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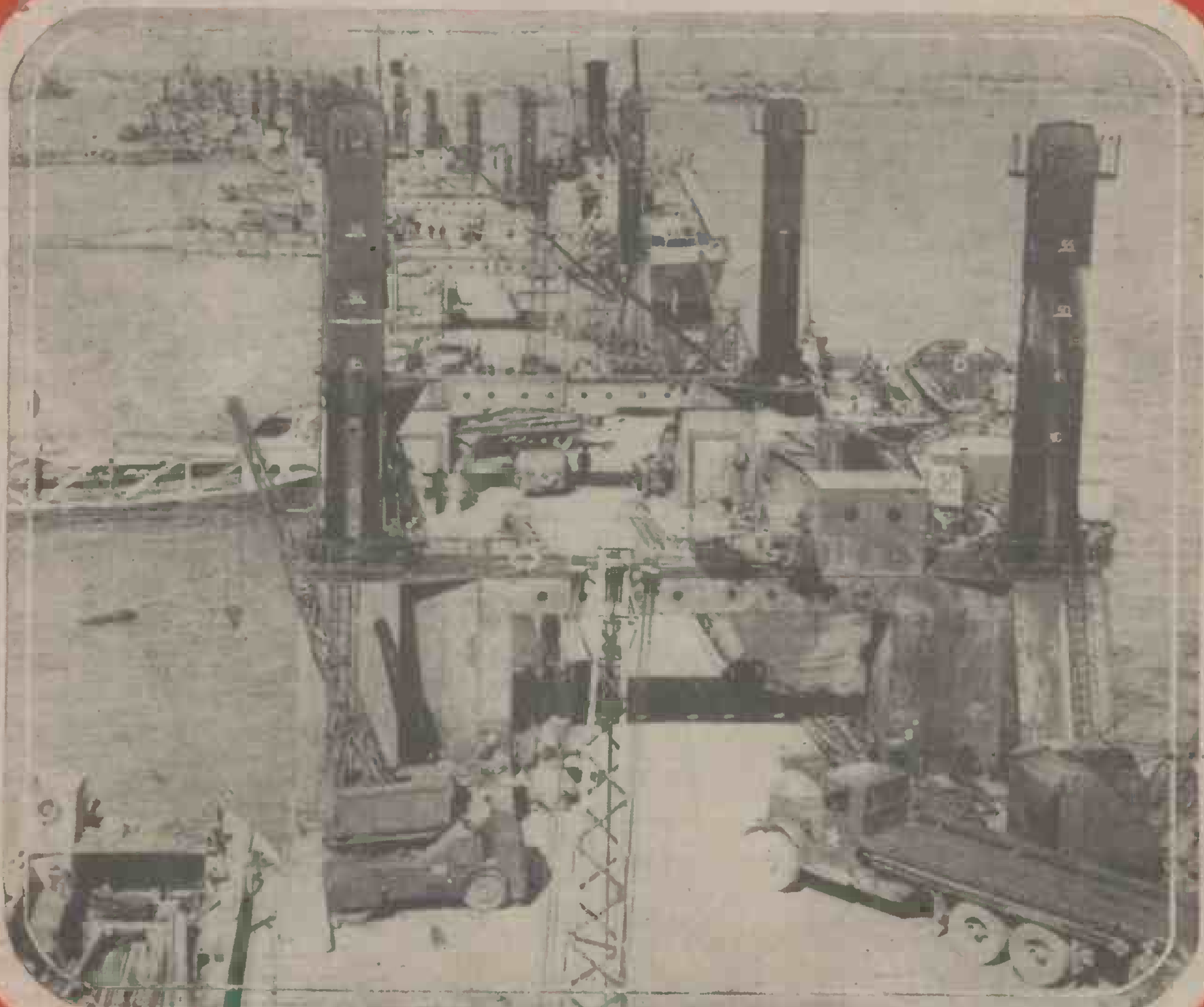

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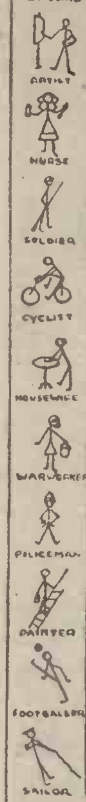

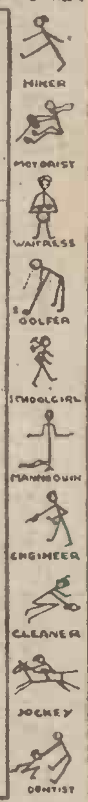

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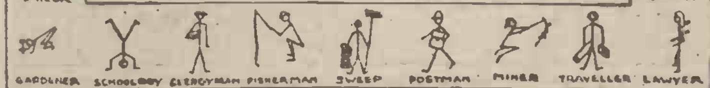

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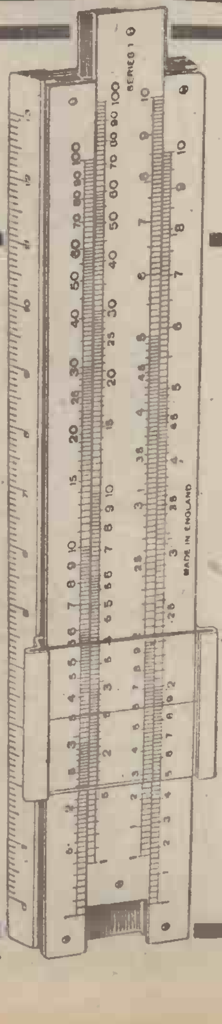

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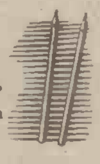

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Owing to the paper shortage "The Cyclist," "Practical Motorist," and "Home Movies" are temporarily incorporated.

Editor: F. J. CAMM

VOL. XII DECEMBER, 1944 No. 135

FAIR COMMENT—BY THE EDITOR

The Gas Industry

ALTHOUGH the gas industry is being superseded for certain purposes by electricity and the development of the Grid Scheme, it is still a most important branch of commerce. There are many who believe that we should develop a gas grid on the lines of that developed for electricity. There are others who think that all power, whether electricity or gas, should be developed at the pit head. As it is, coal is mined, carried by rail to remote parts of the country, and then developed into power. This is wasteful of time and makes the product costly.

We are told that after the war we shall not be free to choose in the new houses between electricity and gas. We shall be told to use one or the other, whichever happens to suit local conditions.

Technical Progress

In its 150 years of existence, the gas industry has made many notable advances in the production and utilisation of gas. Progress has never been more rapid than it has been during the past 40 years. These advances were the subject of the presidential address to the Institute of Fuel delivered by Dr. E. W. Smith.

Dr. Smith had no doubts about the future position of the gas industry. Remarking that it has become the fashion in some quarters to assume that the gas industry is rapidly coming to the end of its useful life, and to assume that for many years there have been little or no technical developments in coal carbonisation, he said: "I believe the opposite to be the case. Not only is gas being used more and more as a heating medium, but the possibilities in the future for the development of the carbonising industries are greater than they have ever been."

Advances are due to the united effort of all engaged in the gas industry—those who make and distribute and sell gas from the gasworks, those who design, build, or manufacture plant in which gas is made or used, and the research men either in individual firms or undertakings or working under the co-operative scheme of research initially set up by the Institution of Gas Engineers and now under the Gas Research Board. The period of 40 years covered in the presidential address was a time of flux, for new and revolutionary systems of gas manufacture were in process of development.

In 1907 the Institution of Gas Engineers' Research Fellowship was instituted at the then recently established Fuel and Metallurgy Department of the Leeds University. In the same year the first Joint Committee of the Institution of Gas Engineers and Leeds University—the Heating by Gas Committee—was established. Thus began a long association between these two bodies, which was crowned in 1910 by the endowment of the Livesey Professorship in the reconstituted Department of Coal, Gas and Fuel Industries at the university with the late W. A. Bone as the first professor. One of the most important results of the work of the Joint Research Committee at Leeds was to attract into the industry men of high scientific ability who, after a period spent upon research, usually settled down in some gas undertaking or contracting firm.

Improved Refractory Materials

Parallel with these advances in education and research came an effort to improve the quality of refractory materials used in gas retorts. The result was that whereas in 1910 the average life of horizontal retorts was found to be 797 days and, with patching, 1,257 days, in 1934 the average life was found to have risen to 1,700 days and it was a fairly common experience for them to attain a life in excess of 2,000 days. The latter figures were obtained with much higher combustion chamber temperatures than appertained in 1910, and between the dates of the questionnaires the average make of gas per ton of coal carbonised had been increased by over 40 per cent. A handsome reward was thus being reaped for the time and money spent.

The first three years of the century had seen the introduction of two new systems of carbonisation, intermittent vertical retorts in Germany, and continuous vertical retorts in this country. The work of the Heating by Gas Committee set up in conjunction with Leeds University in 1907 led to the publication for the first time of accurate data upon the distribution of the heat supplied to the fire. It is not too much to claim that the information thus obtained provided the initial impulse to manufacturers to improve the design of gas fires which has raised the average radiation efficiency from 28 per cent. in 1909 to over 50 per cent.

Immediately after the last war the experience thus gained made it possible for the gas industry to seek the necessary power from Parliament to adopt a calorific value standard in place of illuminating power. This resulted in the Gas Regulation Act of 1920, which set up the requisite standards with appropriate safeguards for the consumers. This was, indeed, a "Magna Charta" for the industry, and its influence on subsequent developments has been profound. One of the most interesting differences between now and the earlier part of the century is that whereas formerly all the water-gas was made in separate water-gas plants, to-day a considerable proportion of water-gas is produced during carbonisation by steaming intermittent and continuous vertical retorts.

Research Work

Laboratory investigations have enabled the behaviour of coals in the retort to be forecast. Since no two coals have exactly the same characteristics, this has been a most important step. The laboratory control has been further extended to materials of construction. Refractory material is a field in which a great deal has been done with the able assistance of the Refractory Materials Joint Committee of the Institute of Gas Engineers. Experience has shown that careful laboratory control of refractory materials and jointing cements used in construction is essential, and, moreover, acts as a stimulus to manufacturers to maintain their quality, whilst at the same time encouraging the development of improvements. Cast iron also plays a most important part in the carbonising industries, and the work of the British Cast Iron Research Association in improving the mechanical and chemical properties of cast iron have been invaluable.

A very important method of development was that of incorporating advances made in gas practice all over the world.

In coke production, in benzole recovery, in removal of naphthalene and water vapour from the gas to prevent blockage of mains, and in the use of coke oven gas to the advantage of industry and the domestic consumer alike, the gas industry has done a great deal of good work within the period under review.

Flying Model Aircraft—Law Relaxed

IN view of the changed war situation, the restrictions governing the flying of model aircraft have now been relaxed to some extent. Subject to the following conditions which supersede those previously published, any type of model aircraft (including gliders) no matter what the motive power, may now be built and flown anywhere in the British Isles. Here are the conditions: Models may not be flown between the hours of sunset and sunrise.

Models may not be flown in officially prohibited areas, or within two miles of any R.A.F. station.

All petrol model aircraft must be set to fly in a closed circuit only.

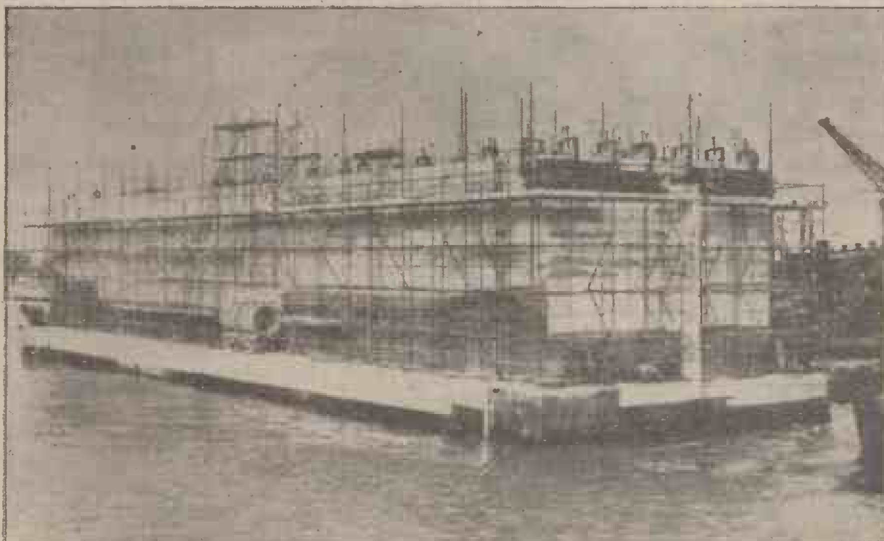
Wing span must not exceed 10ft.

Maximum engine running time for petrol-driven model is to be 45 sec.

Maximum airborne time of any petrol-driven model aircraft must not exceed 2 min. for any single flight.

The "Mulberry" Invasion Harbour

The Great Pre-built Structures which Formed the Port Erected by British Engineers on the Beaches of Normandy at Arromanches



A concrete caisson under construction, to be used as a breakwater. The huge dimensions of this structure will be evident on comparison with the figures of the men seen on the right-hand end of caisson platform.

WITHIN 12 months of the tests with models Britain built two ports, each as large as Gibraltar, and after being towed across the Channel the pre-built units were erected off the coast of Normandy to form a harbour which was in working order a week after D-day. With its help we landed a huge army, thousands of lorries and other vehicles, and thousands of tons of equipment and supplies, despite the worst June for 40 years.

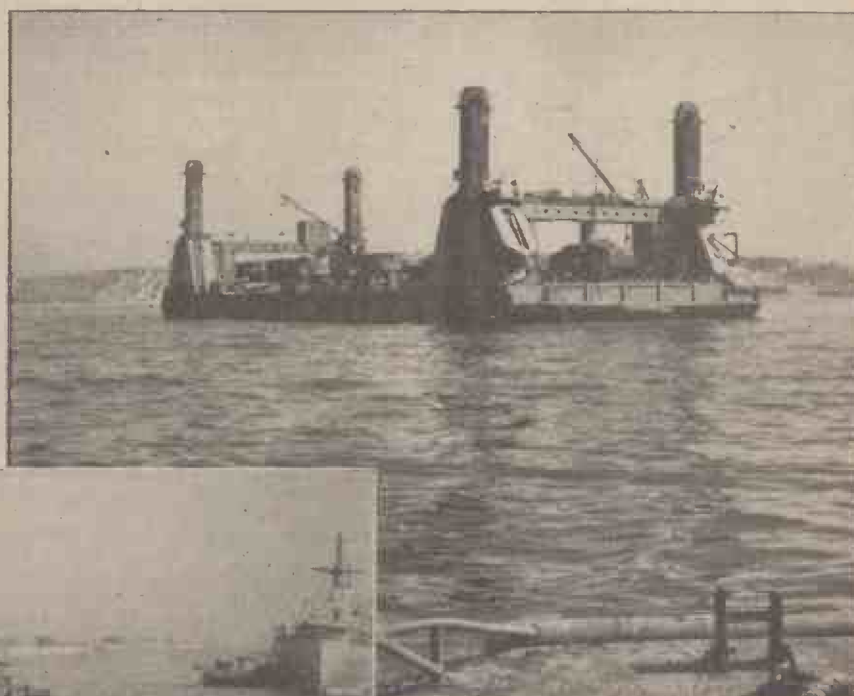
The transportation of the blockships, the gigantic caissons, and other equipment involved the towing of the units from their construction sites to the assembly parks off the South Coast, amounting to over 500 tows.

Before the vast plans could be put into operation experts of the meteorological section of the Royal Navy had to predict to the nearest foot the mean height in any wind of the breakers along any stretch of the Normandy coast.

A line of steel columns filled with concrete form a breakwater, and pontoon bridges, made of barges arranged cross-wise, carry the roads to the pierheads where the ships unload their varied cargoes. Upwards of 20,000 men worked on the breakwater columns alone, in England, before they were towed to their dispersal points on the coast, and altogether about 600,000 tons of concrete and 75,000 tons of steel were used.

Floating Piers

The floating piers, which are clearly shown in some of the accompanying illustrations, were the designers' solution to the problem of linking up the artificial wharves, far out to sea, with the beach. Anti-aircraft guns on platforms on the caissons guard the harbour. Some of the units had to be towed from as far away as Leith, in Scotland.



A spud pierhead off Arromanches after a cross-channel tow.

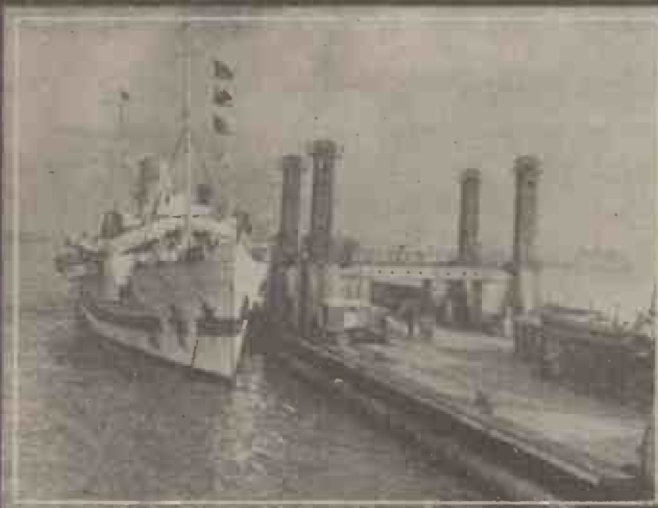
Large concrete caissons forming a main deep-water breakwater. Note the anti-aircraft guns for guarding the harbour.

The caissons, which contained crews' quarters for use during the passage, were towed across Channel by one large sea-going tug of about 1,500 h.p. On arrival off the Normandy beach they were manœuvred into position with the help of smaller tugs. Special valves were then opened, allowing water to fill the caisson and sink it in place. The valves were left open so that the water level remained the same inside and out. It took about twenty-two minutes to sink the largest-size caisson.

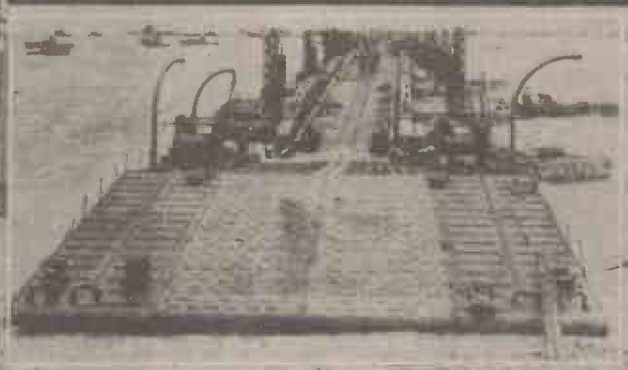
The illustrations give a good idea of the immensity of the work which was the largest and most rapidly erected military undertaking in history.

Pre-built Ports

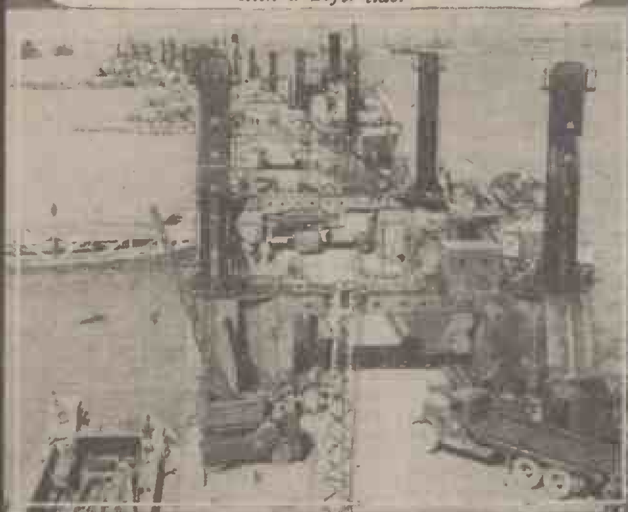
Two pre-built ports, each as big as Gibraltar, were manufactured in Britain in sections, towed across the channel, and set down on the coast of Normandy, at Arromanches. The use of the prefabricated port greatly simplified the problem of supplying the Allied Armies in France. A comparison between the sizes of the ships and vehicles, and the various units which make up the port, illustrates the immense nature of the undertaking.



A hospital ship clearing casualties from the end of a floating pier, so constructed as to rise and fall with a 20ft. tide.



Inshore end of a pier being placed into position on the beach at Arromanches.



A wharf formed of seven pierheads in line.

Concrete caissons in position forming a shallow breakwater.

A pier, laden with traffic, and giving exit to Arromanches.

Another view of one of the piers showing a tank moving towards the beach.

The Aircraft Rocket-projectile

Its Use in Modern Warfare

IT was disclosed recently that four types of British aircraft, the Typhoon, Beaufighter, Hurricane, and Swordfish, have been modified to carry rocket-projectiles. Each aircraft is fitted with eight launching rails, four beneath each wing, from which the same number of rocket-projectiles are fired, either in pairs or as a complete salvo of eight. The launching aircraft experiences no recoil.

The projectile itself consists of a heavy gauge steel case, containing a cordite propellant charge, with a shell-shaped explosive head. The propellant charge is electrically fired.

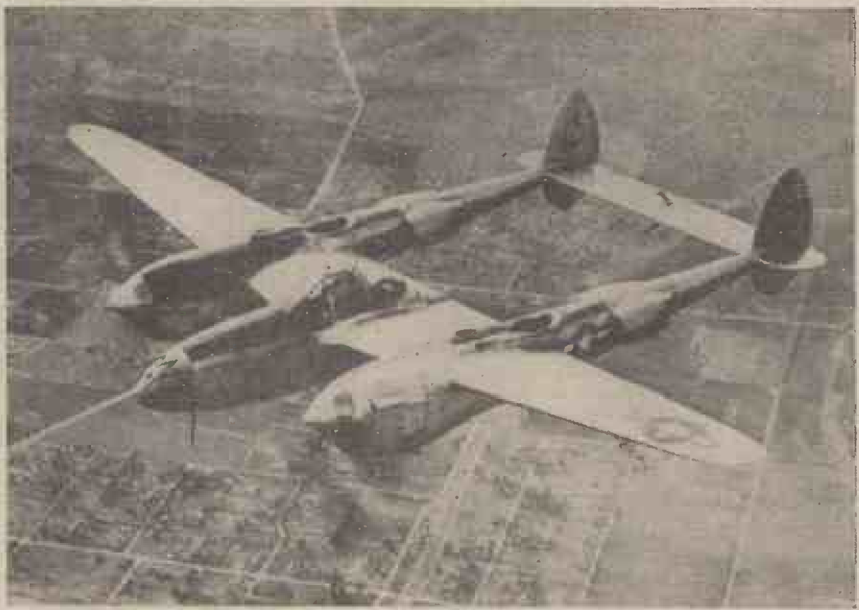
It will be remembered that the aircraft rocket-projectile was first made known some two years ago, the Russian Stormovik IL2 being the first machine to be so equipped. Later, the two-seat Stormovik IL3 and the Lagg 3, Mig-3 and Yak-1 single-seat fighters were similarly fitted. The German tank formations have been their chief prey.

The Anti-bomber Rocket-projectile

The Germans, too, have not been slow in adopting the aircraft rocket projectile, and during the latter months of last year a Focke-Wulf 190 fighter development, intended for the purpose of disrupting Allied bomber formations, made its appearance, along with other converted types, the Ju. 88, the Me. 109 and Me. 110.

Two "projector tubes" only are fitted beneath the wings of the single engine fighters and these carry the 2.5in. rocket shells. Four to six wing launching attachments are fitted to the twin engine aircraft and from these are fired the larger 6in. and 8in. shells. Reports have indicated that some bi-motor aircraft have the "projectors" mounted beneath the fuselage, instead of under the wings.

The projectiles are axially spun for stability, rotation being effected by offsetting the exhaust nozzles which are spaced around a conical collar at the rear of the rocket. The larger projectile is a development of the German 21 cm. cannon shell, a rocket unit being added behind the explosive charge. The maximum range of this projectile, which weighs 200 lb., is in the region of 6,500 yards. A "stick" formed substance, similar in character to cordite, is used as propellant.



The long-range Lockheed Lightning P38 fighter 'plane. This all-duty aircraft has been used for a variety of purposes. Its climb, speed and fire power give it an advantage over enemy fighter 'planes. Owing to its increased range, the Lightning can escort bombers all the way to Berlin.

The firing period, at maximum, is two seconds.

The range of these rockets is such to enable the "projector" aircraft to remain out of range of the bomber's defensive armament while delivering an attack.

American Rocket-carrying 'Planes

More recently, reports from the Far Eastern war theatre have given the names of several American aircraft, both land-based and sea-borne, now fitted for R.P. (the Service abbreviation for "rocket-projectile"), amongst which are included such notable types as the Thunderbolt, Lightning, Mustang, Tomahawk, Airocobra and Dauntless. According to correspondents, these aircraft have achieved considerable success in attacks on Japanese shipping and troop concentrations.

Increased Impact Velocity

A prominent advantage of the rocket-projectile over the conventional light bomb for terrain and marine attack is the increase in *impact velocity*. Whereas a normal type bomb released in the course of a ground strafing assault, for instance, will reach the objective at approximately the same speed as the attacking aircraft, the rocket-projectile, due to its inherent power, will arrive at the target at a considerably improved velocity. The higher the speed of release, the greater is the velocity of impact. The rocket-projectile is, in consequence, able to obtain a greater penetration than the conventional light bomb, and reports from the Russian front suggest that, under certain conditions, the light rocket-projectile is able to cause destruction comparable to that of the heavy bomb released from a high level.

Improved Sighting

Another point of significance is the reduced liability to error with regard to sighting, which is effected by pointing the aircraft at the target, probably with the aid of a normal type gun-sight. The combined action of gravity and forward motion result in the normal type bomb falling with a curved trajectory. The rocket-projectile, on the other hand, due to its independent propulsion, is able to maintain a highly accurate flight path, coinciding very nearly with the line of sight.

The greater precision and improved penetrating potential of the rocket missile would especially suggest advantage in attacks on heavily armoured ships, tanks, and concrete emplacements. Due to the total absence of recoil, the sole limiting factor to projectile size is the aircraft carrying load, and in consequence it is not unreasonable to assume that rocket-projectiles bearing explosive charges rated in several hundreds, perhaps thousands, of pounds will later be employed. When that time comes, it should be possible to end the career of the most heavily armoured war-vessel afloat with but a single hit.

A striking contrast. A rocket-carrying Typhoon on a temporary airfield is passed by the farm cart of a Normandy farmer who is getting on with his work.

Progress in X-rays

The Advances Made in Apparatus and the Application of X-rays

By A. J. WALTON, F.S.R.

(Concluded from page 44, November issue.)

THE mechanical rectifier has been practically superseded by a four-valve circuit consisting of hot cathode valve-tubes, working on the same principle as the hot cathode X-ray tube. In some circumstances one or two valves are used and in the case of a three-phase alternating current, a six-valve circuit is used. To demonstrate what is required, a diagram of the mechanical rectifier is perhaps easier for the reader to understand (see Fig. 11). The rectifier consists of a circular disc of insulating material, such as bakelite, fixed on the shaft of a motor which runs synchronously with the alternating current. Four fixed metal contacts are attached and are connected by a wire in pairs. As the disc rotates the metal contacts pick up the current and distribute it so that the current travels in one direction through the tube. It was a noisy instrument because of the running motor, and also because of the sparking which took place at the contacts. The valve tubes are noiseless. Since the introduction of the transformer, we have many advantages; one is that we can control the output in the secondary circuit at a uniform voltage; this is done by a piece of apparatus known as the *auto-transformer*; it is situated between the main supply of the primary windings of the transformer. It is just another form of closed core transformer; its primary windings consist of a fixed number of turns and the secondary is tapped at a number of points (see Fig. 12).

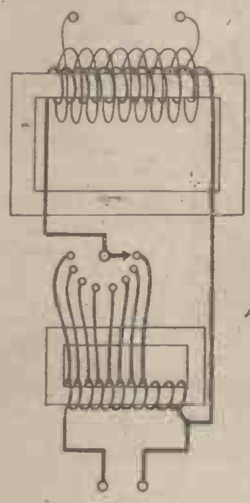


Fig. 12.—Circuit diagram of transformer and auto-transformer control.

Fig. 13.—A developing hanger for X-ray films.

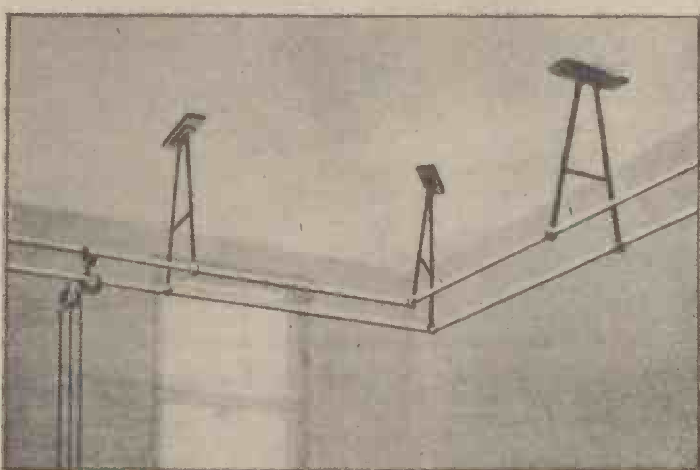


Fig. 14.—"Aerial" tubular fittings for carrying the connecting cables for X-ray apparatus.

