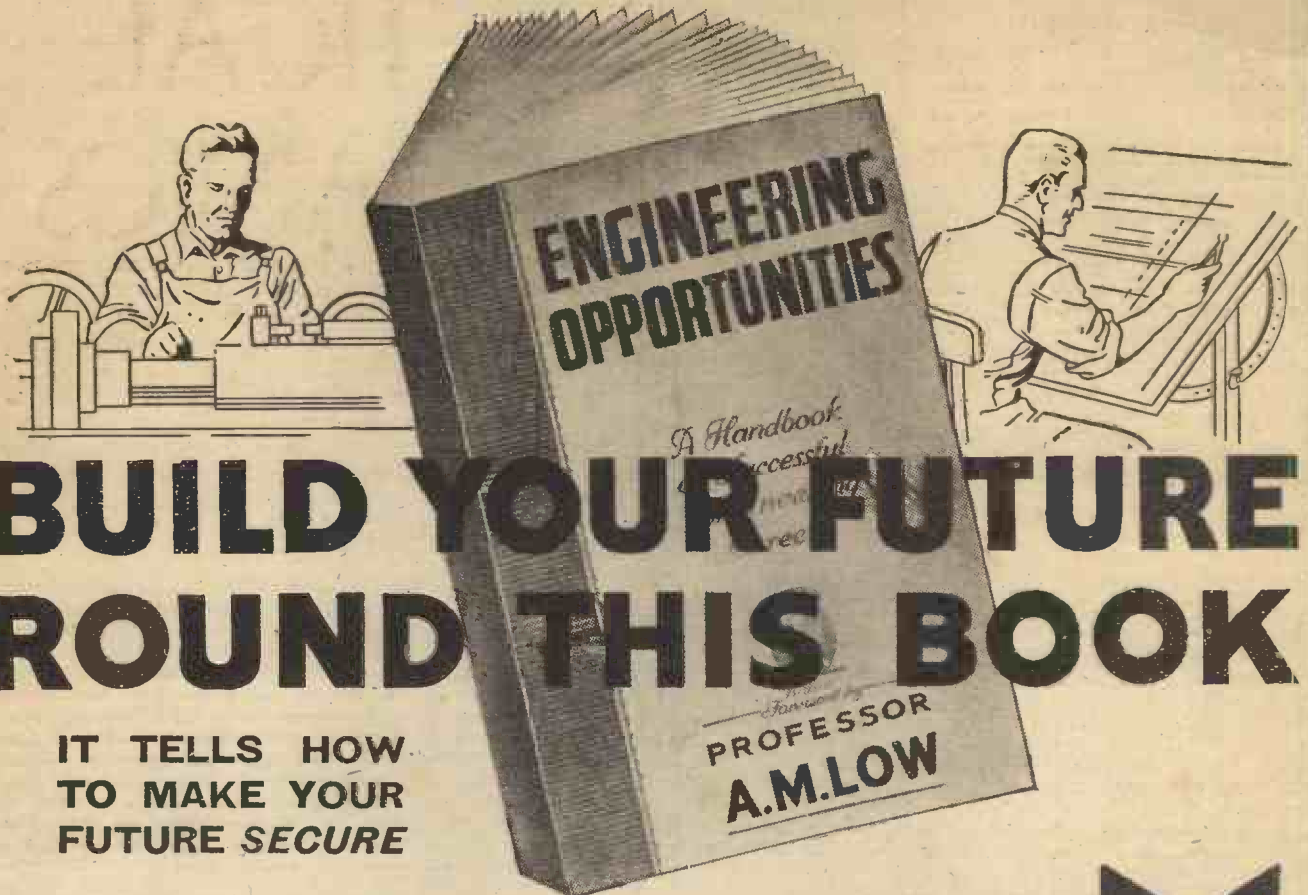
THE FLYING FORTRESS

NEWNES

PRACTICAL MECHANICS

9D.

OCTOBER 1942



BUILD YOUR FUTURE ROUND THIS BOOK

IT TELLS HOW TO MAKE YOUR FUTURE *SECURE*

POST THIS COUPON NOW

In the more competitive days of peace, technical training will be a vital necessity to the Engineer who wishes to safeguard his position and make advancement. "ENGINEERING OPPORTUNITIES" will show you how to secure this all-important technical training quickly and easily in your spare time. This 112-page book is full of valuable information and explains the simplest way of preparing for recognised Examinations. Among the courses described are:

A.M.I.Mech.E.
Inst. of Production Engineers.
Mechanical Engineering.
Draughtsmanship.
Tracing.
Works Management.
Jig and Tool Design.
Maintenance Engineering.
Diesels.
Inspection.

A.M.I.E.E.
City and Guilds.
Electrical Engineering.
Installations.
Electricity Supply.
A.M.I.C.E.
Civil Engineering.
Structural Design.
L.I.O.B.
Building Construction.
Clerk of Works.

A.F.R.Ae.S.
Air Ministry Licences.
Aeronautical Engineering.
A.M.I.A.E.
Repair Certificates.
Automobile Engineering.
Garage Management.
A.M.Brit.I.R.E.
Wireless.
Radio Servicing.
Television, etc., etc.

Special Courses for London Matriculation and R.A.F. Mathematics

If you are earning less than £10 a week, you cannot afford to miss reading "ENGINEERING OPPORTUNITIES." Write (or forward coupon) for your copy, and subsequent matter, immediately. Sent (post free) on receipt of 2½d. in stamps.

WE DEFINITELY GUARANTEE "NO PASS—NO FEE"

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

410a, Shakespeare House, Stratford Place, London, W.1.

Please forward (post free) your 112-page handbook "ENGINEERING OPPORTUNITIES" and subsequent matter relating to the Institute, for which I enclose 2½d. in stamps.

Name.. *Address*..

....

THE B.I.E.T. IS THE LEADING INSTITUTE OF ITS KIND IN THE WORLD

SUBSCRIPTION RATES

Inland - - - - - 11s. per annum.

Abroad - - - - 10s. 6d. per annum.

Canada - - - - - 10s. per annum.

Editorial and Advertisement Office: "Practical Mechanics," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2
'Phone: Temple Bar 4363

Telegrams: Newnes, Rand, London.

Registered at the G.P.O. for transmission by Canadian Magazine Post.

PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. X. OCTOBER, 1942 No. 109

FAIR COMMENT—BY THE EDITOR

De-icing Equipment

ACCORDING to the Ministry of Aircraft Production the Dornier 217E heavy bomber and dive bomber is a twin-engine, mid-wing monoplane with a wing span of 62½ft., and an all-up weight of about 33,000lb. The maximum speed is 309 miles per hour at 18,000ft. The engines are B.M.W. 801, 14-cylinder, twin-bank radial, air-cooled, fitted with fuel injection pump. Each engine develops 1,580 b.h.p. at take-off (2,700 r.p.m.) and 1,460 b.h.p. at maximum power altitude (2,400 r.p.m.). Examination of one of these aircraft shows that de-icing is fitted to the wings and airscrews, a hot-air system being employed in the wing, and a fluid and slinger ring system on the airscrew. Hot-air sprays are fitted to the pilot's windscreen and to each of the windows in the nose of the aircraft. Provision is not made for de-icing on the tailplane, fins, or aerial mast. Port and starboard systems are similar, but independent, except for a common control lever. Hot air is supplied from two muffs round the exhaust pipes behind each engine, and is led through a large lagged pipe in the leading edge. At every rib interspace a small duct taps the hot-air supply, the air being led into a narrow space formed in the double-walled leading edge. The air enters at the bottom of the sandwich and passes forwards and upwards around the leading edge and escapes into the wing just forward of the main spar flange, and finally escapes to atmosphere through apertures at the aileron hinges. The hot-air supply can be augmented by hot air from the cabin heating system when this is not required. The wing de-icing is controlled from the cabin by spring-loaded cables, running over pulleys and operating a flap valve which spills the hot air overboard, when not required, through a pipe emerging under the wing at mid-chord in the fillet outboard of the engine nacelle.

Regarding the muffs, separate exhaust pipes from each cylinder are led back inside the cowling to emerge in groups of four and six near the wing leading edge. The heater muffs are fitted to exhaust pipes from the front and rear top cylinders and take the form of tubes concentric with the exhaust pipe with one end open, and the other end ducted into the wing-heating system. Small metal tongues are riveted to the inside and outside of the exhaust pipe to assist heat radiation. Air inside the cowling already heated by the remaining exhaust pipes is forced through the muff by pressure in the engine nacelle which is produced by an engine cooling fan situated behind the airscrew and driven at 1.72 times the crankshaft speed. The port and starboard hot-air sprays are similar in layout and independent of one another. On each side hot air is supplied from two muffs around the exhaust pipes and is led into the cabin through a 3in. pipe. When not required the hot air is led into the wing de-icing system to be used for wing heating or spilt overboard. Air-flow is controlled by a two-way valve operated from a hand-lever in the cabin. A hot-air spray is fitted to the pilot's windscreen. A small valve in the feed pipe controls the flow to the windscreen spray. A large number of hot-air sprays is fitted to the transparent panels in the nose of the aircraft.

Great advancement has been made in this country in the design of de-icing equipment. This is a most important feature of aircraft design, for at high altitudes a ton or more of ice can form on the wings and other exposed surfaces of the aeroplane.

Pre-built Huts

I RECENTLY dealt with the question of post-war building construction, and mentioned that a committee had been formed for the scientific production of houses partly built in the factories and taken to the site for erection.

The Ministry of Works and Planning have erected nine huts made of pre-built materials on a site near the Tate Gallery. The huts have been designed and built by private enterprise, in conjunction with the Ministry of Works, with the intention of indicating the use which can be made of new building materials to reduce the amount of iron and steel required. These huts indicate a great reduction in first cost and weight. Sawdust concrete is used as the building material inside the hut.

The Engineers' Plan

THE National Committee of the Amalgamated Engineering Union, which held a conference some weeks ago, unanimously adopted a 10-point production programme which reads as follows:

"The Production Minister to be given full powers to operate a single plan for the control of industry; Regional Boards to be given full powers within the regions to organise and use the productive resources; Joint Production Committees to be established in every factory, with access to all material and data on production; the union to have direct representation in all stages of State control, from the Joint Production Committees in the workshops through the Regional Board to the Central Planning Authority; that controllers in key positions shall have no financial interests in the industry they are controlling; effective guarantees to safeguard piecework prices in order to encourage the maximum possible output; arrangements for shopping time for women workers and the establishment of nursery centres for children to enable married women to enter industry more speedily; improvements in all welfare arrangements for the workers to safeguard health and maintain the maximum working efficiency; the further development of works canteens and the setting up of works canteen committees with adequate representation by the workers; that equality of sacrifice be promoted to the greatest possible extent."

The Manchester Heavy Bomber

DETAILS of the Avro-Manchester Bomber, designed by Mr. R. Chadwick, reveals some interesting features. The power plant consists of two Rolls-Royce Vulture liquid-cooled engines. This engine is a 24-cylinder poppet valve engine, the cylinders being 5in. bore and 5¼in. piston stroke. They are arranged in four blocks of six, on a common crankcase with an angle of 90 degrees between the blocks. The piston cylinder and valve gear assembly follow the usual Rolls-Royce practice, four valves being fitted to each cylinder operated by overhead camshafts. Two independent magnetos provide the ignition, and a down-draught carburettor is used which feeds a two-speed supercharger connected to two main trunk pipes, each of which feeds two cylinder blocks. Electric starting is fitted, and the engine develops 1,845 b.h.p. at 3,000 r.p.m. at an altitude of 5,000ft., with the supercharger in low gear. When in high gear the engine develops 1,710 b.h.p. at 3,000 r.p.m. at an altitude of 15,000ft. The engines drive three-bladed full-feathering airscrews, 16ft. in diameter, fitted with de-icing equipment. Fuel is carried in self-feeding tanks in the wing. The Manchester is a mid-wing all-metal cantilever monoplane with retractable undercarriages. Its wing is 90ft. 1in., length overall 58ft. 10in., height 20ft., wing area 1,131 sq. ft., the fuselage is 5ft. 9in. wide by 8ft. 2in. deep, and the bomb compartment in the fuselage is 33ft. in length. The wheels are 5ft. 6in. in diameter. The total weight is 25 tons all-up, the maximum speed is 350 miles per hour (approx.), and its maximum range about 2,000 miles. Over 5 tons of bombs can be carried. Armament consists of eight Browning .303in. guns mounted in three hydraulically operated turrets, one of which is located in the nose, one on the upper part of the fuselage, and one in the tail. There are two pilots, one observer; two combined wireless operators and gunners, and two gunners.

The Boeing B-17E Flying Fortress II.

The Flying Fortress

The Development and Success of America's High-altitude Bomber

JUST over a year ago a new phase in aerial warfare was introduced when the American-built Flying Fortresses went into action for the first time over Brest. Flying at a great height, which makes ordinary methods of aircraft detection difficult, the first intimation that the Germans had of their approach was a stick of bombs bursting in the target area. Thus we see how formidable the high-altitude bomber can be to the enemy.

Since that pioneer operational flight the Flying Fortress has been considerably developed in both design and armament and is now known as the Boeing *B*-17E (Fortress II). Operating with the United States Air Force in the United Kingdom, the Flying Fortress II has recently carried out a number of high-level raids with outstanding success, both in accuracy of the bombing, and also in the absence of losses. They have carried out raids over Occupied France, and subsequent photographs have proved their bombing to be exceptionally accurate. This should be sufficient to silence the critics who persist in saying that high-altitude bombing is inaccurate.

The Early Fortress

A Boeing Fortress in its early edition was tried out by Sir Richard Peirse, Commander-in-Chief of Bomber Command before Sir Arthur Harris. He had no hesitation in saying that it was absolutely a first-class machine. It needed more guns for defending itself, and it had disadvantages for night work in that the turbo-superchargers, which give it its exceptional high-flying powers, tend to glow and be visible to night-fighter pilots. But he asserted in the strongest terms his admiration for the machine. His own pilots who gave the Fortress its first active service experience over enemy-occupied territory endorsed his opinion. Profiting by the constructive proposals then made, the Boeing Company added more powerful armament, in the form of .5 machine-guns, and also armour. In its new form the Fortress is a magnificent machine. It is not capable of carrying the vast loads which are carried by some of the British machines, but it was not designed to do so. It was designed to have the high-flying qualities which would enable it to bomb in the daylight without heavy loss, though inevitably with a smaller load than that carried by our own heavy night bombers.

Tail Modifications

The Boeing *B*-17E (Flying Fortress II) differs from the original *B*-17 in its general outline, especially in the design of the tail. As will be seen from the photographs a gun turret has been introduced and the tail modified. Another important change lies in the vastly increased fin area, which begins almost amidships, and, after rising on a gradual slope to a point level with the loading edge, curves steeply up to a uniformly rounded apex. The rudder, which now forms appreciably less than half the total vertical area, has a slightly curved trailing edge, and ends immediately above the "stinger" turret.

Tailplane dimensions are also considerably modified. The latest design is of high aspect-ratio, having a chord some eight per cent. less at the roots, and an increase of nearly 25 per cent. in its span; there is a straight taper to both edges and small round tips. Another difference is that the tail wheel disappears behind closed doors.

Engine Performance

Engine modifications which have been made to secure maximum performance at high altitudes are still secret, but it is known that the new Flying Fortress has the remarkable speed of over 300 m.p.h. at 25,000ft. This is made possible by superchargers driven by the flow of exhaust gases, and not by the engines. In this way none of the power is taken out of the engines. Another problem was to make bearings which could stand up to the intense heat, and in this connection the Americans have found an alloy which is suitable. The machine is powered by four 1,200 h.p. Wright Cyclone radial engines, and has a range of nearly 2,500 miles, with a cruising speed of 220 m.p.h.

Dimensions

The wing span of the Flying Fortress II is 103ft. 9in., its length is 67ft. 10in. and height 15ft. 6in. The crew of the machine varies from six to nine, and the effect of high altitudes on their health is constantly under review. Before they go up in the Fortress they are put into a pressure chamber which reproduces the atmosphere at 30,000 ft. or more. They learn how to become "oxygen-conscious," and to understand what effect the lack of oxygen has on a man. Among the strange effects are a warping of the judgment, a spurious self-confidence, a slowing down of the brain, blurring of vision, and weakness in arms, legs, hands and feet.

In order to deal with the problem of baling out, the crew are given a special course of parachute drill in which they are trained to use their oxygen until the last moment. When jumping the breath must be held and the ripcord pulled promptly.

Skimming over a highway. This giant four-motored Flying Fortress swoops to a landing at the base for huge bombers established at Harrisburg, Pa. This illustration shows the machine in its earliest form.

Flying Difficulties

Servicing raises such problems as oxygen equipment, turbo-superchargers and the freezing point of grease. On an average raid a Fortress passes through a full hundred degrees centigrade of temperature—the range from boiling to freezing point. Special grease has to be used so that even at 55 degrees below zero it remains a lubricant, and does not turn into frozen lumps. By contrast, petrol at high altitudes has a tendency to boil, and vapour locks must be prevented.

Armament

The Flying Fortress is very heavily armed, and enemy aeroplanes have found it difficult to find a blind spot for attack as the machine-guns are placed to defend attack from every quarter. The bombs, of which a load of about four tons can be carried, are stowed vertically. In the windowed nose of the aircraft is the bomb-aimer's cabin, which is below the pilot's cockpit and is reached through a floor hatch. He is rather better off in the matter of comfort than the gunners, since his cabin is sealed with a thick felt lining which covers the walls. He also wears an electrically-heated suit. The secret Sperry gyroscopically-controlled bomb-sight is used which, it is claimed, is extremely accurate.

The Pilot's Cabin

Two pilots can sit side by side in the pilot's cabin where there are 130 controls, instruments and gauges. One man can handle the aircraft at ordinary heights, but two are usually at the controls at the take-off and at maximum altitude. Inflation of the dinghies, which are used in the event of a forced landing on the sea, is controlled from the pilot's cabin, and almost everything is electrically operated. The radio operator's cabin is forward.

Anti-aircraft gunners have a difficult task in trying to hit aircraft flying above 30,000ft. Two factors make it possible to aim bombs accurately from such a height, the automatic bomb-sight and the clearness of the atmosphere.

In the tropopause, the region three miles thick between the air near the earth and the stratosphere, there is no dust or smoke at all, and it is too cold for there to be any water vapour.

Engineers' Problems

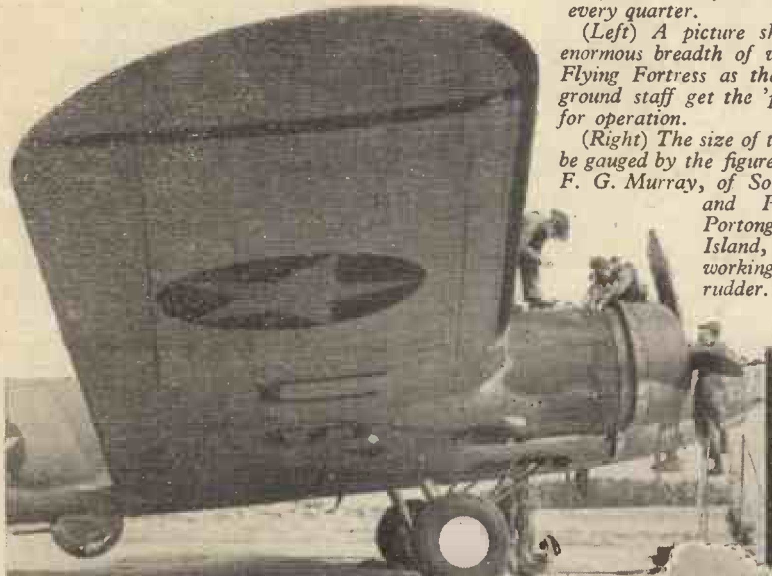
The obstacles in designing a high-altitude bomber like the Fortress are many ; some have been dealt with previously, others which come to mind are that airscrews will not have the same power owing to the reduced density of the air at high altitudes, and thus will not carry the 'plane forward as far for each revolution as they would at sea-level. Also engines and guns that are water-cooled become difficult to operate, and the low density of the air hampers air-cooled engines. Yet again, provision had to be made to protect the crew against reduced pressure and rarefied atmosphere.

In considering the protection of the crew the question arises as to whether this is to be achieved by pressure cabins or special types of suit for each member of the crew. The pressure cabin is a specially designed fuselage which is strengthened to maintain an even pressure inside. Air is sucked into the cabin, under pressure, from the outside and used air escapes at the tail. In such a cabin the crew can move about without discomfort. This is preferable to a pressure suit, which is cumbersome and hampers free movement. One of the dangers of a pressure cabin lies in the fact that a single bullet penetrating both the fuselage and inner cabin would be sufficient to explode the aircraft.

Thus we see what the aircraft designer has to cope with in designing a high-altitude bomber like the Flying Fortress II. That they have met with success is proved by the fact that these giant bombers are becoming a growing menace to the Germans with their "bolts from the blue." They are a brilliant success, although they differ from the British conception of the night bomber, which tends to concentrate on load carrying rather than in speed and height. But do not let us forget that an aircraft which carries half the load of another, yet can fly so high or so fast that it can make twice the number of journeys without being shot down, is at least equally good from the operational point of view as the other.

The American heavy bombers are now making increasing raids into enemy territory. In the B17 Flying Fortress the Allies have a precision bomber flying at a great height and able to drop its bombs with every accuracy. The American crews are enthusiastic at this co-operation with the R.A.F., and ground crews of both countries give a hand in servicing the craft.

