch in which you are interested.)*

The subject or examination in which I am especially interested is

....

To be filled in where you already have a special preference.

(1d. stamp only required if unsealed envelope used.)

Published about the 30th of each month by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and Printed in England by the Newnes and Pearson Printing Co., Ltd., Exmoor Street, London, W.10. Sole Agents for Australia and New Zealand—Gordon & Gotch, Ltd. Sole Agents for South Africa—Central News Agency, Ltd. Subscription Rates (including postage). Inland 10s. 6d. per annum. Abroad, 10s. per annum. Canada, 10s. per annum. Registered at the G.P.O. for transmission by Canadian Magazine Post.