The tapped wires are connected to crank studs on the top of the control table by using one or other of which we can vary the ratio of windings and therefore the voltage we apply to the high-tension transformer. Another advantage is the "*pre-reading kilovoltmeter*." Space does not permit an explanation of the instrument. Briefly, we have a voltmeter on the control table which measures the primary voltage, but it is calibrated in kilovolts and shows the tension available in the secondary circuit. The importance of this is that we can pre-set the required kilovolts to be applied to the X-ray tube, which varies considerably with the variety of work and even with different patients. Another advantage is the electrically controlled timer which when the required exposure time is completed, breaks the electric circuit automatically. This ensures correct time of exposure, which is an important factor. Dark room equipment has improved considerably. From developing dishes to tanks which take the films in the upright position in film hangers (see Fig. 13). The films are processed in chemical solutions kept at a constant temperature by thermostatic control. From weighing drugs to having them already weighed in packets. A much improved safe lighting system. From glass plates to double-coated films, perhaps the biggest photographic advance of all; electric heater for drying the films, etc. Regarding the dangers in X-ray departments. In the early days, the tube and coil were connected with ordinary electric wire. Apart from the electrical dangers, there was a lot of static discharge through sparking and bristling from the wires; the air became ionized; this caused a very serious blood condition which actually caused death. The patients were not in it long enough to be troubled; it was the X-ray worker who suffered. This system of wiring was replaced by tubing through which necessary connections were carried (see Fig. 14). This, together with a proper system of ventilation, did away with most of the trouble. Since the introduction of the shock-proof tube, with its thick covered cables and perfect connections, one can say it has been overcome. The dark developing room troubles have been cured by proper ventilation, large and brighter rooms and fewer hours of work. The X-ray workers as a whole are now protected by definite hours of work and holidays which, it is recommended, should be spent in the open air as much as possible.

Army Apparatus

During the South African War, the Army used in South Africa a 10in. induction coil (a coil which sparked 10in. in air), a hammer

Fig. 15.—A portable X-ray unit of the last war.

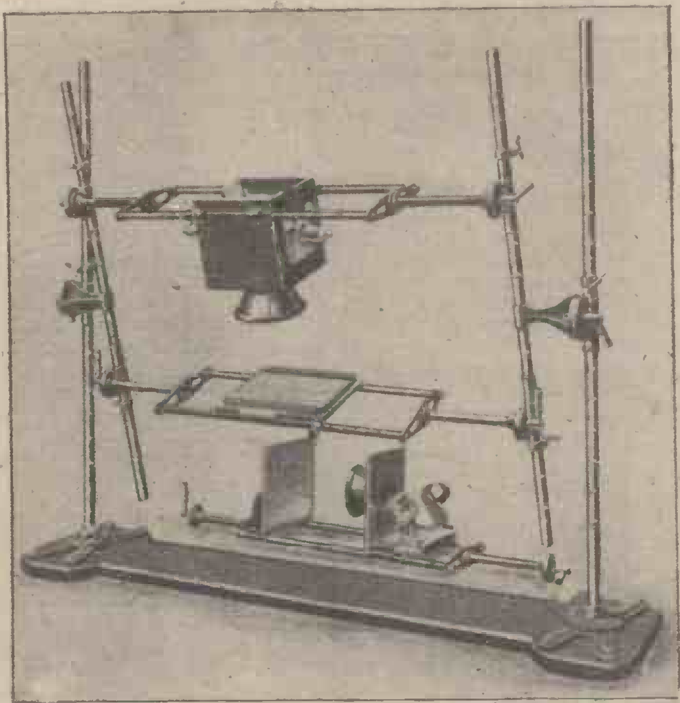


Fig. 16.—*Adjustable X-ray apparatus used in conjunction with an operating table.*

writer, at a later date, took many pictures under the same conditions; on one occasion being requested to take the pictures of the kidneys of a very corpulent Bishop of London; there was no means of cutting out scatter or secondary radiations, each exposure was 10 minutes; to-day the same exposures would be three or four seconds. In India pack mules have carried the same kind of apparatus over the hills to X-ray cases. When the last war commenced, the Army Field Service outfit was a 12in. coil, a mercury interrupter, 12-volt accumulators and a small gas tube. The writer had the opportunity of seeing many X-ray results which were taken in Africa; in the main they were good pictures. Of course, they were all taken for gunshot fractures of bone or for foreign body (bullet and bits of shrapnel). There was no call for the large and intricate examinations which are demanded to-day. The

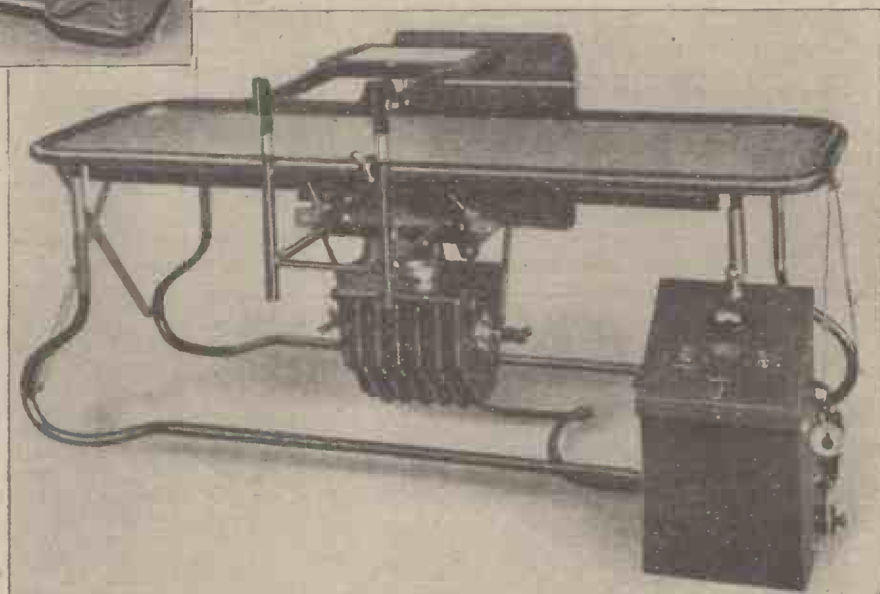


Fig. 17.—*An improved field service X-ray unit.*

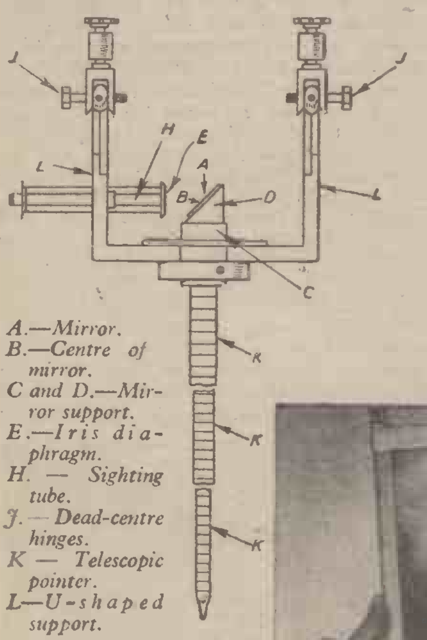


Fig. 18 (*above*). — *Apparatus used for the localisation of a foreign body.*

rupter, 36 volts accumulators, a small petrol engine for charging, a couch and a gas tube of a larger size and improved make to that used in the South African War. Army apparatus, generally, has to be portable. As hospitals were established and electric mains were available, much larger types and apparatus of all kinds were soon installed. Portable units, chiefly for casualty clearing stations, were arranged complete on wagons (see Fig. 15). A 3-ton lorry with a 3 kW dynamo, having an output of 150 volts, 20 amperes, driven from the main gear box. The developing room was in the lorry with a plentiful supply of water; the body of the lorry could be used as an examination room, or a tent could be extended for the purpose. The injuries of the war taxed the brains of many surgeons; special beds of all kinds were designed, some being particularly wide for the full extension of both legs. The surgeon, after setting the fracture, would not wish to move the patient for the removal of a piece of metal which began to give trouble. The writer was requested amongst many other such requests to design a piece of apparatus which would overcome these difficulties. The result of his effort is shown in Fig. 16. To-day, the same movement is used for quite a different purpose.

In this war the transformers with the hot cathode tubes are in use. The original field service sets were made up with a small portable transformer. One unit is of particular interest because it represents another great advance: it is portable yet has sufficient output for work in a hospital. The high-tension transformer, filament transformer and X-ray tube are all immersed together in a tank of oil (see Fig. 17). This system makes the apparatus absolutely proof against dangers of high tension electric shock. Note the tube and transformer in the small tank beneath the couch.

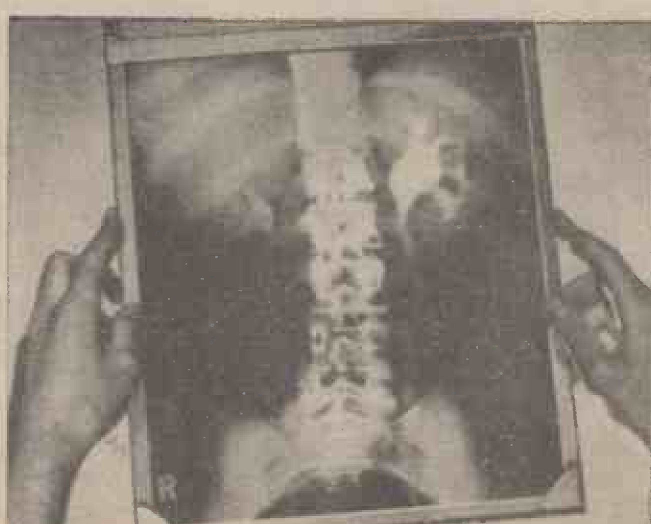


Fig. 19 (*right*). — *An X-ray photograph of a kidney interior.*

Present-day Apparatus

Localisation of a foreign body is a speciality in wartime: this is an interesting job and one which calls for accuracy; it is not just seeing the bullet in one, or even two planes: that is deceiving. Imagine a shadow of your finger on the wall, then move the lamp which throws the shadow: the shadow of your finger moves. Localisation is done by a triangular method; the tube must be perfectly centred so that the central ray goes through a definite point; imagine finding the exact position of a tiny piece of metal in the eye. This centring with the gas tube for various reasons was difficult (see Fig. 18).

This piece of apparatus was designed by the writer when gas tubes were in use; it was attached to the tube box with a hinge joint and could be swung out of the way. One had to find the point where the cathode stream struck the anticathode, the point from which the central ray emerged: this position varied, it was not always in the centre of the anticathode. The mirror beneath set at the same angle as that of the anticathode, 45 deg., had a centre spot, when the bombardment point of the anticathode was centred on this spot: the tube was perfectly centred, the telescopic pointer below continued this line to the desired position.

The Navy have carried their own apparatus on ships for many years. It may not be generally known that certain drugs which are opaque to X-rays are in considerable use. Organs like the stomach and the gall bladder are not visible by X-rays; a shadow of the kidney mass is seen, but the structure of the kidney is not. When certain drugs are in these organs, their internal deformities are usually seen. The drug is not the same for each organ; that which is secreted by the kidney is not secreted by the gall-bladder. The stomach and intestine drugs are given by mouth, the latter may be injected as an enema (see Fig. 13). The drug for the kidney is injected into a vein in the arm and finds its way to the kidney through the bloodstream; the taking of injecting of drugs gives no inconvenience to the patient. Fig. 19 shows a kidney interior and the drug leaving the kidney on its way to the bladder for evacuation. The other side is not seen so well.

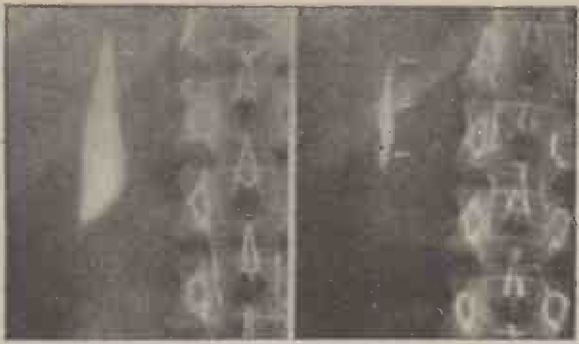


Fig. 20.—X-ray photographs of the internal organs of two different patients, showing the gall bladder gradually emptying. Case 1 (right). Case 2 (below).

Fig. 20 shows the gall-bladder gradually emptying: these are two different patients; it is obvious that the gall-bladder would not be seen without the drug.

There are many other things one could write about X-rays, and parts of apparatus explained. The writer hopes, however, that he has at least demonstrated some of the more common advances in apparatus and usage of X-rays.

The R.A.F.'s New Fighter—The Tempest

HURRICANE, Typhoon, Tempest—these names express the mounting force and power of the fighters produced by Hawker Aircraft Ltd. The last of these, the Tempest, has now measured its prowess against the Luftwaffe, and has had a very successful series of exchanges. Its introduction to normal operations was delayed as it had to be diverted from the fighter's normal rôle to combat the flying-bomb menace in which it scored nearly 600 victories.

Side view of the Tempest showing the fine streamlined fuselage.

The Tempest, like its predecessors, is a single-seat low-wing monoplane, designed by Mr. Sydney Camm. It is powered with a supercharged Napier "Sabre" engine of 2,200 h.p. and has a de Havilland variable pitch four-bladed propeller. Its armament consists of four 20 mm. cannon guns. The span is 41ft.; length, 33ft. 8in.; and its height, 14ft. 10in. with tail up and one blade vertical, and 16ft. 1in. with tail down and one blade vertical.

Londoners saw this graceful addition to the Hawker family when Air Defence of Great Britain was meeting the full assault of the flying bomb. Looking somewhat like the Typhoon, but with the elliptical wing of the Spitfire, and a high tail fin rising from the fuselage in a curve similar to the Flying Fortress, the Tempest was in action as soon as the attacks began.

Until the balloon barrage was moved into Kent the new fighters flashed over South London, circling among the bursts of anti-aircraft fire. Later on they closed in on the bombs, either at sea or over "bomb alley" from the coast to the balloons.

Air Marshal Sir Roderic Hill, Air Marshal Commanding A.D.G.B., flew a Tempest as well as his own Spitfire on flying-bomb patrols when deciding on the disposition of the fighters and ground defences. He used to take off from the airfield at which Wing Commander R. P. Beamont, D.S.O. and Bar, D.F.C. and Bar, and his Tempest wing had met the first attacks and devised combat tactics. W/Commander Beamont, who was a Battle of Britain pilot, and a former test pilot of the Hawker Company, nursed the aircraft through its trials and development with the R.A.F., and trained his pilots in the handling of this extremely fast new fighter.

A front view of the new R.A.F. fighter aircraft, showing the four cannon guns and four-bladed propeller.

The Story of Chemical Discovery

The Work of the Analyst

How the Chemist Aids in Safeguarding Our Foodstuffs Supplies

Frederick Accum (1769–1838), *the first pioneer of foodstuffs analysis.*

AT the beginning of the last century chemical analysis was virtually non-existent. True it is that there were then in use certain rule-of-thumb methods of roughly testing the qualities of various chemical commodities, such as alum, soda, and medicinal salts, but, for the greater part, commercial chemical analysis had hardly been thought of, let alone systematised.

There were at that period a few enthusiastic chemical pioneers, notably Baron Berzelius, who began life as a humble apothecary in Sweden and ended it as the secretary of the Stockholm Academy of Sciences, and also the French chemist J. L. Gay-Lussac, who showed a particular interest in devising methods whereby the nature of materials might be determined. By dint of patient toil and investigation, these enthusiasts, working over many years, gradually brought out reliable methods of analysing materials and of determining not only the nature of their constituents, but also the actual proportion of such constituents.

It was J. L. Gay-Lussac, for instance, who invented the system of volumetric analysis, now well known to all chemical students, by means of which the amounts of certain chemical substances present in solution form can readily be determined. In the main, however, the chemical science of that period was rather more interested in extending its domain by the discovery of new chemical compounds than in establishing scientific ways and means for the competent and reliable analysis of its known substances. It was only at a later date that systematic chemical analysis began to make strides—at first almost imperceptibly, but afterwards at a very rapid rate—and that the analyst's art succeeded in permanently establishing itself.

Accum, the Analyst

One of the first of the chemists—if not *the* first of them—who showed himself to be particularly interested in the analytical detection of adulterants and impurities in foodstuffs was a certain Frederick Accum, a German who was then resident in London. Accum was a curious character. He seems to have been possessed of a goodly measure of the usual German arrogance and bombast, and eventually, in consequence of his being detected in the act of mutilating books in the Royal Institution Library, he had to leave this country rather hurriedly. Nevertheless, while he stayed in England, he did a lot of good, if only in view of his calling attention to the enormous amount of adulteration which the foods of the period were receiving.

The adulteration of foods and beverages was, even in those days, no new thing. It dates back to the time of the Romans, and most probably, too, long before then, there being several ancient records of clay being added to flour and of wines being "let down" with various other liquids.

But, at the commencement of the last century, the population of Great Britain had very largely increased. The demand for food was continually rising, and, since there were no legal checks upon the purity of foods or materials, the adulteration of even the commonest of foodstuffs rose to very high proportions. Bread, flour, beer, wines, spirits, spices, cheese, sugar, tea, coffee, and even common medicines, seem to have been hopelessly adulterated in Accum's day. Wines and beers were treated with lead salts to prevent their going sour. "Cheap gin" contained free sulphuric acid to give it a certain pungency of taste, and some of the spirit distillers even went to the length of putting a little white arsenic in their spirits in order to promote an irritable and an insatiable thirst on the part of the drinker.

Apparatus for the analytical determination of soda in various materials.

An 18th century continental chemical laboratory, which was apparently used for the testing of medicines. (From an old print.)

Death in the Pot

Bread and flour, beside having clay added to them, frequently contained plaster of Paris, whiting, slaked lime, and even finely crushed granite, to say nothing of a certain modicum of ammonia and alum to impart whiteness to the flour.

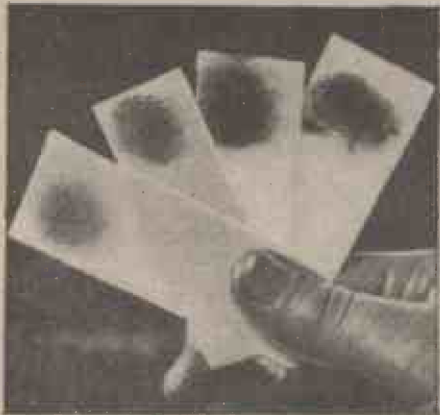
Frederick Accum, in 1820, published his famous book, which he entitled "A Treatise on Adulteration of Food and Culinary Poisons, exhibiting the fraudulent sophistications of Bread, Beer, Wine, Spirituous Liquors, Tea, Coffee, etc., and other articles employed in domestic economy, and methods of detecting them." The title-page of the book bore a picture of a skull in a saucepan, and below it the biblical text: "There is death in the pot" (2 Kings, iv. 40).

"Death in the Pot," as the book (and even its author) were nicknamed, had a large and a ready sale. It was the world's first treatise on "commercial" analysis, dealing not only with the detection of impurities and adulterants in foodstuffs, but also in soap, paper, cloth, paints, drugs, and other common commodities.

Accum, too, heightened his reputation (and the dislike in which he was held in certain quarters) by actually publishing the names of manufacturers whose products he had proved to be adulterated. As a result he made many enemies, and there is little doubt that the commercial world of the time welcomed his hasty return to his Fatherland, where, incidentally, he obtained a Chemistry professorship.

Frederick Accum, with his "Death in the Pot" and other chemical revelations, shocked the public conscience in England. He also managed to stir up the interests of the pioneer chemical analysts. Little by little various Parliamentary Acts were brought into being, each one aiming at the suppression of certain types of food adulteration. For example, the Bread Act of 1830 prohibited the use of alum in flour, whilst a second Bread Act six years later extended the prohibition to other types of adulterating materials.

It was not, however, until 1872, that the first of a long series of Food and Drugs Acts issued from the Parliamentary Houses of Westminster. Vested interests against all such enactments had often been particularly virulent, and the community in general seemed to have little realised the enormous importance of an uncontaminated food supply.



Test papers showing lead stains derived from various trade commodities.

The Official Analyst

In 1875 local authorities were compelled by law to appoint at least one analyst of the highest qualifications. Thus entered the analyst into the service of the community, a service in which he has assiduously laboured ever since.

While chemical analysis is necessarily founded upon the most exact chemical science, it still remains in many respects an art. Many individuals who may be quite excellent creative chemists and researchers fail hopelessly at intricate chemical analysis simply because they lack the patience, the peculiar deftness of manipulation, and the requisite keenness for the detection of the unknown substance, adulterant, or impurity which they may be engaged in tracking down.

Even after a century of chemical analysis there are still many imperfections in this branch of science. The notion that it is possible to "analyse anything" is totally erroneous. True, in the majority of instances, the analyst can always arrive at an approximate assessment of the ingredients of a material, but he cannot always ferret out the exact truth. There is, for example, a famous proprietary sauce which has been on the market for many years, and which is made from a secret recipe. This material has literally defied the efforts of several analysts to determine its exact constitution. Several other trade products fall into a similar category, although, needless to say, their number tends yearly to become smaller and smaller.

Iodine Test

Broadly speaking, the analyst works by means of a systematised summary of the properties of all known chemical compounds. His training has taught him that most chemical substances have specific reactions when treated with certain reagents. Thus, for example, if starch is treated with iodine, it will give an intense blue colouration. This forms the famous starch-iodine test, and so delicate is this reaction that it will reveal the presence of as little as 0.0000001 gram of iodine.

Generally, therefore, any single substance can have its presence revealed by making use of some specific chemical detecting reaction, and frequently enough, by arranging for this reaction to proceed under conditions of great accuracy, the actual amount of the substance in question can be determined.

Of recent years an entirely new system of chemical analysis has been devised. This is "micro-analysis," of which so much is heard nowadays.

Micro-analysis is nothing more nor less than a modification of the older and now "classical" methods of chemical analysis. In micro-analysis the analyst utilises a drop of liquid on a microscope slide or a spot of unknown material on a filter paper. In consequence of the discovery and introduction of new chemical compounds which are capable of giving highly characteristic reactions even in the state of extreme dilution, it is possible to analyse the contents of even a single drop of a fluid. And, by like methods, it is readily practicable to analyse the ink with which a document or a letter has been written.

The art of the analyst—as distinct from that of the mere chemical works "tester"—is nowadays applied in every large industry. Without chemical analysis technical control on industrial processes would be impossible. And likewise, without this extremely important chemical art, the purity of foodstuffs and medicines could never be assured.

Detecting Arsenic

At one time a very common adulterant used to be arsenic. Arsenic is a widely distributed element. It is apt to get into sulphuric acid which has been made from iron pyrites. And since sulphuric acid is used in a large number of manufacturing processes the greatest vigilance has constantly to be taken to see that the pyrites-derived arsenic does not obtain entry into the manufactured product.

The microscopic investigation of food materials is part and parcel of the work of every Public Analyst.

Some years ago a "beer scare" arose. People who had drunk a certain brand of this beverage suffered from the distressing effects of arsenic poisoning. Analysts found arsenic in the beer. The question then arose as to how it had obtained entry into the liquor. It was eventually found that the brewers had used a certain type of manufactured sugar which had been treated with a pyrites-derived sulphuric acid. The arsenic, originating in the mineral iron pyrites, had found its way into the sugar and thence into the ale.

In another more recent instance an analyst found that a manufacturer had unknowingly been using pure white arsenic (arsenious oxide, As_2O_3) as the dusting powder for his boiled sweets instead of an innocuous powder, the purpose of which is to keep the sweets from sticking together. It was only after one or two fatalities had occurred that the incident was legally dealt with.

Marsh's Test

Arsenic is, fortunately, an easy element to detect. The underlying principle for its detection is based upon the celebrated test designed by J. Marsh as far back as 1836. If into a bottle generating hydrogen gas from pure zinc and pure hydrochloric or sulphuric acid we introduce a little of a material containing arsenic, a small quantity of hydrogen arsenide (arseniuretted hydrogen) will be generated also. This hydrogen arsenide is intensely poisonous, its discoverer, Gehlen, being said to have lost his life through breathing merely a few bubbles of it in its pure state. Hydrogen arsenide is an unstable gas. If it is even gently heated it deposits its arsenic on to the heated surface, and often enough, if the surface be a glass one, the deposited arsenic takes a mirror-like form.

Such is the basis of Marsh's test for arsenic. The hydrogen generated in the reaction bottle or flask is passed through a gently-heated glass tube. If any hydrogen arsenide is mixed with the hydrogen, the arsenide is decomposed on contact with the heated walls of the tube, depositing its arsenic in the form of a silvery mirror. Very minute amounts of arsenic can be determined in this manner.

Another common contaminating impurity of a large number of materials is lead. Now, lead is a cumulative poison. It tends to accumulate in the human system until it reaches a certain concentration, after which it gives rise to symptoms of slow poisoning which are often difficult to get rid of.

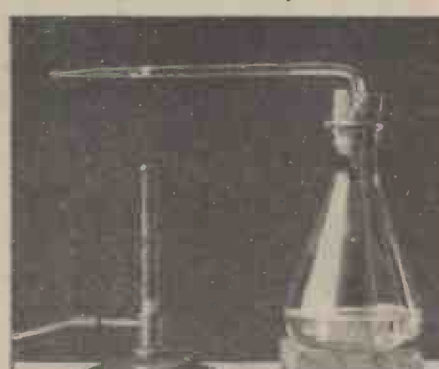
White lead used to be a common adulterant of various foods, for this material is heavy, and, in admixture, substantially increases the weight of materials. Red lead, too, on account of its weight and colour, has in times past been used extensively as an adulterant in the composition of various types of sweets.

Mustard Sets Hard

Not so many years ago household mustard was adulterated with dandelion and turmeric root, china clay and plaster of paris. Indeed, it is on record that a sample of commercial mustard when stirred into a paste with water set hard within a few minutes, owing to its excessive plaster of paris content!

Tea, coffee, and particularly cocoa and chocolate have all received the attentions of the public analyst in their turns. Here the analytical process is more microscopical than chemical in nature, for the adulterating substances lay side by side with the genuine material and thus are easily revealed by microscopic examination.

Chocolate is obtained by grinding cocoa "nibs," which latter constitute the crushed kernels of cocoa beans. The nibs contain much more natural fat (cocoa butter) than do the shells of the cocoa bean. Consequently the price of the nibs is normally about ten times that of the shells. Hence the once not unfrequent practice—which microscopical examination invariably disclosed—of



Marsh's test for arsenic. A portion of the substance containing arsenic is placed in a flask along with pure zinc and pure hydrochloric acid. Any traces of hydrogen arsenide gas which are generated are decomposed on passing through the heated glass tube, with the formation of a silvery film or mirror of pure arsenic on the interior sides of the tube.

adulterating the true chocolate from the nibs with powdered cocoa bean shells.

Egg and Baking Powders

Egg powders and similar domestic articles are a form of food which have received much attention, even in our own times, from the commercial adulterator. It was once common to adulterate an egg powder or a baking powder with crude soda, and even sand has been revealed in these commodities. So, too, have jams and pickles from time to time been the recipients of the adulterator's attentions. The inevitable arsenic has been allowed to find its way into jams; pickles have had copperas, and even sulphuric acid, added to them in order to increase their pungency.

Cheese has not been absent from the list of adulterated foods. In one noted case a Surrey analyst found that certain deliveries of a Gorgonzola cheese had been coated with a mixture of barytes and tallow, barytes being a barium compound and highly poisonous once it is converted into a soluble compound.

Butter, and even margarine, have from time to time been adulterated, not only by the admixture of cheap foreign fats, but also by the incorporation of such things as salt, waterglass, starch, calcium chloride, flour, gelatine, and paper pulp.

In general, the tendency to foodstuff adulteration, apart, of course, from the products of reputable and well-known manufacturers, is still with us, whilst the adulteration of non-foodstuff commodities is, unfortunately, often more prevalent.

With increase of scientific knowledge and scientific aptitude on the part of unscrupulous manufacturers and producers the perfection of the practice of adulteration tends to increase. Yet, at the same time, the vigilance of the analyst from a technical standpoint and the official recognition and extension of his sphere of operations is also increasing, so that in this commercial war between the analyst and the adulterator it is usually the latter who ultimately retires from the contest very much the wiser for his misdeeds.

In our days, thanks to the work of the analyst, assisted by a code of legal enactments, it is seldom that any really flagrant and large-scale case of foodstuff adulteration rears itself up to shock the opinions of the public.

Britain's New Weapon

AMONG the equipment with which the British Army blasted its way into France, and which it is now using, are flame-throwers. Chief among these are the "Lifebuoy," a man-carried weapon, the "Wasp," a light armoured weapon, and the "Crocodile," which is fitted to a heavy tank.

(Above) A "Wasp" light armoured flame-thrower shows its sting when attacking pillboxes.

The Churchill "Crocodile" is the most powerful weapon flame-thrower in the world to-day. With its special fuel it shoots a flame that is terrifying and deadly. This weapon was designed to blast the strongpoints of the Atlantic Wall and Hitler's "Fortress Europe," and it has saved the lives of our infantry in carrying out these tasks.

When this war broke out the Germans had new and improved flame-throwers. We had none.

Flame-throwers were first used by British troops in the Dieppe raid. With them the Commandos put a coastal battery out of action. Those were the "Lifebuoy" type of throwers—man-carried.

(Left) A Churchill "Crocodile" rolls forward with flame belching towards its target.

"Crocodile" flame-throwers going into action.

A Circular-saw Bench

Constructional Details of a Serviceable Tool for the Amateur's Workshop

By J. W. COLE

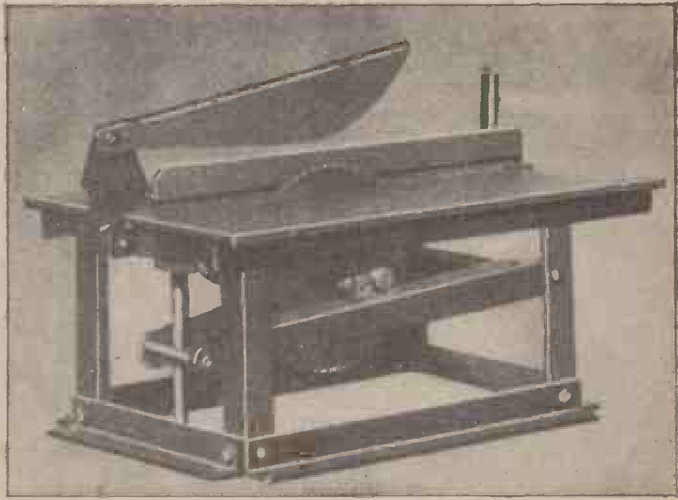
THE saw bench described below costs 10s. for materials and 4s. 9d. for a 6in. saw. It cuts up to 1in. wood easily, and will do grooves and rebates accurately. If required, a sliding and cutting off fence can be added, made on the same lines as the ordinary fence described. The construction allows the saw to be built into a workbench if desired, and this would eliminate the main framework altogether.