The Flying Fortress is very heavily armed and enemy 'planes have found it difficult to find a blind spot for attack, as the guns are placed to defend attack from every quarter.



(Left) A picture showing the enormous breadth of wing of the Flying Fortress as the American ground staff get the 'plane ready for operation.

(Right) The size of the tail can be gauged by the figures of Sergt. F. G. Murray, of South Boston, and Pte. Rudolf Portong, of Long Island, who are working on the rudder.

The gun under the body of the machine.

Getting a Fortress ready for an operational flight.

West African A.A. Battery

These Illustrations of an A.A. Battery of the Royal West African Field Forces Show How the African Soldier Has Been Trained to Play His Part in the Defence of His Own Country. Nearly All the Specialised Work of the Battery, Including Range-finding and Operating the Predictors, is Carried Out by Africans

One of the mobile A.A. guns ready for action. Note the fine physique and smartness of the personnel, qualities which are enhanced by the eagerness and ability of the West African teams to overcome the intricate operations involved in modern A.A. defence.

Loading up. Note the ease with which the gunners handle the shells.

(Above). Africans ascertaining the height, and adjusting the range-finder on to the target.

(Right). Men of the A.A. battery working a predictor, the complicated apparatus which virtually acts as the "brains" of the battery. Its manipulation calls for specialised training and a high degree of efficiency on the part of the operators.

Steam Propulsion for Cars

Its Advantages and Method of Operation

By A. W. NEILD

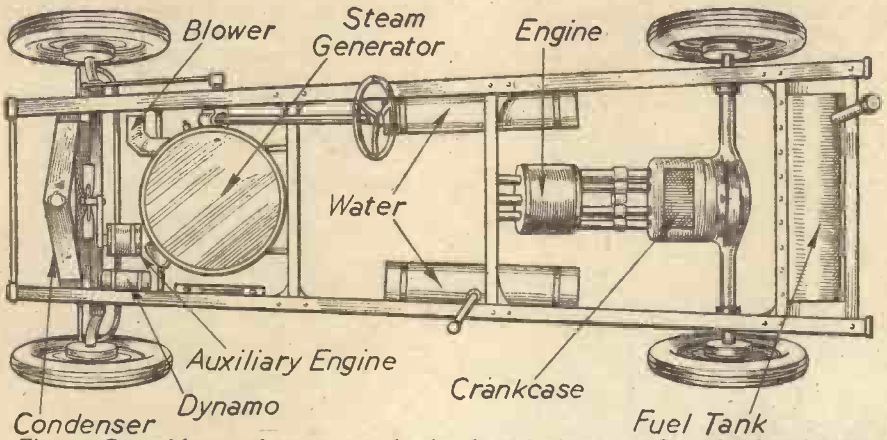


Fig. 1.—General layout of a steam car showing the main features. Control rods and steam connections are omitted for clearness.

STEAM power for cars is no new idea, as steam cars were manufactured long before the last war, and, although by modern standards they appear crude, they were far better in performance than the still more crude petrol cars of that day. It is interesting to note that those early steam cars were so efficient that after a time they were not allowed to compete with petrol cars on the race track as the steam car invariably won! A Stanley steam car driven by Fred Marriott set up a world record in 1906 by covering a mile in 28⅕ seconds. This record stood for six years, and has not yet been equalled by any car of the same weight.

The petrol engine cannot be brought to a much higher degree of efficiency, and, even if it could, it would not be able to compare with a modern steam plant which combines all those desirable features which are much sought after by motorists, such as easy starting, low operative costs, mechanical efficiency, ease and smoothness of operation, and of complete silence. The silence of a steam car is phenomenal to anyone who is accustomed to the racket of the I.C. engine. The smooth feeling of power as the throttle is opened has to be experienced to be believed.

General Considerations

The illustrations are of the popular 10 h.p. car having a double-acting, two-cylinder engine with bore 3¾in. by 3½in. stroke built as a complete unit into the back axle with a 2–1 gearing (Fig. 2). This engine revolves at a maximum of about 900 r.p.m., with steam pressure at 800 lbs. per sq.in. at a temperature of 800 deg. F. Steam car engines are so trouble free, and needing but little attention, that they are generally installed under the floorboards, as, unlike the I.C. engines, they do not need decarbonising or frequent overhauls. The Stephenson valve gear renders a gear-box unnecessary, giving, as it does, three positions of cut-off and reverse, the car travelling as fast in reverse as in forward gear if one wished it to do so. Another advantage lies in the use of the reverse gear, as if, for instance, the car's brakes failed. The car could be quickly brought to a stop by putting the lever directly into reverse and using the throttle gently. Also, when turning the car round on a narrow road the whole operation can be carried out by slipping the lever alternately in forward then reverse, meanwhile keeping the foot constantly on the throttle, turning the car in a quarter of the time taken by an I.C. car.

It is obvious that by using a slow-running engine there is less likelihood of troubles arising from vibration; cylinder wear is greatly reduced, also the wear on the other reciprocating parts. There is an engine on the market which has but 14 moving, working parts. Compare this with the number of intricate and delicate parts of a petrol engine.

Lubrication of the cylinders is accomplished by injecting oil into the steam line before it enters the cylinder. The engine is totally enclosed against the weather and dirt, the cylinders being lagged to prevent heat losses.

The Steam Generator

Model power-boat enthusiasts will be familiar with the working of the flash steam generator, which is the type commonly used in steam cars to-day. Fig. 3 is an illustration in section of such a generator. It is composed of lengths of steel tubing wound circular like a watch spring, each coil being connected with the one above and the one below. Thus, it is possible to wind a very great length of tube into a small space. The size of a generator for the above-mentioned engine would only measure 18in. diameter by 18in. high, and could easily be installed under the bonnet of a car. These coils of tubing being welded together are fitted into the cylindrical insulated container, which has an opening at the top for the entrance of the inflammable vapour, and an opening at the bottom for the exhaust gases.

Combustion

This is accomplished in the following manner: When the ignition switch is closed, current from a storage battery operates an electric pump which supplies paraffin to a float chamber provided with a nozzle situated in a venturi tube. A 6v. or 12v. motor, driving a multivane centrifugal fan at one end of the venturi tube, supplies the correct amount of air necessary for combustion, carrying with it the paraffin vapour into the combustion chamber, where it is ignited by an ordinary spark plug. The mixture burns with a violent swirling motion, so that within a few seconds from closing the ignition switch the inside of the generator becomes a swirling mass of dense flame impinging on to and all around the generator tubes. There is no possible danger of fire with this type of generator, as the combustion takes place inside the heat-proof insulated container, and no evidence of the inferno raging inside is visible from without. A steam pump draws water from the water-tank and forces it through the tubes entering the generator at the bottom, where it is comparatively cool, and is forced high up, where it is converted into steam. At the highest point in the generator is fitted the superheater, and it is at this point that the connection to the engine via the throttle and scale-trap is made. The full cycle of operations is diagrammatically shown in Fig. 4.

Distribution of Parts

Referring to Fig. 1, it will be seen that the steam generator is placed under the bonnet in the place usually occupied by the car's I.C. engine, and the steam engine is bolted to the back axle; this gives the best distribution of weight along the chassis consistent with good design and accessibility. Also, it must be noted that the shape of the car's body does not require any alteration to accommodate the steam plant.

Control of Steam Generation

Steam generation is entirely automatic, no attention being needed by the driver other than seeing that the water and fuel tanks are full. The working of the plant depends upon three main factors: water, fuel and electricity, each having its own circuit through the generator, yet inter-connected with the other two.

The Water Circuit

Water is drawn from the tanks by the steam pump and forced through the main check valve. These check valves are essential, for if they were not fitted steam would blow back into the water pump when the car was standing. Some water is also by-passed through the normaliser check valve into the normaliser tubes; this is to prevent a wide variation of temperature and to ensure a steady and constant flow through the generator. The water first enters the generator at the bottom through the water coils and passes up through the steaming coils to the normaliser coil, where it meets the input from the normaliser check valve. After circulating the normaliser coils the steam enters the thermostat tube and finally through the superheater coil, and thence to the outlet.

The Fuel Circuit

Fuel from the tank at the rear of the car is delivered by means of an electric fuel pump, which is identical with that used on standard I.C cars. The fuel used is generally paraffin, and this is taken to the float chamber and jet in the venturi tube. The blower, which is a multi-vane centrifugal type, supplies the necessary draught to carry the inflam-

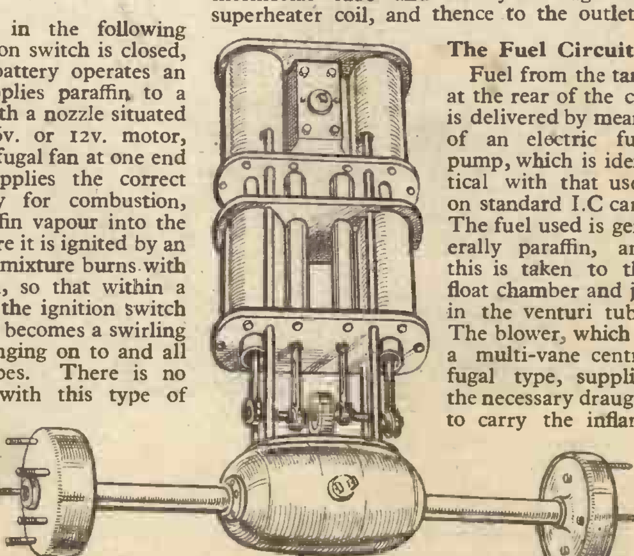


Fig. 2.—A car steam engine, with covers removed, showing general construction. Valve gear is omitted.

mable mixture into the combustion chamber in the generator, where it is ignited.

Paraffin is not the only fuel available, as when using a positive pressure atomising system any kind of inflammable liquid can be used, e.g., Diesel oil, and mixtures of waste lubricating oil, mixed with petrol or paraffin, etc.

The Electric Circuit

Current from the battery, after passing through an ammeter and switch, goes via a contact to the fuel pump and the blower motor, and also to the solenoid steam valve on the steam-water pump. This solenoid valve is fitted to the steam end of the water pump, and in the closed position it is held down by steam pressure. Upon making contact the valve is lifted up and steam is allowed to work the water pump. Next in the circuit comes the coil and spark plug for igniting the paraffin vapour; a coil and contact breaker as is used on I.C. cars will do for this purpose. The spark plug is screwed into an adjustable cage in the side of the combustion chamber.

The Thermostat

This consists of a hairpin-shaped bend in the boiler tube and extends right across the diameter of the boiler; it is placed between the normaliser and superheater coils. Between the legs of the hairpin is welded the thermostat tube, which is made of steel and contains several short lengths of fused quartz rod which are held under pressure by a spring to prevent them shaking about. The steel tube expands and contracts according to the varying temperatures while the fused quartz rod remains constant in its length. The slight movements operate the electrical contacts in the control box, thus controlling the water supply through a solenoid valve.

Method of Operation

The circuits described above work together to keep a constant supply of steam at the right temperature and pressure to the engine. When the ignition switch is turned on, the blower supplies a current of air through the venturi tube, while the electric fuel pump supplies fuel to the venturi jet, and the spark plug ignites the mixture inside the generator. An electric contact also operates on the solenoid valve of the steam pump, and as there is water in the generator tubes, this is soon turned into steam, which flows through the solenoid valve, working the steam pump and supplying the generator with water. If we do not immediately use the car, pressure is built up to 800 lbs. per sq. in., then a pressure contact disconnects the supply of electricity to the blower, fuel pump and spark plug, thus cutting out the fire. Now, supposing that the pressure control failed to function, the steam temperature would steadily rise until it reached 800 deg. F., whereupon the thermostat would operate the electric contact in the control box and cut off the fire, making it impossible to damage the generator tubes. Thus, it will be seen that the working of this system when correctly adjusted is foolproof and entirely automatic. There is absolutely no fear of danger of an exploding boiler as so little water is present in the coils of tubing that, even if after years of use, a part of the tube did give way, there would only be a sharp report like that of a punctured tyre, and a hiss of escaping steam. Even with a burst tube you could get the car home under its own steam, of course, using a considerable amount of fuel and water. Steam generation is so rapid that the car may be driven away within 40 seconds of switching on. When the car is running, steam is taken from the generator, the pressure falls, causing the pressure contact to close, thus starting up the fire again and restoring the steam pressure to its original figure. It will be readily seen that the fire is not constantly on, but only when the engine requires steam; this makes for economy in operation. The exhaust steam from the engine is led through an auxiliary engine, which drives the dynamo and condenser fan.

After leaving the auxiliary engine the exhaust steam is taken to the condenser, changed to water, and is piped back to the water tanks which have a capacity of 15 gallons, giving the car a mileage of between 250-300 miles, according to the weather and type of country. Having the water tanks beneath the chassis gives the advantage of a warm car in winter, although there is no appreciable heat experienced in the summer.

Conclusion

The writer hopes that the foregoing notes and diagrams have been sufficiently clear to explain the workings of the modern steam car. Concerning insurance, there is no difficulty in obtaining cover at a reasonable figure from firms dealing with marine insurance. Taxation is based not on the c.c. of the cylinders but on the heating surface of the generator, 3 cubic feet equalling one horse power in the case of the type of generator described above.

Although steam plants, particularly the generator, have been brought to a high degree of perfection, there is still a very wide field for experiment, especially with engines; some amateur builders are trying to install turbines in their cars, and in this direction alone there are many problems to be solved, opening wide possibilities for the keen experimenter.

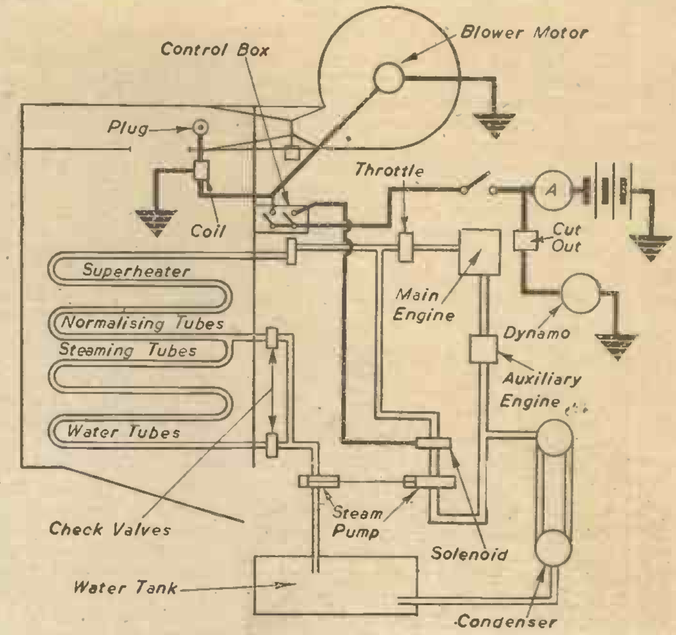


Fig. 4.—Schematic diagram showing the water, steam and electric circuits for a steam-driven car.

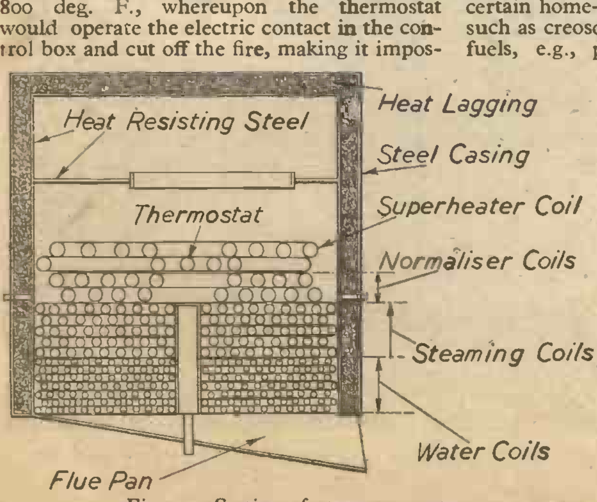


Fig. 3.—Section of steam generator.

Alternative Fuels for Road Vehicles

Two Control Orders

THE Government has decided that in future no vehicle, whatever the fuel used, shall be allowed to operate for purposes which would not justify an issue of motor spirit or diesel oil.

Since the outbreak of war the Government has rationed motor spirit, diesel oil, and certain home-produced "liquid" motor fuels such as creosote. Vehicles operating on other fuels, e.g., producer-gas, coal gas, steam, electricity, butane and propane, have been allowed to have free access to whatever amounts of fuel have been available.

In view of the need for conserving not only fuel, but vehicles, tyres and manpower, it has now become necessary to control the consumption by motor vehicles of fuel of every kind. The control will be effected by two Orders under the Defence Regulations. The first, which came into force on September 1st, prohibits the running of vehicles on fuels other than motor spirit or diesel oil except under a licence. Licences will be obtainable from the Regional Transport Commissioners of the Ministry of War Transport, and will be issued on condition that (1) the vehicle in question is engaged upon essential work for which road transport is necessary (i.e., work which would qualify for motor spirit or diesel oil), and (2) the fuel is available. In the case of vehicles already operated on fuels other than motor spirit or diesel oil, applications for licences should be made as soon as possible to the appropriate Commissioner, specifying the number of vehicles involved (with their index marks and registration numbers), types, e.g., private car, lorry, public service vehicle, etc., and the nature of the work on which the vehicles are engaged.

Owners of vehicles who intend to convert to alternative fuel operation should first obtain the necessary licence from the Regional Transport Commissioner. The second Order, which will bring an "alternative fuel" rationing scheme into operation, will be issued in due course.

It must be appreciated that all alternative fuels are, generally speaking, in short supply, and that further conversions will not be possible in the case of several. Propane and butane are in such great demand for essential industry and for domestic purposes in rural areas that no licences will be issued, even to existing users.

Lower than Life!

Bacteriophage and the Problems which it Sets Us

SOME years ago, an English medical man named Twort made a rather startling and unexpected discovery. He was engaged in the experimental culture of colonies of bacteria. On making a routine examination of some of these colonies he was amazed to find that a number of them had completely disappeared overnight. The culture media in which the bacterial colonies had been growing had not been moved, disturbed or interfered with in any way. Indeed, the entire experimental equipment had been

High-power microscopical examination in an industrial laboratory.

maintained under conditions of rigorous scientific control. Nevertheless, the growing bacteria had suddenly vanished. They had completely disappeared from the sphere of operations, leaving no trace whatever of their former presence.

Twort was very much perplexed by this occurrence. He was at first inclined to put the whole thing down to some experimental error or oversight on his part, but when, subsequently, other bacterial colonies likewise disappeared it became clear to this observer and experimenter that he was confronted with no experimental error, but rather with an entirely new phenomena of the world of microbes.

Following up the few meagre clues which he could find, Twort was able to witness some of his bacteria in the act of disappearing. They seemed to dissolve themselves away in their culture medium. He took bacteria from the "disappearing" cultures and injected them into healthy colonies of bacteria which were flourishing normally. Within a few hours the inoculated cultures of bacteria themselves began to disappear and when these infected cultures were transplanted again into healthy cultures the disappearing act on the part of the bacteria proceeded with great rapidity.

Twort's idea was that he had hit upon a sort of parasite of the bacterial world which itself fed upon the bacteria and thus caused their disappearance. But, unfortunately, this experimenter could find no trace of the suspected parasites. The supposed bacteria-eaters refused to reveal themselves under the microscope and, moreover, they proved capable of passing through the very finest of germ filters which it was possible to devise.

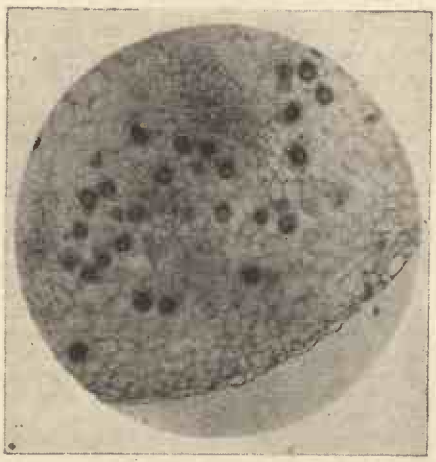
d'Herrelle's Experiment

The next experimenter was d'Herrelle, a bacteriologist. He repeated Twort's experiments, verified them, and added a number of his own. It is, indeed, to d'Herrelle that most of the honour of this fundamental discovery has gone, although, in justice, the Englishman, Twort, was clearly the pioneer of this strange and fascinating branch of bacteriological study.

d'Herrelle experimented with colonies of the dysentery bacillus. He found an ultra-microscopic agent, similar to Twort's, which was able to annihilate dysentery bacteria within the space of a few hours. He made "concentrates" of his unknown anti-dysentery agent and injected them into patients suffering from this disease. They all made speedy and excellent recoveries.

It was d'Herrelle who first coined the name "bacteriophage," signifying a "bacteria-eater," for this strange agent which so successfully removed germs from their sphere of operation.

The almost unlimited promise of d'Herrelle's results with his bacteriophages, however, was not maintained. Many bacteriologists, if they believed in the existence of the bacteriophage at all (and many of them refused to credit the discovery), found that the practical results given by this supposed parasite of the bacteria world were anything but encouraging. sometimes the bacteriophage would act up to its name and effect the disappearance of germs in a most amazing manner. At other times it would, for no apparent reason, refuse to act at all in this manner. Furthermore, germ life, after prolonged exposure to the bacteriophage, seemed to develop a considerable degree of resistance to it in much the



Malignant cells attacking the clear green living cells of the cabbage leaf.

same way as a human being or an animal can acquire a high resistance to germ-borne disease infection.