Main Frame

This is built entirely of 1in. × 3/16in. angle iron, fastened together with ¼in. Whitworth machine screws. The 7in. uprights have holes tapped to receive them. The slotted top plate is screwed down to the angle iron with 3/16in. countersunk screws. Extensions of the top longitudinals carry a ½in. steel rod on which the fence locking block slides. The ends of the ½in. rod are turned down and threaded ⅜in. B.S.F., and held by nuts as shown in Fig. 2. The base angle irons have holes for screws to hold the sawbench down on a table or bench.

Sliding Fence

A steel block 2in. × 1in. × 1in. slides on the ½in. round rod at one end of the bench. A length of 1in. × 3/16in. angle iron, screwed to this block, constitutes the fence. The steel block is slotted so that a locking screw can pinch it on to the guide bar. The locking screw is extended well above the fence to permit tightening by a removable tommy-bar. It should be noted that the sliding block must be exactly level with the table top, and the fence must be parallel to its edge. The fence can be swung clear of the table if required.



The finished saw bench, showing the saw guard in the raised position.

Tilting Frame

This gives height adjustment without the clumsy tilting of the table top itself. Fig. 3 shows the main features, 1in. × 3/16in. angle iron again being used. The wide end of the frame has two brackets contrived by cutting away part of the angle-iron and bending the resulting "tabs" until they are parallel and a nice fit inside the main frame members. A ¼in. rod completes the hinge. The narrow end of the frame has similar tabs carrying the moving bar shown in Fig. 4; this bar is tapped 5/16in. Whitworth and has ends turned down to ¼in. The upper end of the 5/16in. Whitworth adjusting screw turns freely in a similar, but shorter fitting, arranged between two 1in. pieces of angle-iron screwed to the main frame upper cross member. The photograph makes this clear. A milled 1in. nut as shown is used to make adjustments. The overall length of the screwed rod is 6½in., which enables the saw to be raised from 0 to 2in. above the table.

Saw Arbor

This runs in ⅜in. bearings, but the central part is ½in. diameter to match the hole in the saw. Part of this is threaded ½in. B.S.F. (right-handed). Arranged as shown, if the saw is running clockwise (see Fig. 1), then the saw nut will have a tendency to *tighten* as the saw meets increasing resistance. This is important for safe operation. Two 1in. washers, ⅛in. thick and accurately turned, support the centre of the saw and grip it

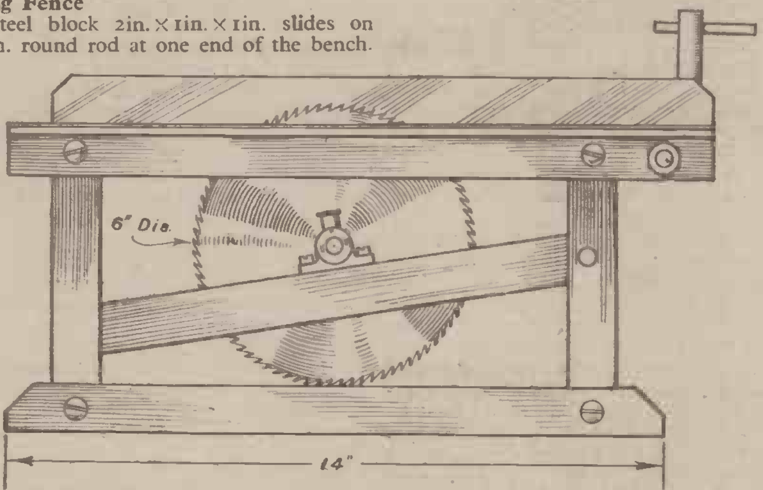


Fig. 1.—Side elevation of the circular-saw bench. (Saw guard omitted.)

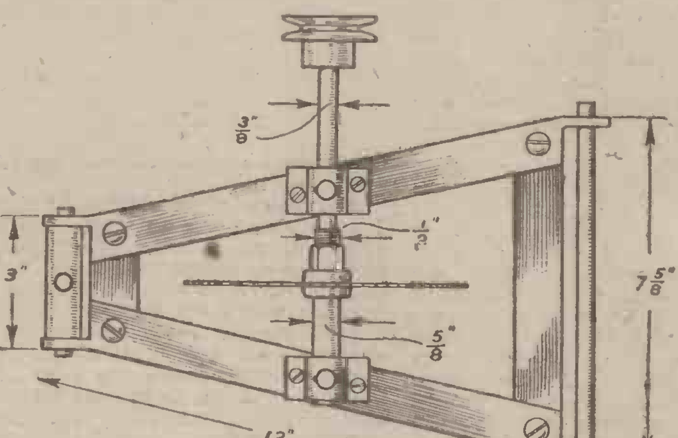


Fig. 3.—Plan of the tilting frame with saw and driving shaft in position.

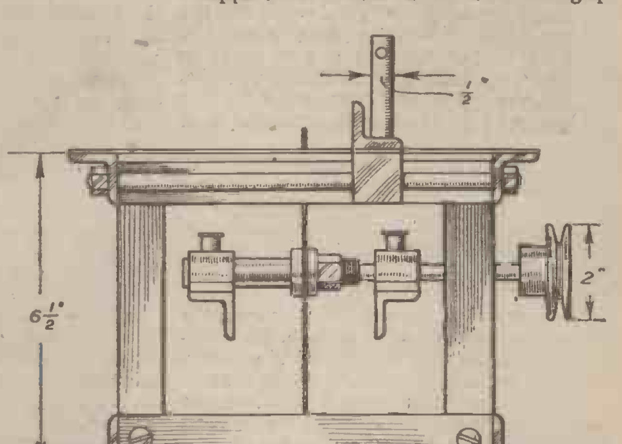


Fig. 2.—End view of bench, showing the rod for guiding the fence.

adequately. A collar and split pin keep the arbor in place.

Bearings

The original bearings are brass, ⅞in. diameter bushes arranged to swing between pointed set screws set in pieces of angle iron. This gives self-alignment (see photograph). Alternatively, plain bearings with flat bases, as shown in Fig. 1 can be used. Care must be taken to secure true alignment. The bearings carry cycle lubricator caps.

Saw Guard

Behind and in line with the saw a hinged metal plate acts as a "splitter." It is slightly thicker than the saw cut, and carries the hollow guard, which hinges so as to raise freely when the wood goes under it. It will be seen that the splitter is tilted back temporarily to raise the guard clear of the saw while it was being photographed. The guard can be removed if required.

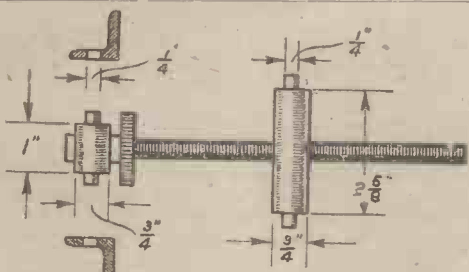


Fig. 4.—Details of the screwed adjusting bar for the tilting frame

Operation

A ¼ h.p. or ½ h.p. motor drives the 2in. pulley by means of round ¼in. belting. A saw spindle speed of 2,000 to 3,000 r.p.m. is suitable.

Colour Photography—2

Notes on Distribution of Colours, Exposure Times, and Indoor Work

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

READERS who have become interested in this all-absorbing branch of our hobby, and have decided to eventually try making a few exposures on a colour film, will have gathered sufficient information to understand that the whole of the work differs in many respects from "ordinary" photography, and requires considerably more care throughout the processing, from the time when the film is being placed in the camera, to the final stages of drying, masking and mounting of the transparency.

You are going to use a film which is the result of scientific research extending over many years, and which has been produced by skilled operators using the best of materials and particularly fine machinery. You can be assured that you have got something which is as near perfect as possible, and which is capable of good results, but you can also be sure that without your quota of care it is possible to make mistakes, and thus fail to achieve what the makers claim.

It is to help you to avoid mistakes that I am going to mention one or two rather elementary but necessary details of a preliminary nature. Before loading the camera give it a gentle cleaning to remove any dust which may have found a resting place in the inside, on the back, or in the slides, and make sure that the working bench is also free of this, for dust, as a rule, is opaque, and spots caused by it on the negative or transparency are difficult to remove. Loading should be done in the dark because the emulsion is sensitive to all light and, if you are using cut, flat films, avoid fingering the emulsion side, as this is very delicate and easily marked. It is necessary to use the opaque shield on the index window at the back of the camera; one of these is supplied with each film or spool, and this may mean that you will have to calculate how many turns of the knob, or lever, are required before making the next exposure.

Some colour films require special filters, provided by the manufacturers free, but for the Dufay roll film D1 the necessary filter is incorporated in the emulsion, according to the makers' instruction book.

Distribution of Colours

It would seem rather unnecessary to make any suggestions on what to take, nevertheless, a few hints may serve a useful purpose. Those of you who have seen colour films at your local cinema may have noticed that the operator, when taking the film, has avoided too much prominence to any one outstanding colour, prefering the subject to be one where there is a general and harmonious distribution of several colours. When taking landscapes Nature generally finds its own remedy either by a variety of colours or tints, or by shadows, but where a sky appears as part of the picture, try to include some, or at least one cloud. It is better to wait for such to appear rather than to expose on a perfectly blue sky. Most of us delight in a cloudless day, but if we are out for a pictorial effect we must avoid "bald heads," even if they are blue. I well remember examining some colour transparencies taken on the west coast of Ireland: delightful sea and rock studies, but out of about a couple of dozen there were only three with clouds, and it was the clouds which made these the best of the set. Another instance of this character occurred in a collection made by a very keen gardener; first came some still life work of cut flowers in vases, bunches of scarlet geraniums, mauve iris and peonies, all of which were very nice, but not so beautiful as a bowl of various coloured roses and another of primroses where the yellows of the flowers blended harmoniously with the greens and browns of the leaves. Let the subjects be well lighted, but hard contrasts must be prevented or avoided.

Let us now give some thought to the very important question of exposure. For both this side of the subject, and for the processing details, I am only going to write about the Dufay colour roll film; no doubt all the other makes of colour films and plates give just as good results, and no doubt they have similar characteristics as regards exposure and processing, but there may be details incident to each, and therefore it is best to keep to the one make while advising those who intend to use any other to be sure to read the intructions given by the makers.

Exposure Times

The first question which naturally arises on this point is "How do colour films compare with others?" The makers tell us that the Dufay requires approximately twice the exposure as would be given when using an ordinary roll-film, or four times that for roll-film of the chrome type. Is an exposure meter of any use with colour work? The answer is yes, especially if you have a reliable one, and are familiar with its working or recording; obviously correct exposure is essential, and any means you can adopt to ensure it is an asset. Would the preponderance of any one colour demand a variation from what would be considered normal exposure? When calculating always work for correct exposure of the highlights, and this would be right for shadows and the colours, but care must be taken to avoid dense shadows and strong highlights. If colour dominates the shadows it might be necessary to increase the exposure slightly. Under this heading it is as well to note that the makers state that in colour photography the correct exposure remains the same whether the subject is relatively near to or far from the camera, and whether or not the subject includes shadows.

To give you an example of the variation of exposure times, a beach and sky scene at midday during the months of May to August, using the lens set at F5.6 would require 1/100th, while all outdoor subjects, other than beach scenes, on bright days with the sun obscured, would want 1/25th, and if the day was dull, 1/10th would be necessary.

Is it possible to use any after treatment to compensate errors in the exposure? Under-exposure tends to give hard contrast and dense results, and over-exposure lowers the contrast and produces light colours. For the former, reduction can take place during the processing as recommended by the makers, or after the film has had its final washing. Intensification can be done by any of the recognised formulæ, although the mercurial bath is advised, and is applied when the other work on the film is completed. Attempts at correcting exposure errors can never produce as good a result as would correct exposure.

Use a large aperture wherever possible for obtaining good transparencies, as it is not wise to stop down except to obtain depth of focus.

Indoor colour photography is possible, but very little practical information can be given, as there are so many factors to be considered; lighting, surroundings, subject, etc., but one or two experiments will provide good data for this work, and if you use an electric meter you are advised to read this by exposing it to a sheet of white paper till the maximum reading is reached at about a foot from the paper, and then to multiply the time by 40. This applies to the use of half-watt or photo floodlight, and with the right compensating filter. The factor for the D3 material is 10, and not 40, so that users of the roll film will recognise that this is faster than some of the other grades, an advantage for both exterior and indoor exposures.

Having exposed the whole of the film, may I again remind you that it does not pay to take risks, and so, before opening the back of the camera to remove the spool, see that all light is excluded from the darkroom, even from the crack under the door. It is always a good plan to well wrap a spool when removed from the camera, and for this reason I seldom destroy the piece of lead foil with which the Dufay films are wrapped originally; it prevents any dust or light getting to the film.

(*To be concluded.*)

[*The Thames plate mentioned in the previous article was not made up of ruled lines, as stated, but of red and green circles on a blue ground.*—ED.]

Inventions of Interest

By "Dynamo"

Uniform Peeling

SEVERAL devices have been proposed to facilitate the peeling of potatoes and other vegetables as well as of fruit. However, it seems it has not been easy to remove uniform external layers from objects of varying sizes and shapes.

A prospective holder of a patent in this country asserts that he has discovered an efficient peeling device. His method produces the progressive rotative treatment of the surface of an object by which the cutting means may advance as required by shape and size rather than at the rate of predetermined relative movement between the object to be pared and the support for the cutting means. He is thus able to remove a surface layer of uniform characteristics from vegetables and fruits of different size and shape.

His paring apparatus comprises the following features:

Rotatable object—supporting means; the reciprocable carrier; means for rotating the supporting arrangement and advancing or reciprocating the carrier simultaneously in predetermined relation; a cutter effective in removing the external layer of the object as it rotates; and a pivot for connecting the cutter to the carrier for travel in an arc in a plane practically inclusive of the axis of the supporting means. As a consequence, the cutter is given a retarded advancement whenever its path varies in relation to the course of the carrier.

Folding Shoulder Butt

A CURRENT application for a patent in this country concerns stocks for firearms of the class intermediate between the automatic rifle and the pistol.

One object of the invention is to provide a shoulder butt which can be folded on the underside of the weapon, the butt being extensible at will. Further aims are to improve the sighting arrangements and to modify certain parts of the firearm without impairing its efficiency consequent upon the improvements.

The foldable shoulder butt is detachably fitted to the rear casing of the firearm. It consists of a triangular device in which a light metal strip framework constitutes the upper and shorter side, and a like framework the lower and longer side. Both sides are hinged to a common base plate forming a shoulder rest. The forward ends of the framework sides are so hinged to the stock or casing of the firearm that the longer side folds within the shorter side and base in the inoperative position.

The folded assembly is nested against the underside of the casing whilst permitting the trigger to act. Automatic locking devices are furnished to secure the folding butt in either its operative or inoperative position.

The use of a butt stock with this class of weapon enables the back sight to occupy approximately the customary rifle position in relation to the distance from the eye.

To facilitate the use of the weapon when the butt is folded, the trigger mechanism is placed somewhat to the rear. There are a trigger guard and trigger casing side plates protruding below the hinged butt members when in the folded condition.

Plastic Laundry-marks

TO identify articles sent to the laundry it is a general practice to print marks on the articles in an inconspicuous place. It appears that another method is to use identification tabs, some of which are made of cloth and sewn to the article, while others consist of metal and are clamped to the fabric.

Yet another practice is to sew identification figures or letters directly into the article.

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."

Having reviewed all these methods, an inventor asserts that none of them is satisfactory. He contends that permanent black marks disfigure the articles and that the same objection can be made to the sewn-on tabs and the sewn-in identification marks, as they cannot be removed.

In the case of metal tabs, which can be removed, he mentions that these tabs often become entangled or torn from the material in the course of washing. They also wear out the fabric.

To overcome these disadvantages, the inventor has devised the following means:

He proposes a tab containing or consisting of a thermoplastic material which is not softened at 100 deg. C. but is softened at a temperature well below the scorching point of textile material. By heat and pressure it may be attached to the latter, which is easily affected by heat—for example, artificial silk. On the face of this are identification marks which are easily removable by tearing off without injuring the fabric to which they are attached.

In one application of the invention a finely woven fabric, such as cotton, serving as a backing, is coated on one side with the thermoplastic material. If desired, more than one coating may be applied.

The side of the tab which is not to be attached to the article is used for the identification mark.

As a protection against scurvy and other diseases, soldiers in the British Army carry in their tunic pockets a small tin box containing about 100 white tablets containing vitamin C. This substance is contained in the juice of lemons, limes, oranges and fresh vegetables. Scores of chemical factories now produce an artificial vitamin C, which is in every way identical with the natural product. Our illustration shows some vacuum evaporators used in making vitamins in huge quantities.

Anti-draught Doors

THE swing door has been occupying the attention of an inventor. In his application to the British Patent Office, he comments upon the disadvantages of this oscillating portal. Remarking that, as a means of draught exclusion, the revolving door is effective, he adds that it has been objected to on the ground that, in the event of a panic, the thoroughfare is inadequate.

The usual form of swing door, he contends, is draughty as a result of its construction. This draughtiness is aggravated when, as sometimes happens, a swing door fails—owing to faulty springs or other cause—to return to its normal position of rest.

The inventor has aimed at rendering a swing door draught-proof when it is closed, whether it is in or somewhat out of the central plane of the door-frame post.

According to his invention, that part of the frame or post which is adjacent to the free edge of the door is curved (e.g., as an arc of a circle) and has a dimension in the direction of movement of the door greater than the thickness of the door. In addition, draught-excluding rubbers are provided along the free edge of the door, and, if required, above or below the door, or in both positions, if found desirable.

The Strength of Materials

A Modern Scientific Mystery Outlined

THE fact that a steel bar ought, in theory, to be about a thousand times as strong as it really is constitutes, at the present time, one of the first-class mysteries of modern science.

Despite the production of our high-tensile metals and other super-strength materials, it does seem that we are, in actual fact, compelled to utilise very inefficient materials for the construction of our modern world. Thanks to patient investigation by means of X-rays, we know quite a lot about the inner constitution of solid materials, even though this knowledge falls considerably short of what we should like it to be. However, we are aware of the general plan upon which the atoms of solid materials are arranged. We know, particularly, how they are positioned and spaced in a sort of three-dimensional network or "lattice," and we have a good idea of the actual distances apart of the atoms constituting a solid substance, for modern X-ray work has made it possible to measure the positions of atoms to within a millionth-millionth of an inch, which is a dimension about ten million times more minute than the diameter of the smallest particle which can be discerned under the most powerful visual microscope.

With this intimate knowledge of atoms in solids it is possible to calculate the intensity of the forces which bind atom to atom in the solid structure. And it is just here that the astonishing fact is revealed that all solid materials seem to be enormously weaker in tensile strength than they should be according to the theoretical calculations which can be made on them.

Steel, for instance, ought, in theory, to be several hundreds and, sometimes, even a thousand times as strong as it is. Copper, tin, brass, and non-metallic substances such as glass, pottery, and the like ought, likewise, to be hundreds of times stronger than they are actually found to be.

What, therefore, is the cause of this basic discrepancy? It cannot be ascribed to errors of observation or calculation. Nor can it be due to the adoption of false theories, for the existence of individual atoms or material particles within solid materials can be proved up to the hilt.

Inhibiting Factor

The only inference is that there exists some factor or factors concerned with the general structure and make-up of solid materials which strongly inhibits the cohesion of atom to atom, or, rather, of atomic cluster to atomic cluster. It seems certain that if this strange factor were not operative the tensile strength of solid materials would be vastly increased. Lightweight bridges, super-lightweight aircraft, and ultra-light building structures would at once become possible, bringing with them not only increased efficiency of design, but also very great saving in actual material. Boilers and other pressure-vessels could be made very much stronger for the same mass of material; a feat which would at once result in a considerable increase in mechanical power of prime-movers and other devices.

The vast discrepancy between the observed and the calculated tensile strength of a solid body has introduced to modern physical science a problem of the first magnitude. At the moment it is essentially an unsolved problem, and it has remained such for about a dozen years. In a way, this strange weakness of metals and other bodies constitutes one of the "hidden" problems of science, for its investigation is anything but spectacular in nature, and progress with it is almost disappointingly slow.

When the late Sir William Bragg, together with his son, Professor W. L. Bragg, commenced their now classical work on the X-ray investigation of crystals, practically nothing was known about the interior constitution of solids. Because the atomic dimensions existing within a solid are smaller than the wavelengths of visible light, it was clear that we could never hope to penetrate the secrets of solids by means of any conceivable system of ultra-microscopic investigation. But the Braggs, using the X-rays, which have wavelengths much more minute than those of visible light, were enabled, by means of a system which they evolved, to measure the amount of scattering which X-rays underwent on contact with a crystal surface, and, by this means, to demonstrate that the constituent atoms are all arranged in definite order or pattern in rows of definite thickness, with each individual atom or particle situated a certain definite distance from its neighbour. It was, as we have already seen from such investigations, that the theoretical strength of metals and other materials ultimately became calculable.

A microscopic view of the fractured cross-section of a thin steel member which broke under intermittent stress. The crystalline nature of the metal and the "hills and dales" of its fractured surface are well discernible, showing that the metal must have fractured along definite lines.

A flaw in a wire mesh which represents the weak spot of the mesh and is likely to grow in extent. In a somewhat analogous manner, flaws in the ranks of atoms constituting solid materials tend to "grow" under stress and are responsible for certain types of tensile weakness.

Griffith's Glass Fibres

Somewhere about the year 1920, Dr. A. A. Griffith, of the Royal Air Force laboratories at Farnborough, happened to notice that freshly-drawn fibres of silica or glass were stronger (about 50 times stronger) than similar fibres which had been drawn for some time. It appeared that such fibres rapidly developed their characteristic weakness after having been drawn.

Griffith, although he was engaged on other work at the time, interested himself in the problem, little thinking, perhaps, that he was setting the ball rolling in respect of the whole mysterious problem of solid strength. He put forward the notion that the weakness of his glass and silica fibres was due to some interior disturbance of the individual atomic particles of these articles. The fibres, said Griffith, were composed of a strong surface layer and a relatively weak core, the latter being due to the existence of interior cracks within the mass of the material.

Griffith's original theory was found to be untenable. Not very long afterwards Professor A. Joffe, then of the Physico-Technical Institute, Leningrad, carefully prepared a thin, parallel-walled glass rod which he subjected to a very delicate tensile test. During the performance of the test he surrounded the rod with dilute hydrofluoric acid, which dissolved away its outer surface. Joffe found that the strength of the rod increased about five times, from which experiment he concluded that the weakness of the rod lay in its surface rather than in its interior, as Dr. Griffith had originally supposed.

Other workers showed subsequently that a silica rod having a freshly prepared surface could absorb traces of both water and alcohol, and that this absorption resulted in its becoming weaker.

Joffe's Experiments

The Russian professor Joffe, confirming these experiments, took crystals of rock salt which he tested for mechanical strength. By performing his tests with the crystals immersed in warm water he found that the apparent strength of the crystal increased more than 160 times. Here again, stressed Joffe, was a case of a material suddenly increasing in strength after its outer surface has been removed.

From a large number of varied experiments such as the ones described above, Joffe put forward the explanation of solid weakness which has come to be at least tentatively accepted at the present day. Joffe's notion was that the entire mass of a solid body invariably contains a large number of sub-microscopic flaws, the exact nature of which he could prove very little about. The more of these flaws a metal contained, the weaker it was.

On this assumption, Professor Joffe brought forward the idea that the bigger the test specimen the more flaws it will be likely to contain, and consequently the weaker it will be. Experiment seems definitely to have confirmed this assumption, for by testing out a large number of silica and glass fibres, Joffe and his co-workers found that the smaller the specimen, the relatively stronger it was.

Let us now go back for a moment to the wonderful work of the Braggs on the subject of crystal structure. By means of their X-ray diffraction methods these two British professors at London and at Manchester were able to investigate the interior structure of a very large number of different materials. They were able to prove beyond all doubt that certain crystalline forms contain fixed arrangements of atoms positioned in a framework or "lattice," as they called it. In this respect, the arrangement of the constituent atoms within a crystal can be likened to the "pattern" formed by a troop of servicemen drawn up on a parade ground.

The X-ray Method

The Braggs' work on X-rays and crystals enormously widened our knowledge of the principles of solid structure. Yet, in one or two respects, it led to some disappointment. For, although the X-ray method can tell us all about the constitutional make-up of a crystal or other solid material it cannot inform us if the theoretical "pattern" is complete in all respects, or whether there exists any areas of disruption between the individual atoms. The Bragg X-ray method gives us an astonishing knowledge of atoms in the aggregate, but it tells us little about individual atoms.

The X-ray eye which science has given us to investigate solid structure cannot reveal the absence of one or two atoms here and there among the atomic framework. Nor can it tell us whether any atoms are permanently out of position with regard to their neighbours, or whether there exists any unusual repulsive force between them. There might, indeed, be a deep cleft within the atomic ranks of a crystal without the X-ray method being able to reveal it.

Sub-microscopic Flaws

The present theory (tentative, it is true, but certainly of working value) concerning the apparent enormous weakness of metals and other solid bodies compared with their calculated strengths, is based on the above considerations. When a metal or other substance solidifies from the liquid state its constituent atoms apparently do not position themselves with perfect dimensional regularity. There exist gaps, vacant spaces within the ranks of the atoms. The individual attractive forces of the atoms are not equally balanced. One atom may exert more attraction on one side than it does on the other. As a result, it may tend to become permanently aligned out of its normal position. That is to say, it is nearer to one of its neighbouring atoms than it is to the other. This sort of thing may be repeated deep down into the material so that there is formed a sort of flaw, crack, or line of weakness in that direction. Under these conditions, when opposing forces act upon the solid material (as they do when it is subjected to tensile stress) the atoms at one side of the flaw-line go one way, whilst the atoms on the other side of the line are pulled the opposite way. The flaw constitutes the weakest link in the chain. The application of external tensile stress increases the flaw, widens the crack, and provides the area or plane at which the eventual rupture of the solid material will take place.

The "laddering" of a silk stocking and the development of a fault in a wire mesh or sieve are cases in point, for in both instances the trouble occurs by the initiation and rapid growth under stress of a single weak spot.

A photograph showing a flaw extending or "growing" through a mass of metal. Here the metal is copper and the flaw has been set up by the intermittent twisting of the metal.

It is now thought that most solid materials, even, indeed, the strongest of steels, are more or less riddled with these sub-microscopic flaws which extend through the mass of metal and terminate on the surface. It is the surface flaws which matter the most, because these give rise to the areas of rupture and breakdown. If the surface flaws could be got rid of, the actual tensile strength of the material would at once go up enormously.

Electrical Sputtering

Microscopic observation of these supposed cracks in the surface of metals and other materials has not yet been made. Professor Andrade, of the London University College, has, however, made a near approach to this observation. By means of a delicate method of electrical "sputtering" in a high vacuum he has been able to deposit particles of silver or gold on to various objects. In most instances he has found that the sputtered metal has tended to arrange itself in straight lines on the surface of the experimental object. Even when the sputtered metal has been dissolved off its support and the latter has been again subjected to the same sputtering treatment, the almost perfectly straight lines reappear.

The inference here, according to Andrade, is that the particles of sputtered metal tend to align themselves in the invisible cracks, the whole effect being not unlike, in principle, the "filling" of the surface grain of an oak board with a white pigment in the production of "limed oak."

It has even been possible to obtain a criss-cross of lines on the surface of one variety of diamond by means of the electrical sputtering method. However, on another type of diamond these characteristic lines have failed to appear, and it is just this variety of diamond which is the stronger of the two.

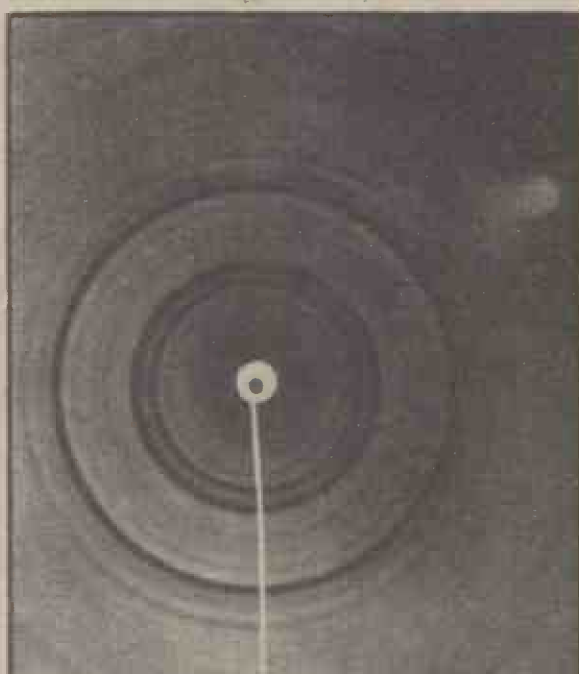
It is on the above lines that the initial attacks on the important and far-reaching problem of solid strength have been made by individual workers at varying times during the last decade or so. The problem is a very tangled, involved and unusually difficult one, for it brings to the fore factors which are more or less totally unknown and which, as yet, can be little guessed at.

Areas of Disunion

What seems to be at the root of the apparent weakness of solids is the existence of numerous areas of "disunion" (for want of a better word) among the orderly rows of individual atoms making up the solid material in the mass. It is these lines of weakness, flaw channels, sub-microscopic cracks, or whatever you like to imagine them as, which inhibit the solid interlocking of the entire mass of atoms making up the solid material. Hence, when tensile stress appears, some atoms go this way, others go the other way. The atomic house is patently divided among itself. Ultimately, it falls.

Whether the existence of these areas of "disunion" or discontinuity is "natural" to all solid materials, whether, under any circumstances, it is avoidable, and whether existing weak areas can be healed up and united by any possible means are all important problems for the future. At present we have no information whatever on such matters.

It follows, however, that if, by any means, the constitutional strength of metals and



An X-ray photograph showing the concentric scattering of the X-rays during their passage through a crystal. It is from a study of such "patterns" that the arrangement of atoms in solid materials can be determined. The white line is a silhouette of the device used for holding the crystal in the path of the X-rays.

other bodies could be increased by even 20 per cent., a new era in structural and engineering science would be ushered in, to say nothing of the actual saving in material which would result.

"Crystal slip," which is the well-known cause of the more or less common fatigue of metals, has, so far as can be seen, little to do with the problems involved in the apparent constitutional weakness of metals, for metal fatigue only affects those metal members which are intermittently stressed. The rupture or breakdown of metals under steady and prolonged stresses seems to be a different thing altogether, although, naturally enough, this effect may take place concurrently with the more fundamental effect of metal breakdown due to constitutional weakness.

Clearly, however, much original investigative work still remains to be performed in the domain of this still perplexing and obscure subject before the necessary light is thrown upon the matter. The subject was first seriously opened up about a dozen years ago. It has advanced a little during the intervening time but, unfortunately, the day when we can even prophesy the ultimate appearance of "theoretical strength" metals is still quite undiscernible.

Steel-framed Houses

Demonstration Houses Built at Northolt, Middlesex, by the Ministry of Works

ON the Northolt Grange Estate, Northolt, Middlesex, the Ministry of Works have erected several blocks of houses built of various materials designed to make use of such labour and facilities that are likely to be available in the immediate post-war period. These houses after being open for inspection by members of the public and building trades, etc., will after a period be used for occupation.

The accompanying illustrations give a good idea of the pleasing appearance of two of the houses of steel-framed construction. The house seen on the right has a structural steel frame with 4½in. brick to the 1st floor level, sheet steel on fibre board above and 2in. lightweight concrete block as inner lining. The house on the left has a cold rolled frame with cement render on steel sheet above, or steel wire fabric to 1st floor level, steel sheet above with an inner leaf of plasterboard panels bonded to fibre board.

Two of the houses built with British Iron and Steel Federation steel frames. As will be noticed, these houses are semi-detached, the one on the right having brick walls up to the first floor level.

The attractive front entrance of one of the houses.

Various other types of houses and flats have also been erected on this estate, a noticeable feature being the variety of fittings. In the working kitchen of some of the houses there are fireclay sinks, some of vitreous enamel, and some stainless steel. In the flatted dwellings the steel kitchen and bathroom fitting, which is installed in the Emergency Factory-made Bungalow, has been incorporated and cupboards have been used as partitions between two bedrooms. It would be possible to incorporate in house design the cupboard units that are displayed in the flats. One feature of the construction of these flats is the absence of wet trades above foundation level. Practically the only wet material used was the mortar for jointing the concrete blocks. Further, the construction enables the roof to be put on at a very early stage, so keeping all internal work dry.

The electric kitchen in one of the houses.

Cars Designed by the Law

By Prof. A. M. LOW

I AM one of those queer people to whom motoring brings not only thoughts of the explosion speeds of gas or expansion ratios, but also of the habits of bees, ants, or any of the delightful creatures which used to live in the country before lanes were turned into ordnance workshops. In short, I am very fond of my car, and I miss its casual use terribly, in spite of an excellent bicycle.

But I read, nowadays, so much unpleasing news about cars and their appurtenances that the words of Col. McLagan, of the S.M.M.T. came as a relief. "The present method of car taxation," he said, "will have to be revised so that creative designers can make automobiles that will sell overseas." Just so. Larger cars could, in fact, be far cheaper but for a childish law which satisfies no one but a few short-sighted manufacturers.

So much else on the motorists' horizon seems bad. First of all "they"—the modern sign of authority in requisitioned hotels—tell us that peace and petrol go poorly together. I gather that the continent has to be well supplied with fuel, food, roads, and vehicles, long before "they" will condescend to remember a little place called England.

The "Microcar"

The second complaint is that we have apparently failed to learn the lesson of the large-engined Jeep as compared with our 1,000 c.c. pets, and that we are soon to expect the appearance of what I must call the "microcar." I also suspect a legacy of war restrictions which will be unhelpful to trade, and valuable only to the staffs they maintain.

Now I dislike most small cars. Nearly always. It is a personal view, but there are others who agree, and there are very few British cars to which we can turn. My experience of the rather "buzzy" miniature is that the item of comfort is sadly missing. Being of great age, and after some unexpected years in the Army, comfort is one of the most important things if I am to follow my country bees in peace. Or if I want to maintain the highest praise of any transport, sometimes to forget that I am travelling at all.

Cars, of course, should function uphill with the same sensation as that of coasting in neutral with the engine "off." And I find that the 1,100 c.c., and under, job leaves nearly everything to be desired, except cheapness and ease of wheel changing. Silence, smoothness, ease of seating, and effortless acceleration have all gone.

Nor am I so foolish. For twenty years a large proportion of the public have been willing to pay £300 over and above the cost of a car with an identical performance as to speed and passenger capacity, to receive the very qualities that we affect to despise. Yet the semi-spring, whining wagon that we call "sports," seems likely to win the peace as the sole result of a system of tax that might have been designed either by a prejudiced maker or a professional wrestler.

Some years ago I made an amusing experiment. With great difficulty I collected a dozen non-motorists. These sufferers I drove "round the houses" after blindfolding them most carefully before leading them to the cars. Two cars I used: one English about 18 h.p. very good, another about 25 h.p. American, very "bad." I told my patients that one was a Rolls-Royce. All had heard *that* name, and after the comparative drives, no less than 10 were certain that the "Yank" was of that beautiful breed.

I asked them how they chose. "But it was easy," they said, "it was gliding—we were not bumped—not so much noise—no grindings. The latter were bottom gear and not my gear-changing. Ten out of twelve! And one of the select two said he liked to hear the engine and to feel it was there!

I confess that I must usually buy a second-hand car. My observations have told me that, having no ready access to a suitable workshop where maintenance is free, I cannot keep a small engine in the pleasant tone that alone ensures good behaviour under neglectful periods of use. Nor am I willing to follow an instruction book that has the unparalleled nerve to invite attention every 500 *or* every 1,000 miles.

American-type Cars

Often I have owned an American-type car. I reckon that the appalling tax which cheats me out of far more than is paid by the driver who can afford to pay four times as much, and who covers four times my mileage on public roads, is partly offset by capital cost. My journeys are not long enough for consumption to matter greatly, and I have discovered, incidentally, that the medium "fussy" vehicle often uses as much fuel as a high geared model of 50 per cent. greater capacity.

If cars must be taxed, and it is quite illogical to do so, it seems clear that the money paid should be proportionate to use. So foolish to bow to any formula which juggles with capacity. The possible variations of bore to stroke are not very wide in practice. Any restriction on design is bad if we believe, as we are so fond of saying, that regimentation is unhelpful.

How right is Col. McLagan! What military car is so successful as a Jeep? What car, over colonial roads, is preferred to the large-engined machine? What British manufacturer has had a chance to compete in quantity, experience, or freedom with a Buick or any of its many minor cousins?

An engine should have plenty of "power in hand." And this means without excessive engine speed in an internal combustion engine which is not inherently suited to traction at all. During the war, research has compressed years into weeks in the matter of knowledge. Money has been spent like water on engineering development. We have new metals, new designs, lighter alloys, far better fuels, and production methods that were formerly unknown.

Is it too much to hope that these good things will be freely used without prejudice? There is nothing clever in compelling a wine-glass engine to overwork. The motor is there to provide comfort, as well as to move itself from A to B. Remember that, not long ago, the spokesman of one of the greatest American combines said that his "outfit" could switch to car production at full output within seven weeks from the date of peace. I read that, in the States, paper and other amusing things are being "released." Does anyone really believe that manufacturers are thinking now of swords instead of ploughshares?

The world needs cars. The continent will have few restrictions of an artificial nature, and I suggest that if we hold up our designs, our driving, and our cars much longer, other lands will have the same dear old 10 years' start. It is the red flag days again. Only far redder in more ways than one! The American Government has just aided a group of industrialists to visit South America to discuss the establishment of a plant to produce popular-priced cars. This, I imagine, is quite without significance to our "authorities."

Of what use is it to say proudly "after the war 600 c.c. will do the work of 2,000 c.c.—small cars will carry big loads at 60 m.p.h." We know it. A 900 c.c. car would always take four fat men at 70—or at least has done so for some years. If this was all that mattered, why large engines at all? Why a colonial market? Why American cars here in the home of engineering progress?

My trouble is, no doubt, that I enjoy the soft, silent comfort *and* speed of a larger car. I cannot get anything like it in England, and it is high time that the design ban was removed with blackouts and other disadvantages under which the countries we shall help do not suffer. Surely a few million civil servants can devise a better plan than to say "all cars must be so small that they cannot compete with any others out of England." If it has been possible to restrict petrol so that doctors who leave their route by a few hundred yards can be prosecuted, it should not be beyond wit to impose a "user" tax that does no harm to commerce. A petrol tax is so simple that I realise it is unlikely to be adopted.

Thermal Efficiency

The cult of thermal, at the expense of all other, efficiency, has surely had its day. Even the myth that "American cars don't last" has long since been exploded. I have many times purchased old "Yanks" for a few pounds. After five years they start easily, are well sprung, bear huge overloads, are fast without nursing, they seldom need decarbonisation, and they are not terribly uneconomical when first cost, depreciation and maintenance are borne in mind.

It distresses me to think that other countries are now preparing novelties. I am sorry that heaters, automatic hoods, self-raising jacks, radio, blowers, and other gadgets should be found abroad. It seems to me that this vital time of "change over" soon to come is a heaven-sent opportunity for us to grasp what politicians call the fruits of victory. Tiny cars have their great uses. So has good solid heavy British design. But please let us not forget that we should now be very busy re-planning everything and changing old for very new indeed. A utility réchauffée of 1939 in models or laws will not go far when the improving test of hard competition begins again.

Switchgear Development

The Progress Made in This Important Branch of Electrical Science

By J. H. M. SYKES

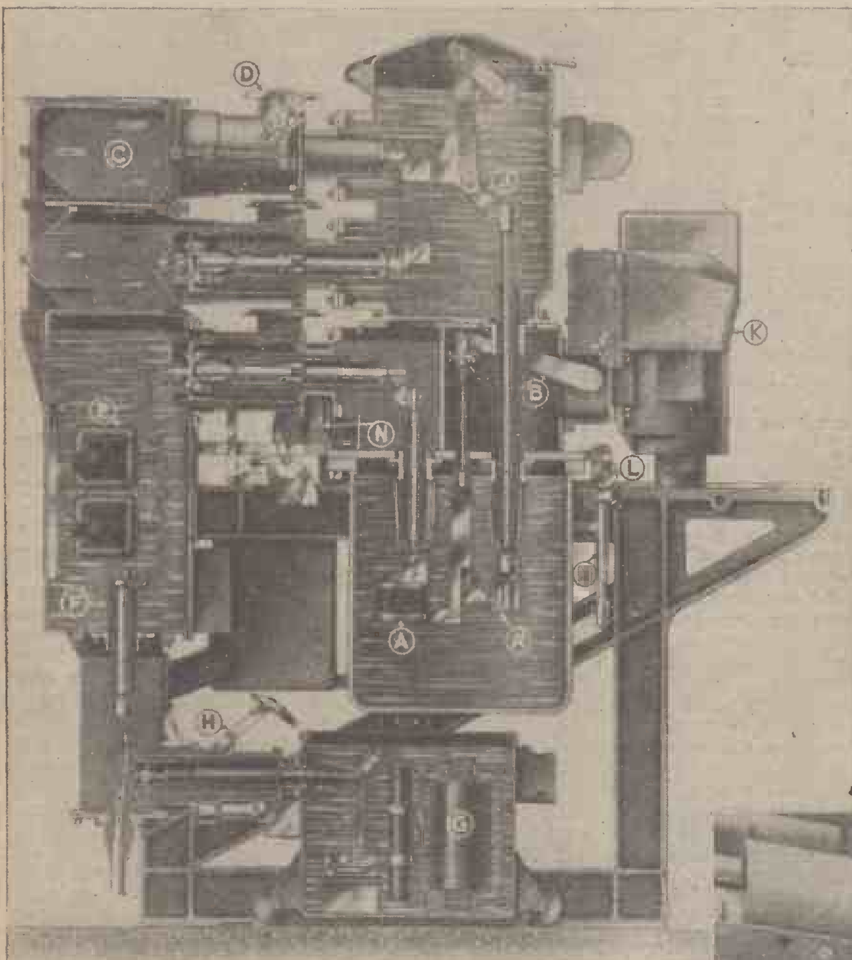


Fig. 1.—Sectionalised view of a modern metal-clad circuit breaker for 3-phase, 50 cycle, 6,600-volt circuits.

FROM the earliest days when men began to use the magic of electricity and to experiment with the incredible services it could perform, the methods of controlling and interrupting the electric circuit presented peculiar problems of their own.

In the beginning, when batteries and small dynamos were the only sources of power, the switch used to break the circuit was a simple affair. It was not long before the knife switch, in the form in which it exists in simple applications to-day, was developed. The early forms were designed simply for good surface contact when the switch was closed, and various manufacturers developed ingenious designs of spring-loaded contacts, multi-blade assemblies, and the like, for the purpose.

Later, some provision was made for the control of any arc which might arise when the circuit was broken. With the gradual increase in the size of prime movers and dynamos, it was beginning to be realised that the main problem in switchgear design was going to be the control and extinction of the arc formed when circuits of greater and greater inductance and capacity were disconnected under short-circuit conditions.

The first steps were to make the actual break quicker and independent of the speed of manual operation, and spring loaded auxiliary contacts attached to the blade of the switch were one of the first steps in this direction. But progress soon tended towards the increase both in power and in voltage of electrical systems in all parts of the country, and the change over to A.C. generation, with its resultant problems in the capacitance of long transmission cables, feed-back from rotary convertors and the like, all of which caused the switch arc to become more powerful and uncontrollable than before, made it necessary, before long, for great concentration of designers' thought into the preparation of switchgear capable of dealing with the conditions the rise of the electrical industry presented.

For the higher voltages, the obvious step was to increase the length of blade, to operate it remotely by an insulated shaft, to speed up the break by means of more powerful springs, and to place the whole switch in a compartment of brick or stone where any flame or explosion could not harm the operator. The need for automatic opening on overload became imperative, as the fuse—which had hitherto been the only form of protective device—became so bulky, unmanageable and often unreliable that it could no longer be the sole source of protection for electrical circuits of growing importance.

Automatic Tripping

The industry, therefore, was called on to design a switch which would "trip" or open automatically when called to do so by overload in the feeder it controlled.

This meant a radical alteration in the design of the actual circuit breaking element of the switch. It was not long before a general type of design was evolved which mostly took the form of a tank full of transformer oil—a thin mineral oil of a high flash point—and in this was immersed the whole of the switch contact assembly, so that the arc would be immediately quenched. The design of this assembly had so far altered from the simple knife switch as to become a type where the incoming wires were brought through insulators in the top plate to contacts mounted on porcelain posts on one side, while the outgoing wires were similarly brought into symmetrical posts on the other side. Incoming and outgoing contact points were bridged, when the switch was closed, by a horizontal contact piece which rose and fell vertically. When the switch was closed, the insulated operating rods fixed at right angles to the contact piece were drawn upwards by a linkage mechanism against a powerful spring, and were held in the closed position by a light trigger called the trip catch; and this, when operated by a simple electro-magnetic device such as a solenoid, allowed the spring to drive the contact-making assembly very rapidly downwards, drawing the arc through

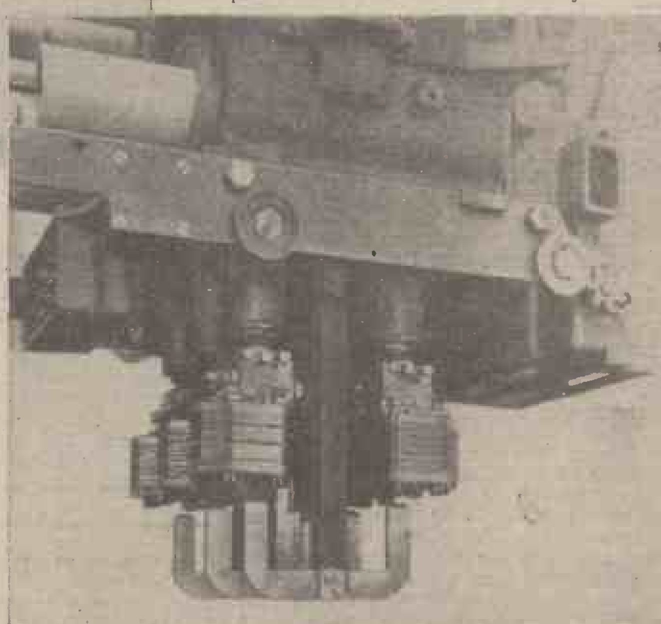


Fig. 2.—Typical oil-filled circuit-breaker contact assembly, showing "explosion pots."

the oil. This process is still in use to-day (Fig. 1), but every feature of the original design has been developed and modified as the result of experience. The early designs were to a great extent empirical, and there were many failures as the amount of power controlled rapidly increased (especially as designers did not fully realise the extent of the enormous electro-mechanical forces developed in the conductors during short-circuit conditions). The switch tank and assembly were mounted in steel or concrete cubicles with the outgoing cable connections at the bottom and the busbars at the top. The handle for closing projected through the front cover. When the switch was called on to break the very large fault currents which resulted when the whole of a central power station fed into a dead earth on an outgoing cable, the arc so produced, together with the momentary mechanical stresses, was sometimes sufficient to explode the tank, ruin the cubicle and cause disastrous fires.

The general trend of progress was towards strengthening the tank until it became as it is to-day, a boiler-plate assembly of great mechanical strength; to increase the volume of oil for better quenching of the arc; to speed up still further the tripping operation by the use of more powerful springs, more delicate trip catches, lighter moving parts and careful attention to other parts of the mechanical linkage, and to begin to pay attention to the actual form and design of the contacts themselves so that the arc was directed in channels where it could do no harm.

"Metal-clad" Principle

Another principle, too, was making rapid headway. It was the "metal-clad" principle, where not only was the switch itself in a steel tank, but its connections to the busbars, and the busbars themselves, were solidly encased in insulated media of various kinds, and then also clad in metal. This meant that switchgear was no longer subject to faults arising from its bare connections, such as those due to inflammable gases arising

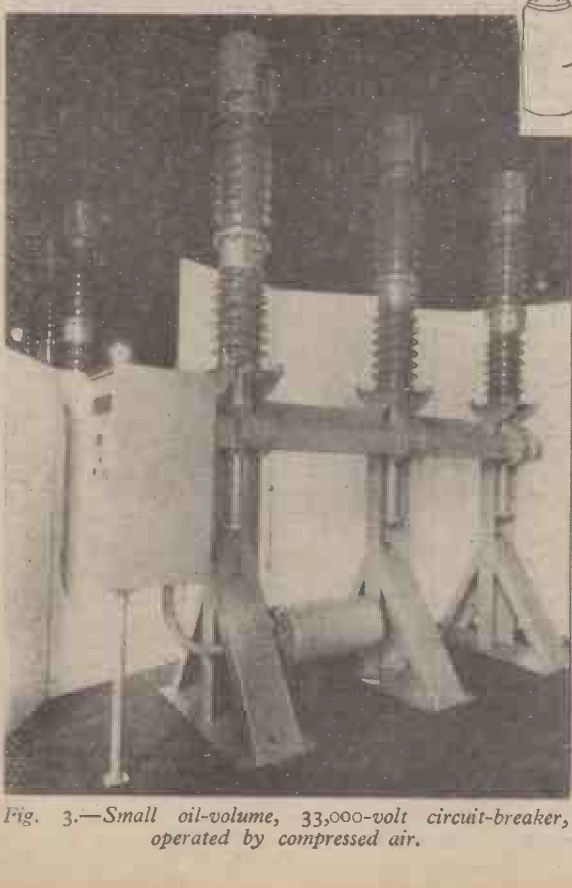


Fig. 3.—Small oil-volume, 33,000-volt circuit-breaker, operated by compressed air.

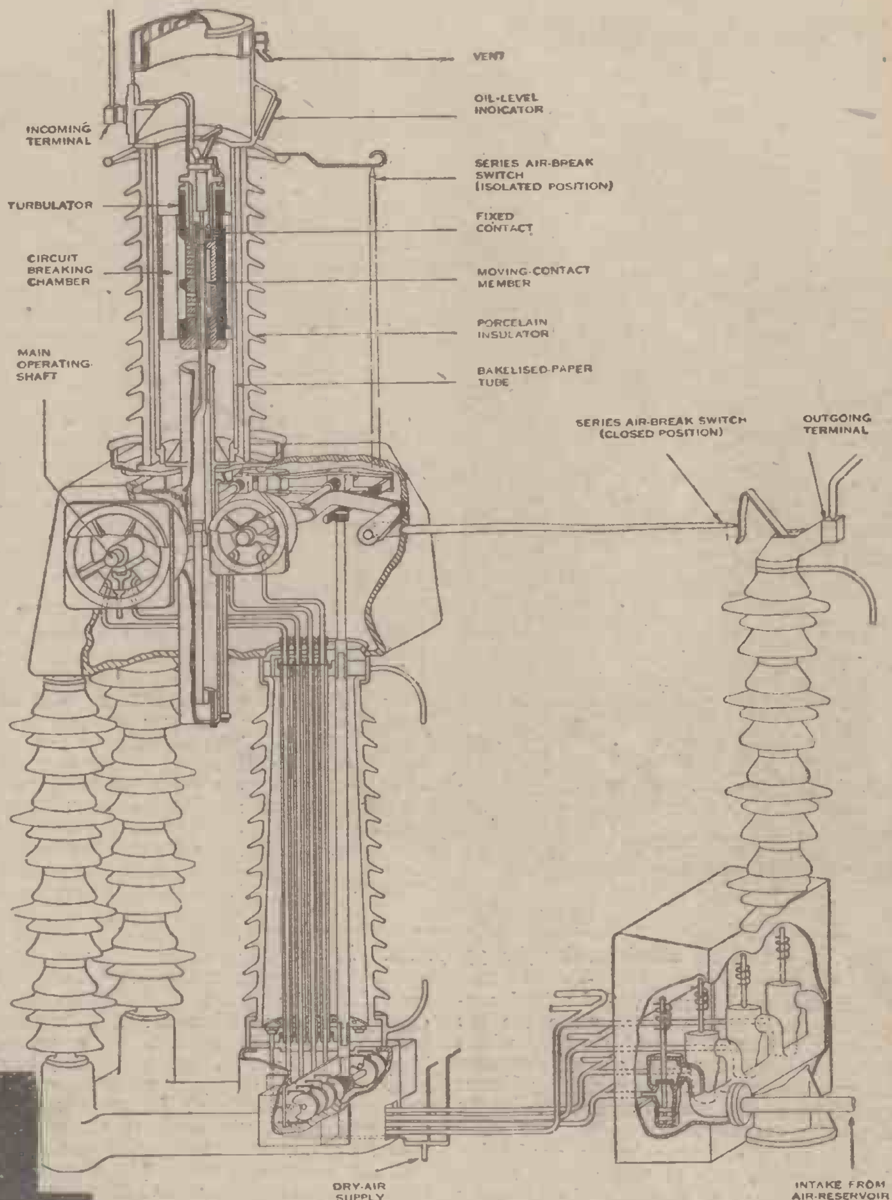


Fig. 4.—Perspective view (part sectional) of a 132,000-volt circuit-breaker unit, with small oil-volume switch, operated by compressed air.

from the oil-quenched arc, and it meant also that phase-to-phase faults became almost negligible. It made the general design of switchgear very much more simple and compact, and helped, too, in the protective gear schemes, as it made earth faults almost the only type of failure to be guarded against. A typical metal-clad switch in which there is no bare connection is shown in Fig. 1. Here the whole assembly can be divided into two parts, fixed and moving. The two sets of alternative busbars are shown at C, and the device seen above the switch itself at J allows the incoming cable to be connected to either. Projecting from the busbars and from the cable are spouts, and the switch assembly itself can be pushed in, as it is shown in the illustration, so that contact is made with these spouts, or it can be completely withdrawn to the right of the figure by means of the rack and pinion gear at L, leaving the spouts covered by automatic shutters D, to ensure complete isolation of the outgoing circuit from the busbars. The actual contacts are shown at A, one of them having its explosion pot removed for the purposes of illustration. The incoming cable connections are indicated by letter F, while E denotes the current transformer, and G the voltage transformer, for protective gear and metering purposes. The switch is closed by the solenoid K through the linkage B.

By about 1930, switchgear manufacturers were able to produce circuit breakers which would control circuits of up to 66,000 volts, and for normal carrying currents of as much as 2,000 amperes. But there were still many empirical factors used in their designs, and it was decided to organise laboratories on a large scale for common use where sufficient power could be available to test all types of switchgear, if necessary to destruction. Special motor-driven alternators, with a large fly-wheel to store energy, were used in this work, and scientists began to learn more about the fundamental principles of arc control.

Before long all leading manufacturers began to develop forms of "explosion pot,"

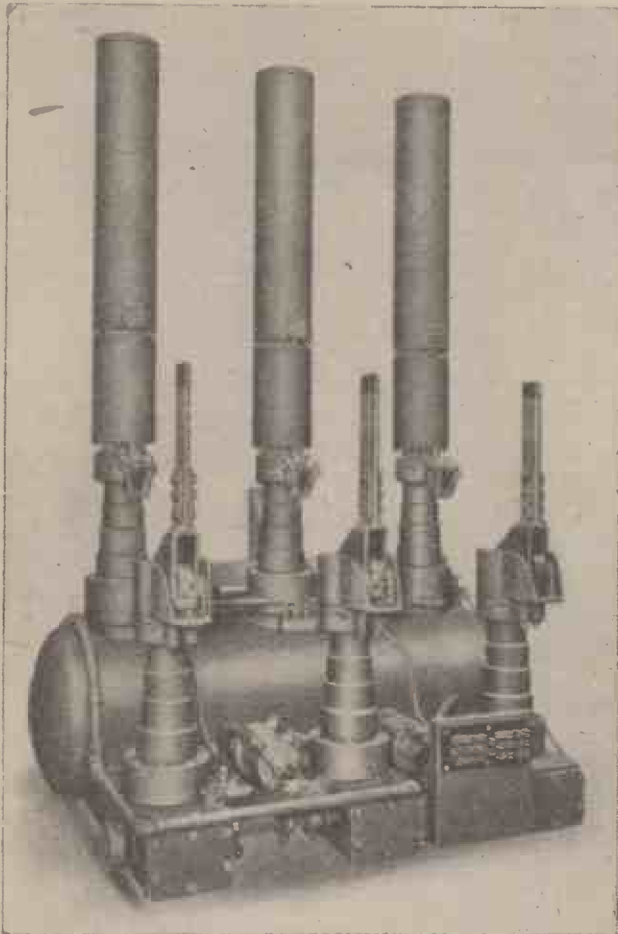


Fig. 5.—Air-blast circuit breaker for 33,000-volt circuits.

which were used to surround the fixed contact on the switch and to guide the arc through various forms of passage, which have the effect of driving the oil across or through the arc path, thus obtaining instant extinction at the first current zero in the alternating current wave.

With the help of these devices, our leading designers were able to predict very closely the performance of their switchgear under the most severe conditions of short-circuit, and they were able, in many cases, to reduce the volume of oil considerably. The influence of the design of explosion pot, the strength of the spring, and other mechanical features were, at the short-circuit testing stations, capable of being observed with the greatest exactitude.

The cathode-ray oscillograph is widely used in this work, since by its aid the exact voltage and current and time conditions in connection with the moment when the circuit commences to be interrupted can be not only observed but photographed for permanent record. In modern installations of switchgear of the general designs illustrated, there are both indoor and outdoor types. In an indoor installation, the switches will be either self-contained, that is, of the metal-clad type as in Fig. 1, or of the same layout as regards the circuit breaker, but with the busbars and other gear enclosed in stone cubicles. The switch will be closed, remotely, by means of a powerful solenoid or motor-wound spring, and it will, of course, be tripped by a similar but smaller solenoid. The contact mechanism, as shown in Fig. 2, will consist of some form of explosion pot which controls the arc so completely that, with the extremely rapid break, it is possible for a very small quantity of oil to be sufficient. Indoor installations of this type are generally within the limits of 6,600 to 33,000 volts, although higher voltage designs are occasionally to be found. Outdoor schemes will have a similar switch, but in this case the whole switch tank will be weatherproof, and the connections will be brought out through the top plate in porcelain insulators to bare connections, from whence they are run to the overhead busbars. There is no limit to the voltage for which these schemes may be designed. In this country, there are a vast number of 132,000-volt circuit breakers constructed according to this plan, while on the continent and in America installations up to 280 kV have been successfully commissioned.

Pneumatic Operation

But new lines of thought about circuit breaker design have gradually been winning their way to the fore. The simple oil-filled design, however carefully the arc is controlled, cannot but require sufficient oil to constitute a serious fire risk, and the "small oil volume" types which have been manufactured of late years, have been based broadly on the principle of not only using the maximum control of the actual arc, but of producing an acceleration for the breaking movement of the contact, of a greatly increased order. To do this, it has been necessary to abandon the orthodox spring-and-linkage methods of operation and to substitute pneumatic methods where high pressure of compressed air, operated through carefully designed blast valves, acts on a moving piston or vane of the lightest possible design. This type of mechanism most conveniently produces a short break which would not be sufficient for complete isolation of the circuit under all conditions, and so a second break which does not actually rupture fault currents—that is, it operates when the main circuit breaker has broken the circuit—is sometimes introduced.