Worst of all, however, was the discovery that although the bacteriophage would, under very carefully controlled conditions, effect the disappearance of specific bacteria in flasks, glasses and test tubes, it more often than not refused to do so when injected into the human or animal body. For this disappointing result the bacteriophage was not responsible, since it has been shown that in diseased conditions the body so strenuously fights and resists the infecting germs that it opposes the accompanying bacteriophages as well. Hence, when the diseased human or animal organism succeeds in destroying the invading bacteria it usually brings about fatal casualties in the ranks of any friendly bacteriophages which may also be present. At least, that is the explanation which is given for the almost universal failure of the bacteriophage to function in the animal body in the highly successful manner in which it can be made to act in experimental laboratory-grown cultures of bacteria.

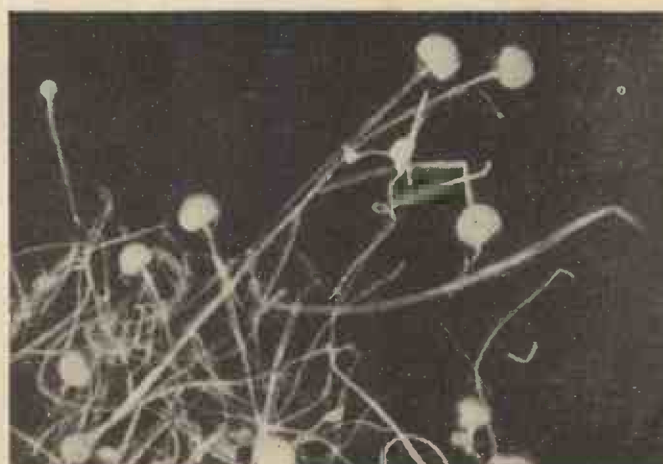
From a practical standpoint in the cure of diseases, therefore, the bacteriophage has been more or less a failure up to the present. But such a fact does not in any way take away from the enormous amount of scientific interest which is inherent in this remarkable parasite of the germ world.

What is Bacteriophage?

What is the precise nature of the bacteriophage? Such a necessary and fundamental question has never been answered completely. At first it was thought that the bacteriophage was a sort of ultra-microscopic germ which attacked normal-sized germs, killing them first, and then causing them to dissolve away in their surrounding medium. Other workers considered that the bacteriophage was not a living entity, but that it was essentially a chemical substance or enzyme which was somehow or other generated within the culture medium in which the bacteria were grown.

It was shown that the bacteriophage is an extremely potent agent and that, under laboratory conditions, one part of it in a hundred million of bacteria is capable of more than decimating the bacterial colony within a few hours. A few chemical workers concerned themselves with the isolation of the bacteriophage medium or agent in much the same way as they would start out to concentrate a newly suspected vitamin, but they never succeeded in their quest. If, indeed, the bacteriophage is merely a chemical substance, it must unquestionably constitute a virulent germ poison of almost incredible potency.

The bacteriophage is filtrable. It will pass through the finest of germ filters. For this reason, mainly, its true nature is still un-



An enormously magnified picture of common mould growing on bread. Note the bulbous seed-heads.

determined. Workers with the ultramicroscope now claim, however, not to have isolated the bacteriophage, but definitely to have seen it (or its shadow) as a result of observations made by ultra-violet light. The bacteriophage is claimed to have been actually photographed and to have revealed itself as existing in particle form, that is to say as discrete units, and not as a continuous material such as syrup or treacle.

The bacteriophage particles are ultra-microscopic in diameter. They range in size from 2 to 90 millimicrons, one millimicron

A good example of the bacteria present in contaminated water. These germs are extremely minute, but they are giants compared with the size of the bacteriophage particles.

being one billionth of a metre. Possibly, after the cessation of the present hostilities, the improved technique of the recently-made-practical electron microscope will be employed in the further investigation of this strange entity, the mysterious bacteriophage, and with more definite results.

The most perplexing problem of the bacteriophage is whether it is alive or whether it is merely a chemical substance. So far as we can ascertain at the present time, the bacteriophage seems more non-living than living.

The arguments against its being a definitely living entity are these: the bacteriophage seems to be quite free from protein matter, which is, in Nature's economy, indispensable for the production and maintenance of life, even of the lowliest character. The bacteriophage cannot reproduce itself. It will not grow and multiply in any known medium. It is highly resistant to heat and to the action of certain bacteria-destroying chemicals, such as chloroform and acetone. If it is not actually alive, it functions in many respects as if it were living. For this reason there have not been wanting experimenters who have suggested that in the bacteriophage we are actually confronted with a medium or an agent which forms a definite bridge between the lowest of living organisms and the most elaborate of definitely non-living chemical substances. The bacteriophage is, as it were, lower than life, but higher in Nature's scale than a mere inert chemical.

Non-living Matter!

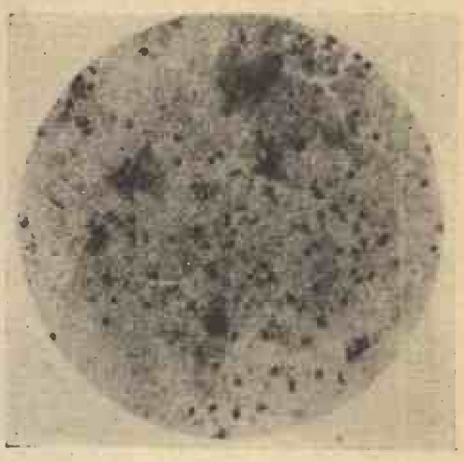
Maybe, such a viewpoint is the true one. It certainly meets many of the facts of the case. Very possibly, the bacteriophage is essentially an "activated" form of non-living matter which, in the presence of some specific lowly living organisms, such as certain strains of bacteria, is enabled by some complex automatic chemical mechanism yet unknown and, perhaps, little suspected by us, to function as a bacteria-killer.

If the bacteriophage turns out to be a little lower than life, yet a little higher than mere gross matter, then we are once again faced with the old theory of spontaneous generation, because, in such an instance, we have an "activated" form of material spontaneously arising from a purely inanimate substance, to wit, the nutrient bacterial culture-medium.

If we are able to discover the precise chemical nature of the bacteriophage, will we ever be able to synthesise it? And if we are thus able to create this agent artificially in our laboratories, will such a material be "activated" in the same manner in which it is when it arises seemingly spontaneously in our bacterial culture-media?

Such problems are truly engrossing ones, since they take us to the very fundamentals of organic life as we know it.

There are individuals who place great faith in the results which will accrue from the



Germs of tuberculosis magnified 1,000 times. If the bacteriophage can be made to act as a consistent killer of the germs, the conquest of "T.B." will be certain.

further electron-microscopic investigation of the sub-bacterial world, for they see in the knowledge so attained an almost certain key to the present-day many problems of human infections and diseases, including that major pathological ailment and malignant condition —cancer. Whether such hopes will be justified is more than one can prophesy.

Notes and News

Navigators' Workshop—and Club

THE idea of a workshop and club for navigators has been taken up by a northern station of Bomber Command. A one-storey wooden building has been divided into three small rooms and a large one, with two astro-domes in the roof. Here the navigators can gather to discuss their problems, plan their flights, and practise with their various intricate instruments. Here also they can relax during their spare moments, and can talk "shop" to their heart's content.

When all the crews have been briefed for the night's operation, the squadron's navigators assemble for the more detailed briefing by the station navigation officer. The largest room in the hut has been furnished with tables and forms; a blackboard stands at one end, and maps and photographs cover the walls.

Routes to avoid the searchlight belts and the concentrations of anti-aircraft guns are plotted. On a large map of Germany the navigation officer shows the positions of dummy fires which might puzzle an inexperienced hand. Officers, warrant officers and sergeants sit side by side working out their courses, marking their tracks on charts, jotting down estimated times of arrival over certain points. Tracks, times and distances are read out and are checked so that any miscalculation can be corrected.

Formerly such work, between briefing and take-off, was done individually, by the officers in their own rooms or by the sergeants in their crew rooms. Now in their new "workshop" the navigators can work in ideal surroundings, under expert guidance. A navigator, too, is always learning; his practice on the instruments provided is continuous. Here in his own club he can use the sextant, protractors and computors, and all the other constantly improving equipment.

During the day navigators mount the platform under the astro-domes and "shoot" the sun; at night they "shoot" the stars, and descending into a narrow room below—comparable with their cabins in the four-engined bombers—they work out the positions. They also memorise the positions of the stars—those beacons with which no enemy action can interfere and which are the most dependable guides for navigators.

New Marking for U.S. Fighters

AMERICAN fighter 'planes have recently been taking part, with the R.A.F., in sweeps over the Continent, the American machines bearing their national marking, a white star on a blue ground, as shown in the accompanying diagram.

Floating Glass

GLASS of cellular construction that floats like cork and can be used in lifeboats and pontoon bridges is being made at Pittsburgh, U.S.

Dry Ice

IT is stated that dry ice (solid carbon dioxide) is likely to eliminate the noise of rifle fire. When used in a .22-calibre rifle it needs no propellent charge, and makes only a slight plop when fired.

Silk Insulation for Wire

IT is reported that silk spun by Japanese silkworms is helping to conserve Australia's rubber stocks by insulating copper wire used in radio sets.

Wooden Ships for U.S.

ACCORDING to a recent report, wooden ships are the latest additions to the U.S. Navy. Eighteen minesweepers with twin diesel engines are being built of oak at Cleveland, Ohio, at the rate of one every two weeks.

"A Photographic Range-Finder"—Note!

IN reply to several readers, the distance between the ⅛in. hole and the end of the case is ⅜in. in the range-finder described in the August issue.

THE MONTH IN THE WORLD OF

Science and Invention

A model of a new tank which has no vulnerable parts. It has one gun that fires in all directions. The model was exhibited recently at the Inventors' Exposition in New York.

An Unsinkable Craft

A BIRMINGHAM man is at present experimenting with a light, unsinkable craft which may prove the means of saving the lives of air crews brought down in the sea. This remarkable craft utilises sealing principles first adopted by the ancient Egyptians to preserve their rolls of papyrus.

Plywood is used for the construction of the boats, which, the inventor claims, are not only unsinkable but unbreakable, and capable of withstanding the heaviest seas. It is stated that buoyancy is maintained by six water-tight compartments, and the boats can carry two or more built-in fresh-water tanks and sufficient concentrated food for 10 men for seven days.

They are equipped with automatically lighted flares, electric torches, convex mirrors for flash signalling and two light tubular steel masts crowned with reflecting spheres which, by flashing back the rays of the sun or a searchlight, would draw the attention of any passing ship or aircraft within seven to ten miles of the "ship-wrecked" crew. The boats can be made in any size, small enough to be carried by aircraft, and large enough to be classed as lifeboats for large ships. They are flat-bottomed, but no matter in which position they reach the water, the "well" for the shipwrecked seamen automatically adjusts itself to give them a good chance of reaching safety.

Powdered Meat

AMERICA will soon be sending dehydrated meat to this country. Before eating it will have to be soaked in water for an hour, boiled for 10 minutes, and left to simmer for 10 to 20 minutes. It will arrive in dry powdery form, in cans. It has taken three months to perfect the dehydration process, driving off 90 per cent. of the moisture and vacuum-canning with a 70 per cent. reduction in weight and 65 per cent. saving in vital shipping space.

New American Engine

THE U.S. Navy Department announce the mass production of "one of the best engines any submarine chaser ever had." Believed to be the lightest engine for ocean duty yet made, it takes up a third of the space of the most successful diesel engine.

Distilling Sea Water

SCIENTISTS are now trying to produce an apparatus for distilling sea water suitable for use in a lifeboat, according to a written reply by Mr. Noel Baker, Parliamentary Secretary to the War Transport Ministry.

"Photomicrographic Record"

IN order to preserve centuries-old manuscripts and historic documents against war damage, a London photographer is working in the Public Record Office, London, snapping 10 documents a minute. His electric camera, working in the glare of four powerful lights, holds 1,500ft. of film. Each tiny exposure picks up perfectly the slightest mark on the original document, and the print can be enlarged to a considerable size. This "microphotographic record" of history will eventually be sent to America for safe keeping by the Congress Library.

Miniature Radiography

BY miniature radiography, referred to by the Health Minister recently, 200 people can be X-rayed in an hour at a cost of 2d. each. Instead of the X-ray casting the life-size shadow of the lungs on a film, the image is formed on a fluorescent screen which glows where the rays strike it. This screen is photographed on miniature film, which is examined through an enlarger. The patient stands on a platform like that of a weighing machine, rests his chest against a panel and holds his breath for a moment while the operator presses a button.

Tunnel Under the Sea

A TUNNEL under the sea which it is claimed will be the first in the world, has been started between Shimonoseki, in the main island of Japan, and Moji, in the island of Kiushiu. The tunnel will be nearly two miles long.

A New "Tommy" Gun

BRITAIN'S new "tommy" gun, which is now in production, is known as the Sten Machine Carbine. It is all metal, the butt being merely a metal rod with a flat strip at the end to fit the shoulder. It can fire at the rate of about 600 rounds a minute, or can be used for single shot firing. The effective range is about 200 yards, and fired over the sights it is extremely accurate. It takes down into three pieces which can be carried in the pockets of a battle dress and fires 9 mm. rimless ammunition, which means that it can use German and Italian ammunition.

Flying Lorries and Trains

"FLYING trains, buses, and even lorries may yet be common, and with the numerous aerodromes which the belligerent countries now possess, there is little to hinder their general use." This glimpse into a flying future was given by Mr. W. A. McCartney, Edinburgh City Engineer and Master of Works, in his presidential address to the annual conference of the Institution of Municipal and County Engineers in Edinburgh recently. Mr. McCartney said that the war-time growth in the size and capacity of aeroplanes suggested that aerial travel was about to become a competitor to the motor-car, train and steamship.

New U.S. Engine

THE U.S. Navy has disclosed the development of a new liquid-cooled engine approaching 2,000 h.p. If the Navy's

A scene in a war-time glass factory. An electrically-driven stirrer in action in a pot of molten optical glass inside the furnace.

This all-American machine is being used by the farmers for clearing reeds from Fen Districts in readiness for cultivation.

development policy is followed, a new series of naval fighter craft, faster and more powerful than any now on first line duty, is in the making.

Germans "Secret" Discovery

THE Germans, in addition to boasting of their more-protective armour for battleships, are now stating that one of their scientists has made a secret discovery which makes their ships more unsinkable. This scientist is said to have produced a material six times as buoyant as cork, which is packed into watertight compartments of heavy ships.

Large Office Building

IN Washington is being constructed what is probably the largest office building in the world. It is being built for the United States War Department. So far only two wings have been finished, but already there is accommodation for 7,000 workers. When the whole building is complete, 30,000 men and women will work there every day. The new building will have no lifts.

New Surgical Instruments

ARMY surgeons in the Middle East are using new types of surgical instruments which "floodlight" the interior of the body.

Made of a transparent plastic material which transmits light round corners, does not conduct heat and is virtually unbreakable, the instruments are made in about 30 different shapes, to suit any kind of operation.

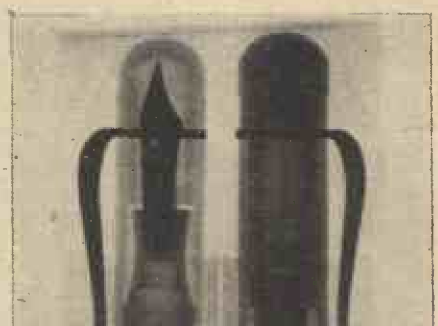
Similar instruments have been made in other countries for some years past, but they had the disadvantage of losing their shape in sterilising. The new instruments, however, are made of a methyl-methacrylate plastic specially developed by British chemists, which will stand any amount of boiling without losing shape.

Paint made from Slate

CAMOUFLAGE paint is now being made from the millions of tons of waste from slate quarries of Cornwall and Wales. In making tiles or slates, time is more costly than the raw material. If a piece of slate rock does not split easily into the shape required it is thrown aside. Slate with a pinkish tint is usually rejected. Ground into a coarse powder, slate goes to the making of camouflage paint. In finer form it is a useful filler in paint used as an undercoat for metallic surfaces. It also appears as a cheap distemper and in roofing felt to take the place of tiles for war factories.

Celestite Flares

IN Gloucestershire is found a mineral called celestite, containing strontium salts which furnish material for tracer bullets and signal flares for shipwrecked seamen. The salts give the flares a vivid red colour which can be seen for a greater distance than any other. The celestite deposits in this corner of England are by far the most important in the world, and in peace-time are almost the only ones worked commercially. Apart from flares for ships, aerodromes, and ordinary fireworks, strontium compounds are used to crystallise sugar from beet, for fillers in electric batteries, and in the chemical, pharmaceutical and ceramic industries.



An X-ray photograph of an explosive pen and pencil set found among the belongings of the eight alleged Nazi saboteurs on trial before a military commission in Washington, D.C. These are clever incendiary gadgets which when operated give off an intense sheet of blue-white flame that can ignite almost anything it touches. This X-ray picture was made in the F.B.I. laboratory.

The Bailey Invasion Bridge

MR. DONALD COLEMAN BAILEY, A.M.I.C.E., who is a draughtsman in the Army's experimental bridging establishment, has designed a new type of bridge which according to experts is "the R.E.s dream"—superior to anything the Germans have.

The "Bailey Bridge," as it is called, is something altogether new in simplicity of construction and great carrying load. It is quickly erected, with the advantage that it is put up on land and pushed over whatever river or chasm is to be crossed.

Fire Cubes

THE R.A.F. are reported to be dropping a new form of fire-raiser to destroy German military depots along the Belgian coast. They consist of cubes of phosphorus, reddish-yellow in colour.

New Quick-freezing Process

ARGENTINA'S meat packers are busy on a new quick-freezing process which will result in a big saving in ship cargo space. The scheme involves the removal of bones from meat, compression and quick-freezing. A ton of quarters prepared in this way occupies 50 cu. ft. of cargo space, compared with 106 cu. ft. per ton for chilled meat, and 80 cu. ft. for frozen boned meat.

Recording Starlight

MORE sky can be seen with the new McDonald Observatory 82-in. telescope at Fort Davis, Texas, than with any other American telescope. This is because McDonald Observatory is farther south than any other observatory in the U.S.

It can be sighted upon thousands of stars that never come within the range of more northern telescopes. The whole sky, except for a 30-degree radius circle round the South Pole, will be covered by the giant telescope.

The McDonald telescope records starlight a million times too faint for the human eye to perceive.

Crumb Structure of Cakes

A NEW camera has been devised which judges bread and cake by taking pictures of the inside cell and crumb structure.

Noiseless Movie-camera

FOR the first time since sound motion pictures came into use more than ten years ago, the motion-picture industry has a noiseless camera which can be used inside a sound studio without any sound-proofing box, or "blimp" as it is known in the industry.

The new silent camera, weighing 60lb., was described to the Society of Motion Picture Engineers by G. Lambe, of the Twentieth Century Fox Film Corporation. The monitor view-finder truly conforms to the image being photographed on the film so that the cameraman no longer has to make allowances for parallex. The camera turret mounts four lenses which are quickly changed, while the entire camera is sealed from the action of sand, dirt or water.

Battery-electric Bicycles

Their Construction and Operation

By P. G. BOYD, B.Sc.

The electrically driven bicycle, the construction of which was given in our June, 1942, issue.

A BRIEF description of the writer's battery-electric pedal cycle was given in the June issue of PRACTICAL MECHANICS. It is hoped that these further notes will be of use to others who are at present experimenting with these interesting and useful machines.

On the question of taxation, etc., the writer can only refer to his own particular case in Ireland. He has a motor driving licence and third party insurance (cost, 15s. per annum), but has neither registration plates nor road tax disc. There appears to be no exact provision for taxing, as the machine is a motor-assisted pedal cycle, and is strictly experimental. So far, the authorities have neither asked nor been asked any questions.

General Layout

A strong bicycle with tyres about 2in. is recommended, but all unnecessary dead weight should be avoided, so as to allow for the weight of the battery. A low riding position to reduce windage and increase stability is desirable. The disposition of the battery and the motor should be such that when the rider is seated the total weight, which is considerable, is divided fairly evenly between the two wheels. If front wheel drive is decided on (which gives anti-skid drive, the weight not interfering with the steering as much as one would imagine), the supports for holding the motor should be arranged to strengthen the front forks as they might otherwise be too weak to carry the extra load of the battery and motor.

The battery should be located so that it is as low as possible, and also so that spilled electrolyte does not damage either one's clothes or the cycle parts. It should also be spring mounted to reduce shocks, and be accessible for topping-up.

Two good brakes are essential, because of the greater speed and weight.

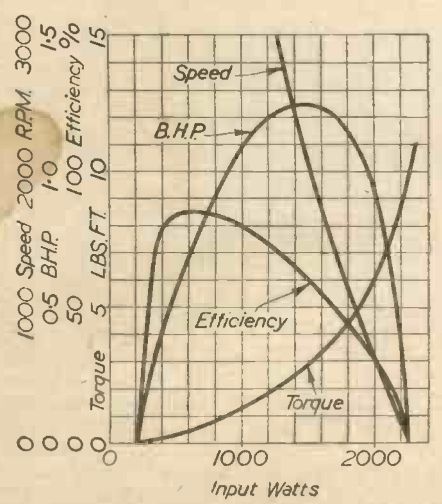


Fig. 1.—Characteristics of a good 12-volt starter motor when fed from a 12-volt starter battery. The battery volts fell to 5.8 on full input.