This type of switchgear, which is unconventional when judged by the standards hitherto existing, is illustrated in Figs. 3 and 4. The first illustration shows a 33,000-volt installation where the auxiliary or secondary break is not required. The current enters at the extreme top and passes through the circuit-breaking element, which is the higher of the two porcelains on each of the three single-phase units, and leaves at the bottom of the switch. The air operating mechanism is in the compartment on the left, and the storage cylinder for reserve air pressure is seen below. Fig. 4 is a diagrammatic view of a 132,000-volt circuit breaker which has been in service for some time on the National Grid. The main break, in the topmost vertical porcelain insulator, needs only 30 gallons of oil per phase, as compared with the 1,300 or so gallons used on the more conventional, earlier types. Here the series air break is used, since the short main break is not considered sufficient isolation under all conditions. There are two air-motors, of the vane type, one for the circuit breaker itself, and one for the series air break.

Air-blast Design

Working parallel with these developments, other designers on the continent, in America and in this country were endeavouring to obviate the use of oil entirely, by "blowing out" the arc by means of a powerful blast of air. There were many difficulties in the development of this design—for instance, it was obviously absolutely necessary to extinguish the arc at the first current zero after the contacts had parted, as if this had not occurred the initial force of the air-blast would have been expended, and there would be no means of further arc extinction. These problems have been satisfactorily solved, and it can be prophesied with some confidence that future switchgear will be mainly of the air-blast design. Fig. 5 shows a typical scheme for a 33 kV circuit. This incorporates the auxiliary break mentioned above in connection with the pneumatically-operated gear, but this time it fulfils a different and more vital function. The energising of the trip-coil opens the main blast valve which allows the air under pressure to flow up the blast pipe nozzles, and when it reaches the main contacts, which are kept closed by means of springs, it opens them in piston fashion, and thus interrupts the circuit; while in its subsequent rush to the exhaust vents it carries with it the ionised particles which form the arc. But the main contacts only stay open as long as the blast is on, and so immediately after they have opened the air pressure is fed into a simple piston which operates the auxiliary or series break. The blast having been expended, the main contacts drop back, but the circuit has been completely isolated by the opening of the series break. For the closing operation the series break alone is used. In some cases a resistance is automatically introduced momentarily into the circuit during the opening stroke, and in the illustration this is shown mounted above the main contacts. The circuit breaker itself is that portion of

Fig. 6.—Air-break switch for 660 volts, 1,600 amps.

the gear mounted immediately above the stepped bakelised-paper supports.

Low Voltage Circuit Breakers

So far we have considered entirely high voltage switchgear for the standard 3-phase 50-cycle systems. In the early days a switch, whether for high or low voltage, was constructed on much the same principles. But with the extreme specialisation that has taken place in the various branches of the art of switchgear design, the low voltage breakers which are equally important in the general layout of the electrical industry, have developed along different lines. For direct current, the usual method of arc control is to use a magnetic blow-out whereby the connections to the switch come through a coil so disposed as to develop a strong magnetic field which, when it interacts with the arc, causes it to be drawn into a convenient and safe arc-shute which allows it to pass harmlessly into the air. The general trend of design both for D.C. and 3-phase A.C. circuit breakers for voltages up to, say, 600 volts, has been to increase the speed of operation by means of powerful spring linkage mechanisms, in which every possible device has been employed to reduce friction and to do away with the effects of inertia. A modern example, for 660 volts, 1,600 amps, 3-phase A.C. is shown in Fig. 6. Special types of low voltage gear have been developed to meet every need. Radio engineers have needed switches where the high frequencies of the currents they carry have necessitated every insulating part being of the special low-loss dielectrics which the wireless technician has found necessary. Mining engineers have required switches which will pass the Government testing station examination in respect of being flame-proof, and many ingenious devices are used to ensure that no matter how severe the arc it cannot cause ignition of any inflammable gases in its vicinity.

This brief review of switchgear development shows that what was once a relatively unimportant and certainly very simple part of the electrical engineer's equipment has become the subject of a major branch of electrical science. The early pioneers could scarcely have conceived, when they added small improvements to the knife switch, of the colossal amount of power which later switches would be called on to control.

The author is indebted to Messrs. The English Electric Co. for permission to reproduce Figs. 1, 2, 5 and 6, and to Messrs. A. Reyrolle and Co. for Figs. 3 and 4.

Modifying Car Dynamos and Starters—3

Rewinding of Armatures and Field Coils

By D. E. BARBER

(*Continued from page 54, November issue*)

IN part 2 of this series, a method was given for approximating the wire gauge size to use for the new winding, and the importance of an accurate armature winding diagram was emphasised. The main essential of such a diagram is that it must portray correctly the relative positions of the coil sides, slots, commutator bars, and coil-to-bar connections, and to avoid mistakes, it should be as simple as possible. Since the coils of an armature winding are invariably identical, and as their connections follow one another progressively round the armature, there is nothing to be gained by showing all the coils on a winding diagram, so that some simple convention, as shown in Fig. 9, will be quite satisfactory; with this method the winding is assumed to be opened out and laid flat. Fig 9a represents a "lap" winding, the coil ends being connected to two adjacent commutator bars. The "span" of the coil is slot 1 to slot 10 and the fact that the mica between bar 1 and bar 2 falls opposite slot 5 is recorded, since it fixes the correct position for the coil-to-bar connection. The other type of winding used is the "wave" winding, and is depicted in Fig. 9b. The same general procedure is followed for fixing relative positions, but it will be observed that the principal feature of this winding is that the two connections to the commutator now lie very far apart; it is thus doubly important here to number the commutator bars correctly. In the case of multiple coils, that is, where two or more coils lie in the same slots, the connection diagram should be suitably modified, as shown in Fig. 9c.

Insulating the Core

Having stripped the original winding, the core can now be prepared for its new winding and, as the old insulation will have been removed, the reinsulating process should be tackled first. In this important matter, cleanliness is most essential, as many breakdowns have been caused through metal filings, swarf, and dust, all of which are usually generously scattered around the amateur workshop. The reader should, when insulating a core, endeavour to adequately cover all metal likely to come in contact with the coils, and various insulating materials are used in this connection. The ends of the core are usually protected by fibre washers, whilst "Empire" cloth or thin leatheroid is useful for the slot portion; with regard to these slot linings, they should be made large enough to extend some way out of the slot so that, after winding, they can be turned over and wedged in place, as shown in Fig. 10. In the case of hand windings, where the slot lining provides insulation as well as mechanical protection of the coil, a thickness of .005 inch "Empire" cloth, plus a layer of .01 inch leatheroid, will provide sufficient insulation for voltages up to 250.

Hand Windings

The majority of automobile dynamo windings are hand windings, that is to say, that the coils are wound on to the core straight off

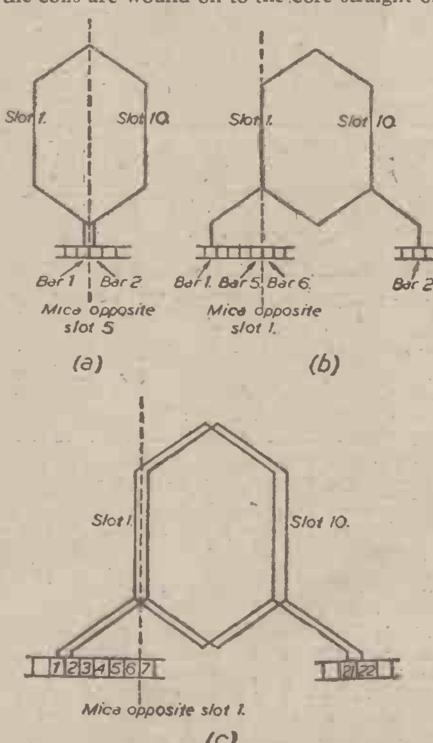


Fig. 9.—Winding diagrams.

the wire drum. As in all types of armature winding, hand winding calls for a fair amount of skill and practice, and the aim of the beginner should be to take great pains rather than to rush the job. After insulating the core, the armature should be placed between the centres of a lathe or in a suitable wooden frame, and the coils should be wound on, care being taken to avoid kinks in the wire. The starting end of the wire should be plainly marked, preferably with coloured cotton sleeving and, after every few turns, the windings should be gently tapped with a hide mallet or fibre block so that it beds down nicely into position, thus avoiding bulges. When the reader becomes experienced, it will be found that the wires can be coaxed into place without a great deal of tapping, and in this way the danger of shorted turns is appreciably reduced. As each coil is completed, the finishing end should be marked with a second piece of sleeving, of different colour, and secured before proceeding with the next coil. With mulitple coils, after putting on the required number of turns, the wire should not be cut, but should be looped and twisted, thus forming a tapping on the coil; these tappings should also be marked with some distinctive colouring. After the loop has been brought out, the remaining turns can be put on to the coil. To avoid short circuits between coils, small pieces of good quality brown paper should be placed in position wherever the end-windings cross each other, as these are inherently weak points. Similarly, a strip of the same material can, with advantage, be placed between the top and bottom coil sides in the slots.

Former Windings

Occasionally it may become necessary to rewind an armature, using the former winding method, which means that the individual coils are wound, formed into shape, and insulated before assembling into position on the core. Fig. 11 shows the type of wooden frame or former which is used to wind the coils, together with the method of winding and tying off the coil ready for removing from the former. Fig. 11c is a sketch of a completed former-wound, multiple coil, showing particularly the "step" which should be given to it in order that it may be assembled neatly into position on the core. The taping up of the coil should, for windings up to, say, 250 volts, consist of one half-lapped layer of .005 "Empire" tape, in which case only the leatheroid slot lining need be included, as this serves as mechanical protection.

When the core is provided with semi-closed slots, former winding is thereby complicated as only the end windings can be taped up, since the slot portion of the winding must be left free, in order that the individual conductors may be passed into the lot a few at a time. In this case the slot insulation should be the same as would be used for the equivalent hand winding.

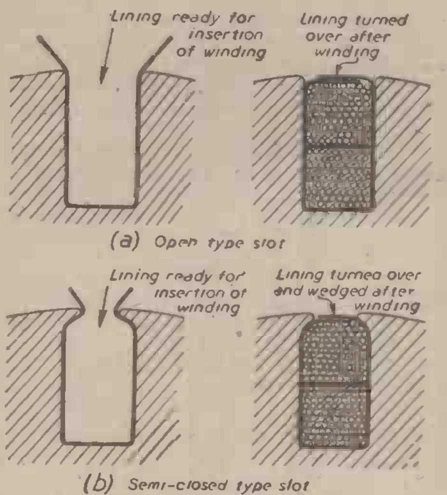


Fig. 10.—*Slot linings.*

Connecting-up and Finishing-off

After the coils have been assembled on the core, the connections to the commutator can be made. Except in the case of very fine conductors, the commutator bar should be provided with a small sawcut to take the two conductor ends, which will be soldered to it. Before actually connecting, the space behind the commutator should be built up with string or tape to give good support to the wire ends. When soldering, only good quality resin flux should be used, and care should be taken that the solder runs right into the sawcut mentioned above. A common mistake is to use an iron of insufficient size, so that the joint does not get hot enough for the solder to run properly. The leads from the coil to the commutator bar should be protected by sistoflex sleeving right up to the actual connection, since it is often here that shorts occur.

With regard to securing the coils in the slots, if semi-closed slots are used the insulating lining can be turned over and a wedge of fibre or bakelite will then hold the coils in place. In the case of open slots, however, the lining should be turned over as before, but some turns of binding wire should be then wound tightly round the core to secure the coils. Sections of the core are provided with a reduced diameter to take these bands, thus preventing them from standing above the surface of the rest of the core. Examination of the original armature before stripping will make clear the method to be followed. In addition, a band is usually wound over the front and back end-windings, but these are often of thin, strong twine, whereas the core bands should be of copper wire, about No. 24 gauge, and tinned to facilitate sweating up in several places to secure them. The final stage is the dipping of the armature in some good quality varnish to keep out the damp; if the wire used in the coils is enamel covered, the armature should not be dipped, as some varnishes attack the enamel covering. An external coat of shellac or similar varnish is, however, quite permissible. If considered necessary, the commutator can now be skimmed up in a lathe, using a very fine cut and a rather high speed; care should be taken that the soldered connections are not ripped off during this operation.

Field Coils

The armature winding having been suitably dealt with, attention can now be turned to the field coils. The preliminary tests, as outlined in article 2 of this series, will have established the number of ampere-turns that the new coils must provide. A method is now required for deciding what size of wire to use and how many turns to wind on. In the case of series coils, the calculation is simple, as the field current is the same as the armature current, so that in order to find the number of turns to put on, divide the required amp-turns by the field current. The size of wire depends on this current and can be found by assuming that a "current density" of about 2,500 amps per square inch of copper section is permissible, so that if the field current were, say, 10 amps, the wire would have to have a sectional area of .004 square inches. On looking up the wire tables it will be found that No. 15 S.W.G. has a section of .004072, and would thus be suitable.

The design of shunt coils is a little more involved, as the wire size will depend on the voltage at which it is desired to work the field. Usually, to allow for a little variation and the inclusion of a small series resistance for adjustment, the voltage across the field is taken as about 75 per cent. of the terminal voltage. Before the calculation can be made, an estimate of the average length of one turn of the original field coil should be made; the following formula will then give the "ohms per yard" value for the wire size required. Reference to the wire tables will then enable the equivalent S.W.G. to be read off.

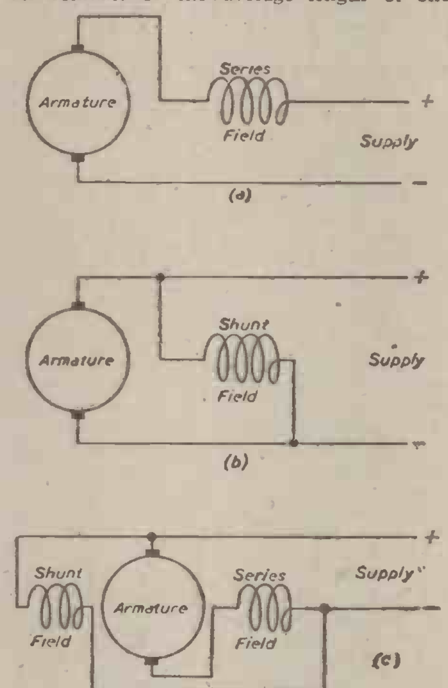


Fig. 12.—*Diagrams illustrating methods of connecting.*

$$= \frac{\text{Terminal volts} \times 36 \times 0.75}{\text{Amp-turns per coil required} \times \text{Av. lgth. of one turn in inches} \times \text{Number of coils in series}}$$

To return to the example of design given in article 2; it will be recalled that an excitation of 400 amp-turns per coil was decided upon, that the machine was four pole, and that the terminal voltage was to be 120. A measurement of the original field coils showed that the length of an average turn was 11.8 inches, so that these values can be substituted in the formula as follows:

$$\text{Ohms per yard} = \frac{120 \times 36 \times 0.75}{400 \times 11.8 \times 4} = 0.189$$

From the wire tables, the nearest sizes are No. 29 S.W.G. and No. 30 S.W.G. Either of these may be used, the former giving slightly more ampere-turns, but, at the same time, increasing the field excitation loss a little. The whole of the available space should be utilised for the coils, so that after fixing the wire size, as many turns as possible should be wound on. It is interesting to note that for a given gauge of wire the ampere-turn value of a shunt coil is almost independent of the number of turns, although too few turns will cause a high field current with a corresponding increase in excitation loss.

The actual winding of the field coils should present no special difficulty, and will be found much simpler than the armature winding. The rule of cleanliness is equally important in the case of field winding, and should be rigidly adhered to. A coil winding former of similar design to the armature coil former should be made, and the necessary turns can then be quickly wound on. Two layers of .005 inch "Empire" tape will provide adequate insulation, whilst a further layer of cotton tape may also be applied if mechanical protection is desired; the tape should not be drawn too tightly, otherwise distortion of the coil will result. Coil leads should, if possible, be of a flexible nature, as breakages of the wire often occur where the wires leave the coil. It will be found that the remarks previously made on the subject of dipping armatures are also applicable to field coil dipping, and in the majority of cases the same varnish can be used for both jobs.

Compound Field Windings

Fig. 12a and 12b show diagrammatically the method of connecting up the armature and field system of a series and shunt machine respectively. Sometimes, as was mentioned in an earlier article, it is desirable to boost up the field of a shunt machine when on load by means of a few series turns; this extra series winding is called a compounding winding, and is connected as shown in Fig. 12c. If, on running up for the first time, it is found that the inclusion of the compounding winding reduces the terminal voltage on load, the winding is opposing the shunt winding, and should be reversed. The number of turns to put on such a winding is largely a matter for experiment on the basis of individual requirements. For instance, if the generator supplies a load via a long cable run, it is a good plan to make the full load terminal voltage a little higher than the no-load voltage to compensate for the drop in voltage in the cable. In this case, "over compounding" can be advantageously employed, this entailing a few series turns over and above the normal value.

(*To be continued.*)

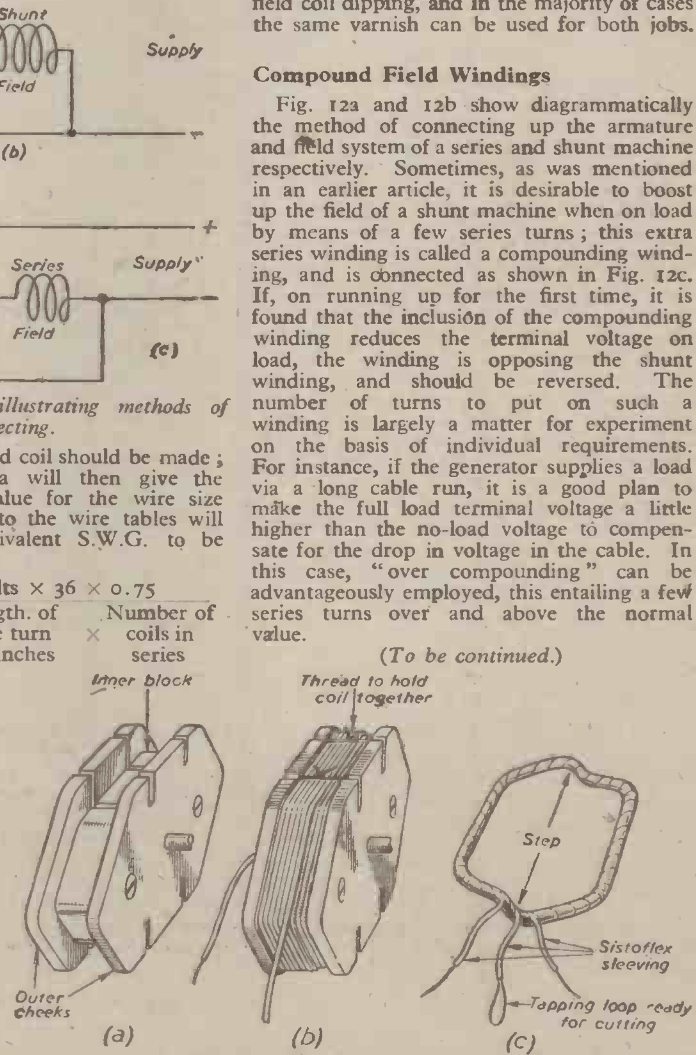


Fig. 11.—*Three stages in winding.*

Rocket Propulsion

Further Details of American Research : The First British Rocket Society

By K. W. GATLAND

(*Continued from page 50, November issue*)

SINCE its formation in 1930, the American Interplanetary Society published a monthly *Bulletin*, but in May, 1932, the title of this was changed to *Astronautics*—a journal to-day heralded as the finest of its kind. From that time until January, 1933, the Society's official publication continued to appear each month, but in order to reduce expenditure, issue has since been made at quarterly intervals. Economy thus achieved financially, a more elaborate research programme was drawn up, and in September, 1933, the construction of three more rockets was begun.

In the Spring of the year following, however, the Society changed its name, the term "Interplanetary" being discarded in favour of the more conservative American *Rocket* Society, a change made in the belief that many prospective members considered the Society's space-crossing ideal unattractive at that early stage of technical development; nevertheless, it was emphasised that the alteration by no means meant to infer a general abandonment of the interplanetary idea.

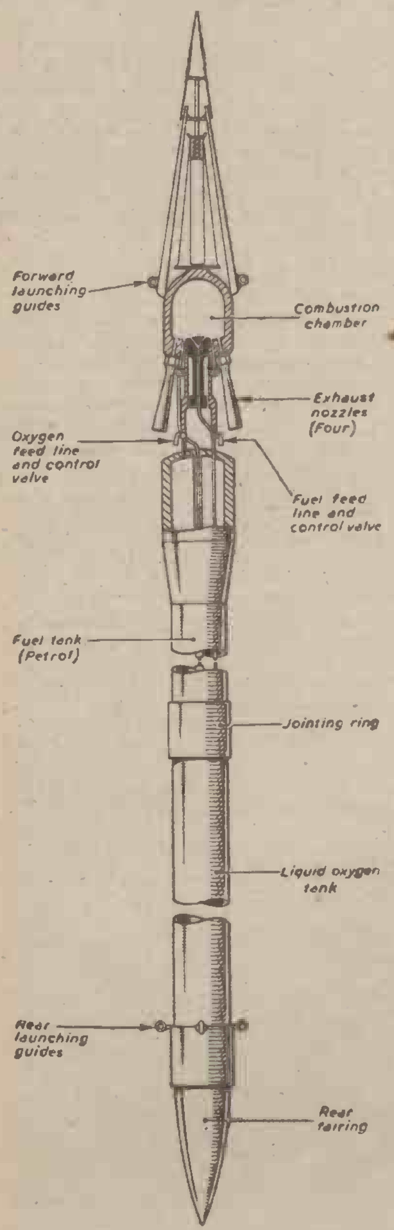


Fig. 14.—Experimental rocket No. 4, of the American Rocket Society (1934).

A.R.S. Revised Research Programme

For the prosecution of the new development programme, the A.R.S. Experimental Committee was divided into three sections, and certain research engineers made responsible for the individual design and construction of the three projected rockets, the following, many now well known among rocket authorities, being prominently featured: Experimental Rocket No. 3, G. E. Pendray (at that time President of the Society), A. Africano and B. Smith; Experimental Rocket No. 4, L. Manning, C. Ahrens, A. Best and J. Shesta; and Experimental Rocket No. 5, N. Carver, H. F. Pierce, and N. Schachner.

A.R.S. Experimental Rocket No. 3—Design

The general layout of the Society's third rocket (Fig. 13) was, to say the very least, original.

The combustion chamber was located at the rocket "head," the top of which formed externally a conical nosing. The motor was built in two halves for easy replacement should any damage be sustained during testing runs.

A nozzle of high expansion ratio extended the entire length of the rocket, and for almost half its depth the nozzle was jacketed by the petrol tank, which served as coolant for the nozzle throat, the heat dissipation acting conversely to vaporise the fuel, and facilitate the feed problem.

The liquid oxygen tank was positioned concentrically within the outer rocket shell, and by this arrangement the volatile "supporting" element was adequately insulated from combustion heat. The space between the two tanks was employed for storage of compressed nitrogen, employed for feeding the fuel.

Supported about the lower portion of the rocket, a venturi duct, or "thrust augmenter,"—a device designed to increase thrust and provide stability during flight—was fitted.

A.R.S. Experimental Rocket No. 4—Design

Rocket No. 4 (Fig. 14) differed considerably from the former design; the motor, located at the rocket "head," incorporated four nozzles inclined laterally to eject the exhaust away from the narrow section tanks. The fuel tank was supported directly beneath the motor, and the liquid oxygen tank below this.

The complete rocket, fitted with nose and tail fairings, measured 7ft. 6in., the maximum cross-sectional diameter being only 3ft.

A.R.S. Experimental Rocket No. 5

In the fifth rocket project a feeding system was evolved which dispensed entirely with the compressed gas "charger"; instead, the expansion of the *liquid oxygen* being employed as the fuel pressure medium. This was arranged by the simple procedure of housing both liquids within a common cylindrical tank, the two fluids being separated by a movable piston. Pressure due to expansion of the liquid oxygen caused the piston to rise in the cylinder, so applying the pressure to the fuel, the pressure within the oxygen compartment at the same time remaining adequately sufficient to provide self-feed of the "supporting" element. The reaction motor was fitted, as in Rocket No. 3, at the "head" of the projectile, serving the dual purpose of combustion chamber and nosing.

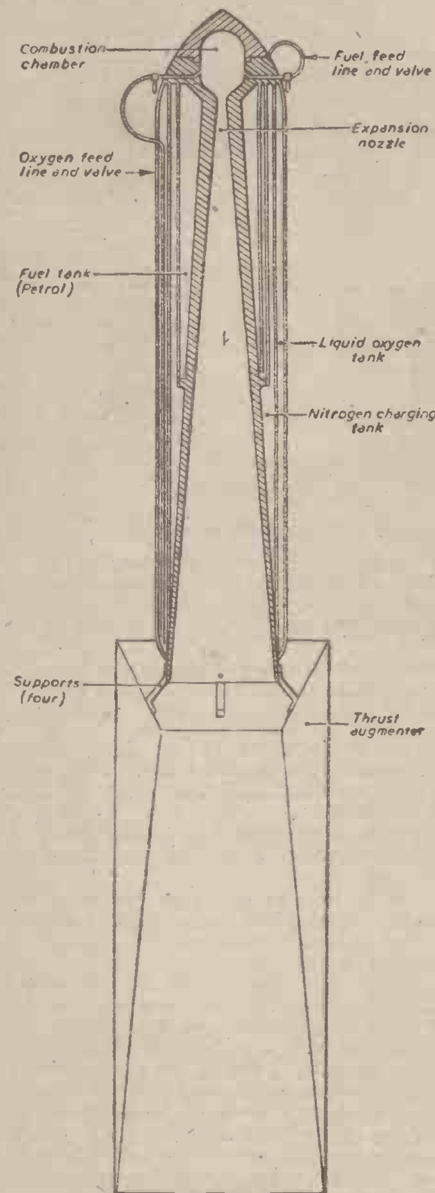


Fig. 13.—Experimental rocket No. 3, of the American Rocket Society (1934).

A.R.S. Experimental Rocket No. 4—Trials

The first rocket to be completed, Experimental Rocket No. 4, was put to preliminary stand test on June 10th, 1934, the trial taking place at the Society's proving ground, Staten Island, New York. As a result, a fault was found to be that the inlet ports to the combustion chamber did not allow for an adequate supply of fuel, which resulted in oxydation and "burn out" of the motor.

Another motor was constructed, and the

Professor Hermann Oberth and others of the Verin für Raumschiffahrt E.V. In the foreground is one of the early "Mirak" type rockets. The other is an altitude rocket developed by Oberth (1931).

necessary alterations to the feed system carried out, but it was not until September 9th that the rocket was finally launched in free-flight.

The test was reported in the October issue of *Astronautics*, describing the flight as follows:

"Directly the valves were opened, the rocket leaped from the launching rack. Almost vertical flight was maintained for nearly 300 feet, at which point the rocket turned rather sharply out to sea. It was at this point, observers assume, that the burned out nozzle failed, shifting the direction of the propulsive forces acting on the rocket. The rocket rapidly sloped over until it was headed directly towards the water. Shortly after the change of direction, it began to 'hunt.' It struck the ocean with a terrific splash, the force of the impact bending the upper part."

During test, the rocket rose to a maximum height of 382 feet, and attained a speed well in excess of 600 m.p.h.

The projectile was recovered and examination of the motor revealed that one of the four nozzles had suffered severe burning rear of the "throat" with the result that the reactive balance had become upset, thus affecting the rocket's stability. Due to this defect, the parachute release mechanism did not function.

The term "hunt" referred to in the official test report may require elaboration. This is merely an expression meant to convey the manner in which a projectile may be observed to deviate from side to side as the result of compressibility, built up at the nose, when its forward speed is in the sonic region. The swerving is a natural inclination to dodge this local compression area.

This problem has since been overcome, to some extent, by the employment of automatic stabilising devices, such as the highly successful gyro/vane system tested during the Goddard rocket trials of 1935.

In the light of experience gained from the tests of Experimental Rocket No. 4, the A.R.S. Experimental Committee concluded that a great deal more routine ground test work was necessary before any practical gain could result from the firing of Rockets Nos. 3 and 5.

As the rocket motor had been the chief fault in every experiment hitherto conducted, the main effort was directed toward the general improvement of the propulsion unit.

Reaction Motor Tests

At the Society's proving grounds at Creswood, on April 21st, 1935, the first series of individual motor tests was made, and a number of motor forms embodying both long and short nozzles were put through their paces on the proving stand. The results of various tests were, however, by no means conclusive. It was found, for instance, that the length of the nozzle did not have material effect on the developed thrust of a given combustion chamber. Some measure of improvement was found when varying feed pressures were tried; it was discovered, for instance, that efficiency was greatest if the fuel was introduced into the chamber at a *high* pressure.

The most satisfactory results of the day's work were obtained during the second test conducted, when a maximum thrust of 59lb. was recorded, the chamber pressure being 300lb. For this particular experiment, a short nozzle was fitted. The maximum firing period was 17 seconds.

As the result of these and subsequent motor trials, a considerable amount of empirical data has been obtained for the research files of the Society. Such is the reliability of this data that most features of performance can now be predetermined during design, the test results being mere confirmation of the calculated figures. These methods of calculation will be discussed in a subsequent article.

British Rocket Development—Limitations

In Britain, the development of the rocket can hardly be said to have received encouragement—officially, the use of liquid oxygen for purposes of rocket experimentation is prohibited. The sole range of propellant available for research in this country must come within the bounds of the specified term "approved composition"; that is, certain fuels of the "solid" or powder variety. Yet the restrictions do not end here; under the obsolete Explosives Act, 1875, any experimental rocket, if the experimenter wishes to "keep within the law," though it employs as fuel "approved composition," may be put to test only if the following conditions are satisfied: (a) The firing range must be sanctioned by the local police authorities concerned. (b) The design of the rocket must be approved by the Secretary of State, through his advisers, and (c) The filling of the rocket must take place in premises licensed under the Explosives Act, 1875. It is stated that approval could not, under any circumstances, be given for the use of the liquid oxygen-hydrocarbon propellant; small wonder that to-day, apart from the developments of our American associates, we find the enemy alone using technically progressive rocket weapons.

The First British Rocket Society

Despite the fact that almost insurmountable difficulties lay in the path of the would-be British rocket experimenter, thanks to the determination of one, P. E. Cleator

Valier rocket car, powered by the Heylandt constant volume combustion motor, being charged with liquid oxygen prior to a test (1930).

(author of a foremost rocket literature in the English language, "Rockets Through Space," pp. 246, Allen and Unwin, 1936), the first and probably still the most renowned rocket organisation yet formed in this country, the British Interplanetary Society, was brought into being in 1933. As a beginning, important Press contacts were made, and thanks to resultant publicity, interest in the new science of astronautics was slowly but surely aroused all over the country.

The first official meeting of the Society took place on October 13th, 1933. The founder, P. E. Cleator, was unanimously acclaimed president, while C. H. L. Askham became vice-president, and L. J. Johnson, secretary. The number of persons in attendance at this intial assembly of the Society was six. By the end of the year the membership figure has risen to 15, and due to added publicity provided by the first issue of a Society *Journal*, which for some months was reflected in the National Press, the Spring of 1934 found the Society's numerical strength at 29.

The group's chief problem at that early stage was one of limited finance—publication of a *Journal* at regular intervals was hardly possible on the subscriptions of so few, leave alone to allow for practical research. Various avenues were exhaustively explored in the attempt to gain financial support, but with no success. Finally, in desperation, the Government was approached, and this is what P. E. Cleator has to say of the move in his book, "Rockets Through Space": ". . . The Air Ministry evinced not the slightest interest. The Under-Secretary of State, in refusing to discuss the matter, explained that although rocket experimentation abroad was watched with interest, scientific investigation into its possibilities have given no indication that jet-propulsion could be a serious competitor to the internal-combustion engine and the propeller of the aeroplane. In the circumstances, there could be no justification for spending either time or money on rocket experimentation. . . ."

Here is a classic example of the handicaps which oppose progressive thought in this country. To-day, we can judge for ourselves how wise was that official decision; the German Messerschmitt Me. 163 rocket-propelled fighter, and thermal-jet aircraft, bears adequate testimony.

Further Goddard Research

Soon after the Guggenheim grant made in 1929, Dr. R. H. Goddard set up an isolated laboratory near Roswell, New Mexico, and there continued with his experimental research.

Work at Roswell consisted largely of routine tests of rocket motors and feeding systems, and apart from a brief report, which appeared in the American Rocket Society Journal, *Astronautics*, September, 1934, little information of Goddard developments was forthcoming:

"The work consisted in the construction and flights of a number of models designed primarily to test operation rather than reach great heights. Flight speeds in excess of 400 m.p.h. were obtained. . . ."

In March, 1935, however, information was given of the free-flight trial of a large meteorological rocket, which incorporated a unique stabilising device.

During an initial trial on May 31st, the rocket rose to an altitude of 7,500 feet, attaining a velocity in excess of 700 m.p.h., the time taken in reaching the peak of trajectory being 14.5 seconds. The gyro-stabilising system embodied was designed to operate when the rocket axis deviated more than 10 degrees from the vertical, and at this angle the controlling mechanism brought into play vanes which acted to deflect the rocket exhaust, and so momentarily offset the thrust reaction, to return the projectile to its true flight path.

A motion film taken of the ascent shows the rocket shooting upwards, the action of the stabliser being clearly marked by the undulation of the projectile as it is constantly corrected to the vertical. Further tests of the gyro-controlled projectile took place in October of the same year. The height reached on this occasion was 4,000 feet.

The rockets tested in 1935 weighed from 58 to 85lb. No particular attention was given to obtaining lightness of construction.

Goddard Motor Trial Results

During the test of a certain liquid oxygen/petrol fuelled reaction motor, weighing 5lb., the combustion chamber being 5.75in. internal diameter, a maximum thrust of 289lb., and an efflux velocity of 5,000 feet per second, were recorded. The motor developed 1,030 h.p.

A report of Dr. Goddard's research progress, principally concerning the Roswell experiments, was published in 1936 under the title *Liquid Propellant Rocket Development*, 10pp., Smithsonian Misc. Collections 3381.

(To be continued.)

Letters from Readers

Engineer-built Houses

SIR,—I have read with great interest your series of articles on engineer-built houses, and I am very glad to know that engineers are at last going to interest themselves in the building of houses.

After the last war the engineers tackled the motor-car and not only greatly reduced the cost of cars but also improved both their performance and looks, and I hope they will do the same for houses.

I have noticed that when unloading bricks for house building they are taken five at a time and thrown from hand to hand, and have often wondered why bricks are not made five times as large as they are now. If they were it would surely save cost in building.

Also, why take, say, a door in plain wood and hang it and then paint it with a brush under the worst possible conditions. Surely it would be better to spray-paint it in a factory and take it to the site ready for hanging.

The bombings we have endured have, I feel sure, sickened a lot of people of the very thought of plaster ceilings, and also of plaster on walls, and I hope we shall see plastic boards in place of plaster.

There are many things in the houses we have had to live in that can be improved and money saved by alternatives, and I, for one, am very glad to see that at long last some brains and new ideas are to be introduced into the building trades.

A. H. BENTLEY (Horsham).

Power for Traction

SIR,—I would like to point out an error made in reply to a reader's query, which appeared in your issue of PRACTICAL MECHANICS dated November, 1944.

Your correspondent states that the resistance to the motion of a pneumatic-tyred vehicle on normal road surfaces is the sum of:

(a) Total weight (lb.) divided by 20.

(b) Total weight (lb.) divided by the gradient factor.

(c) Frontal area (sq. ft.) multiplied by

$$\left[\frac{\text{speed (ft. per sec.)}^2}{25}\right]$$

(d) Total weight (lb.) multiplied by acceleration in ft. per sec. and divided by 32.2.

The force required to accelerate the car, however, is not given correctly by (d), as no allowance is made for the acceleration of the engine parts, road wheels, and the whole of the transmission system.

The force required to accelerate the above mentioned masses is given by:

$$F = \frac{\frac{1}{r^2}\left\{I_A + G^2 I_B\right\} \times f}{g}$$

where F = Force (lb.), r = effective radius of road wheels (ft.), f = acceleration, g = 32.2, I_A = moment of inertia of road wheels and transmission system (lb. – ft.^{2}), G = gear ratio $= \frac{\text{Speed of engine (r.p.m.)}}{\text{Speed of wheels (r.p.m.)}}$, I_B = moment of inertia of engine parts (lb. – ft.^{2}).

This force F should be added to (a), (b), (c) and (d) when calculating the required tractive effort.

—F. L. ELLIS, G.I.Mech.E. (Oxford).

"Catalin"

SIR,—We have noticed in your November issue of PRACTICAL MECHANICS that a correspondent has inquired about information concerning the material "Catalin," and that you have stated that "Catalin" is a proprietary product manufactured and marketed by the Catalin Corporation of America.

We would advise you that "Catalin" has been manufactured and marketed in Great Britain by this Company since 1937. It is a proprietary product and, as you say, is manufactured by the controlled chemical interaction of Phenol (carbolic acid) and Formaldehyde (formalin). The material is then cast into sheets, rods, tubes, etc., for special castings of particular designs. "Catalin," as distinct from mouldings (i.e., Bakelite), is produced with or without a filler to make transparent, translucent or opaque objects by a casting process.—CATALIN LIMITED (Waltham Abbey).

THE WORLD OF MODELS

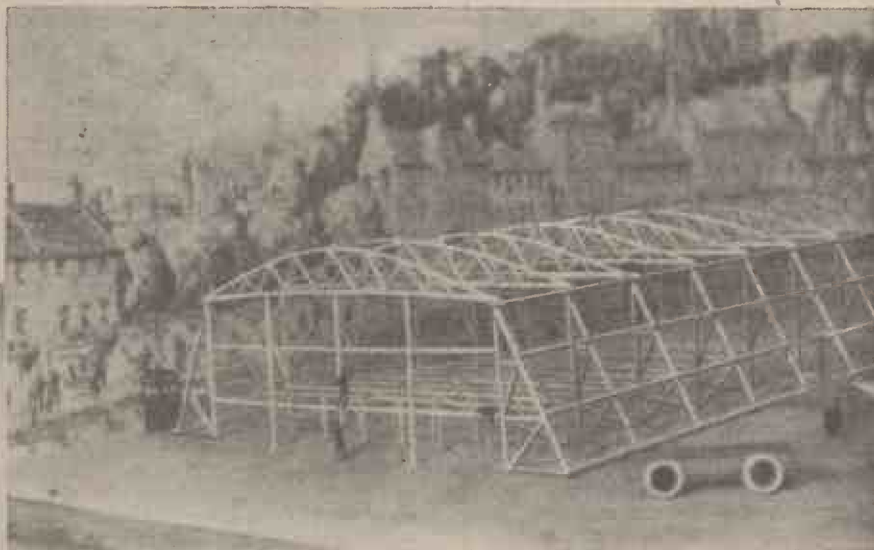
By "MOTILUS"

This Month We Present "Drama in Miniature"—a Consulting Engineer's Model Theatre; Also More Post-war Model Planning, and the Ubiquitous "Christmas Gift"

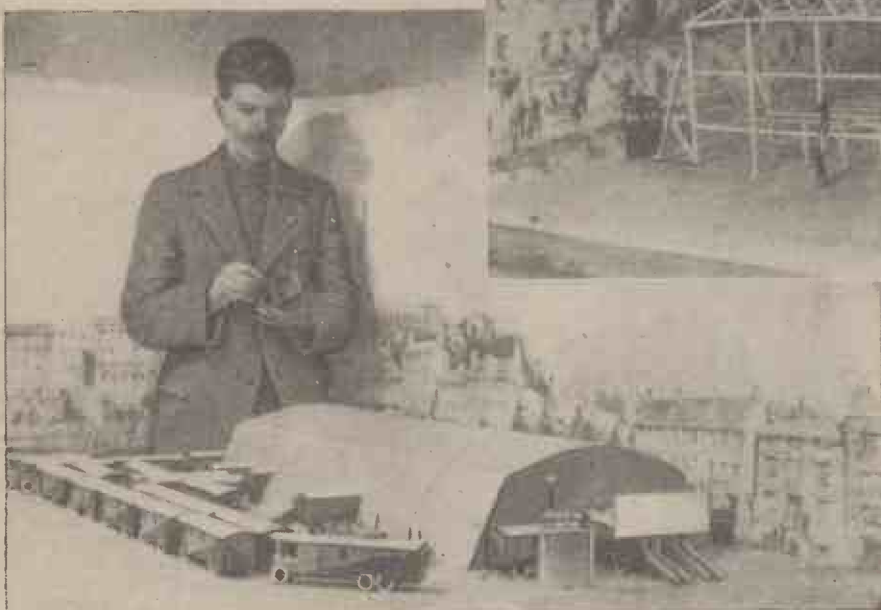
THIS war has at long last brought the theatre to the people. E.N.S.A., C.E.M.A., and other organisations have carried the drama of to-day to munition works, canteens, large army camps, and even to small isolated posts in all parts of the British Isles and to our armies overseas.

Most of the companies travel complete with their scenery and props of a standard size suitable for a small stage or platform, sometimes staying three or four days, sometimes only one night and then moving on. There is usually a general manager and a stage manager responsible for the production, and a selection of professional players.

When one pauses to consider that there is only one town in fifty in this country that possesses its own theatre, this new regime of E.N.S.A. and C.E.M.A. has given those in the Forces particularly, and of course many civilians, hitherto unsuspected opportunities of seeing much that is good of English drama from Shakespeare up to Shaw, Priestley, and Coward.



The structure of the auditorium erected.



Mr. J. Cameron Ridley, the designer of the travelling theatre, with his model.

Model Traveling Theatre

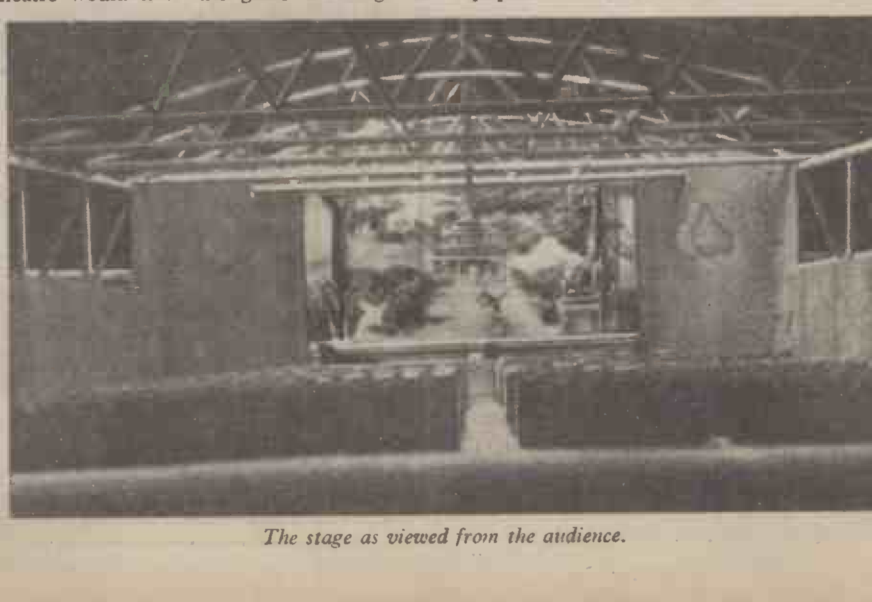
It has however fallen to the lot of a Midland consulting engineer, Mr. J. Cameron Ridley, to design and make a model of what he considers the ideal travelling theatre. One essential for a successful performance to be given is the atmosphere of "theatre." Mr. Ridley has designed a semi-permanent structure of timber, which incorporates modern lighting, comfortable seating, good accoustics and ventilation, and an unimpeded view from all angles, of the stage. The main building can be adjusted in size to accommodate audiences small and large, and with the skill of the travelling showmen, the theatre can be erected in a few hours.

The essential features comprise the properly raked floor and the usual "tip-up" theatre seats. There is a revolving stage in order to speed up changing of the sets, and the accommodation of the travelling players consists of fully equipped dressing rooms and living quarters, among which are included dining room, bedroom, bathroom, and kitchen.

Being complete and self-contained, this theatre would have the great advantage of accommodating its artists, thus overcoming the trouble of securing local temporary "digs."

Mr. Ridley's plans and models have been examined by theatre experts, and many think that a travelling theatre as depicted in these illustrations could easily become, under efficient management, an economic and practical proposition, with tours arranged in the same way as obtains with the existing theatre. There would be the agent preceding the "tour," who would go in advance arranging publicity, settling the site and dealing with the bookings. The parts of the structure would be conveyed by lorries with a team of erectors to set it up and equip the interior. These men would be responsible for back-stage and front of the house labour during the shows.

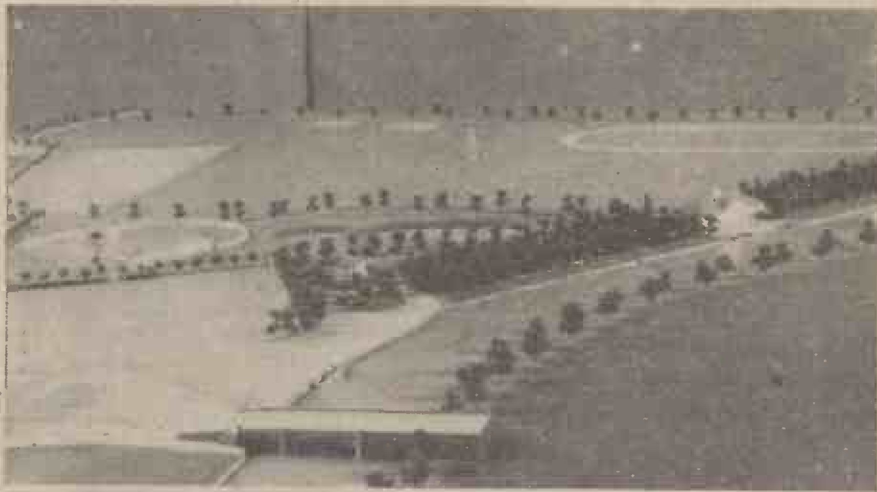
Mr. Ridley has prepared a memorandum on his Travelling Theatre, for which he estimates a capital outlay of just over £12,000 would cover the theatre and its equipment without the show.



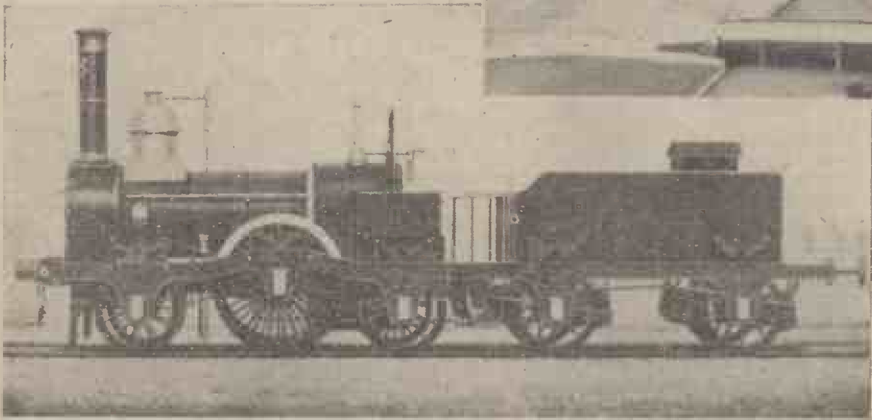
The stage as viewed from the audience.

The photographs show various stages in the erection of the model, which is to a scale of ¼in. to the foot, or 1/48th actual size, The dimensions of the model building are 30in. by 14in., representing an actual size of 125ft. by 55ft., a space which it is not difficult to find in or near most towns or villages of any size.

For years, says a writer, the travelling circus has made merry with the millions. Here is a chance for the theatre to take the same road. Any reader interested in the travelling theatre will do well to get in touch with the inventor and designer, Mr. J. Cameron Ridley, with a view to its adoption and a welcome extension to the "Theatre to the People" movement.



A good example of post-war modelling.



Photographic copy of coloured drawing of one of the Sharp Roberts engines built for the South Eastern Railway in 1844.

A Waterfront Model

As another example of post-war modelling I am pleased to be able to publish a picture of the scheme put before the Peterborough City Council by the City Engineer of Peterborough, Mr. F. I. Smith, A.M.I.C.E., showing a proposed layout of the almost waste land in between the river Nen and the open-air swimming baths. This consists of the conversion of the almost waste land near the river front into a flowered and treed walk, and the erection of a boat-house and café, the construction of an artificial boating lake, and other amenities of a city park.

It is hoped to put this in hand as soon as hostilities cease, when work will be required to eliminate the unemployment "gap" which appeared after the last war.

Centenary Exhibition

Many railway fan readers will no doubt have heard something of the exhibition organised by the Southern Railway to celebrate the centenary of the opening of the South Eastern Railway at Maidstone, in September, 1844. The exhibition was held at the museum at Maidstone, and consisted of about eighty old prints, photographs, models and newspaper cuttings. The Mayor of Maidstone (Alderman Sir Garrard Tyrwhitt-Drake) on opening the exhibition said he recalled the days when the railway was facetiously called the "London Smashem and Turnover Railway." In those days the train left Maidstone at 10 in the morning and arrived in London under the hour, which is better than the timing to-day.

Among the exhibits in the special glass case were a model of a "Schools" class locomotive, a "Merchant Navy" class locomotive, and also a model of the new "Q.1." class "Austerity" locomotive. There was a very fine large coloured drawing of one of the Sharp Roberts engines built for the South Eastern Railway in 1844, which is reproduced on this page. Had it been peacetime when this exhibition was held, there is no doubt it would have been much more fully attended by a number of visitors outside the Maidstone area. An interesting brochure was published, which gives particulars of the early days of the railway and its incorporation in the Southern Railway system on the electrification of the line opened on July 2nd, 1939.

The Model Hobbyist of the Future?

This issue reminds us that Christmas is rapidly approaching again—the sixth wartime Christmas. I wonder what some of our ten-year-olds of to-day would think if they could go round the toyshops of London as they were in December, 1938, when everything was to be had for the asking? Complete clockwork train sets for about half a crown, ingenious mechanical novelties of all kinds from 6d. upwards, Bassett-Lowke and Hornby and American and German made clockwork and electric trains of all prices. The present generation have certainly had to be satisfied with much simpler toys owing to wartime conditions—in many cases rather crude ones. This will be a help to those manufacturers who have had to turn over during the war to Government work, and will not be able in the first year of peace to produce the marvellous range of novelties that we were able to feast our eyes on as late as Christmas, 1940.

Will the modern boy still like the railway and the ship, or will his mind be taken up with tanks, aeroplanes and other weapons of war of which he has seen and heard so much during his impressionable years.

Some boys have been lucky enough to get wooden toys made by craftsmen in their spare time, and the young lad in this picture is spending a happy Christmas holiday with his wooden constructional engine. Why not try your hand at this sort of thing? It is simpler than it appears.

A young model locomotive owner, piecing together his wooden constructional model of a locomotive.

Safety Device for Electric Irons

THAT handy domestic appliance, the electric iron, when left unattended with current passing through it, if brought in contact with inflammable material, would constitute a danger. To protect against this contingency, an inventor has devised simple and effective means for visually indicating the passage of current through the heating element.

His device comprises a handle, of which a part or the whole is formed from transparent or translucent material. In this handle there is a recess for the accommodation of an electric lamp which, being wired in the circuit of the heating elements, when the current passes through, illuminates the handle. Not only does this arrangement act as a reminder to the operator, but it also affords to other persons a clear warning of the state of the appliance. The device may also be utilised in connection with a soldering iron.

QUERIES and ENQUIRIES

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

Artificial Snow

I WISH to construct what is, I believe, called a "Snowstorm." It consists of a hollow glass sphere of approximately 3in. diameter, containing a model building and some small white flakes. The latter, when the sphere is shaken, swirl around and gradually settle, giving the impression of falling snow. For the snow I have tried the frost used for sprinkling on Christmas trees, but it sinks too rapidly, even when the sphere has been filled with water. Could you please suggest a liquid, clear, chemically inactive, and with a specific gravity slightly higher than that of water for use with this "frost," or alternatively, a suitable material for the "snow"?—E. Philbin (Hove).

AN excellent material for the "snow" to which you refer, is pure benzoic acid, which is a light, crystalline material. Alternatively, you could use pure naphthalene flakes, but benzoic acid is better. Either of these materials can be obtained through a local druggist. There is no heavier liquid than water which would be suitable for your purpose, unless, perhaps, you used a strong solution of glycerine (if you can obtain it!). A strong solution of sodium silicate (waterglass) might suffice for a time, but it would tend to go cloudy.

Anodic Treatment of Aluminium

CAN you give me particulars of the process for the anodic treatment of aluminium and light alloy parts? What current density per square inch of metal to be treated is considered best? Assuming that low voltage D.C. current is available, together with simple home-made electro-plating baths, is it considered that the process could, successfully be carried out in a model engineer's workshop?—G. W. Plumbe (Wick).

THE anodic treatment of aluminium and light alloys is an electro-chemical process in which the parts to be immunised against corrosion are made the anode in an electrolyte solution, e.g., a 3 per cent. solution of chromic acid (CrO_3) in water at 40 deg. C. The current consumption is approximately 0.2 kW. per sq. ft. of surface treated. Other electrolyte solutions are oxalic acid plus chromium salts, or dilute sulphuric acid with a glycerine content. The voltage range is from 0-40 from the start to the end of the first quarter hour, and 40-50 for the last 10 minutes. Assuming all precautions are taken, e.g., cleaning thoroughly beforehand, washing thoroughly afterwards with cold, and later, hot water, followed by drying, and the process is thoroughly understood, e.g., the need for gradual rise of voltage as the anodizing progresses, we see no reason why you should not achieve success with the equipment mentioned. You will probably experience trouble, however, if you try to anodise alloy metals containing over 5 per cent. copper or high in silicon.

The following table will show you the correct voltage regulation.

Time	Voltage
1st 15 mins.	0–40
16–50 „	40
51–55 „	40–50
56–60 „	50

You will get improved corrosion resistance if you paint and enamel the parts after they have been anodised.

Matt Black Paint

I HAVE made an episcope and wish to paint the inside with matt black heat-resisting paint. Can you advise me of the type and from whom it can be purchased?

Also, can you tell me how the crystalline lacquer finish, used so much for the outside of metal instruments, is done? If there is any alternative heat-resisting (outside) finish you could recommend, I should be glad of details.—A. Holdsworth (Nottingham).

MESSRS. JOHNSON & SONS, Manufacturing Chemists, Hendon, London, N.W.4, make a good matt-black, heat-resisting paint for fine instrument work such as you describe. You should be able to obtain such "matt-black" varnish from any photographic suppliers. We believe, also, that Messrs. Flatters and Garnett, Ltd., Oxford Road, Manchester 13, make a similar type of varnish.

In order to obtain a crystalline exterior finish, you must add a solution of a metallic soap (such as aluminium stearate) in acetone to your black lacquer and then subject the lacquered article to heat in an oven. Since, however, acetone is quite unobtainable by the ordinary user, we do not think that you will be able to work this process. Why not write to Messrs. Johnson & Sons, mentioned above, in order to ascertain whether they can supply a ready-made lacquer of this "crystalline" type?

Most of the black external finishes to which you refer are stove enamelled, that is to say, they are baked at fairly high temperatures, a process which is very difficult to imitate on the small scale.

Waterproof Poster Paint

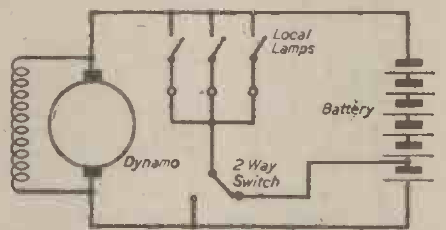
COULD you please tell me how to make ordinary poster paint waterproof and still retain the matt finish? I believe bichromate of potash has something to do with it. The type of waterproof poster paint I require is one that can be thinned with water, yet stand up to outdoor use.—P. R. Alderwick (Haverfordwest).

QUITE a simple method of rendering poster paints (water base) waterproof is to incorporate about 5 per cent. of a good quality casein glue in the paint mix. A casein glue for this purpose may be obtained from Messrs. J. Beard and Co., Great Ancoats Street, Manchester. The paint becomes waterproof a few hours after being laid on the surface.

Another method is to incorporate about 3 per cent. of gelatine in the paint mix, and, when this has dissolved, to add about ½ per cent. of ammonium, potassium or sodium bichromate. This mixing operation must be conducted by artificial light. The insolubility of this paint is acquired after it has been exposed to light for some hours, the bichromate, under the action of light, rendering the gelatine absolutely insoluble. If too much gelatine is employed, the paint will dry shiny; if too much bichromate is used, a strong yellow coloration will result. Paint containing bichromate and gelatine *must* be kept in the dark when not in use, otherwise it will gradually solidify.

Booster Cell for Charging Circuit

I HAVE a 12-volt lighting set with the dynamo at some distance from the battery, and when the dynamo is charging, the voltage to the group of bulbs situated at the dynamo house, etc., is about 13.5 volts. Therefore I need a booster cell in series with that light group to reduce the voltage 1.5 volt. Could I make this cell and if so, how? Its maximum load is 6 amps.—A. Spence, Downby).



Circuit diagram of a charging circuit showing switch for booster cell.

THE simplest way of dealing with your problem would be to run a separate wire from the dynamo house to the end cell of the battery. A two-way switch could be used to feed the local lamps from either 5 or 6 cells as required. Another method would be to fit another brush on the commutator of the dynamo in such a position that the voltage between this brush and one of the main brushes is 12 volts when the main brushes give 13.5 volts, and feed the local lights from this. You could, of course, use a reversed accumulator cell in circuit with the local lights, this would have a capacity of about 60 ampere hours; but as this would be charged up when the local lights were used you would have to make some arrangements for discharging the cell. Another method would be to use a separate resistance in circuit with each local lamp, together with a two-way switch to cut out the resistance when not required. Each resistance should have a value in ohms equal to 1.5 divided by the lamp current.

Composition for Covering Floorboards

I HAVE an upstairs room which was used for lumber, but I now wish to convert it into a sitting-room-workshop for my own use. The floor joists have weakened and the floor is sunk in the middle and very uneven, so I would be much obliged if you will give me particulars of an inexpensive mixture which I could make and apply on top of the floor boards and leave to dry and set hard like cement.—W. E. Berney (Cootehill).

IF, as you say, the joists of your floor have weakened, there must arise the question of whether they will be able to support any additional weight, consequent upon laying a coating of composition over the boards. This is a matter which can only be decided after examination.

The best composition which you could apply to your floorboards is a hard asphalt flooring mastic, but this requires special skill for its laying and, moreover, it is, in consequence of recent restrictions, unobtainable by the ordinary person.

There are two alternative mixtures which you could use, although we cannot guarantee that you will be able to obtain adequate supplies of the necessary materials. The first of these mixtures has the following composition:

Sawdust	40–60 parts (by weight).
Cement	30–40 „ „
Slaked lime	5–10 „ „

The above mixture is kneaded into a paste with strong waterglass (sodium silicate) solution. It is then trowelled or "screeded" on to the floor and left to set.