Choice of Motors—Starter Motor

The motor should be of the series field type. Generally, old motor-car starter motors are the only such types available, but unfortunately these are very inefficient at small loads; they also have unsuitable bearings and are inadequately cooled for longer journeys than about two miles. Their speeds are also very high, necessitating a greater gear reduction than 5 to 1, which is difficult to provide unless something more complicated than a single chain drive can be arranged. The characteristics of a typical good starter motor are shown in the graph, Fig. 1. It is evident from the curves that this machine is designed not for electrical efficiency at small loads, but for maximum torque at low speeds, that is, for engine starting. This is a 12-volt motor weighing 15lb. Its no load speed is about 10,000 r.p.m.—too high to test safely—and its speed at maximum h.p. is around 2,000 r.p.m. It will be seen that while its maximum efficiency rises to about 85 per cent. at 0.7 h.p., its efficiency at 0.2 h.p. is only about 30 per cent., and its speed here is about 8,000 r.p.m. This latter h.p. is the one which is the more important, for the electric bicycle. If no other type of motor is available, it is not impossible to alter a good starter motor, both mechanically and electrically, so as to make it reasonably suitable. To use a 12-volt motor, and a 6-volt or 8-volt battery in order to reduce the speed is, however, very inefficient.

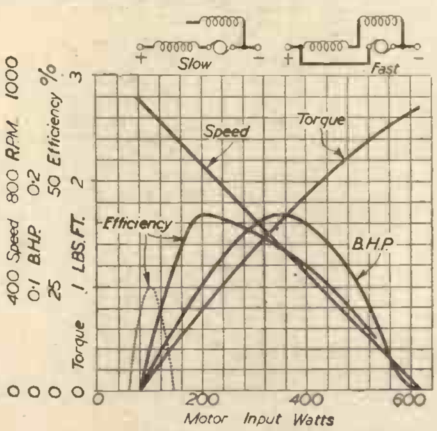


Fig. 2.—Outboard motor characteristics. The full line curves are for 12-volt battery and "fast" circuit. The dotted curve is for both 12-volt "slow" and 6-volt "fast."

Outboard Motor

Fig. 2 shows the characteristics of a battery-driven motor intended for use in a small outboard boat. This motor weighed 10lb., and could be used with either a 6- or 12-volt battery. Until it was brake-tested it was thought that this motor would be very suitable, but, as the curves show, although its h.p. and speed are suitable, its efficiency and its stalled torque are very low, even on 12 volts (on 6 volts its maximum efficiency is only 25 per cent., as shown by the dotted curve). This motor had two speeds, as shown in the circuit diagrams at the top of Fig. 2. Unfortunately, in the "fast" and maximum power switch position it was a shunt motor. It might have been possible suitably to alter this motor, but air in place of water-cooling might have been difficult to arrange.

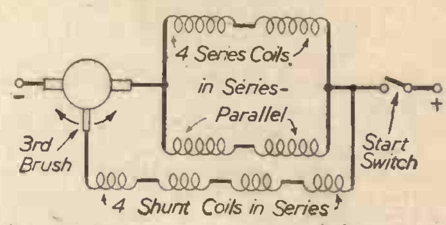


Fig. 3.—Dynamotor connections before alteration.

Dynamotor

The next motor which was tried was a dynamotor, that is, a generator and motor in one unit. It was taken from an old 12 h.p. Morris car of about 1925 vintage. On preliminary trial on the bicycle it was found to give a level road speed of about 30 m.p.h. with a 26in. wheel and 4 to 1 gear reduction. It would climb almost any hill, but this was rather severe on the battery. This motor was obviously too powerful, because, without ventilation, it showed no signs of heating, even on long runs. Its weight was 33lb.

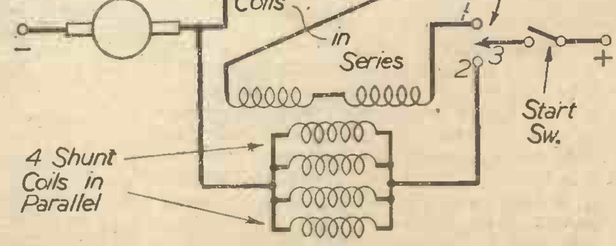


Fig. 4.—Dynamotor connections after final alterations. Contact 3 makes to either 1 or 2 separately, or to 1 and 2 together, thus giving three speeds.

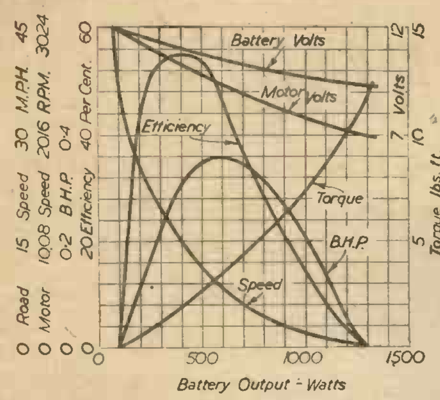


Fig. 5.—Characteristics of 12-volt 33-lb. dynamotor after alteration. The top two curves show the large drop in voltage as the output increases.

Figs. 3 and 4 show the dynamotor's connections before and after alteration, respectively. The alterations aimed at reducing the speed and the power, and increasing the efficiency at small loads. The first alteration was to remove the third brush (it is not required for motoring, and is a source of inefficiency) and connect the shunt field straight across the 12-volt supply. This resulted in the shunt field watts going up to about 120 watts, which was very excessive. Although this had the effect of reducing the speed, a more economical method of doing the same thing had to be evolved. It was found on examination of the four series field coils that they were connected in series-parallel, as shown in Fig. 3. By reconnecting them in series, which was very easily done, the series field ampere-turns for a given motor current were doubled, and the speed was correspondingly reduced. This alteration had the disadvantage of increasing the resistance of the series field from 0.006 to 0.024 ohms, but it had the advantage of reducing the starting current and starting torque. The extra watts loss due to the increased series field resistance is not of much significance for a normal current of around 30 amps., but, in any case, this was reduced later by an alteration to the shunt field coils.

The speed was still further reduced and the efficiency increased by reducing the air gaps between the armature and the four pole pieces to a minimum. To do this thin iron packing pieces were inserted between the pole pieces and the frame.

Shunt Field Alterations

The excessive shunt field watts were reduced from 120 to about 60 by inserting a resistance in the shunt field connection. A switch was added in the shunt field circuit to enable it to be either switched in or out. This gave two apparently convenient speeds of 17 and 20 m.p.h., but in practice the 20 m.p.h. speed (shunt field switch open) was nearly always used. This meant that the shunt field windings were not being fully utilised. The final alteration to the shunt field was to change the connections of the four coils from the series connections shown in Fig. 3 to the parallel connections shown in Fig. 4, and then to connect these four paralleled coils in parallel with the series field coils as also shown in Fig. 4. This had many advantages, in addition to giving three speeds as follows:

(a) 20 m.p.h. when 3 is connected to 1,
(b) 12 m.p.h. when 3 is connected to 2,
(c) 18 m.p.h. when 3 is connected to 1 and 2;

(a) is used when there is a following wind, (b) when accompanying a pedal cycle, and (c), which is the most efficient, nearly always.

Fig. 5 shows the characteristics of this dynamotor as finally altered. Some readers will be interested to know that all the data from which the curves in Fig. 5 were calculated was obtained on a road test, and not a bench test. The only meters used were an ammeter, voltmeter and speedometer, and also a spring balance to measure the stalled torque. The only inaccuracy is the assumption that the motor's losses under the headings iron, friction and windage are constant between no load and full load, and the writer believes that this is a reasonable assumption to make for this particular motor.

Overall Efficiency

It should be noted, if comparing Fig. 5 with Figs. 1 and 2, that in Fig. 5 the overall efficiency, h.p., torque and speed for the motor, and all the leads to it from the battery are shown. In other words, the voltmeter in Fig. 5 was connected across the battery, whereas in Figs. 1 and 2 the voltmeter was connected across the motors. The road tests for Fig. 5 had the advantage of disclosing the fact that although the leads to the motor did not show signs of heating, the watts loss in the leads were very high. This point is evident from the two voltage curves in Fig. 5.

Fig. 6 shows the diagram of connections of all the equipment on the writer's bicycle at present.

Small Dynamotor

The dynamotor described above has covered over 600 miles and has given absolutely no trouble. The journeys were mostly six miles non-stop and it never showed signs of overheating. Its only disadvantages are its heavy weight of 33lb. and its still low efficiency at small loads. Recently a smaller dynamotor, which is believed to have been fitted to a 9 h.p. Humber car of around 1926 make, has been

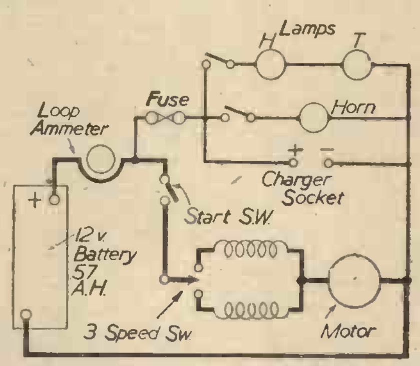


Fig. 6.—The complete circuit diagram. The starter switch, charger socket ammeter, lamp and horn switches are arranged from left to right on a handlebar panel.

obtained. This dynamotor weighs 23lb. but it is hoped to lighten it considerably. This machine has been preliminary bench tested and it is hoped that it will be more suitable than its bigger brother. It may be necessary, however, to rewind the armature and/or field coils.

Motor Overhauls and Alterations

Whatever type of motor is used it is essential that it should be in good condition, both electrically and mechanically. To clean out old oil and carbon and copper dust it is generally necessary to dismantle the machine completely. When dismantled all parts should be carefully examined and tested where possible. Bearings should be checked to see that they are very free, but if they are worn they should be renewed. It is generally necessary to turn down the commutator and, if possible, this should be done in its own bearings rather than in a lathe. The commutator micas should be carefully undercut. If necessary new brusher should be obtained and properly bedded in with sandpaper. Generally, and in particulas if the bushes are worn, the spring pressure on the brushes should be slightly increased to reduce the voltage drop on the commutator. The brushes should be free, but not loose, in their holders, and there should be positively no movement in the brushes up and down as the armature rotates. Good commutation is essential and if sparking persists, experiments with different grades of carbon brushes, or with copper-carbon brushes, and also different brush positions should be tried. To check that there is little sparking, remove the commutator cover and test the machine in the dark, both on the level road and up hill.

Unless the motor's no load watts losses (mostly iron, friction and windage) are less than about 100 watts, and the load losses (copper, iron, friction and windage) at an input of about 300 watts are less than 150 watts, the motor should be repaired or a more efficient motor obtained. With a reasonably suitable motor it is well worth while spending considerable time improving its cooling, reducing its weight, and making it more suitable and more efficient generally.

Battery

The motor and the charging plant available will determine the voltage of the battery to be used. The speed required, and the distance to be covered between charges will determine the capacity or size of the battery. If choices are to be made, it may be stated that, for equal weights, a 12-volt motor is much more efficient than a 6-volt one, but, on the other hand, a 6-volt battery will store slightly more watt-hours of electricity than a 12-volt one of the same size and weight.

Standard motor-car starter batteries of the lead-acid type, although not intended for full charge and discharge cycles of operation, are reasonably suitable for the electric bicycle provided they are carefully maintained. A typical 3-cell 6-volt battery of this type with a capacity of 100 amp.-hours at the 20 hour rate of discharge weighs 48lb. and occupies 0.4 cu. ft. The reduced output obtained from this battery (or other similar but different capacity batteries on a per cent. basis) is indicated in Fig. 7. It will be seen that it will give 22 amp. hours if discharged in ½ hour, 55 amp. hours if discharged in 1 hour, 65 amp. hours if discharged in 2 hours, etc.

As in the case of all battery driven vehicles, the battery chosen should, for maximum efficiency, be no larger than is necessary. This applies particularly in the case of the bicycle where one may always pedal home if the battery becomes discharged on the road. It would be inefficient to carry a separate reserve battery in any circumstances.

Perfect battery maintenance is essential when dealing with equipment of this nature, otherwise the life and efficiency of the cells will seriously be affected.

(*To be continued.*)

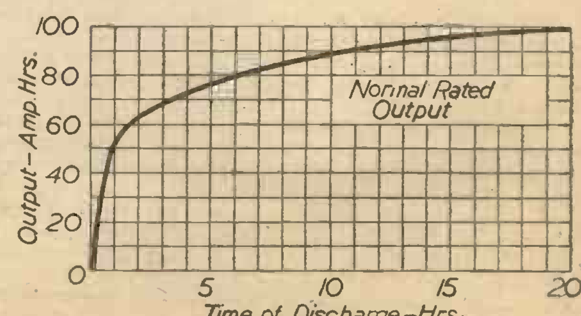


Fig. 7.—Reduced output obtained from 100 amp.-hr. car starter battery, of lead-acid type, when rapidly discharged.

Flying at High Altitudes

Notes on the Temperature Variations in the Stratosphere, and How They Affect Aircraft Design

By T. E. G. BOWDEN

A Mustang fighter 'plane in flight high above the clouds.

THE variation in the properties of the atmosphere at different altitudes is of extreme importance when dealing with the calculation of aircraft performances and aircraft design.

The atmosphere is made up of a homogeneous mixture of dry air and water vapour, the quantity of which varies considerably. It may be divided up into the following layers—the Troposphere and the Stratosphere. The name given to the boundary between these two layers is the Tropopause (see Fig. 1).

The Troposphere is the layer next to the earth's surface in which the variation of temperature is great, and the maximum height of which varies from approximately 35,000 ft. over England to 50,000 ft. at the equator. The temperature drops from 15 deg. C. at 0 ft. (sea-level) to −56.5 deg. C. at 40,000 ft., as shown in Fig. 2, and above this height remains practically constant. Both the density and

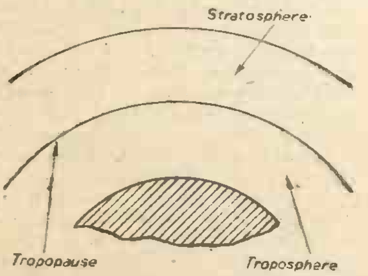


Fig. 1.—Diagram indicating the Tropopause boundary.

the pressure fall with increase in altitude. At sea-level the relative density and pressure are 1.00, but at 40,000 ft. the relative density has fallen to 0.244, and the relative pressure to 0.184, as in Fig. 2. Thus from the foregoing it will be understood that in the stratosphere the temperature does not vary greatly, but the density and pressure are still getting less and less.

Reduced Density

Due to the decrease in density the drag of an aircraft is decreased, but at the same time the horse-power developed by the engine (unless it is supercharged) also decreases. The drag reduction is explained by the following formula: $D = C_D \rho S V^2$, where D is the drag in pounds, C_D equals the drag coefficient, ρ (the Greek letter rho) is the density of the air measured in slugs per cubic foot, S equals the wing area in square feet and V equals the velocity in feet per second. It will be seen that if V is kept constant and ρ falls in value D must also be reduced. Unfortunately this decrease is countered by the fact that the required speed to enable the wing to lift the aircraft is increased with height, e.g., L (lift) = W (weight) = $C_L \rho S V^2$, i.e. if ρ falls from .00238 at sea-level to .00119 at 28,000 ft. the speed to lift a fixed weight increases from V to

$$\sqrt{\frac{V^2 \times .00238}{.00119}} = V\sqrt{2} = \frac{V}{\sqrt{\sigma}}$$

where σ equals the relative density.

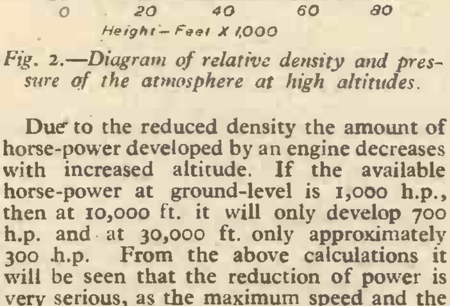


Fig. 2.—Diagram of relative density and pressure of the atmosphere at high altitudes.

Due to the reduced density the amount of horse-power developed by an engine decreases with increased altitude. If the available horse-power at ground-level is 1,000 h.p., then at 10,000 ft. it will only develop 700 h.p. and at 30,000 ft. only approximately 300 h.p. From the above calculations it will be seen that the reduction of power is very serious, as the maximum speed and the rate of climb will decrease. The efficiency of the magneto is also affected at high altitudes owing to the reduced density, as the current produced, instead of passing to the sparking plug electrodes, tends to discharge itself inside the magneto through paths of lower resistance.

Supercharging

To overcome this difficulty a device known as a supercharger is fitted to many modern engines which are used by aircraft requiring good performances at high altitudes. The object of a supercharger is to increase the amount of air admitted to the cylinders to counteract the reduced density. By this means the available horse-power does not fall with increase in height until a certain altitude, depending upon the type of supercharger, is reached. The horse-power may even increase with gain in altitude. In order to maintain the available horse-power for as long as possible a two-speed supercharger has been developed.

The rate of climb depends upon the excess horse-power available, i.e., the available horse-power minus the required horse-power. The formula giving the rate of climb is as follows:

$$\text{Rate of climb} = \frac{\text{Excess horse-power} \times 33{,}000}{\text{W (the weight of the aircraft)}} \text{ ft./min.}$$

Thus at a high altitude, as the available horse-power is diminishing, the rate of climb is also falling. The point at which the excess horse-power is nothing is therefore the ceiling, i.e., the maximum height to which the aircraft can climb (see Fig. 3). The Service Ceiling is a more practical height, being the

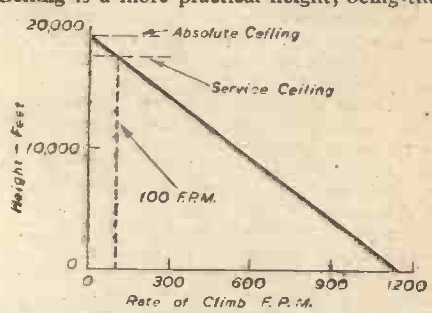


Fig. 3.—Indicating maximum ceiling in relation to rate of climb.

height at which the rate of climb falls to 100ft. per minute. If the curves for the required horse-power and the available horse-power are plotted (see Fig. 4) it will be seen that there can only be one forward velocity. From this it will be seen that to gain the absolute ceiling a definite speed is required.

Airtight Cabins

The reduction in density of the air as well as affecting the engine's efficiency entails the use of either oxygen-breathing apparatus for the aircraft's crew or an airtight cabin, the

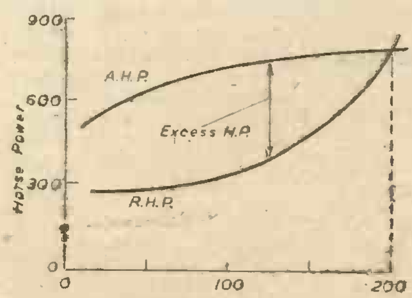


Fig. 4.—Horse power/speed curves.

pressure in which can be maintained at a reasonable figure. The structural difficulties which the second method causes are now being solved, and the oxygen-breathing apparatus will probably not be used in the future except for small aircraft in which the extra weight involved by making the fuselage airtight would reduce the performance. If no precautions are taken to safeguard the crew when the aircraft is flown at excessive altitudes their perceptions will be dulled due to lack of oxygen, and, finally, they will lose consciousness, resulting in loss of control of the aircraft.

The effect of low temperatures and an excessive amount of water vapour combine to form one of the greatest dangers, i.e., ice accretion. The result of ice forming on the wings and fuselage is to alter the profile of the wing, increase the drag and increase the weight. The lifting properties of the aerofoil will be reduced and thus, if no steps are taken to get out of the ice-forming region or to remove the deposit by spraying with de-icing compound, the aircraft will be forced to lose height. Pieces of ice are also liable to jam the control services or to be flung off the airscrew blades, causing damage to the surrounding structure. The windsereen will also be obscured and instrument orifices choked. Vibration due to uneven loading of the airscrew blades can easily start and may lead to fractures and consequent loss of one or more of the blades. For aircraft which are intended to fly in regions of low temperature, precautions must also be taken to prevent the controls seizing up due to the oil freezing in the bearings. A guard should be fitted to the carburettor air intake to prevent blockage with ice particles.

High Wind Speeds

In the stratosphere, owing to the fact that the quantity of water-vapour is very small clouds are practically non-existent and visibility is exceedingly good. This factor combined with the absence of bumps (vertical currents) makes the stratosphere an ideal region in which to fly. Wind speeds may be as high as 100 m.p.h., which properly utilised could be of great assistance.

From the above facts it will be seen that the design of an aircraft and its engines are considerably affected by the atmosphere, and its varying properties. A machine intended for use in low altitudes varies immensely from one designed to fly at high altitudes. In conclusion, the advantages of flight in the stratosphere, which reduces the drag and demands high speeds, outweigh the disadvantages, pointing to the fact that this region will be far busier in the near future.

Wheeling out a torpedo for loading on to a Swordfish aircraft of the Fleet Air Arm.

The World of Aviation

U.S. Torpedo Bomber : Armour-piercing Cannon : Aerial Aircraft Carriers : The Avro Lancaster : New Altitude Fighter

U.S. Torpedo Bomber

DETAILS have recently been released of the Grumman Avenger, the new U.S. torpedo bomber. The main feature of this machine is that it carries a 21in. torpedo, as compared with the smaller 18in. torpedo of our own torpedo-carriers. The torpedo is fitted in the belly of the Avenger, and long bomb doors, hydraulically-operated, swing open to release the torpedo. A ton of bombs can be carried instead of the torpedo. The aircraft is heavily armed, with a gun position beneath the rear of the fuselage, in addition to a rear turret on top of the fuselage. It has a top speed of 270 m.p.h. and a range of 1,400 miles at 215 m.p.h. The Avenger is powered by a 1,600 h.p. radial engine, the same h.p. as that of Germany's crack new fighter—the F.W. 190.

Armour-piercing Cannon

NOT only does Britain lead the world in aircraft development, but also in aircraft armament. The Hispano cannon-gun, now fittted to our fighters, fires a 9½ oz. shell capable of penetrating more than a ½in. armour plating. Originally a French invention, the Hispano cannon-gun, now being built in British factories, has been improved as the result of operational experience by fighter 'planes, and is now almost perfect. There are 220 parts to each gun.

Aerial Aircraft-carriers

NAVAL aviation experts in Washington have proposed the construction of aerial aircraft-carriers, each capable of carrying 10 to 12 dive-bombers, fighters and reconnaissance aeroplanes. Their sponsors claim that the carriers—which would be rigid airships—could be made largely of plastics, thus avoiding the use of the country's strategic metals. They would be " more manœuvrable, cheaper to build and much quicker " than sea-going aircraft-carriers, and could be armed against air attack.

The aeroplane would be lifted and propelled by a combination of engines, helium gas and air tunnels. It would have a flying deck between 180 and 200ft. long from which the fighters would take off. The carrier was described by engineers of the Aero-dynamics Research Corporation as designed to adopt the lighter-than-air principle without the bulk of lighter-than-air craft. Through it would run four tunnels, in which engines would create suction to give pulling power, while propellers would give thrusting power.

The Avro Lancaster

THE Avro Lancaster, which is really a four-engined version of the twin-engined Manchester, is reputed to be the fastest heavy bomber in the world. Although this machine has a loaded weight of many tons, it has a top speed of nearly 300 m.p.h. The Lancaster has a wing spread of 102ft., a fuselage of 69ft. and is 19ft. 7in. in height. It is powered by four Rolls-Royce engines, giving a total of well over 4,000 h.p., and carries a crew of 7 or 8. The engines drive de Havilland Hydromatic three blade full feathering airscrews, 13ft. in diameter. The machine has twin fins and rudders, and is fitted with gun-turrets in the front, top and rear of the fuselage.

New Altitude Fighter

GENERAL H. H. ARNOLD, Commanding-General of the U.S. Army Air Force, recently disclosed some details of America's new high altitude fighter, the P.47, known as the Thunderbolt, which, he claims, can outfly and outfight any known enemy machine. The most interesting feature of this machine is that it is the first fighter to be fitted with a turbo-supercharger—a " boost " device working off the exhaust instead of the engine. It has a 2,000 h.p. Pratt and Whitney radial engine, and is credited with a service ceiling in excess of 40,000ft. and a maximum speed of about 400 m.p.h. The Thunderbolt must be a big machine, for it has the exceptionally heavy all-up weight of about 13,000lb.

The Story of Chemical Discovery

No. 15.—The Rare Gases of the Atmosphere

THE Honourable Henry Cavendish (1731–1810) was a first-rate scientific experimenter. Despite his many curious eccentricities, he elucidated numerous chemical facts of prime importance, and he figures largely as one of the "fathers" of our present-day chemistry in view of the essentially basic nature of much of his experimental work.

One of Cavendish's memorable experiments was the one in which he showed that when electric sparks are passed through air a portion of the oxygen combines with a part of the nitrogen of the air, forming oxides of nitrogen which can be absorbed by means of a solution of caustic potash.

As far back as 1785 Henry Cavendish separated some nitrogen from air, and, working with this gas, he admixed successive quantities of pure oxygen with it, subsequently sparking the mixed gases in an enclosed tube standing open-end downwards in a basin of strong caustic potash solution. Cavendish's idea was to "use up" all the nitrogen by sparking it with successive portions of air, thereby converting the nitrogen bit by bit into its oxides which were absorbable by the caustic potash solution. But, curiously, no matter how long he sparked his gases there always remained in the sparking tube a tiny bubble of gas which persistently refused to become absorbed by the caustic potash solution.

"Unabsorbable Bubble of Gas"

In his accounts of these experiments Cavendish duly recorded the persistent and ineradicable presence of this tiny bubble of unabsorbable gas, which, he says, "was certainly not more than 1/120th of the bulk of the gas let up into the tube." Seemingly, even old Henry Cavendish himself, working away in his Clapham Common house towards the conclusion of the 18th century, had an inkling of the fact that this unabsorbable bubble of gas in his spark tube differed in some way from the nitrogen of the air, which, at that time, was termed "phlogisticated air." For he writes: "If there is any part of the phlogisticated air of our atmosphere which differs from the rest we may safely conclude that it is not more than 1/120th part of the whole."

There, for more than a hundred years, the matter rested. Cavendish had not the facilities necessary to carry out the further investigation of his unabsorbable bubble of gas. His written record of its presence became buried under vast accumulations of other scientific papers, so much so that until the year 1894 chemists believed that dry air, freed from carbon dioxide and other contaminating impurities, was purely a simple mixture of oxygen and nitrogen. Cavendish's bubble had long been forgotten. If any scientific researcher did, by chance, stumble across this observation of Henry Cavendish in the dusty recesses of old libraries he would almost instinctively disregard it, putting it down to Cavendish's unavoidable experimental error. In the year last mentioned, therefore, scientists considered that they knew all that there was to know about the composition of the atmosphere.

Then came the Honourable John William

Sir William Ramsay.

Strutt, 3rd Baron Rayleigh (1842–1919), Professor of Experimental Physics in the University of Cambridge. Lord Rayleigh had long been interested in the accurate determination of the physical constants of gases. He was, too, about this time, trying to check up on an old theory of William Prout, a London doctor (1786–1850), according to which all the chemical elements are more or less compounds of hydrogen, their atomic weights being exact multiples of that of hydrogen.

During the course of a most exact experimental determination of the atomic weight of nitrogen, Rayleigh was surprised to find that the density of nitrogen gas which had been prepared by separating it from air was about a half per cent. greater than the density of nitrogen gas prepared from ammonia or from some other chemical compound. This fact admitted of no possible dispute. Hence, Lord Rayleigh drew the conclusion that the small but persistent discrepancy was due to the presence of some heavier gas admixed with the nitrogen which had been obtained from the air.

Discovery of Argon

Alive to the possibility of a new element being present in the air, Lord Rayleigh prepared a quantity of "pure" nitrogen from air and repeatedly passed it backwards and forwards over red-hot magnesium turnings. Now, metallic magnesium not only combines with oxygen to form an oxide, but, also, with nitrogen, thereby giving rise to a *nitride*. After a tedious and a protracted experiment, Lord Rayleigh succeeded in absorbing the whole of his air-extracted nitrogen by means of the red-hot magnesium. By this means he obtained a quantity of a residual gas which was not absorbed by the magnesium metal, even when the latter was raised to white heat. Rayleigh also repeated the more than a century-old experiment of Henry Cavendish. He obtained just the same small unabsorbable bubble. Later he carried out this experiment on a much larger scale, and obtained no less than two litres of gas, which, unlike nitrogen, was not absorbed after sparking with oxygen or after repeated passage over red, and even white-hot, metallic magnesium.

The above experiments were conducted in collaboration with Sir William Ramsay, Professor of Chemistry in the University College, London, the chemical side of the researches being undertaken by Ramsay, while Lord Rayleigh concerned himself more particularly with the purely physical aspects of the investigations.

The new gas showed an entirely different spectrum from that of pure nitrogen. It had a density of 20, compared with one of 14 for nitrogen, and, unlike nitrogen, it refused to form any chemical compounds whatever. Many attempts were made by Ramsay to get the new atmospheric gas to enter into chemical combination, but all these endeavours failed completely. In view of this fact, Ramsay named the new gaseous element—for it was none other than that—"argon," the word being derived from the Greek *argos*, meaning "idle," or "inert."

The discovery of argon startled the chemical world when it was first made public by Lord Rayleigh and Professor Ramsay at the meeting of the British Association at Oxford in the summer of 1894. In fact, the announcement of argon's discovery was received with some actual opposi-

A pre-war continental laboratory engaged in the production of helium, neon and xenon tubes for electrical use.

tion. Many chemists and scientific men refused to believe in the existence of a new element. They suggested that Rayleigh and Ramsay had hit upon a peculiar modification of nitrogen, such as N_3, analagous to the modification of oxygen, known as "ozone," which has the formula O_3. But Rayleigh and Ramsay quickly proved conclusively that argon was most definitely a new atmospheric element and that it has an atomic weight of 39.9.

Sir Henry Miers, afterwards Professor of Crystallography at Manchester, drew attention to the fact that when certain rare minerals, notably cleveite, a rare Norwegian ore of uranium, were dissolved in acid they evolved a gas which had been supposed to be nitrogen. Miers suggested that this observation might not be accurate and that the gas evolved by the dissolving cleveite might contain some argon.

Cleveite was extremely scarce in those days, but Ramsay records that he managed to purchase a gram of it for 3s. 6d. and that, on dissolving this in dilute sulphuric acid, he obtained a minute quantity of gas which he at once proceeded to examine spectroscopically for the presence of argon and nitrogen. To his astonishment, however, the cleveite gas contained neither nitrogen nor argon.

"Krypton" Gas, or Helium

Ramsay at once inferred that he had hit upon yet another new element. He named it provisionally "krypton" (from the Greek *kryptos*, "hidden") and almost at once he sent a specimen of it to Sir William Crookes for further spectroscopic examination. Crookes was one of the leading physical scientists of the day. Before long Ramsay received a report on the new gas in the form of a laconic and somewhat mystifying telegram: *Krypton is Helium*.—Crookes.

The purport of this now historic telegram will require some elucidation. For this, we must go back to 1868, in which year the English astronomer Sir Norman Lockyer and the Frenchman Pierre Jules César Janssen, were examining the spectrum of the sun's light during an eclipse. They both observed in the spectrum of the solar photosphere a bright yellow line which was unknown in the spectrum of any element associated with our own planet. Consequently, Lockyer concluded that this spectral line must necessarily be due to the presence of an elementary gas in the sun which was unknown on earth. To this solar gas he gave the name of "Helium" (from the Greek, *helios*, "the sun").

Sir William Crookes, and also, of course, Professor Ramsay, were well aware of the existence of helium in the sun. Hence, Crookes' telegram to Ramsay conveyed to the latter the confirmed information that he had, while looking for something else, discovered the solar gas in earthly surroundings.

On March 26th, 1895, Ramsay publicly announced the discovery of helium on earth to the Royal Society. Helium, like argon, was also found, after many experiments, to be chemically inert, although, in recent years, certain combinations of helium, tentatively named *helides*, have been described.

Further Investigations

During the years 1895, 1896 and 1897 a vast number of minerals were investigated with a view to extracting helium from them, but no new sources of this gas were found. The air evolved from the waters of certain mineral springs, such as the one at King's Well, Bath, was found to contain a trace of helium to the minute extent of 1 part of this gas in a million parts of air. Subsequently, however, more adequate helium sources were located in the gases evolved from certain American oil and mineral springs.

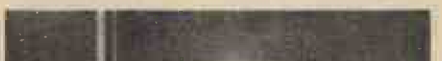
One of the main characteristics of helium is its extreme lightness, it being, next to hydrogen, the lightest known of all the elements. Another characteristic is its non-inflammability. These two properties at once made helium into a very desirable gas for airship use, particularly at a time at which the airship was considered to have superior powers to the aeroplane.

Strictly speaking, helium should be termed *helion*, since, by universal consent, the termination *-ium* is reserved for metallic elements.

The glow surrounding the spiral electrode in a neon lamp. Next to argon, neon is the commonest of the rare atmospheric gases.

Liquid Air

Towards the end of the last century, a Russian named Olszevski developed a new method of liquefying air and for distilling it fractionally. The method was further developed and improved in 1898 by Dr. W. Hampson. In the March of the latter year, Hampson handed to Ramsay a quantity of liquid air the more volatile contents of which had been allowed to evaporate. For this reason, the concentration of the less volatile constituents in the liquid air sample was greater than would normally have been the case. From this sample of "concentrated" liquid air, all the remaining nitrogen and oxygen were extracted and the residual gas was examined spectroscopically. Argon was present, of course, but, in addition, Ramsay ascertained the presence of an entirely new gas, differing in its spectrum from argon and helium. This gas he again termed "krypton."



A typical sample of liquid air, from which present supplies of the rare gases of the atmosphere are obtained.

Later in the same year (1898) Ramsay freed a large quantity of liquid air from nitrogen and oxygen and obtained the residual gas (argon) in fair amount. This he carefully fractionally distilled from the liquid condition. On June 12th, 1898, he examined the most volatile (i.e., the lightest) portion of this residual gas. He found that its spectrum-tube emitted "a blaze of crimson light," quite different from that produced by any other element.

Neon Gas

Another new atmospheric gas had been discovered! Ramsay cast around for a name to fasten on to this new element. He dubbed it "neon," from the Greek *neos*, "the new one"; and "neon" this extremely useful gas had remained ever since.

Finally, in the same year, Ramsay discovered a further unknown gas in the heaviest portions of the liquid air distillates. He called it "xenon" (Greek, *xenos*, "the stranger"). It turned out to be a gas having similar inert properties to those of its associated gases.

The discovery and isolation of five new gaseous elements in the space of four years forms an historical feat with which the name of Sir William Ramsay will ever be associated. All these gases are present in the earth's atmosphere, but in such minute amounts that, were it not for the development of the technique of liquid air distillation, they would never have been isolated, studied and commercially used.

Nowadays, however, their production is comparatively easy. When purified air is liquefied and fractionally distilled, xenon distils over first. Next comes the krypton, then the oxygen, then the argon, next the nitrogen, and, finally, a mixture of neon and helium.

Commercial Usage

The various gases are, for commercial usage, purified by reliquefaction and re-distillation from the liquid state. They each are freed from traces of nitrogen and oxygen by treatment with metallic calcium and with alkali metals at red heat.

Neon and helium are finally purified by a systematic absorption by activated carbon at the temperature of liquid air.

In order to obtain supplies of argon for electric lamp manufacture, tens of thousands of cubic feet of air are liquefied every month by the industries concerned. Neon, of course, is an exceedingly important member of this group of "Rare Gases of the Atmosphere" in view of its characteristic warm orange glow when submitted to the influence of a high-frequency electric discharge. It is, fortunately, one of the commonest of the rare atmospheric gases, one part of neon being contained in 65,000 parts of air.

Xenon is the rarest of this curious group of atmospheric gases, there being only one part of xenon in 11,000,000 parts of air. In order to obtain 1 lb. of pure xenon it would be necessary to liquefy and treat about 1,200 tons of air.

One part of krypton exists in every 1,000,000 parts of air, while there is one part of the solar gas, helium, in every 200,000 parts of atmospheric air. Argon is the commonest gas of the whole group, about 1 per cent. of atmospheric nitrogen comprising this gas contaminated with traces of the remaining rare gases of the atmosphere.

Post-war conditions are likely to bring about a rapid increase in the employment of electric discharge lamps for illuminating purposes. For all such purposes one or more of the "rare" or "inert" atmospheric gases will be required.

Odd Jobs in House and Garden

7.—Repairing Floorboards : Replacing Window Panes

By "HANDYMAN"

OCCASIONALLY it becomes necessary to raise a floorboard, or part of it, for the purpose of repairing a damaged piece, or for obtaining access to a water or gas pipe.

For raising a floorboard, a crowbar or cold chisel can be used for prising up the end of the board after punching in the nails. After raising the board sufficiently, slip a thick piece of wood under, as shown in

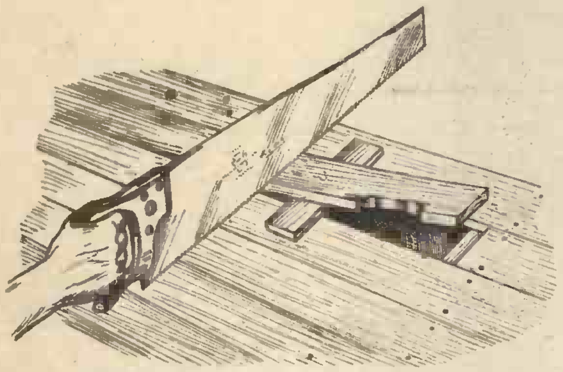


Fig. 1.—Method of supporting the end of a damaged floorboard whilst sawing through it.

Fig. 1. The board can then be cut through above a joist with the saw held at an angle, so as to leave the ends of the board bevelled. The positions of the joists which, of course, are at right angles to the boards, can easily be located by the rows of nail-heads.

When there is no joint near the piece of board to be removed, two saw-cuts must be made. Bore the board obliquely with a brace and gimlet, and make slanting cuts with a keyhole saw, as in Fig. 2, as close as possible to the joists at each end of the damaged piece of board. Each end of the new piece of board can be supported on a wood fillet screwed to the joist, as in Fig. 3.

Sometimes a board can be raised sufficiently to permit sawing through directly over a joist, in which case the supporting fillets would not be required. The bevelled ends of the new board would then be nailed down, as in Fig. 4.

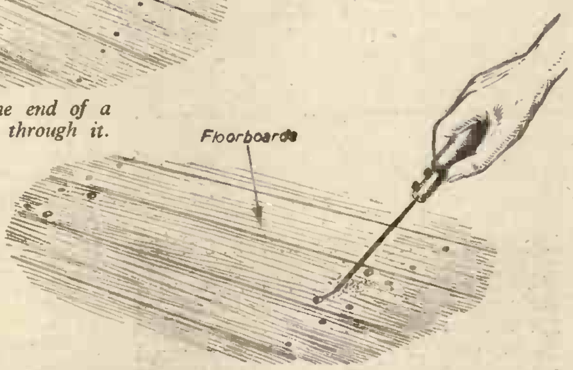


Fig. 2.—To remove a short piece of a floorboard between joists, make oblique cuts with a keyhole saw.

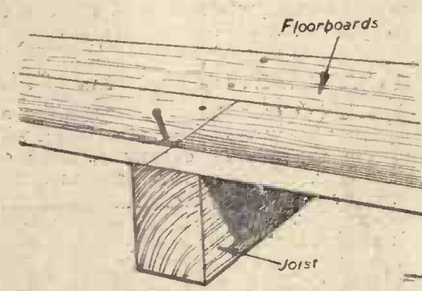


Fig. 4.—Showing how the bevelled ends of a new piece of floorboard are nailed down.

Filling Holes

Holes and small cracks in floorboards can be plugged with plastic wood which, after it has set hard, can be chiselled flush with the floor. If the wood-filling is treated with the same stain, or polish, as applied to the floor, it will hardly be noticeable.

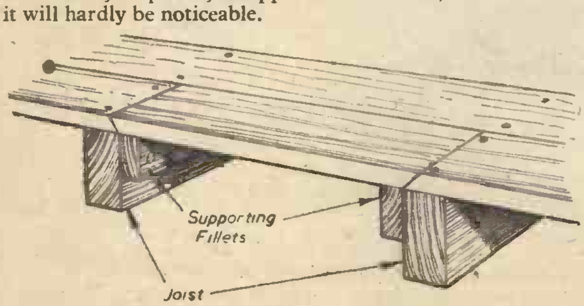


Fig. 3.—The ends of a short piece of floorboard supported on fillets screwed to the joists.

Wide cracks between floorboards can be filled in with slightly tapered strips of wood, which can be lightly hammered in place (Fig. 5) after the application of hot glue. After the glue has set, any projecting parts of the wood strips can be planed level.

Another method of filling unsightly cracks between boards is to make a paper pulp and press it into the spaces. Prepare the pulp by boiling some thin strips of newspaper in a small quantity of water and then adding some hot glue. Mix well, and after pressing the pulp firmly in place, allow it to harden, and then smooth it over with coarse glass-paper.

Replacing Window Panes

To replace a badly cracked, or broken window pane is not a difficult job for the householder to undertake if properly tackled. To begin with, three tools are essential, viz., a putty-knife, a hammer, and a hacking-knife; an old chisel is also useful.

The first thing to do is to remove all loose pieces of glass that can be pulled away from the frame, and dislodge the rest of the glass that its still held firmly. This can be done by chipping away the old putty with the hacking-knife and hammer, as in Fig. 6. This must be done carefully to avoid damaging the rebate by cutting into the wood. When all the broken glass has been removed, continue to chip away the putty all round the window frame and, with the chisel, scrape the rebate

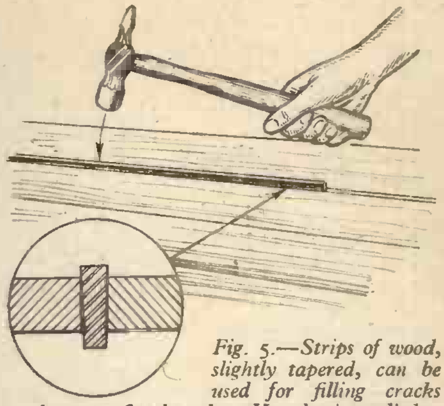


Fig. 5.—Strips of wood, slightly tapered, can be used for filling cracks between floorboards. Hot glue is applied to the strips before hammering them in place.

clean, after removing the brads which held the old pane in place.

The next step is to take the measurement for the new piece of glass. This must be done carefully, preferably with a 2-ft. rule, and the length and width of the new pane should be $\frac{1}{8}$-in. smaller than the opening between the rebates. A local builder or glazier will cut the glass to the required size, and will also supply the putty.

Fitting the Glass

Before placing the glass in the rebate, a thin bed of putty has to be formed all round for the edges of the glass to rest against; but before doing this give the rebate a coating of paint, and allow to dry before applying the putty. If this is not done, the bare wood will absorb the oil from the putty and render it useless.