The second composition has the formula:

Bituminous emulsion	1.75 parts (by weight).
Cement	1 part. „
Sawdust	1 „ „
Crushed limestone, granite, brick or other mineral filler	4 parts.

This is laid in a manner similar to the preceding compositions.

In either case, you should lay brown paper on the floorboards and apply the composition on top of the paper so that the layer of paper exists between the actual wood of the floorboards and the composition which has been laid down. The same technique should also be followed if an asphalt mastic is laid down.

Heating Powders

BEFORE the war one used to be able to buy what might be termed "chemical hot-water bottles." One of these consisted of a bag about 8in. by 6in. in which was a powder. Upon the addition of a few teaspoonfuls of water heat was given out and when it began to cool down the addition of a little more water was only necessary to heat it up again.

I should be greatly obliged if you could inform me what the chemicals inside were and in what proportion they were mixed?—M. Whitehead (Uppingham).

THE "heating powders" to which you refer are complicated to make, and they do not always work satisfactorily or reliably. However, here is a formula of such a powder:

Fine iron filings	8 oz.
Ammonium chloride	1 oz.

Mix the above ingredients thoroughly. Then add 1/16 oz. of the following mixture:

Manganese dioxide	10 oz.
Calcium chloride	1 oz.
Iodine (or thymol)	.005 oz.

The above powder heats up on the addition of water.

A rather better heating substance is the following:

Sodium acetate	135 grams
Glycerine	4.5 „
Sodium sulphate. Cryst. ..	3.0 „
Sodium sulphate. Anhyd. ..	6.7 „

The rubber container holding the above mixture is placed in boiling water for not more than 10 minutes. After that time the substance will be found to have become partially liquefied. During its recrystallisation and solidification, the substance will give off heat at a comparatively even temperature (about 110 to 115 deg. F.) for about an hour, after which time its activity can be renewed merely by placing the container in boiling water again.

Moulding Composition

COULD you please supply me with a formula for a compound for making book-ends, plaques, statuettes, and similar articles?

I find plaster of paris will not stand rough treatment.—T. Winship (Ilford).

THE simplest material which you can use for book-end making is ordinary cement mixed with a suitable grit, such as white sand, or crushed silica rock and, perhaps, coloured by the addition of a little suitable pigment.

A good mix would be the following:

Portland cement	60 per cent.
Grit	30 „
Pigment (iron oxide, chromium oxide, etc., ochre)	10 „

This mix would have to be moistened with water and then packed into wooden moulds. After setting, the surfaces could be ground smooth and then semi-polished.

Alternatively, you could use a magnesium oxychloride composition, such as the following:

Calcined magnesite	60 per cent.
Grit	30 „
Pigment or other "filler," (including sawdust, if desired)	10 „

The above is moistened with a 40 per cent. solution of magnesium chloride and the resulting paste is packed into moulds. This composition takes two days to set and four days to harden, but it gives very sharp impressions, since it expands slightly on setting.

Metallurgical Analysis

COULD you advise me on the choice of a book dealing with such modern developments in metallurgy as analysis by (a) electrolytic means—I understand that the sample is dissolved in acid and then plated out on to a platinum wire; (b) colorimetric means, where the depth of colour of the solution in which the metal has been dissolved is measured by electrical means by an instrument not unlike a photographic exposure meter?—K. N. Martin (Stanmore).

YOU will find in the second edition of "Steel Manufacture Simply Explained," by Gregory and Simons (Pitman, 7s. 6d.), a complete chapter on modern developments in the metallurgical analysis of ferrous metals. This is written in a manner designed for comprehension by either layman or engineer. It does not deal with the electrolytic method of analysis, which is mostly used for determining the oxides in ferrous materials. The principle of the method is the same as the chemical solution method in that the metallic constituents are separated from the non-metallic, and the oxides determined in the residue. The specimen constitutes the anode of the cell, and the electrolyte decomposes all non-metallics except the oxides. A complete account of the washing and analytical procedure will be found in a paper by T. L. Joseph on "Oxides in Basic Pig Iron and in Basic Open Hearth Steel," in the "Transactions of the Iron and Steel Divisions of the A.I.M.E. for 1937," vol. 125, p. 204.

Obliquity of Connecting Rod

CAN you give me the formula dealing with steam-engine connecting-rod length for a given stroke? In my particular case with the stroke of 15/16in. I cannot determine how long the connecting rod should be between centres to give equal movement of piston either side of middle position due to obliquity of connecting rod.—A. Price (Birmingham).

WITH any length of connecting rod the piston is not at the mid-point of its stroke when the crank is perpendicular to the direction of motion of the piston.

If r = crank throw
l = length of connecting rod

the error in position of the piston when it should be at the mid-point of its stroke is

$$l - \sqrt{(l^2 - r^2)}$$

and this is approximately $\frac{r^2}{2l}$

The only way of getting no error is to use a connecting rod of infinite length, which is impracticable. In no normal steam engine is the error of any importance.

Melting Scrap Brass

I SHALL be obliged if you will advise me on the following. I want to melt some scrap pieces of brass, up to about six pounds, to be cast as small bearings, and would like to be able to attain a heat of up to 2,000 deg. F.

I presume a small crucible would be necessary; if so, where can I obtain this and of what material is it best made? How best could I obtain this heat—by furnace or electricity? I would also be glad to know of any books on the subject.—S. A. Booth (Belfast).

PRESUMABLY the quantity of brass you wish to melt is not large, in which case you will probably obtain excellent results from a small oil-fired tilting furnace, which will melt 150lb. of brass, with an oil consumption of 14lb. per 100lb. of metal. Larger furnaces of this type can, of course, be obtained. A small furnace of this type will give 10 melts per eight-hour shift. It is, of course, possible to use lift-out crucibles, heated by coke, or by producer gas (where there are several crucibles). The single-phase Detroit electric furnace can also be used for melting brass, but would hardly be economical for a small quantity. We suggest you write to the Morgan Crucible Co., Ltd., Battersea, London, and put your problem up to them. A good book is "Industrial Heating Furnaces," published by Chapman and Hall, Ltd., London.

Overshot Water-wheel

I AM using an overshot water-wheel for driving a dynamo for charging accumulators and obtain approximately 30 watts output. The water is conveyed to the wheel by a 4in. pipe, and the available fall is 4ft. 6ins.; the normal flow is 25 cu. ft. per minute.

Which type of turbine would be most satisfactory, and can you suggest a suitable design or any book which would give details for so small a power?—G. M. Whiteley (Shipley).

THE figures quoted suggest that the water-wheel is giving an efficiency as high as could be expected from a turbine for such a small output. For the comparatively small head of 4ft. 6in. a vertical-spindle axial-flow water-turbine may be recommended as the most suitable type of turbine, but there is no certainty that it would give any higher efficiency than is being obtained at present. We do not know of any book that gives practical design details for small turbines, but certain types are made by Stuart-Turner Ltd., Henley-on-Thames.

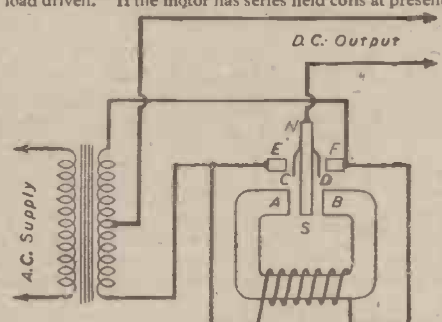
Rewinding D.C. Motor for A.C.

WILL you please answer the following queries:

1. I have a small motor which runs off 250 volts D.C. How can I rewind this to run off 230 v. A.C.? The armature has 8 slots, and the field is of the two-pole type. Can this be made into an induction motor?

2. How can I make a self-rectifying vibrator converter to run off 230 v. A.C. having an output of 120 v. D.C.?—M. Clift (Skegness).

(1) IF the whole field iron system of your motor is completely laminated the machine could be used as a series motor, the speed of which will vary with the load driven. If the motor has series field coils at present



Circuit diagram of a vibrating rectifier.

it is possible it will operate on 230 volts A.C. without modification, or at any rate with about 30 per cent. of the present field turns removed. If it has a shunt field at present these coils will have to be rewound with fewer turns of thicker wire connected in series with the armature. The armature should not require any modification. If you will forward a fully dimensioned sketch of the field iron system, including the air gap clearance between the armature and field poles (which may be measured by means of feeler gauges) we will let you have suggestions for winding the field coils. It would be a very difficult matter to convert the machine into an induction motor.

(2) It will be understood that the unsmoothed output of a vibrating rectifier is not at a constant voltage. The components of such a rectifier are a transformer having a ratio of about 1 to 1, this preferably having tappings for voltage control; a centre tap being brought out from the secondary winding. An electromagnet having poles at A and B, as in the sketch, must be fed with current at supply frequency; a light permanent magnet NS having flexible spring contacts C and D is suspended by a flat spring as indicated. The polarity of the poles A and B is reversed each half cycle so the magnet swings in synchronism with the supply to close contacts CE and DF alternately. The period of contact closing can be adjusted if E and F are mounted on screws.

Using Electric-Motor as Windcharger

I HAVE a two-pole shunt-wound electric motor rated at 36 volts, 3 amps, 1,800 r.p.m. It is very well made and has ball races.

I am considering using it as a windcharger dynamo, but realise that its output at wind-propeller speeds would be very small. What output might be obtained?

I have been told that if I connect the two field coils each in parallel with the armature brushes I should be able to get the following outputs. Can you say whether they are approximately correct and if so, would the present windings be capable of carrying the current?

With two field coils and armature all in parallel with each other:

Output at 900 r.p.m., 12 volts 6 amps.
Output at 600 r.p.m., 8 volts 4 amps.
Output at 300 r.p.m., 4 volts, 2 amps.

I also understand that the output of a shunt-wound motor when used as a dynamo at the same speed is two-thirds of input as motor. Thus, as motor, 36 volts 3 amps, 1,800 r.p.m. As dynamo, 24 volts, 3 amps at 1,800 r.p.m. Is that correct?—F. Hewlett (Yelverton).

THE actual current output obtained from a dynamo is equal to the terminal voltage divided by the resistance of the circuit, assuming there is no back voltage in the external circuit. This is subject to the fact that the safe full load current which can be delivered without dangerous overheating depends on the size of the armature conductors and is therefore the same at all speeds and voltages, subject to a slight reduction at low speeds due to reduced ventilation and cooling. Therefore you could not obtain more than 3 amps output.

With a given machine the generated voltage is proportional to the magnetic field strength and, with a given field strength, is proportional to the speed. It is advisable to retain the magnetic field strength as near as possible to its original value, which means that the current through each field coil should be kept the same as at present. To obtain this the two series connected field coils could be connected in parallel when the machine is run on half voltage by reduction of speed. Take care that the field coils are connected to create poles of opposite magnetic polarity. Since there is a certain volt drop in the machine owing to its resistance and armature reaction the machine should be run at rather more than half speed to obtain half voltage. Therefore, if you run the machine as a dynamo at, say, 1,000 r.p.m., and connect the two field coils in parallel you should obtain about 18 volts 3 amps.

It is difficult to say what voltage would be obtained if the machine is run at less than 1,000 r.p.m., as this will depend on the design of the machine. If it was designed to run with the field magnets saturated, the voltage just below 1,000 r.p.m. would be proportional to the speed, i.e., about 14 volts at 800 r.p.m. With unsaturated fields the voltage would be much less, as the field current falls with reduction of generated volts. In any case the voltage would fall almost to zero with any appreciable reduction of speed.

If it is essential to run the machine at less then about 1,000 r.p.m., the field coils would have to be rewound with fewer turns of heavier wire than at present, so the product of the increased current and reduced turns would give the same ampere turns as at present. The resistance of the new field winding would have to satisfy the condition that the resistance of the field circuit multiplied by the required field current gives the generated voltage. Provided the ampere turns are thus unaltered the generated voltage would be directly proportional to the speed. If at the low speed the generated voltage is too low, the armature would have to be wound with more turns than at present. With the same field strength as at present the armature turns would govern the voltage, since voltage is proportional to the armature turns in series. If the armature is wound with more turns smaller wire would have to be used, and this would reduce the safe full load current.

Metal-rubber Bonding

I DO a considerable amount of pin grinding on special machines which, up to a year or so ago, were reasonably free from trouble. Recently, however, I have had endless trouble owing to the rubber strip coming loose off the metal saddle. I have tried various adhesive solutions in order to overcome this, but cannot get a rubber to stay put for more than a few hours after being put into service. It appears to be well stuck to begin with, but the heat generated by the process of grinding seems to soften the adhesive, with the result that the rubber soon comes loose and fails to hold the pins in position.

Of course, the rubber I have to use now is not up to the usual quality, and it is possible that this is the cause of my trouble.—R. Lister (Dewsbury).

THE really satisfactory adhesion of rubber to metal often presents difficult problems, particularly in the instance which you quote in which the rubber-metal bond is continually subjected to strain. You may be quite sure that the actual rubber which you use is not at fault, since even the highest quality rubber would give rise to the same trouble.

Strangely enough, the nature of the metal appears to have some influence upon the strength of the bond, brass (and in particular, a 75 per cent. copper, 25 per cent. zinc brass), giving by far the best adhesion. However, in your case, we imagine that you cannot determine the nature of the metal to which the rubber must be bonded, and the advice which we give below applies equally to all types of metals bonded to rubber.

Good metal-rubber bonds may be obtained by the use of bitumen and rubber solutions. Dissolve ordinary hard "asphaltum" in either benzol or naphtha until a fairly thick, creamy solution is obtained. Smear a thin layer of this solution on to the metal surface, and, at the same time, smear a thin layer of thick rubber solution on to the rubber surface. Allow these respective solutions to dry out to the tacky stage. Then place a fairly substantial layer of the rubber solution on to the bitumened surface of the metal, and, likewise a coating of bitumen solution on to the rubber-solutioned surface of the rubber. Allow these respective surfaces to become fairly tacky. Then, if possible, dust one of the surfaces with flowers of sulphur. Bring the surfaces into firm contact (under light pressure if possible) and allow them to remain undisturbed until dry.

The bond thus produced should be reasonably enduring. In the event of much heat being evolved, the sulphur will combine with both the bitumen ("asphaltum") and the rubber, these materials thereby undergoing a species of vulcanisation and thereby becoming tougher.

Another mode of effecting a bond consists in rubber-solutioning both surfaces, and, at the tacky stage, introducing a casein cement (of which there are several proprietary makes) between the prepared surfaces, contacting these under pressure for about 30 hours.

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

Comments of the Month By F. J. C.

Time Trial Plans for 1945

THE R.T.T.C. has wisely made the decision to announce next season's programme earlier than hitherto to enable the handbook with the full list of fixtures to be published at the beginning of the 1945 season, not some time afterwards.

All the 1945 championships have been allocated and this will enable clubs to arrange the remainder of the 1945 trials accordingly. The championships have been allocated as follows:

- 25 miles to be arranged by Liverpool District Council on week-end No. 16.
- 50 miles to be arranged by North Midlands District Council on week-end No. 24.
- 100 miles to be arranged by Central District Council (who have entrusted the promotion to the Broad Oak R.C. of Nottingham) on week-end No. 20.
- 12 hours to be arranged by London North District Council on week-end No. 26.
- Hill-climb to be arranged by Manchester District Council (date not yet fixed).
- 25 miles (women) to be arranged by Midland District Council on week-end No. 18.

In view of the possibility of large-scale demobilisation of clubmen during the 1945 season, the regulation made last February confining the championships to riders who had completed a trial at the appropriate distance during the three previous seasons has been relaxed for 1945. Any rider who has a trial to his credit at the distance of the championship event concerned will be eligible to enter, but priority of acceptance will be given to those whose last ride at the distance was performed since January 1st, 1943.

To enable non-accepted entrants to the 1945 championships to know the position in time to enter another trial, all championship entries will close 19 days before the event.

The secretary or chief official of a championship event cannot compete in that championship.

A major change has been made in the conditions of the 1945 A.R. competition. Instead of being based on events at 25, 50 and 100 miles, as in 1944, the 1945 competition will comprise events at 50 and 100 miles and 12 hours.

On the dates of the men's 25 miles, 50 miles, 100 miles and 12-hours championships, those championships will be the only events eligible for inclusion in the competition.

Competition Records

HITHERTO no regulations for these records have been published. Pursuant to the powers given them by the National Council in February, 1939, the National Committee have adopted the following regulation, which takes effect immediately, but the changes involved in these regulations will not invalidate any claims pending for records already made:

The Council shall adjudicate upon claims to have established record times in road trials under R.T.T.C. regulations at 25, 30, 50, 100 and 200 miles and 12 and 24 hours on bicycles, tricycles and (except at 25 miles) tandem bicycles by individual riders and teams of three machines. The following special conditions shall apply:

(a) No claim shall be considered unless the performance to which it relates is made in an event in which members of 10 or more affiliated clubs are eligible to take part. Such event must have been approved by the District Council beforehand having jurisdiction, and a start sheet must have been issued to the participants in advance and the claimant's name must have appeared thereon at the time of issue.

(b) The elapsed time for record purposes shall be calculated from the starting time shown against the claimant's name on the start sheet.

(c) In the event of more than one claim to a particular record being submitted in respect of performances on one date, the fastest time or greatest distance claimed shall first be considered and, if accepted, shall stand as record.

(d) No claim shall be considered unless the time-keeping arrangements in the event concerned complied with the standards laid down by the Council for timekeeping in open events, and the course is certified by the District Council having jurisdiction as having been measured and approved in accordance with regulation 27. The distance between the start and finish shall not be greater than the following: 25 and 30 miles, one mile; 50 miles, two miles; 100 and 200 miles, five miles. For 12 and 24 hours events the course shall be of the normal out-and-home nature.

Claims to have made a competition record shall be submitted in the first place to the District Committee having jurisdiction. The District Committee shall investigate the claim and shall satisfy themselves of the accuracy of the times and measurements, the genuineness of the performance and the compliance with all relevant regulations. If satisfied, they shall then submit the claim to the National Committee with their recommendation. Throughout all processes the forms issued by the National Committee shall be used. The National Committee shall adjudicate on the claim, and their decision shall be final.

The most important regulations brought about by these changes are that competition records cannot now be made in single club events, nor by riders who enter at the last moment, and whose name is not on the start card. Another important decision is that all late starts will be debited against the rider, and that a particular record cannot be awarded for more than one performance on any one day, that one performance being the fastest if accepted. These new regulations will, subject to approval by the National Council, be incorporated in the 1945 Handbook.

It has been decided to present championship medals to all 1944 champions and placed riders and members of championship winning teams.

1945 Fixture List

ALL open events for next season must be arranged and notified to the national secretary by December 14th, 1944, otherwise they cannot be included in the 1945 fixture list. District Councils will make whatever arrangements they consider necessary to achieve this object, including the holding of early date-fixing meetings.

Post-war Problems of the Cycle Trade

THE British Cycle Manufacturers, at the request of the Board of Trade, have reviewed the problems with which they will be faced when the war ends. They point out that apart from auxiliary trades it is believed that at the outbreak of war there were approximately 150 manufacturers of bicycles, 32 manufacturers of motor-cycles, and 200 manufacturers of components and accessories, or materials for both machines. Two-thirds of the manufacturers have been engaged chiefly on war work, and of these about a dozen bicycle manufacturers and seven or eight motor-cycle manufacturers have been supplying their respective products. It is estimated that within 12 months from the end of the war the output of bicycles could be increased to 6,000,000 a year for home and overseas. Thirty-four cycle and component manufacturers could resume peace production at once. The position is more serious with motor-cycle manufacturers.

In order to speed up reconstruction the following suggestions are made: Modification of Essential Works Orders; early return of key personnel; speedy reconstruction of factories; availability of further tool-room plants as war contracts end; complete abolition of Purchase Tax; cheap money for buildings and plant; freedom of export markets from Lend-Lease restrictions; acquisition of surplus Government plant at fair prices; and Income Tax Concessions for depreciation.

Bicycle manufacturers have not the desire to leave the Midlands, and are unable to consider proposals for the removal of their activities to the depressed areas.

Considerable competition is expected after the war from bicycle assemblers in the Dominion and Indian markets, particularly if they adopt import tariffs. A continued development of sales is anticipated in the Colonial Empire, where Japan was the chief competitor before the war, and in Western Europe, where competition from Germany was particularly severe.

The Memorandum assumes that the post-war manufacturing activities of both Germany and Italy will be controlled with a consequent revival of the European trade lost to Germany through the latter's policy of undercutting by subsidies. It is also presumed that Japan will lose her export trade.

Paragrams

Stratford St. Mary, Suffolk.

A Welcome Sight

MILESTONES have been replaced along Huntingdon sections of the Great North Road.

A Proud Record

SERGEANT WILLIAM HENDRY, the third member of the noted Hendry family of Glasgow, has been awarded the Distinguished Flying Medal for "skill and devotion to duty."

An Irish "12"

J. GRAY, Northern C.C., had the distinction of winning the first open 12-hour event ever to be held in Ireland. He covered 222 miles.

Bramley Wheeler's Loss

NORMAN HOLMES, of Leeds, former hon. treasurer of the Bramley Wheelers, has died of wounds in Italy.

1944 Best All-rounder

A. R. G. DERBYSHIRE, Callava Road Club, is the R.T.T.C. Best All-rounder for 1944. He is also national 12-hour road champion.

Seath Retiring

L. M. SEATH, well-known member of the Vegetarian C. & A.C., and prolific road rider, has retired from competitive work. For the past 11 years he had been an active time-trialist.

Hill Climb Champion

F. H. WORTHEN, Manchester Clarion C.C., became Britain's champion hill-climber by virtue of his win, with 3 mins. 12 4/5 seconds, of the Catford Hill Climb.

Pioneer Dies

JOHN OWEN, North Road C.C., whose son, Tom, is very well known on North London roads, has died. He was 84.

Veteran's Fine Ride

J. B. AUSTIN, 43-year-old Oxford City Road Club member, was fastest in a veteran's 25-mile event with a fine ride of 1.6.54.

Chippenham's Revival

THE revival of the Chippenham Sports Club Festival provided an excellent opportunity for some fine track racing in which members of Bristol clubs prominently featured.

The Sailor's Return

GEORGE DOWNES, Gateshead C.C., who had been abroad for almost three years, was married during a short leave,

Hebburn's Coming-of-Age

HEBBURN VICTORIA, C.C., celebrate their coming-of-age in 1945.

After Three Years

G. H. BURGESS, Bronte Wheelers, is now known to be a prisoner-of-war in Japanese hands. He was reported missing almost three years ago.

Wong Ling Kwong's Win

IN a 10-mile road time trial, promoted by the All-Chinese Cycling Club in Liverpool, the winning time was 29 minutes 40 seconds, and the winner, Wong Ling Kwong, who rode a gear of 104.

H. Mawby Prisoner-of-War

NEWS is to hand that Harold Mawby, Yorkshire Road Club, is a prisoner-of-war in German hands.

Yiewsley R.C. News

ELEVEN members of the Yiewsley Road Club are serving with the Forces: two have been reported missing. S. Euratt, serving with the Fleet Air Arm, has been awarded the D.F.C. He holds his club's 25-mile record.

Killed in France

VICTOR FOREMAN, Norwood Paragon C.C., has been killed in action in France.

Club Record Broken

R. G. PEARSON has broken the Redditch Road Club's record of 34 minutes 29 seconds for the journey from Redditch to Bromsgrove and back. The previous holder was D. Gardner, who is now serving with the R.A.F.

Colin Cameron Killed

FLIGHT-SERGEANT COLIN S. CAMERON, South-Eastern Road Club, lost his life in an air crash. He was a fine rider, and gave promise of an excellent road career.

De Laune C.C. News

D. H. EVANS, De Laune C.C., is now known to be a prisoner-of-war in Germany. Clubmate Pilot Officer G. W. Hinde has been posted as "killed in action" following a heavy raid over Duisberg.

Reunion in Italy

FOUR members of the Bynea C.C. have met in Italy. They are the brothers William and Islwyn Wheeler, R. T. Williams and W. Peters.

Wounded in Italy

L. SLINGSBY, champion of Bramley Wheelers, has been wounded while serving in Italy.

Captain K. V. Hancock Killed

CAPTAIN K. V. Hancock, Yorkshire Road Club, has been killed in action in France.

Fifty Flights

WILLIAM McMULLEN, Bournemouth Jubilee Wheelers, a Pilot Officer in the R.A.F., has over 50 operational flights to his credit.

Parachutist Missing

AMONG those posted as "missing" following the epic of Arnhem was Cyril Ayley, Southern Paragon C.C.

A Lost Medal

W. HOOPER, Swindon Wheelers, came through Dunkirk carrying with him a club gold standard medal. Later he lost it, but, two years after the loss, his club secretary was advised by the Chief Constable of Leicestershire to the effect that the medal had been found. It has been returned to the owner.

New Dunlop Post

MR. A. E. OSBORN, Dunlop acting general manager in Manchester, has been appointed general sales manager of a new Division for special products, particularly of an industrial kind, with headquarters at Albany Street, London.

Mr. Osborn has been in the rubber industry since he began with the Silvertown Rubber Co. before the last war, during which he was a pilot in the R.A.F. He joined Dunlop in 1926 as London manager of the Macintosh group.

Tyre Makers' Symbol

A BADGE has been adopted by the Tyre Manufacturers' Conference, representing all British tyre makers. It is a simple design showing the letters T.M.C. in bold relief against a tyre in the background. The symbol will be used on all Conference notepaper, publications or posters.

Evening at Tonypandy, Rhondda Valley. To the left is Llwynpia Mountain.

Around the Wheelworld

By ICARUS

Legislators!

A LEGISLATOR is one who makes laws, and it is therefore wrong even for the less informed of our critics to refer to those in the higher positions in the cycling world as legislators. They have never made any laws (thank goodness!) although they like to lay down the law. Some of these cycling leaders and critics take on airs and graces.

Herne Hill Arrangements for 1945

THE National Cyclist Union announce that season training tickets for 1945 will cost 15s., and evening training tickets 6d. They have also settled the schedule of prices for hire of the ground, cabin fees, etc.

The S.C.C.U. will organise a meeting at Herne Hill on Good Friday, 1945, whilst the Union itself is promoting a Grand Opening meeting on Saturday, June 23rd. It is probable that this meeting will be of an international character. The meeting of champions has been fixed for Saturday, September 8th, 1945.

C.T.C. Change

AT the end of January, 1945, Neville Whall becomes secretary of the C.T.C., and R. Shaw the Editor of its Journal.

"Merrie England"

A FIRST-CLASS presentation of Sir Edward German's "Merrie England" is now showing at the Winter Garden Theatre, London. My reason for referring to it here is that W. Hinds, in conjunction with Reginald Fogwell, has put the show on. Hinds is, of course, the well-known cyclist who adopts for his theatrical enterprises the name of Will Hammer—his business as a jeweller being located in Hammersmith. It is a show well worth seeing, and is quite the best performance of this famous musical show that I have seen.

Dinner to the Champions

THE committee of the London West District Council of the R.T.T.C. gave a dinner at the Holborn Restaurant on November 8th to honour those members of clubs in the London West area who are the 1944 R.T.T.C. champions.

I list them, together with their performances: 12 hours, A. E. Derbyshire (Calleva Road Club), 233¼ miles; 100 miles, A. C. Harding (Middlesex Road Club), 4h. 28m. 12sec.; 50 miles, A. C. Harding (Middlesex Road Club), 2h. 6m. 35sec.; 25-50 and 100 miles, A. E. Derbyshire (Calleva Road Club), average speed over three distances, 23.549 m.p.h.; 12 hours team race, Calleva Road Club, who share the honours with Altrincham Ravens. The teams of both clubs deadheated with a distance of 684½ miles. The Calleva team were: A. E. Derbyshire, R. Brown and W. Perkins.

Mr. A. V. Jenner (Charlotteville C.C.), chairman of the London West District Council, was in the chair on this occasion and proposed the toast of the champions. There was a response from A. E. Derbyshire only, as A. C. Harding was unfortunately unable to be present. There were speeches by F. J. Camm, H. England and Rex Coley.

R.T.T.C. and S.A.C.A. Meeting

A MOST cordial meeting between representatives of the R.T.T.C. and S.A.C.A. was held in Carlisle on Sunday, November 5th, to discuss the present position regarding an All-British Championship competition and the possibility of formulating a scheme for an All-British competition, on a permanent basis, which could commence in 1945.

The S.A.C.A. representatives, having heard in detail the reasons which led the R.T.T.C. to decide that they could not entertain a competition in 1944, undertook to recommend to their association the discontinuance of the proposals they had announced regarding 1944.

The representatives will place before their respective committees a scheme for an All-British Championship competition to commence in 1945, based on results at 50 and 100 miles and 12 hours. The adoption of any scheme is, of course, a matter to be decided by the membership of the two bodies, before whom it will be placed in general meeting.

R.T.T.C.-N.C.U. Joint Statement

MR. JAMES KAIN, the chairman of the London Section of the British League of Racing Cyclists, comments as follows on the joint statement issued by the R.T.T.C. and the N.C.U. on massed-start racing, and which was published in our last issue.

In the joint statement issued by the R.T.T.C.–N.C.U., dated October 10th, 1944, it mentions "A number of people have broken our rules and promoted massed-start racing on the public highway . . . these people have been suspended and our action has been overwhelmingly backed by the membership of our bodies." Who are the "people" who have been suspended? When were they suspended? For what crime were they suspended? I have now personally contacted over 100 active B.L.R.C. members who, including myself, have had no notice of suspension served (with its democratic right of appeal), nor has any of our names been published in the press. Is it that these would-be Law Lords have realised and appreciated some of the finer points of English Common Law, and therefore dare not publish these names?

Regarding the "overwhelming" backing of the R.T.T.C.–N.C.U. membership, when did the R.T.T.C. obtain this "overwhelming" support? I have yet to learn of any attempt by the R.T.T.C. executive to obtain the opinion of its adherent members upon this specific subject. Is it that they dare not risk the attempt to arrange a "public opinion" poll open to the whole of their membership? or is it that they prefer to shelter behind the newly found champion of road sport, the N.C.U., whilst this body of utilitarian cyclists rattle the hollow bogy of suspension?