To form the bedding of putty, take a piece of well-kneaded putty in the hand and pro-

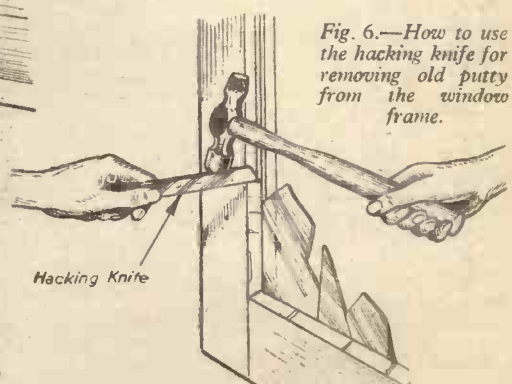


Fig. 6.—How to use the hacking knife for removing old putty from the window frame.

ceed to apply a layer round the rebate by pressing it in place with the thumb, as shown in Fig. 7. The putty must be soft and pliable, if not, add a few drops of linseed oil and roll it between the palms of the hands.

Carefully place the new pane in position, bottom edge first, and gently press it along the four edges, so that it squeezes some of the putty out at the back, as in Fig. 8. This superfluous putty is afterwards removed with the knife. Now hammer in two or three small brads along the side of the glass to hold it temporarily in place, as in Fig. 9. When tapping these brads in place keep the hammer

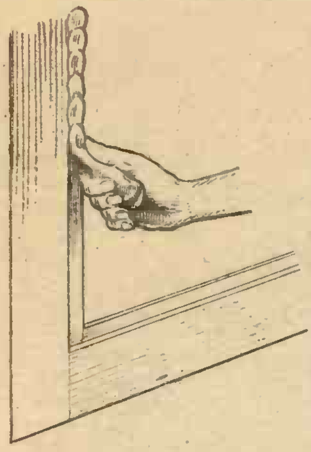


Fig. 7.—Pressing the facing putty in place with the thumb.

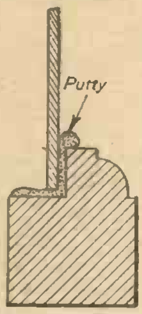


Fig. 8.—Section showing the lower edge of a window pane supported in the bedding putty.

head flat against the glass to avoid breaking it. These brads are finally covered with the facing putty and left in.

Now, with the thumb, work some putty well into the corners of the window frame and glass, putting it on as evenly as possible. With the putty-knife, smooth the putty to a neat bevel all round the window frame, as in Fig. 10. Hold the knife flat and firmly on the putty, drawing it along from corner to corner.

Lastly, trim off the surplus putty at the back of the glass. The top edge of the bevel at the front should be level with the top edge of the rebate on the inside of the window frame.

The window should be left for 24 hours before the glass is cleaned, in order to give the putty time to harden. It can then be painted to match the rest of the window frame.

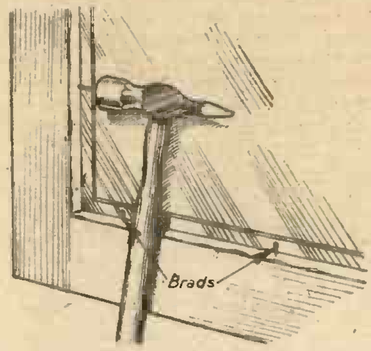


Fig. 9.—When hammering in the small brads for holding the window pane in place, let the hammer rest lightly against the glass.

In some types of windows, the glass is held in position on the outside of the frame with narrow wood beading instead of putty. The glass is first bedded in putty in the back of the rebate, pressed in place, and the strips of beading, mitred at the corners, are fixed with fine nails. In this case, brads will not be required for holding the glass.

Before taking out any broken glass the beading, with nails, should be prised off with a chisel. Take care not to break the strips of beading, as it is advisable to replace these in their original positions, after the new pane has been put in. Remove the old nails, and use slightly longer nails when refixing the beading, using the same nail holes.

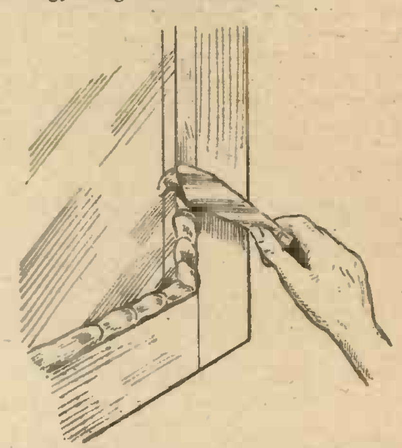


Fig. 10.—Using a putty knife for smoothing the facing putty to a neat bevel.

Formidable War Weapons

America's Latest Battleship : Britain's New Tank Gun

New American Warship

THE fighting naval power of the United Nations has been considerably strengthened by the launching of the 45,000 ton American battleship *Iowa*. In this naval giant are 800 miles of welding and 1,130,000 driven rivets. The only information released regarding her specifications is that her main battery will consist of 16in. guns and that her length is 880ft., only 200ft. less than the *Queen Mary*.

New Building Technique Used

The great weight of the *Iowa* at the launching stage is partly explained by a new technique which has made it possible to build in much armour usually fitted later. Her cost is about £25,000,000. Completed seven months ahead of her scheduled time, she is the sister ship of five similar battleships: *Missouri*, the *New Jersey*, the *Wisconsin*, the *Illinois* and the *Kentucky*. The *Iowa* is the fourth ship of that name. It is somewhat ironical to recall that her immediate predecessor was scrapped under the Washington Treaty limiting naval armament, while still on the ways.

As the Assistant Secretary of the Navy, Mr. Ralph Bard, said at the launching, she was "scrapped in the name of peace—peace that existed in the minds and hearts of honourable men."

Terrific Fire Power

"The new ship," he declared, "would not be scrapped until she has become a museum piece, and she will take her place in America's mighty post-war navy to help to ensure as long as necessary a just and lasting peace. The Japanese and Germans have built stealthily, and they have perhaps built well, but I can guarantee they have never fashioned such a weapon as this ship."

It is stated that the *Iowa* can fire faster and farther than any other ship afloat and is a weapon far advanced over the battleships sunk at Pearl Harbour.

Because of extreme width and the unusual launching weight, four sets of ways were used. The weight of the cradle alone, with sliding ways, was 2,275 tons. The ship displaced enough water to flood 46 acres to the depth of 1ft.

Britain's New Heavy Tank Gun

BRITAIN is now producing quantities of a new heavy 6-pounder gun, which will penetrate the armour of any German or Italian tank. Soldiers who have used the 6-pounder testify to its all-round excellence. It is mobile, has a high rate of fire, and remarkable qualities of armour penetration. These things combine to make it, in the words of the troops, "very handy."

The picture on this page was taken at an Ordnance factory "somewhere in England," where these guns are being produced. Of the workers in this factory no fewer than 80 per cent. are women.

Canada has also produced a new rapid-firing tank machine-gun—the Browning .30—which is now in production. It has great destructive power.

A Sub-machine Gun

THE Navy Department in Washington announced recently that the U.S. Marine Corps have officially adopted the Reising sub-machine gun. Several thousand of these deadly, close-range guns, firing 400 to 450 rounds a minute, have been issued to marine parachute troops and other special assault units.

The Reising gun is effective at 300 yards or more, and is suitable for mechanised troops, airborne infantry, vehicle operators and others whose duties require a short, light, high-powered and accurate weapon. The gun is of .45 calibre.

The finished gun, showing the thick armoured plating to protect the gunners.

Our Busy Inventors

By "Dynamo"

Rationed Chessmen

CHESSMEN are the subject of an application to the British Patent Office.

These pieces have hitherto been formed of more than one kind of material. Chessmen de luxe have been carved in ivory, but players who could not afford ivory pieces contented themselves with a set made of wood. Flat paper chessmen are sometimes to be seen, this variety being specially designed for travellers or for pocket chess boards. The game has also been played with chessmen of real flesh and blood, when human beings have undertaken the rôles of the pieces.

In these days of rationing it is appropriate that there should be proposed chessmen whose manufacture requires a very limited amount of material. The inventor's idea is a piece moulded in silhouette form from metal or plastic material.

To enable the piece to maintain its equilibrium a base is provided of width sufficient to prevent it from toppling over. The ordinary design appears on each side of the piece.

Obviously the flat nature of these chessmen will enable them to be packed in a very confined space.

'Plane with Satellites

WE are all aware of the fact that the equipment of modern warfare includes what is known as an aircraft carrier, but we have usually associated the idea with a ship. The principle has been extended to a giant aeroplane. This carries a number of small piloted aircraft, such as fighter aeroplanes, which may be released individually while the aircraft carrier is in flight, and re-embarked on the carrier while both are in flight.

An improved device of this type, for which a patent in this country has been applied, is the conception of a British baronet.

According to this invention, small aircraft having propellers at their tail ends, which, after release, can operate under their own power, are housed within the main wings of the carrier aircraft. The tail propellers are outside the trailing edges of the wings, which are large enough to accommodate members of the crew, whose duty it is to release the small aircraft and to take them on board again.

Amateur Inventors' Chance

AT the present juncture, when ordinary business is seriously impeded by the war, it is natural that the number of patents applied for should not attain the pre-war standard. Yet, in spite of the distraction, a considerable quantity of inventions are patented each week. About one-third of these are of a nature relating to war.

It is of special interest to the amateur inventor to know that, after the last war, £1,500,000 was paid out by the Government to inventors. Of this huge sum amateur inventors received a large share.

I understand that ideas are fairly considered by the Government. So here is a chance for the budding Edison to forward his brain wave to the Ministry of Supply. Particulars of devices relating to aircraft should be sent to the Ministry of Aircraft Production.

It is not necessary for these inventions to be patented, although the expert assistance of a patent agent is a material help in clearly and comprehensively describing an invention.

Seaplane Landing Lights

AN interesting recent invention is an improved light buoy of the kind used to designate landing areas for seaplanes.

The author of this device asserts that seadrome buoys are not frequently employed, and adds that, since the production of light on a buoy is expensive, it is usually desired to operate the lights only when 'planes are landing or taking off from the seadrome.

Consequently, means for readily controlling the operation of the buoys must be provided. This generally necessitates an actual manual operation at the buoy, as there are usually self-contained lighting units having controlling switches.

The inventor reviews the various types of light buoys which have been suggested for seadromes. Among these are ordinary light buoys such as are used in marking ship

An American soldier-inventor explaining the operating characteristics of a new fragmentation bomb.

channels. These buoys, he contends, are not suitable for a seadrome, as they do not remain stationary in agitated water and also owing to the fact that their light reflects on the waves. Another drawback is that they are apt to damage parts of the 'planes coming in contact with them. Moreover, the expense incurred is an obstacle to their being used.

Buoys have also been made from floats constructed from drum sections obtained by cutting a drum in half vertically and welding a flat metal sheet over the opening in the drum. The light has been mounted on this float and current supplied to it by a submerged cable extending from the shore.

However, owing to the continual rocking of the float, this cable was frequently damaged and it was often severed by the anchors of ships. An additional disadvantage of this buoy was that in daylight its visibility was low.

Light Buoy for Seadromes

THE general aim of the improved seadrome light buoy in question is to overcome the above-mentioned and other objections to known types and to furnish a buoy which is desirable from a commercial point of view.

An additional object is to provide a strongly made economical buoy readily accessible from a control boat and one which will not cause injury to a seaplane coming in contact with it.

Yet further objects of the invention are: a self-contained light buoy; a buoy in positive engagement with the light-producing means which it carries; a buoy which will not easily skid over the water; a buoy which maintains the light in a vertical position, and one which is an effective daylight marker. To this omnibus list of characteristics is added the feature that the buoy can be quickly assembled.

Broadly speaking, the invention is a light buoy made from an open-centred tube in which a light-producing member is supported by means connected with only the inner periphery of the tube.

This buoy is a self-sufficient unit wherein energy supply means for a light are carried at or below the centre of the tube and are adapted to mount a light above the tube.

Aircraft Launching

AN inventor has been devoting special attention to the devising of apparatus for the launching of aircraft.

He maintains that he has evolved an improved device of the type in which auxiliary power is applied to accelerate the speed in order to facilitate take-off.

One cause of aeroplane engine failure, he contends, is the strain resulting from operating the engine at higher power than is safe during take-off. In addition to the resistance, including air resistance and the friction of running on the ground, the accelerating power necessary to bring the craft up to speed within the length of the runway is high; and, in the case of short runways, often dangerously excessive.

In some instances the 'plane is heavily laden at the time of launching, and in many cases, even on flying fields, the runway is short.

The inventor has also borne in mind the comfort and welfare of the pilot. He states that the effect on the latter must not be injurious. If the 'plane is started too suddenly, the jerk may be harmful to the pilot. But the inventor admits that the human body is able to stand an acceleration equal to several times the acceleration of gravity.

His contrivance aims to provide arrangements adaptable to various circumstances, including those attending the launching of aircraft from decks of ships, from stations where a portable apparatus must be used, and from flying fields of more permanent character.

His apparatus comprises a runway for an aircraft, an induction motor for accelerating the speed of the 'plane along the runway, including a primary element and a secondary element, one of which extends along the runway while the other is movable with the aircraft, and a generator connected to deliver to the primary electric current of gradually increasing frequency.

The P.M. Battery Clock:

How to Install Slave Clocks, Each Controlled Still

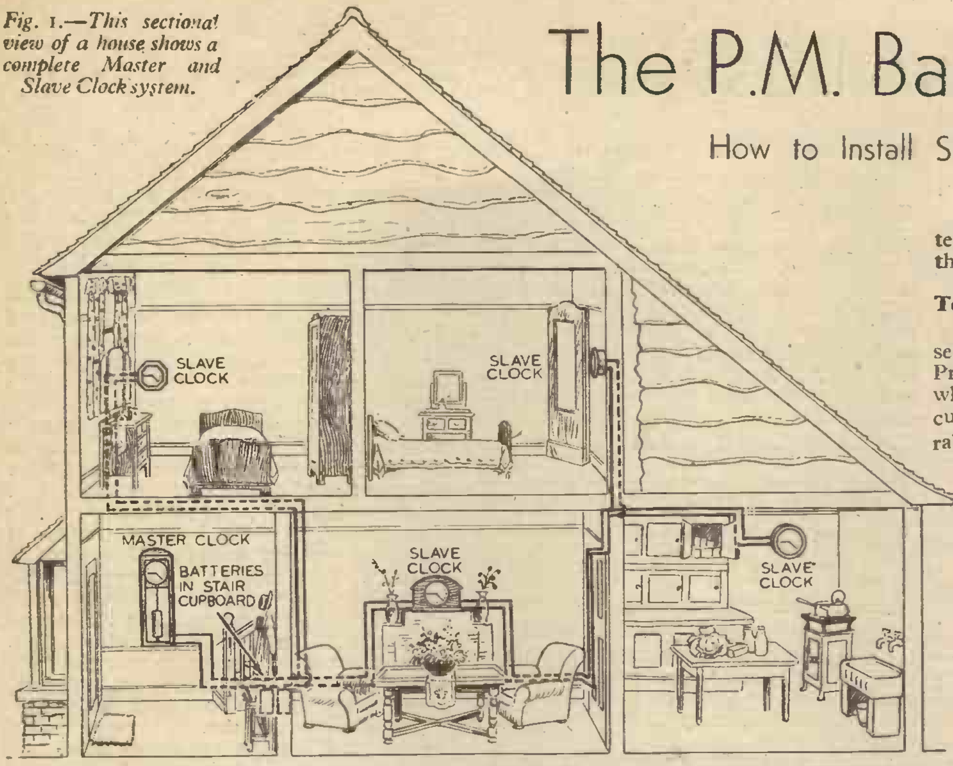


Fig. 1.—This sectional view of a house shows a complete Master and Slave Clock system.

This Article was First Published in our November, 1938, Issue, which is Now Out of Print. In Response to Numerous Requests We Now Reprint It

THE war has brought about a large demand for battery clocks, for it was realised by those who were using mains operated clocks that in the event of a cut-off of the electric mains supply they would have been without a timepiece. In homes where the electric supply is not available a battery clock provides a solution to the problem of clock winding, for our clock will run for at least two years, from one pair of cells.

Unlike the synchronous mains clock which cannot easily be adapted for such purpose, our battery electric clock will control a number of slave clocks throughout the house, and this article shows how, by adapting some cheap alarm timepieces, you may install in your home a complete electric clock system controlled by the one master clock, which, once adjusted to correct time, will give you accurate time in every room in the house.

The Works of the "Slave"

The first thing to obtain is an old clock. Remove the spring and take out all the cogs except the two behind the face. Fix the frame of the clock together again and replace the fingers if these have been removed. It will be seen that when the knob, which was for adjusting the fingers, is turned, the fingers move round rapidly and easily. This constitutes the mechanical part of the clock.

A cog wheel must be made with 60 teeth. This requires some care, but it may be easily made, provided that the diameter is large enough. Mark out on a sheet of brass or mild steel about 1/16in. thick, a circle 3in. in diameter. With the same centre draw another circle 2¾in. in diameter and move this radius 1⅜in. round, marking on the circumference of the smaller circle. This is divided up in six equal parts, each of which must be divided up into 10 equal parts. The teeth are cut to the shape shown in Fig. 3, and are trimmed off by using a three-cornered file.

When the wheel is complete, it must be soldered on to the shaft passing through the clock.

The Electric Part of the Clock

The electric part of the clock consists of a powerful electro-magnet. Obtain two carriage bolts, 1½in. by ¼in., and file the heads flat. Cut a bracket of soft iron and drill it to take the carriage bolts. The holes should be 1¼in. apart. Fix the bolts in the bracket and wrap them with insulating tape. Wind the bolts with No. 24 D.C.C. wire, packing it on as neatly and tightly as possible. Cut a strip of spring steel for an armature and leave a small lug projecting so that it may be screwed on to the back of the clock. Cut the back for the clock from ½in. wood and by means of the brackets mount the clock in the centre. (See Figs. 2 and 5.) The end of the armature is bent at right-angles and the end is then bent again at right-angles to form a small hook. A piece of soft iron is riveted to the armature strip to aid the attraction of the magnets. Mount the armature so that the small hook engages with the wheel, and mount the magnets so that they will easily attract the armature. The construction of the stops A is quite simple and straightforward. They consist of 1in. bolts and nuts, with the nuts soldered to the metal brackets, and should be mounted in the position indicated. (See Fig. 2.) The arm B is a strip of mild steel cut and mounted as the armature. Two terminals should be fixed on the back to which the magnet coils are connected.

Testing the Clock

Test the clock as follows: Connect it in series with two dry cells and a morse tapper. Press the key and adjust the stops so that the wheel advances one tooth each time the circuit is completed. The spring B acts as a ratchet and, when the current is switched off, the armature springs back and the wheel remains in its position. It will be seen that for each tooth the wheel advances, the finger moves on one minute. This should be tested for all 60 teeth.

On the spindle of the second finger of the master clock, fix a contact about 1in. long. This may be a piece of wire twisted round the shaft and secured with a blob of solder. On the back of the clock an insulated contact is fixed so that once each minute the two contacts meet. Solder a wire to the frame of the clock and another to the insulated contact and connect them in series with the clock and two dry-cells. (See Fig. 7.) Once each minute the circuit is completed, and the wheel advances one tooth and the minute finger travels on one minute. Once the clock is installed it needs no attention, except for the occasional renewing of the batteries.

To finish the clock off, build a case round the "works" and design and cut a suitable dial*, then stain the whole a dark brown.

Any number of these clocks may, of course, be operated from the "master" clock which was described in the January 1942, issue, and the only question is the carrying of the necessary wires from master to the slaves. The best arrangement will be found to include all the slaves in parallel, that is, two wires are run from the master to the farthest slave, and branches taken from the two wires to each clock as desired.

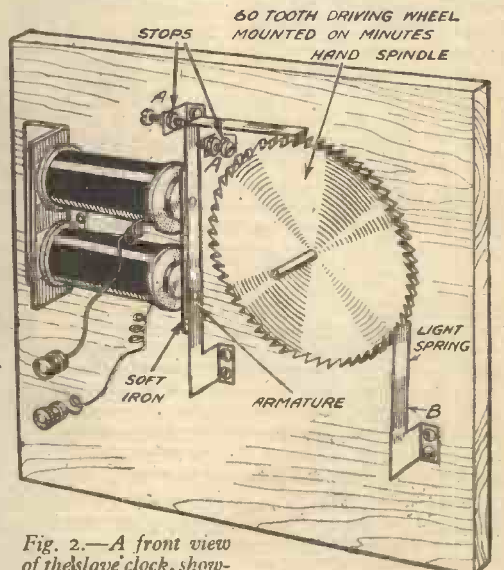


Fig. 2.—A front view of the slave clock, showing the construction.

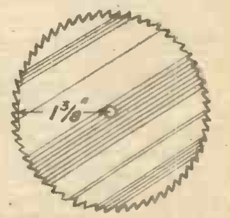


Fig. 3.—The cog wheel is cut with 60 teeth.

A stout art board dial can be obtained for 1s. post free, from the publishers, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

The "Slave" Mechanism

by the Master Clock, Blueprints of Which are Available

Chimes

If chiming or striking mechanism is required, this will most conveniently be arranged on the master clock, or in its vicinity, although there is no reason why the master should not be built (without the small indicating clock at the top) and installed in a cellar or attic, out of the way, and each room fitted with a slave. In this case the striking or chiming mechanism could be fitted in the required room or in the hall. It is not proposed to give any actual constructional details at this point for installing a suitable chiming mechanism. There are numerous different methods of fitting such apparatus, which may be electrically driven or clockwork-operated, the actual mechanism being set into operation by electrical means at the required time.