I would emphatically remind this latter body that the subject matter of the joint statement concerns cycle road racing . . . since when has the N.C.U. started catering for cycle road racing? From where has this assumed dictatorial authority over road men suddenly materialised? The only cycle racing over which the N.C.U. has control is path racing on enclosed tracks, and having, by their ineptitude, ruined this sport, they now have the presumption to try to gate crash into the road game. In each of the 10-year periods since 1888, when the N.C.U. outlawed the road game (the nursery of future path champions, by the way) the N.C.U. Racing registrations have consistently registered new low records, and their 1939 Racing registrations figures have already been comfortably surpassed by the wartime registered Racing membership of the youthful B.L.R.C.

Mr. Chamberlin, who spoke at most of the poorly attended meetings at which the 99.9 per cent. anti-massed start vote was recorded (sounds like a Nazi plebiscite result), knows only too well that throughout the whole country a total of less than 50 registered racing men attended . . . such is the "overwhelming" R.T.T.C.–N.C.U. backing!

Service Pay Concession

THE Dunlop Rubber Co., Ltd., has decided that no deduction will be made from the Company's grants to their employees now in the Forces in respect of Service increases in pay recently announced.

The Company's personnel will therefore receive the full advantage of the new increases, which run from 7s. to 77s. a week for the Japanese campaign and from 2s. 4d. to 21s. a week as a Far East allowance, in addition to the war service weekly increment of from 7s. to 21s. for three years' service, with an extra 3s. 6d. to 7s. for each year of service over three.

C. A. Smith Passes

IT is with great regret that I record the death on Wednesday, October 11th, of that famous cycling character, C. A. (Bathroad) Smith, at the age of 77.

As a personal friend of many years' standing, I keenly feel his loss. In the 'nineties, C. A. Smith swept very nearly all before him; and his vast array of cups and trophies packed one room of his house at Cobham where he resided, almost opposite that famous old coaching inn, "The White Lion," (of which for many years he was proprietor) on the Portsmouth Road he loved so much.

Equally good on bicycle and tricycle, he won races and broke records in quick succession, and beat many of the giants of the sport of his day, including S. F. Edge. He had a vast knowledge of cycling history, and knew almost everyone associated with the sport and the industry intimately.

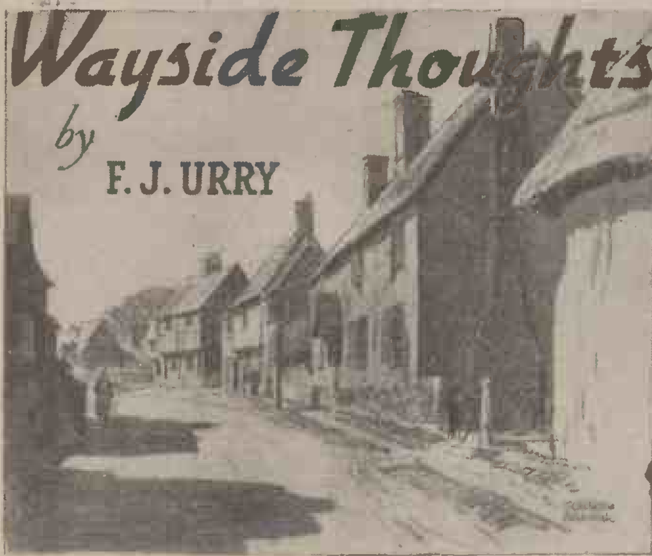
Although at one time he owned several cars, as well as a museum of early mechanically-propelled vehicles, he never deserted cycling, and each day, with very minor exceptions, he rode from 30 to 50 miles. He kept a very accurate diary of all his rides, and his home was a store-house of cycling books, periodicals and photographs.

As every cyclist knows, he maintained throughout his life that it was necessary to have a first-class machine with properly cut chain wheels, and his own machine, which is over 40 years old, is so equipped, and has the original chain and chain wheel on it. We lunched together once a week, and I learned a good deal of the early history of the sport from him. He once told me that he owned one of the first pairs of pneumatic tyres which came into the country, and every time they punctured they had to go back to Dublin for repair. He was a fierce but fair critic, and deplored the fact that the sport was not on the same high plane as it was in the last century. Almost up to the time of his death he regularly attended the meetings of the Roadfarers' Club, of which he was a Fellow and member of the Council.

On the day of his death he had just completed a 20-mile ride. He passed suddenly but peacefully away. There is no need for me to detail the many races he won, for the story has been told many times in this journal.

All of his papers and press cuttings are in my possession, and, as space permits, I shall deal from time to time with matters of interest, and which have not hitherto been published. He will be missed by many hundreds, for he was a familiar figure on the roads of the Home Counties.

Wayside Thoughts
by F. J. URRY



East Hagbourne, Berkshire.

New Prices?

WE are now near enough to the end of this awful war to glance at the possible picture of the post-war world as far as our pastime is concerned. The first item to consider is the new cost of our bicycles, the basic prices that will rule after the industry has got going again. Pre-war that figure was £4—£3 19s. 9d. to be precise—and from that basis every other bicycle value was reckoned. Now it seems to me that such a figure cannot possibly return, quite apart from the question of Purchase Tax, which to-day stands at 24 per cent. on the retail price. I imagine that the old conditions of employment will not return—will not be tolerated—and wages cannot slump to the pre-war rates if we are going to enjoy that better world so widely promised. Material will cost more, labour charges will be higher—and a bicycle is mainly a labour charge—and it is more than possible the dealer will need a bigger discount from the manufacturer to meet his increased charges. As to what the new basic price will be I have no definite knowledge, but if it is within the region of £5 less tax then I think it will be on very reasonable terms. I cannot conceive it being less, anyhow as far as the home market is concerned.

All-round Advance

I THINK that a rise of 25 per cent. on the old figure will be the all-round advance on every type of bicycle, and its equipment and accessories. Pre-war the S.A. 3-speed hub was listed at £1 extra; in reason, we cannot expect that figure to remain. So with tyres, and brakes, and bells and pedals, chain-wheel sets, chains, saddles, touring bags, lamps, and all the host of extras that go to make the complete bicycle. If the advance is no more than the suggested 25 per cent. we riders will be fortunate, for there will be few other commodities, either in the travel sphere or the house, that will be purchasable at so modest a rise over pre-war prices.

Many More Cyclists

ANY modest rise in the cost of bicycles will not make the slightest difference to the numbers in use. I have thought that for years, and I think so still; the difficulty was to persuade the industry that the ultra-cheap machine would not lessen the public demand. In the post-war years I imagine the chance of proving my theory that price, within reason, will not reduce the numbers of machines in service but actually add to them will never have the opportunity of testing. I believe that by 1950 we shall see the number of cyclists in this country round about the fifteen million mark, and that a bigger percentage than is now the fact, will be riding good class machines. And this, despite the Purchase Tax. I am gravely doubtful if that impost will be cancelled right out; it is too easy to collect, too simple for any Chancellor of the Exchequer to forgo; anyhow, as far as the immediate future is concerned. We may get a reduction of the charge when Income Tax and such things as the beer tax come up for review, but that, I think, is the best we can hope for. We may have to pay for our past political sins, and this is an easy way of collecting payment, for it touches all road travellers. It is unthinkable that car P.T. would be cancelled or reduced in impost without a similar relief being given to the bicycle. One hopes these additional charges will make us realise the wonderful value we get from the pastime, and take a little greater care of our property; there is plenty of room for such an improvement. Some of my trade friends think these additions to cycling cost will tend to make the bicycle of one type and class the cheapest. Personally, I think just the opposite, for the brainy buyer will surely realise as never before that the very best bicycle must be the cheapest, pound for pound, mile for mile, and energy—that very personal power—so easily saved.

Their Great Opportunity

OF course, it is up to the trade to make the public more cycling conscious. I'm sorry to use so overworked a phrase, but, in this connection, it is so definitely right. The public are hopelessly ignorant of cycling. To them it is hard work, the kind of labour to be dropped at the first opportunity to acquire powered perambulation. The hikers sneer at the bicycle curiously enough—this geared walking with horizons multiplied four times—the motorist scorns it, grows fat and puffy, and wonders why he feels so old at 50; and, as for the man-in-the-street, he is altogether too superior to "straddle a bike," it might upset the crease in his trousers. Yet, what is wrong with cycling, whether it be for pleasure or the convenience of owning your private time table? There are so few private things you can own in these days that he is a wise man who preserves at least one that is well within the confines of his purse. Is it more manly to be active than idle; is activity and youth worth preserving, is it a happiness to travel, and on your way see, and hear and smell beauty; is it a joy to go silently over our heritage—the King's Highway—sit amid the grandeur over which we should dilate *in excelsis* were it a picture; is it a fine thing to make a holiday of any idle hour? If these things are true—and to me they most assuredly are—are they worth preservation for your use and that of all mankind? You agree? Yes, it would be difficult not to. That, then, is cycling as I see and enjoy it; and so can you, for it is no patented process of living, but simply a return to that love of country that lives in the heart of most of us, gained by the aid of a small miracle, that mechanical contrivance called a bicycle. The trade may believe in all these things. If they do, let them publish their gospel for the greater happiness of all men.

Talk It Up, Write It Up

I'M afraid my predilection for side issues has made me stray from the main topic, but these major subjects, like the main roads, are so frequently less desirable or less interesting than the byways. We were talking of prices, and I was trying to say that within reason the figures at which the post-war bicycle will be sold will have very little—if anything—to do with the popularity of the pastime, or its use as a convenient service vehicle. None of us buy bicycles because they are cheap, but because we need the use of them. Some use them for pleasure, the majority as a work and errand hack; but nobody buys a bicycle for a decoration, outside the museums, and collectors of historic models. Yes, the majority of us are utility cyclists, and up to now the industry has been contented they should remain so. Of course, as these people grow up and prosper, they don't keep on riding, even for convenience. The manufacturers and the dealers, in the main haven't, why should they expect other people to remain cyclists when the years of impecunity have passed? What an awful acceptance of the *laissez faire;* what a mark of class distinction to fasten on a great pastime? All the fortunate and favourable things I have said of cycling are true, and the people who decry the pastime do so in that hole and corner method of the club and pub., talk that is so difficult to track down and challenge in the open columns of print or the platform of debate. This sort of detraction has gone on for years—ever since the advent of the cheap car—and nothing has been done about it outside the technical press.

Time For Enthusiasm

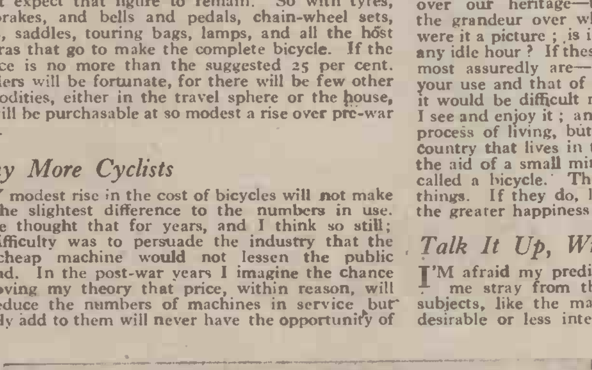
IT is just about time we started a period of attraction towards cycling, to write and talk about it with the conviction of enthusiasm. For thirty years or more it has confounded its critics by its steady advance in popularity and the numbers of its advocates; with little enough aid it has become, and will remain, the greatest travel vehicle of the country in point of numbers, and with these facts actually in being at this very moment, what do you think the pastime could become if properly taken in hand and its virtues made articulate to the general public by the only people who can afford to undertake the gigantic task, and the only people who would profit by the certain results—the trade? I will leave the subject there for the moment; but I love the game too well, and have taken health and joy in such full measure from its practice, that sooner or later I am sure to enter the lists on its behalf, and cross a nib with my controversial friends.

Making Use of Time

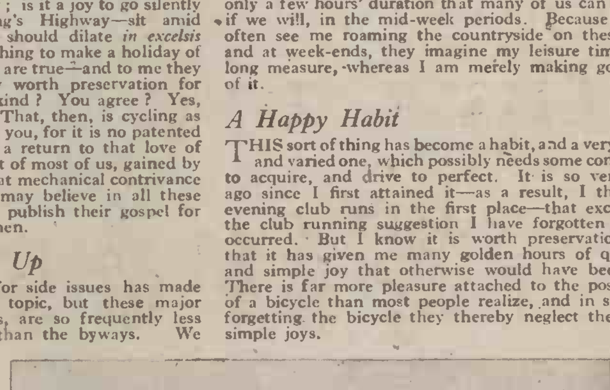
I AM often charged with being a man of leisure—and I wish it were true. The fact is that I am fortunate in my home anchorage, which is on the edge of the country, and it is always beckoning me to go and look at our Warwickshire woods and the sloping fields running down to the little rivers. As a matter of fact my working hours are normal ones and my holidays—when I get them—are supposed to be three weeks per annum, extended just beyond the usual fortnight as a kind of reward for lengthy service. What happens is that I try to make full use of my free time and never miss an opportunity of getting out, even if it is only for a couple of evening hours; that is the luck of the home position, not always comparable with many of my friends. Yet I do think thousands of people are slow in making full use of their bicycles for holiday purposes, even those short holidays of only a few hours' duration that many of us can snatch, if we will, in the mid-week periods. Because people often see me roaming the countryside on these trips and at week-ends, they imagine my leisure time is of long measure, whereas I am merely making good use of it.

A Happy Habit

THIS sort of thing has become a habit, and a very happy and varied one, which possibly needs some conviction to acquire, and drive to perfect. It is so very long ago since I first attained it—as a result, I think, of evening club runs in the first place—that except for the club running suggestion I have forgotten how it occurred. But I know it is worth preservation, and that it has given me many golden hours of quietude and simple joy that otherwise would have been lost. There is far more pleasure attached to the possession of a bicycle than most people realize, and in so often forgetting the bicycle they thereby neglect their own simple joys.



Newcastle Bridge.



The Open Air Theatre at Scarborough.

CYCLORAMA

By
H. W. ELEY

A stop in the Rhondda Valley, above Penycraig. In the middle distance is Trealaw mountain, and to the right Craig-yr-Eos.

A "Nip-in-the-air" Ride

I ALWAYS think that there is a peculiar joy in cycling when the air is "nippy," and one feels that exercise is needed to promote the circulation, and get one warm. All very well to extol the pleasures of summer riding, but there is a strong case to be made out for winter riding, too . . . and the other day, starting pretty early in the morning, I had a grand ride through the country around Tamworth, and Lichfield, and Atherstone. "Border" country this . . . for one may, in the course of quite a modest ride, touch Staffordshire, Warwickshire, and Leicestershire; and it is all good riding country, with much of historic interest and charm. But it was the tang in the air which did me good; I had been "chained" to a desk for more hours than is good for one, and it was good to breathe the exhilarating air and feel that the cobwebs of the city were being blown away. Get out on the bike while the glories of autumn are here! That is sound advice, and—I take my own medicine!

How Many?

FROM time to time, one sees figures and statistics about the number of cyclists in Great Britain . . . but the figures vary considerably, and I have never been at all sure that the oft-quoted figure of ten millions is really accurate. What kind of a census has ever been taken? And does the figure include juvenile riders? It would be interesting to have an accurate figure, and it should be possible to obtain it . . . but I confess I do not know from what source. If the total *is* ten millions, then the cyclists of these islands are—or should be—a very powerful body, with lots of "sway" in matters of legislation affecting cycling and those who indulge in it.

The Lights Go Up

NOT everywhere . . . not in London; but in the heart of the Midlands, the last couple of weeks have been memorable, for streets have been gay with lights, and there has been a new joy in taking a ride at night. In spite of the fact that the restricted lighting is not, of course, anything like pre-war illumination, the difference from the true black-out has been remarkable, and more than welcome. One may hope that the better lighting in Midland towns may have a good effect on casualty figures—still far too high.

Memories of Middelburg

HOLLAND is in the news, and because in peacetime I used to visit Walcheren Island fairly frequently, and loved the cycling Hollanders, the story of destruction caused me to grieve. Everyone cycles in Holland, and I have good memories of rides around Middelburg, that quaint medieval town; of rides to the great wall of Westcapelle; of Flushing—where one greeted one's English friends off the boat from Harwich. Good, flat country—ideal for cycling, and even if one did not take one's own mount across, it was so easy to hire a machine from one of the many shops which catered for the cycling visitor. When Holland is really free, and the war is over, I plan to go there again . . . and indulge in good rides with friendly Dutchmen—those cheery Dutchmen with the inevitable cigars; those good Dutch women, with their passion for scrubbing and cleaning, and their skill in making round Dutch cheeses!

Crown of the Year

IT was good, indeed, during October, to get out into the English countryside and see the colourful pageant of Nature. The berries of the rowans gleamed like blood-drops in the sun; the elderberries were laden with black clusters of berries, and on the high ridges the trees were turning to gold and russet and brown. Mother Nature was mixing her autumnal colours with a lavish hand, and in the woodlands there was a riot of beauty. The cottage gardens were still gay with flowers . . . Michaelmas daisies, asters, dahlias, golden rod . . . and in the rose beds there were still some lovely blooms. All too soon the picture will fade, and King Winter will grip the land; if we are wise, we shall make the most of these good autumn days, and get in as many rides as we can.

The Names on Bikes

IT was a Sunday in October, and there were three of us . . . taking our rest at an inn. Our bikes were propped up against the trunk of an ancient elm, and we sat and sipped our ale on a weather-beaten old bench. I fell to thinking of the names of the three machines. One was a "Norman"; one a "Robin Hood," and the third a "Three Spires." And, somehow, imagination ran riot, and the names brought visions of places, and things, and associations. "Norman" . . . a bike from Ashford, in Kent, and I had thoughts of the ordeal which Kent has endured these long war-years; I thought of great shells dropping into Dover Town; of all the flying-bombs which have hit the Kentish towns so hard; and then I thought of how Kent has ever been in the forefront of English history . . . thoughts came to me of St. Augustine, of the Pilgrim's Way, of the murder of Thomas à Becket in ancient Canterbury.

Memories of Sherwood

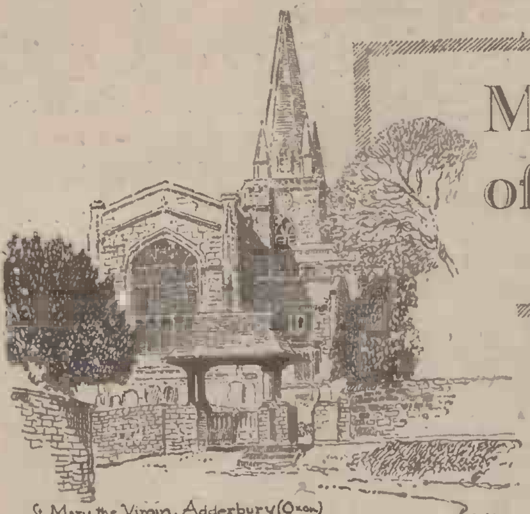
I GLANCED at the transfer on the "Robin Hood" machine, and I was away on a magic carpet into fair Sherwood, slipping through the glades with the gallant Robin himself, talking under a huge tree with Maid Marian, and enjoying all the thrills of outlawry in the dense forest. And when I turned my eyes to the "Three Spires" bike, then I wandered in spirit in old Coventry, and thought of her scars, of her fascinating industrial history . . . clock-making, silk, bicycles, motor-cars, aeroplanes! I thought of Starley, and the old pioneering days of the cycle industry. And I even had a mental picture of Lady Godiva making her famous ride through the narrow streets . . . with old Peeping Tom taking his look at the Earl's lady! All these casual, chasing thoughts set in motion by the transfers on three bicycles! Who can say that Romance is not ever at our elbow?

The War . . . and Rubber

I WAS reminded the other day that the defeat of Germany will not necessarily mean good or ample supplies of raw rubber. Malaya is still in the grip of the Japs, and until we get back that rich and chief source of crude rubber supplies, I guess we shall have "synthetic" rubber with us. "Synthetic" has done a remarkable job, but I gather that it can never take the place of "crude"—and we must hope for the day when the Malayan estates will be free again, free to send us those picturesquely-marked cases of raw rubber to feed the machines in the tyre-making plants, and give higher quality to our cycle tyres. Meanwhile, the Ministry of Supply is still preaching "tyre economy" and the necessity of taking special care of our covers and tubes.

President of the Roadfarers

THE holder of this office, as many cyclists know, is Lord Brabazon of Tara—the holder also of the first air-pilot's licence in Great Britain. Keen, practical, and possessed of a vast knowledge of matters aeronautical, Lord Brabazon is interested not only in the skies, but in our roads, and all "Roadfarers" know with what urbanity and charm he presides over the functions of the club.



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

My Point of View

BY "WAYFARER"

Touring Costs—

A RECENT paragraph was cut off in its youth owing to my unfortunate habit (the result of enthusiasm!) of over-running the space allotted to this contribution. I was pointing out that the 11s. 6d. per day which had been spent on my July tour did not represent the actual cost of the holiday. After all—it may appear to be regrettable!—I've got to live—somewhere—and, being away from home, the cost of my "keep" there was, of course, saved.

I am now in a position to supplement these details by citing the experience on an October holiday. I spent five nights at a house in Shropshire, where I paid 7s. 6d. for dinner, bed and breakfast: total, £1 17s. 6d. Devoting most of the hours of daylight to cycling, I had five lunches at various establishments along the road, at a total cost of 13s. On the first day of the holiday I also had tea, which cost me 1s. 9d. Thus my total expenses for those five October days (during which I did 381 miles) were £2 12s. 3d., averaging 10s. 6d. a day. And there's a war on! The total is a shade lower than normal for these particular times because—reluctantly enough!—I made do with three meals a day instead of four. With a substantial lunch at 1 p.m., and a good dinner at 6 or 7 p.m., I managed to live without my usual tea, except on the one day mentioned. Once again I emphasise that this half-guinea a day is the *gross* figure, taking no account of the money I saved on housekeeping bills at home. I am almost constrained to ask: "Can you beat it?"

—And Experiences

LET me add (though it is hardly germane to the aspect of the matter which I set forth to discuss) that from the weather point of view the former of these two holidays was the most brilliant I have ever experienced. It may also be added that, while my riding-programme was irregular (sometimes I did 30-odd miles in the morning, and sometimes only 12), there was always time for sitting on walls and gates, doing nothing vigorously, or lying full length on grassy banks. So long as I was out for 12 hours or more every day, I didn't mind how I spent the time, though it will be noted that I averaged 64 miles a day—without really trying! I was not quite so lucky with the weather on my October holiday, having a pair of wet feet on most of the five days.

Return to Lamplight

IT is always with mixed feelings that I view the "taking off of the hour," and the inexorable backward movement of lighting-up time. I regret the departure of the summer, but I welcome the arrival of the autumn. I deplore the shutting-down of the long evenings of light, but I hail the coming of ample opportunities for riding in the dark, of which phase of the pastime I have always been inordinately fond. I appreciate, of course, that one can have a quota of night-riding at any time of the year, but, in practice, one does not exchange the joys of going to bed for the delight of cycling beyond midnight. During what we call the winter months it is easy to indulge one's fancy in the way of riding behind a lamp, and I have never been backward in obtaining my share of this fascinating aspect of cycling.

Riding in the Dark

DURING two recent week-ends, when I spent the Saturday night away from home, I was able to enjoy a pleasant spell of riding in the dark, and I found all the old-time joys awaiting me. To some extent, those joys have been eclipsed by the annoying wartime regulations relating to our lamps, but these have now been very much eased, and I feel quite at home, and perfectly happy, travelling through the pool of darkness. What a pleasure and advantage it has been to get back almost to pre-war lighting! I don't think that the white matt decoration of the "innards" of a lamp detracts much from the volume of the light, and I find that, with the disappearance of the mask from the front glass (I ripped mine out as soon as the powers-that-be said "Go," and without waiting for the appointed day!), I am obtaining pretty well all the illumination I require. My night speed has gone up. I do not mind how black the night is—on the other hand, the blacker the night, the better can my light be relied upon to "do its stuff"; and the most tortuous and involved of the country lanes are receiving quite my old-time patronage. Incidentally, having tried most kinds of lighting methods, I pin my faith to carbide.

One pleasant feature of the current return to lamplight is that the country scene is no longer a mass of unrelieved black. The cottage windows, as of old, wink cheerfully at us as we pass, the internal lighting being screened by multi-coloured (or even white) blinds. Now that we are back at this halfway house between pre-war and post-war lighting arrangements, one realises how dismal the uniform blackness of the countryside during the war-years really was.

Two Conversations

I HAD just started out for a day's ride the other Sunday morning when a voice at my elbow murmured: "Good morning, sir! This isn't the way to Ireland!" A pretty thought, coming from a young friend who has cycled far and wide on the Continent of Europe, and who is aware of my affection for "the Island of the Saints"! We sped along in an easterly direction, and then I retorted: "If I like to make it so, this *is* the way to Ireland. My wife remarked to me at breakfast half-an-hour ago that any road seems to take me to the places I desire to visit. That is the case, and I instanced to her (as I now do to you) my monumental 'short cut' from Killarney to Birmingham via Dublin, Belfast, Larne, Stranraer, Ayr, Newton Stewart, Dumfries and Carlisle. So, if that's the way from Ireland, I claim that *this* is the way to that grand touring country, although we're facing in the wrong direction at the moment. . . . So long! I'm turning right here!"

My hostess at a tiny cottage whose windows, when the foliage permits, commands a view of the Malvern Hills, goes by way of being a cyclist—not exactly a cyclist of my calibre, for the probability is that I account in a month for a greater distance than she achieves in a year. But she *is* a cyclist—and she confesses she loves her bicycle, which she uses for conveying her on shopping expeditions and for going to whist-drives, etc. The other Saturday, when I called at that tiny (and remote) cottage for tea, my hostess told me that she had just cycled to the next village, three miles away, on a matter of business. Here and there she saw a friend waiting at the roadside in the hope of getting a lift, and one of them called out: "Oh! Mrs. Smiler! I wish I could cycle like you do!"

"Hard Work" Fetish

I AT once took up the cue. "They could if they would," I opined. "But the trouble is that they won't try. They leap to the conclusion that cycling is hard work: they can't see that it's really much easier than walking—and *very* much easier than standing about waiting for a lift. Why the blazes"—I was warming up!—"they won't give cycling a fair trial, that's all one asks, I can't imagine. These people would be just as enthusiastic as you are if only the desire to cycle was there, and if only they would get rid of this hard work fetish."

All of which I believe to be profoundly true.

Notes of a Highwayman

By LEONARD ELLIS

Britain's Touring Grounds

STATISTICS have shown that among the numerous touring grounds of the British Isles, Devon and Cornwall have held a leading place in popularity for many years. There is no particular reason why the two counties should always be merged, as they are quite dissimilar. Perhaps, however, for hard-riding tourists, unwilling to linger too long, there is not sufficient territory in either county to occupy them for a whole fortnight. Without doubt there are many of the more leisurely ones who are content to "do" Devonshire by itself and to reserve Cornwall for another holiday. It is not too much to say that these will derive the greatest benefit, as many fortnights must elapse before one can really say that every corner of these two paradises is familiar ground. Taking them as a group, however, what are their chief characteristics?

Glorious Red Devon

ONE may say that among the English counties there is no other that can be matched with Devonshire as an all-out playground. North, south and centre there is unlimited beauty and unrivalled variety. Yet north is different from the south, and the centre is really a a land apart, unlike either. Most people agree that North Devon is more appealing—I won't say more beautiful because I do not profess the ability to define the term to everyone's satisfaction. The north is more unspoilt, less sophisticated, but the south possesses the colour, the sub-tropical luxuriance of foliage that is not present in the north. At the same time the south contains most of the popular "resorts," full of boarding-houses, parks, and an air of artificiality that the average tourist does not hanker for. Here, however, particularly between Teignmouth and Torquay, will be found that exquisite combination of red loamy soil and fresh green. There is perhaps no more colourful stretch of coast in Britain than the Labrador slopes. On the north side there is one ever-changing panorama of wooded slopes, secluded combes, deep ravines and precipitous cliffs.

Hills and Scenery

THE roads are good in parts, but some of the finest scenery can be found along roads that deter all but the hardy cyclist. The gradients are severe, and it is said that there is no hillier length of road imaginable than that from Porlock to Ilfracombe, but what a wealth of grandeur. Inland there is Dartmoor, a wild tract of country studded with isolated tors. Here in the proper season is a purple and green world of heather and bracken. Roads are few, and there are places where it is inadvisable to stray from the beaten tracks. Here is history and mystery, solitude and grandeur, peace unequalled. Cornwall is entirely different from Devon.

Cornish Coastline

THE people are different, scenery is different, the accent is different. Another great difference is that one must concede at once that by far the greater part of Cornwall's glory lies along the coast, and as a coastline it has no equal. Along the south-west corner, embracing the Lizard and Land's End, is some of the most wonderful rock scenery that one could imagine. Cornwall has many other attractions, and not the least is the wealth of memories and reminders of King Arthur, and the numerous quaint fishing villages, teeming with interest and pictures. In neither county does industry obtrude unduly. There are a few large towns in Devon, but apart from these almost the only "factories" are the little places devoted to the manufacture of the famous Devon ware. There is more industrialism in Cornwall, but even this cannot compare with most counties. The county has been famous for many centuries for its tin and china clay, and the evidences are hard to hide. Stone quarries are also encountered, but it cannot be said that smoke or ugliness predominate anywhere.

The Lizard, Cornwall.

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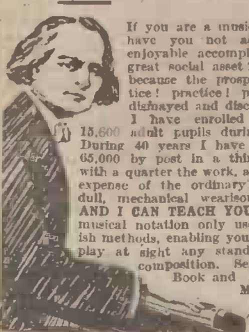

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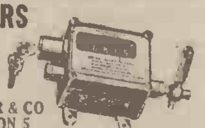

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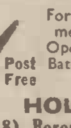

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