Operating Mechanism

Westminster chimes, consisting of ordinary brass rods clamped to tune to the required notes, may be easily constructed, and the four hammers operated by a rotating drum fitted with small projecting fingers or cams. A small electric motor could be set into operation for this purpose, very little power being required. The small dry cell would operate this. Alternatively, large diameter brass tubing could be used to provide heavy churchlike tones, and hammers for these could be power-operated, each by a small magnet or motor, the individual motors or magnets being set into operation through the medium of a rotating contact maker, itself driven by a small motor.

It should not be difficult to arrange a small wheel operated on the lines shown in Fig. 2, with contacts at the four quarters. The hour-striking mechanism will, of course, have to be separately controlled, owing to the time taken when chiming the longer hours, unless some scheme can be incorporated for giving continuous action on the striking mechanism while the minute wheel continues to move.

Radio Interference

It will probably be found that every time the contacts close in the master or slave clocks a "click" will be heard in the loud-speaker if a radio set is in use. This may be prevented by wiring a large capacity condenser across the actual contacts. A value of 2 or 4 mfds. will be found quite suitable. This will also prevent the points of the contacts from becoming pitted due to the arc which takes place. A lamp may, of course, be used in place of the condenser, but the latter component is to be preferred. If it is desired to economise on the drain on the dry batteries, these may be dispensed with and the clock operated from an ordinary battery trickle-charger. In this case a really reliable charger should be used, capable of giving an output of about .8 amps. at 6 volts. To avoid damage to the charger due to the back E.M.F. which will take place when the contacts are made and broken, it is desirable that an artificial load shall be applied to the charger. A very useful load may be adopted by connecting an old accumulator across the terminals of the charger (the cell being filled with acid, of course), or alternatively, a large capacity mansbridge condenser having a capacity of 2,000 mfds.

Reliability

One of these clocks has been in use for several years with a trickle charger as the source of supply with a 2,000 mfd. condenser (12 volt) across it and no trouble of any kind has been experienced. The contacts have not been touched or cleaned and the trickle charger still functions perfectly. The charger was actually screwed to the back board of the master clock behind the dial and a twin-flex lead is taken from the back of the clock to a mains socket on the wall near it. Ordinary standard twin-laid bell wire is used for connection between the various slaves and this is carried in the picture rail in some rooms and along the top of the skirting board in other cases, and is thus more or less invisible.

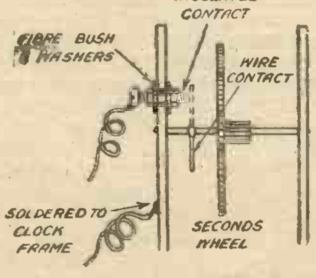


Fig. 4.—Side view of the mechanism, showing how the contacts are mounted.

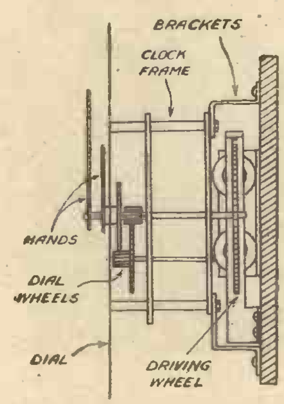


Fig. 5.—A side view of the slave clock, showing the driving wheel, dial wheels, and hands.

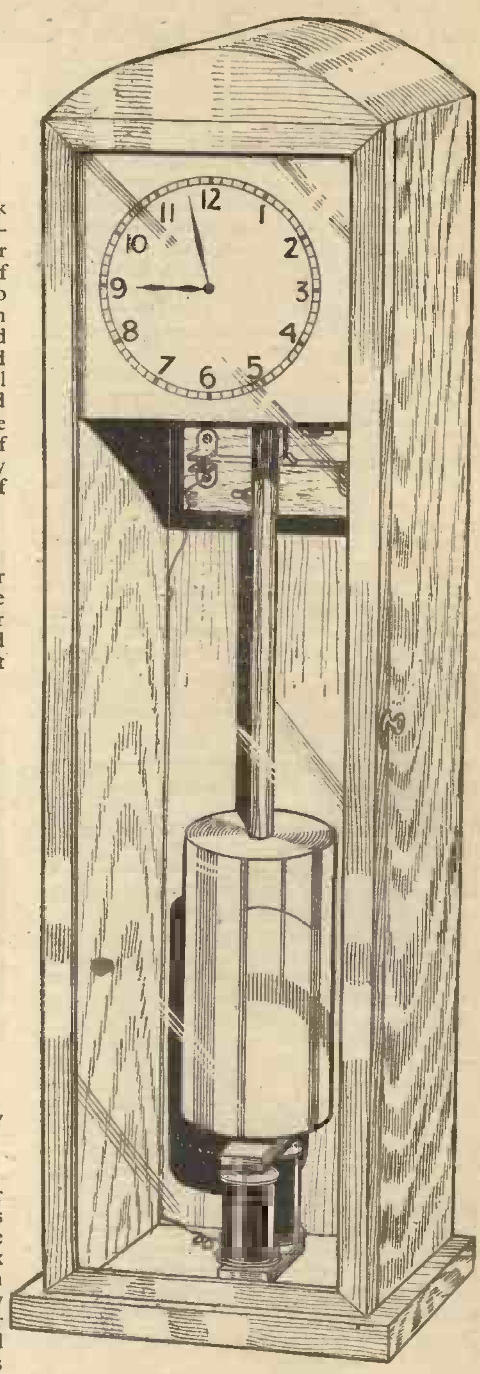


Fig. 6.—The master clock, full constructional details of which are given in the January, 1942, issue.

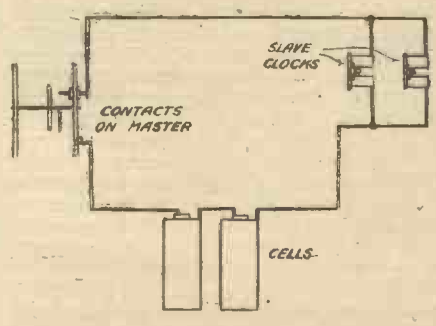


Fig. 7.—Wiring connections for the master contacts and slave clock magnets.

MASTERS OF MECHANICS

No. 78.—John Baptist Porta, the First of the Physicists

THE progress of quarrying and mining which took place during the latter portion of the Middle Ages brought with it the necessity of sinking deeper and deeper underground shafts and tunnels in order to strike the desired mineral seams. The construction of mine shafts, however, at once brought into existence a problem which for a long time proved to be an almost insurmountable obstacle to the steady evolution of new and improved methods of mining.

The problem was one of water. Invariably when mine shafts were driven more deeply than usual into the ground they rapidly became flooded. Ordinary land-drainage methods were impossible of application in such instances, so that recourse had to be made to methods of hand-pumping, endless chains of buckets—the latter often being animal-driven—and to similar crude mechanical devices for ridding the mine shafts of water. Yet, in many instances, all these contrivances were noticeably inadequate for the work of deeper mine drainage. Some far more potent agent was needed for the purpose.

Raising Water from Mine Shafts

Thus the problem of drawing water in more or less continuous quantity from a mine or a quarry shaft became an increasingly urgent one as time went on. It was a problem which engaged the minds of many practical men of the period and, incidentally, it constituted the problem the attempts at the solution of which led ultimately to the invention of the steam engine.

One of the several romantic personages who endeavoured to come to grips with the problem of water-draining was a Neapolitan experimenter, one Giambattista della Porta, or, to give him the anglicised rendering of his name, by which he is better known at the present day, John Baptist Porta.

Porta, a man of independent means, was undoubtedly a highly original thinker in experimental matters and was, indeed, one of the first to break away from the long aversion to experiment and observation which had, for more than a thousand years, held sway throughout the then civilised world. Owing to his remarkable creative and agile mentality, Porta may be termed the first of the physicists, for it was he who conducted many of the primary and pioneering experiments in optics, mechanics and other physical sciences.

Using Steam Power

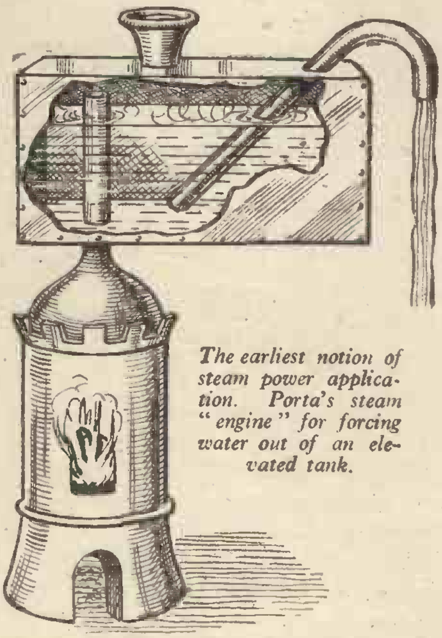
Porta was the first man to think out an application of steam power for the purpose of water-raising, and also gave to the world the notion of the darkened optical chamber—the camera, in fact. By making numerous experiments with lenses and mirrors, he made possible the invention of the telescope, and several other optical devices. It is possible that Porta himself may actually have constructed a crude yet serviceable telescope before his contemporary, the better-known Galileo, made his celebrated "optic tube."

Of the earlier record of John Baptist Porta there is little to narrate. He came of a noble Neapolitan family, being born at Naples in 1538. His education and upbringing must have been of a superior type, for he gathered around him in Naples a select circle of scientific amateurs who were devoted to pursuits like his own. Porta and his kindred acquaintances constituted themselves into a sort of local scientific society, meeting together at regular intervals for the purpose of planning new experiments and discussing the observations which had been made on past experiments.

Early Writings

At an early age, Porta distinguished himself by writing a book on "Natural Magic." The book constituted a curious medley of technical facts and observations, the majority of which were, perhaps, devoid of any real scientific value. Yet the book earned for Porta a lasting fame. It was written and published at a period when the art of printing was coming into popular use and demand. Because Porta's "Natural Magic" was one of the first of the "scientific" treatises to be forthcoming from the early presses, it was translated into most of the European languages. Even to this day, the volume remains one of the "classics" of early science.

John Baptist Porta—a portrait reproduced from the frontispiece of one of his books.



The earliest notion of steam power application. Porta's steam "engine" for forcing water out of an elevated tank.

Exactly how John Baptist Porta started upon his scientific career of experiment and observation, we do not know. He seems, however, to have come across an Italian translation of Hero's work on "Pneumatics" which was originally written at Alexandria in the 1st century B.C., and to have at once become fascinated with the crude mechanistic descriptions and experiments of that author.

Porta's Steam Apparatus

In 1601, Porta published a commentary on Hero's works, and it is in this Commentary that we find described and illustrated the world's first practical suggestion for the application of steam power.

Porta's steam apparatus therein described comprises a spherical vessel heated on a fire-grate. The upper end of the spherical vessel enters a tank containing water and projects above the water-level in the latter receptacle. An exit-pipe dipping below the water-level is provided. Porta's notion was to raise steam in the spherical vessel or boiler, and to lead the steam into the space existing above the surface of the water in the closed cistern. The steam exerted a pressure on the water, which was forced downwards and consequently caused to flow out of the exit pipe.

Porta is the first writer to describe any means by which water can be caused to flow upwards. It is, however, to be feared that Porta's "engine" was quite an impracticable device, although it showed great originality. It had, too, an ultimate practical outcome in that it inspired later workers to adopt the same principle of steam pressure for the purpose of forcing water up long pipes out of wells and mine shafts. Porta, who was quite clearly the first practical steam experimenter of the Christian era, demonstrated, also, the fact that when a vessel, such as a wine flask, is filled with steam and then quickly inverted over a trough of water, with its neck dipping below the surface of the water, the latter liquid will rise up into the flask so as almost to fill it. It is not clear from Porta's writings whether he realised the full implication of this experiment, which was due, of course, to the creation of a partial vacuum in the flask in consequence of the condensation of the steam by the external water. However, other experimenters at a later date profited by Porta's descriptions of his vacuum experiment, and they applied its principle in the further development of steam-power.

The First Camera

The invention of the optical dark chamber is, as we have seen, to be ascribed to this pioneering experimenter of Naples. Porta describes how by making a small circular hole in the window-shutter of a darkened room he was able to make the images of external objects appear on the opposite wall of the room. The smaller the hole the sharper the projected images became, but the less brilliantly illuminated they were since the smaller aperture admitted less light.

By fitting a simple type of convex spectacle lens into the hole in the window shutter an improvement in the brilliancy of the projected images was obtained.

Here, of course, we have the very first "camera," in the form of a darkened chamber to which light rays are admitted via a suitably placed lens. Through the centuries the *camera obscura*, as instruments constructed on this principle were termed, was employed for a few scientific and artistic purposes and, eventually, the principle became one of first-rate importance when it was adopted in the early portion of the nineteenth century by the first photographic pioneers.

Concave Speculum

Another of Porta's discoveries of this period was the use of a concave speculum or mirror which was placed in front of the aperture of his darkened chamber and which served to collect light rays proceeding from external objects, and to transmit them into the dark chamber. This was the first time that a concave mirror had been put to such use, and its adaption in this manner made possible the construction of the "reflecting" type of telescope in which the images of the distant stars and other heavenly bodies are collected by means of a concave mirror, and are then reflected back into the eyepiece of the telescope.

Porta is not usually credited with the actual invention of the telescope, although in his scientific writings he has much to say on this subject.

An 18th century camera lucida which was used for drawing and tracing of projected images. It was the outcome of Porta's original camera obscura.

He also dabbled in chemistry and, to some extent, in natural history. He wrote a useful book on distillation, from which it may be gathered that he studied the physics of the subject fairly extensively. New types of retorts and stills are described in this volume, and, from the observations and remarks contained therein, it would seem that he managed to hit upon the principle of "fractional distillation," whereby one liquid can be separated from another, a process which, of course, is nowadays of enormous importance in the manufacturing world.

Altogether, John Baptist Porta, the "First of the Physicists," led a life which provided many useful contributions to early science, his chief claims to fame comprise his notion for applying steam pressure, and his *camera obscura* principle.

This indefatigable experimenter died in Naples on February 4th, 1615. At that time early science was beginning to make substantial progress. The laws of mechanics were being investigated in the light of the new learning, and experiments were becoming more precise and accurate, and were being more frequently made.

Demagnetisation

Practical Methods for Treating Small Objects

THE working of many delicate mechanisms, such as watch and clock movements, can be seriously upset as the result of hair springs, levers and other small parts becoming magnetised. Faults due to this cause are difficult to detect, and almost impossible to rectify without special equipment.

Magnetisation can occur in a number of ways, but is chiefly due to the affected part having been brought into contact with another magnetised object, or having come under the influence of the strong magnetic field in the vicinity of a generator, motor or other piece of electrical apparatus. A very common cause lies in the use of magnetised tools for purposes of adjustment. Tools can easily become magnetised, particularly when used for the repair of electric clocks, loud speakers, etc., and it is interesting to note that tools are very often magnetised, due to the influence of the earth's magnetic field, when left in a drawer undisturbed for long periods, and lying in a north-south direction. A routine demagnetisation of all tools is well worth while if much delicate work is undertaken.

There are four methods of achieving demagnetisation:

1. By percussion.
2. By heating.
3. By magnetic induction.
4. By electro-magnetic induction.

1. *Percussion.*—Tapping a magnetised object with a light hammer will greatly reduce its magnetic strength. For best results the object should be placed in an east-west direction when being tapped, but even so it is difficult to entirely destroy its magnetism. Many articles, of course, would be irreparably damaged by such a procedure.

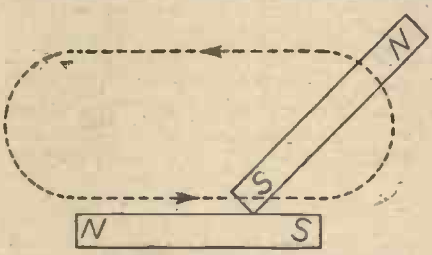


Fig. 1.—Simple method of demagnetisation.

2. *Heating.*—A magnet can be completely demagnetised by heating it until it is red hot. Although very effective, this is not a practical method as obviously most tools or other articles would be useless after such treatment.

3. *Magnetic Induction.*—If the article to be demagnetised is of a convenient shape it can be partially demagnetised by stroking it with a permanent magnet, as in Fig. 1. It is, however, impossible to entirely destroy the magnetism in the body without remagnetising it in the opposite direction. The method, therefore, is of no practical value.

4. *Electro-magnetic Induction.*—The remaining method, that of electro-magnetic induction is completely effective and convenient but, before proceeding to a description of the method, it would be well to consider the theory of demagnetisation.

Magnetisation Curve

Fig. 2 shows the magnetisation curve of a specimen of steel. The horizontal axis represents the magnetising force (H) and the vertical axis represents the resultant flux (B) in the specimen due to that force. The ratio between B and H is known as the permeability of the material and the curve is usually referred to as a B/H curve.

If the magnetising force is increased from zero to some value OA, the flux in the specimen increases, following the curve OB, to B. Upon reducing the magnetising force to zero the flux decreases along the curve BC and at zero magnetising force the flux in the specimen maintains a positive value OC. This value OC represents the residual magnetism retained by the specimen, thus making it a permanent magnet.

If the magnetising force is now reversed and increased in the opposite direction, the flux will continue to fall along the curve BC until at a point D it becomes zero. The magnetising force H has still, however, a value greater than zero and equal to OD. This value OD is known as the Coercive Force and is, in fact, the force required to demagnetise the permanent magnet.

If the magnetising force is still further increased to a negative maximum, reduced to zero, and again increased to a positive maximum, the B/H curve forms a closed curve known as a Hysteresis Loop.

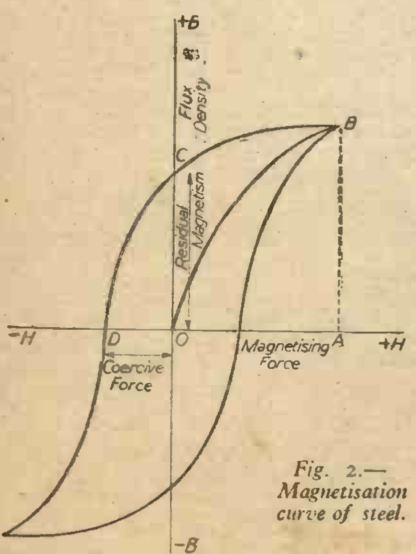


Fig. 2.—Magnetisation curve of steel.

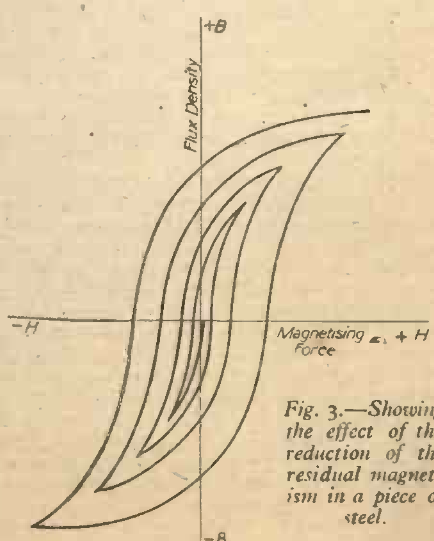


Fig. 3.—Showing the effect of the reduction of the residual magnetism in a piece of steel.

It would seem from the foregoing that, in order to demagnetise a specimen, it is only necessary to apply a magnetic force to it equal to the Coercive Force and of opposite polarity to the permanent magnet. This is certainly true but, because of the difficulty of accurately estimating the value of the Coercive Force, the method is impracticable.

However, referring to Fig. 3, if, after completing the hysteresis loop of Fig. 2, the magnetising force is increased to a slightly lower value than the previous maximum and

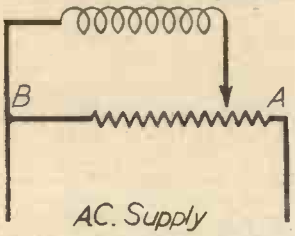


Fig. 5.—Circuit diagram of connections for demagnetising by the A.C. method.

then decreased to zero, it will be seen that the residual magnetism is reduced. If the cycle of operations is continued, the value of the magnetising force being varied between positive and negative values while the maximum value is successively decreased, a curve such as that shown in Fig. 3 is obtained. It will be seen that the value of residual magnetism is continually reduced until, when the swing of the magnetising force becomes zero, the resultant flux in the specimen is zero, and it is in fact demagnetised.

D.C. Method of Demagnetisation

The principles outlined above can readily be applied to practical demagnetisation problems. A variable resistance is connected across the source of D.C. supply. A coil, within which the tool or other article requiring demagnetisation is placed, has one terminal connected to the mid-point of the resistance. The other coil terminal is connected to the sliding contact of the resistance. A centre zero voltmeter is connected across the coil, as in Fig. 4.

When the slider is at the end of the resistance A a positive potential is applied to the coil. Moving the slider to the centre O reduces the potential to zero, while at B it is increased to a negative maximum. The magnetising force of the coil is thus capable of being swung from a positive maximum to a negative maximum.

The procedure for demagnetising is to move the slider backwards and forwards, successively decreasing the reading shown by the voltmeter. The voltage swing will finally be reduced so much as to be too small to give a reading. The specimen will then be completely demagnetised.

A.C. Method of Demagnetisation

As the requirements for demagnetisation are a continually reversing and decreasing current, it would appear to be advantageous to use an A.C. supply. The reversals can thus be obtained without the use of any mechanical contrivance. This is, in fact, the case and it offers a very practical method of achieving demagnetisation.

The variable voltage is obtained by connecting the resistance across the source of A.C. supply. The coil is connected to one end of the resistance and to the sliding contact, as in Fig. 5. No voltmeter is required.

In order to demagnetise a specimen it is placed inside the coil and the sliding contact is moved to end A of the resistance; so

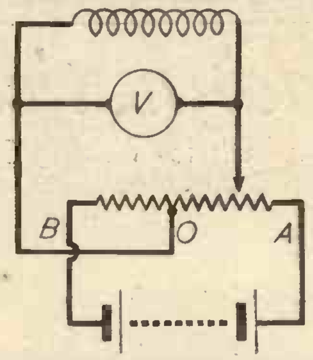


Fig. 4.—Circuit diagram illustrating the D.C method of demagnetisation.

applying full voltage to the coil. The slider is then slowly moved back to end B, gradually reducing the voltage to zero. The specimen is then entirely demagnetised.

In practice a slightly different arrangement is preferred. The resistance has another resistance of very much lower value connected in series with it (Fig. 6). One end of the coil is connected to each of the sliding contacts. When operating, A is moved to O, then B is moved to O. This enables the voltage swing at low values to be more readily controlled, and to be reduced in much smaller steps, making better results obtainable.

Practical Details

A suitable coil can be made by winding

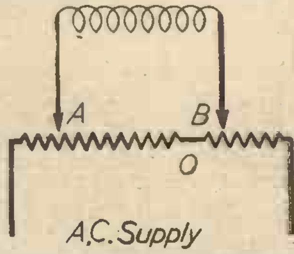


Fig. 6.—Two resistances in series enable the voltage swing to be more readily controlled.

800 turns of 20 S.W.G. D.C.C. copper wire on a 1in. diameter paxolin or cardboard tube. The tube may be 4in. long and provided with a round disc or cheek 2½in. diameter at each end.

For the D.C. method a 6-volt car battery provides a convenient source of supply, and the coil current should be taken from a 20 ohm resistance, capable of carrying 2 amps., connected across the battery.

The same coil is quite suitable for use with the A.C. method, but a transformer is required to reduce the mains voltage of 200-250 volts down to 6 volts. The transformer from a mains wireless set is suitable, and one should be obtained with a heater winding giving 6 volts output at 2 amps. The resistance used in the D.C. method can also be used again but should have another resistance of about 1 ohm, with the same current rating, connected in series with it, as previously explained.

It will be noted that the maximum voltage applied to the coil on D.C. is 3 volts whereas on A.C. it is 6 volts, and it may be thought that the coil will thus be overloaded when on A.C. This, however, is not the case, as the impedance of the coil is greater on A.C. due to its inductance and, in fact, the coil takes a slightly lower value of current when on A.C.

How Britain's Large Bombers Were Planned

WHEN, a few weeks ago, several squadrons of big, four-motor Lancasters flew over 800 miles in daylight to bomb the German submarine yards at Danzig, followed by an attack by Stirlings on the Lubeck naval yards, it was more than a triumph for their R.A.F. air and ground crews, and the organisation behind them. It was also evidence of the foresight and skill of the men who, several years before, planned the new heavy bombers which are now carrying an increasing load of Britain's bombing offensive against Germany.

Is it realised that the Stirlings, Halifaxes, Manchesters and Lancasters, whose very existence was a secret until fairly recently, were in fact visualised as long ago as 1936 by the aircraft designers and the Air Staff? Not, of course, in all their details; nor with all the latest devices which war experience has shown to be necessary to keep British aircraft ahead of German design. But in its main outline the big, high speed bomber of long range which to-day is the R.A.F.'s most powerful weapon of offence was conceived just six years ago. It was one of the safeguards against the carefully laid plans of the Axis for an eventual attack on the British Empire. Another was the idea for an 8-gun fighter, conceived at about the same time, which eventually took form as Hurricanes and later Spitfires.

Four-motor Bombers

The new type 4-motor bomber visualised by the Air Staff as the bomber of the future was born at a conference held in the Air Ministry in May, 1936. It was held to consider a specification, then known only as a Number, B12/36, for a heavy bomber landplane. The Air Staff officer behind that specification was Air Vice-Marshal R. D. Oxland, C.B.E., who now commands a bomber group.

The specification which resulted in the modern 4-motor bombers of the R.A.F. called for an aircraft with a certain range and bomb load. Its wing span must not exceed so many feet, speed at a given height be not less than so much. It must be able to defend itself from any angle, have accommodation for so many crew, a range of so many miles. Above all, this masterpiece of the future had to be capable of taking-off and landing within given distances. Another thing required was that the aircraft should be "buoyant"—that is capable of floating should it be forced down into the sea. For such a "solid" aircraft as the new, high performance bomber had to be, that last requirement was a designer's headache.

That specification, and a later one for a somewhat similar type, were passed to the aircraft industry and the selected firms were asked to build aircraft that would measure up to those far-reaching requirements.

Step by step, and with the accumulated knowledge and skill of 30 years' flying experience, these British firms—Short, Handley Page, and Avro—all expert constructors of large aircraft, turned that bold idea into practical reality.

Handley Page Halifax

Certain details about the resulting types of 4-motor bombers—Stirling, Halifax, and Lancaster—produced for the R.A.F. from these far-sighted specifications have lately been released. Here, for example, are the figures for the Handley Page Halifax, which may be regarded as generally typical of the new line of British heavy bombers. Wing span, 99 feet; length, 70 feet; height, 22 feet; engines, four Rolls-Royce, 12-cylinder Merlins; 3-bladed airscrews. Special equipment includes slotted flaps for improved take-off and de-icing apparatus including tail unit and airscrew; and there are several batteries of machine-guns.

Speed and load are still service secrets but Britain's big, new bombers are about the fastest and most hard-hitting bombers in the world, much ahead of anything in service with the German Air Force.

Air or Liquid-cooled Engines for Aircraft?

The Advantages and Disadvantages of the Two Types

Experts examining the controls in the cockpit of the F.W. 190. The well-balanced B.M.W. 1,600 h.p. engine can be seen, also the two 7.92 mm. machine guns, mounted on the top of the engine.

THE choice of the type of engine to be used in an aircraft requires a careful weighing-up of the advantages and disadvantages respectively of either air- or liquid-cooled engines. For aircraft requiring low powered units, e.g., trainers and sporting machines, in line or radial air-cooled engines are almost universally used, whilst for larger power units both types of cooling are employed.

The air-cooled engine has the following advantages. Its weight per horse-power is less than that of the liquid-cooled engine, due to the fact that no heavy radiator with the necessary pipes, coolant and controls need be fitted. The weight per b.h.p. of the Rolls-Royce Merlin II is 1.35lb., whilst the Bristol Pegasus XXVII, which is air-cooled, weighs only 1.24lb./b.h.p. These figures are important, as more payload or its equivalent, e.g., extra petrol to increase the range, may be carried when the engine with the lower weight for the same horse-power is fitted. An exception to this rule, i.e., that the air-cooled engine is lighter than the liquid-cooled type, was the Schneider Trophy Rolls Royce engine, which weighed approximately .7lb./b.h.p. This engine was specially built for racing only.

Through having no radiator, cooling liquid, pipes, etc., all maintenance difficulties connected with these parts and also freezing troubles in cold climates are avoided.

The cost of an air-cooled engine is less than that of a liquid-cooled one. Amongst the reasons accounting for this are the facts that, the crankshaft being very much shorter in the case of the radial air-cooled type requiring less machining, the number of bearings is less, and there is no radiator with its attendant accessories.

Efficient at High Temperatures

In climates in which high temperatures are reached the air-cooled engine has the advantage owing to the fact that there are evaporative losses from the liquid-cooled engine when the radiator temperature reaches approximately 80 deg. C. (this figure varies according to the coolant used). The air-cooled engine, on the other hand, can operate efficiently at higher temperatures.

An important point where military aircraft are concerned is the fact that air-cooled engines are less vulnerable to damage by enemy fire. If the cooling system of a liquid-cooled engine is hit, the engine cannot function for very long. A hit in the crank-case would allow the coolant to be lost, but an air-cooled engine would continue to run unless some vital part was damaged.

Maintenance is easier, due to the fact of greater accessibility and less accessories. Full power is acquired more quickly when starting.

Disadvantages

The disadvantages of the air-cooled engine are as follows. If a defect occurs in the cooling, its effects are probably not noticed for some time, whilst in a liquid-cooled engine the rise in temperature of the coolant would be recorded on the instruments in the pilot's cockpit.

The frontal area of the radial air-cooled engine is very much greater than that of the liquid-cooled type, and this fact greatly increases the drag. A Rolls-Royce Merlin (liquid-cooled) develops approximately 250 h.p. per square foot and a Bristol Hercules (air-cooled) develops approximately 90 h.p. per square foot. The losses in horse-power due to cooling increase as the square of the forward velocity increases so that the engine with the smaller frontal area for the same horse-power is the most efficient.

Owing to the shape of the radial air-cooled engine it is more difficult to produce a streamline fuselage unless the cowling is very carefully designed.

Streamlined Fuselage

The liquid-cooled engine possesses the following advantages over the air-cooled radial.

Most important of all is the fact that the frontal area is very much less. This allows a fuselage of almost perfect streamline shape to be adopted bringing the form drag down considerably. Even after allowing for the area of the radiator, the liquid-cooled engine has still the smaller frontal area.

The pilot's forward view from the cockpit is generally very much better when a liquid-cooled engine is fitted especially in the case of single-engine machines. This is a very important factor when taxi-ing on the ground or attempting to land on small or awkwardly situated aerodromes.

Higher compression ratios may be used resulting in increased power. This is due to the fact that the cylinders are cooled more uniformly than in the case of the air-cooled engine.

Fuel Consumption

The fuel consumption of a liquid-cooled engine is less than that of the air-cooled type. For flights of short duration in which the petrol consumption is small an air-cooled engine is the most economical but for long duration flights the liquid-cooled engine, despite its greater weight, is the most efficient, as less fuel will have to be carried. For example, an air-cooled engine weighing 1,100lb. and developing 750 b.h.p. (cruising) consumes 1,000lb. of fuel for a flight of 2 hours whilst a liquid-cooled engine developing the same horse-power but weighing 1,400lb., will consume 850lb. Totalling the engine and fuel weights it will be seen that for this short flight the air-cooled engine totals 1,100+1,000=2,100lb. and that the liquid-cooled engine's total equals 1,400+850=2,250lb. proving that the air-cooled type is more economical as a greater quantity of payload, i.e., useful load may be carried. For a long distance flight of 10 hours the position will be reversed as the total weights are now 1,100+5,000=6,100lb. and 1,400+4,250=5,650lb. The consumption of lubricating oil is also less in a liquid-cooled engine.

For military machines requiring protection against bullets and other anti-aircraft fire, the shape of a liquid-cooled engine's cowling gives a small inclination to the direction of motion thus allowing lighter armour to be fitted as the enemy fire will tend to glance off the cowling surfaces rather than to penetrate.

The Focke-Wulf Fw 190H

In conclusion, after weighing up the advantages and disadvantages of the two types it will be seen that for high-speed flight the liquid-cooled engine is the better proposition, and that the air-cooled engine is superior when fitted to low-speed aircraft. However, with careful cowling and improved cooling systems the air-cooled engine is still a serious rival to the liquid-cooled engine, as has been proved in the case of the Focke-Wulf Fw 190H fighter. This aircraft is fitted with a fourteen-cylinder two-row radial air-cooled B.M.W.801 engine. The cooling and the cowling are very efficient, a fan placed behind the airscrew improving the cooling, and a close fitting long-chord cowling being fitted. This power unit is very compact and enables the aircraft to possess a high degree of manœuvrability

THE WORLD OF MODELS

By "MOTILUS"

Modelling Under Difficulties : Realism in Model Railways : Specialised Model Work

An Architect's Model Work

I HAVE heard many strange and interesting stories, in my travels up and down the country, about people who have found solace and a certain amount of what I will call, for want of a better word, "steadiness," when firewatching, or during a distant raid, by concentrating their energies on model-making.

This hobby of theirs takes various phases. Some have a partiality for making waterline models of warships and merchant ships. Others prefer to construct intricate pieces of metal work, and some even undertake the long and more difficult task of building a model locomotive from castings and parts, according to the amount of tools they have at their disposal, and the conditions under which they have to perform their duties.

There is a rather fascinating, though at the same time poignant, story of a model-maker I had the pleasure of meeting recently. He is an architect, Mr. Gilbert J. Pratley, A.I.A.A., and here is the story which I have his permission to tell to you here.

In connection with his work as a civil servant he had to undertake A.R.P. duties on certain nights, and the suggestion of making a model railway station to while away tedious hours was put forward by one of his superiors at the office. Evidently this gentleman had taken a great interest in a special town-planning model, produced by Mr. Pratley in connection with his architectural duties, and it was planned that they should construct a complete layout comprising terminal and wayside stations, factories, bridges, tunnels and so forth, for the gentleman's young son.

This was a big project, and quite elaborate to embark on as a whole, and Mr. Pratley decided to make a beginning with a model wayside station which would be used as an independent unit and be incorporated finally in the whole layout.

The design was completed, produced to the appropriate scale on paper, and the basic work in wood was roughly finished by the week-end of April 12th, 1941. While carrying out his duties as a voluntary fire-fighter on the night of Wednesday, April 16th, Mr. Pratley was caught by the full blast from a land mine and three explosives, and sustained a fractured base of the skull, with concussion of the brain and other multiple injuries. He lay in hospital for several months, during which time he was unconscious for many weeks, but was gradually restored, by the great care of the nursing staff, to a feeble state of convalescence and was allowed to return home, although not fully discharged from hospital.

Cardboard, Glue and Paint

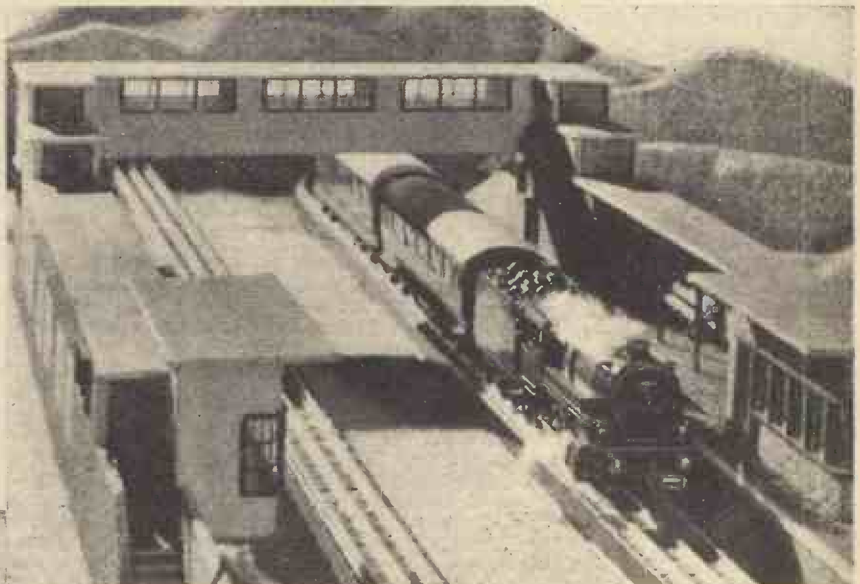
On his return home he found a large neat parcel of cardboard, glue, paints and other articles, but, try as he might, Mr. Pratley could not recall how or why they had been bought. When told he had purchased them from Kettles' the name "Kettle" did strike a sensitive note, and only then did he remember his visit to the shop, the very day that he had been injured in the air raid. In Mr. Pratley's own words: "I remember being on the first floor, and even recall the over-zealous salesgirl there, but my journey there and back, whether it was afternoon or evening, or during the morning, is still a complete blank. Curiously enough this trivial incident is the only thing that can be recalled in a four months' memory lapse."

Model Railway Station

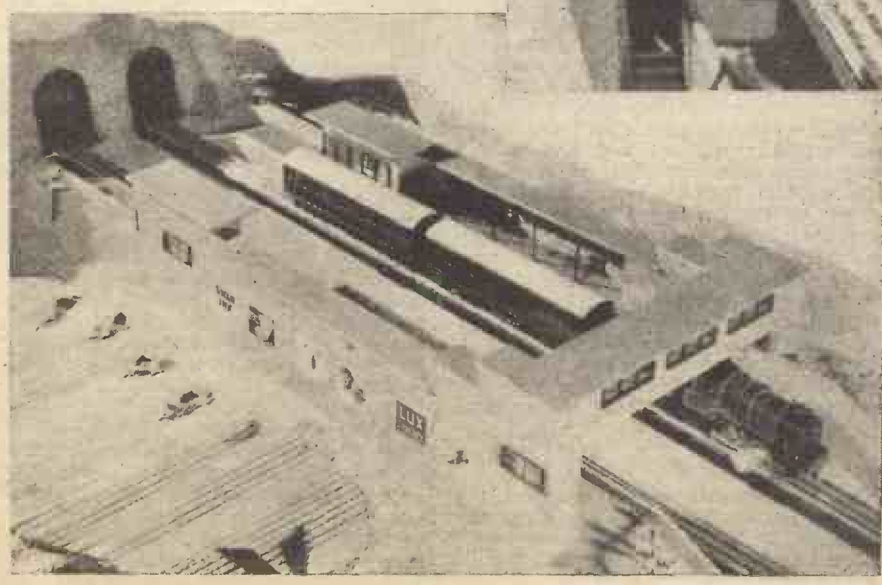
Mr. Pratley decided it would aid his powers of concentration and his faculties with regard to architecture and construction if he carried on with his model-making. He had the wooden base, the plans and necessary materials for construction, and, by a painfully slow process, eventually completed the railway station. Since then a lighting installation has been incorporated.

He believes that, quite unconsciously, he has carried out, by working the hands with the brain, a system which has now been advocated by the medical profession for shell shock and concussion of the brain cases, as aiding patients to regain their powers of concentration.

For the interest of readers the model has been constructed on a framework of wood, the actual building in various thicknesses of cardboard, painted with imitation stone paint, to give a concrete appearance. The windows are of thick Cellophane with projecting frames of cardboard, and the platforms finished in fine sand on glue with stippled paint finish. The small benches are constructed of bent 15 amp. fuse wire with cardboard seats and back, and the columns supporting the canopy are simply "nails, painted."



The wayside station, looking from the hill over the tunnel.



Another view of the station, with the overbridge in the foreground, and showing the tunnels.

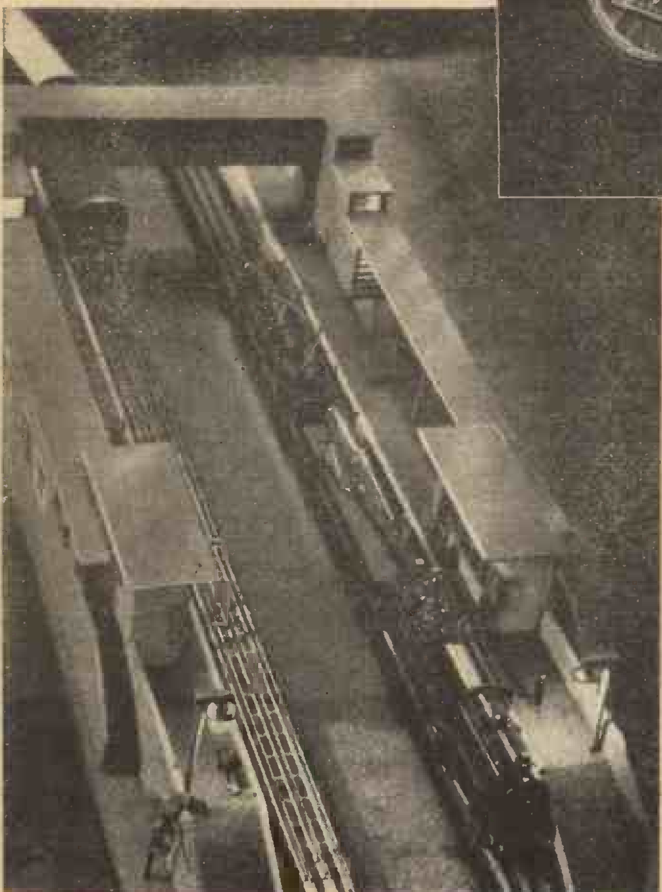
The excellent photographs, the work of Edward Mandinian, show the finished wayside station—a fine job, and doubly so when one considers under what conditions it was completed. Mr. Pratley's own residence, in which he worked, was badly damaged by blast and the whole of the model's construction was carried out during the early part of his convalescence, under rather difficult conditions. May he go from strength to strength, and I look forward to publishing a photograph of the finished railway layout one of these days!

Scale Model Accuracy

Different model railway owners strive for different perfections in their model railways. Some favour variety of locomotive types, some choose to have a superb assortment of passenger or goods rolling stock, and some prepare the nearest approach to a perfect model permanent way or work out an elaborate signalling system, but most difficult of all is to combine all these things into one realistic whole—scale accuracy on a model railway.

Mr. W. S. Norris of West Byfleet, Surrey, has, I think, reached as near perfection in this last respect as anyone I know. His railway, which is gauge "O" and based on G.W.R. practice, has been described in detail in the model railway publications, but I cannot miss this opportunity of showing readers of PRACTICAL MECHANICS just one picture taken on his railway, which depicts the marvellous realism he has achieved. It would take more than an expert to say it was not the real thing! Actually it is a gauge "O" six-coupled G.W.R. goods locomotive, with its train, passing under an openwork lattice station overbridge.

Trophy model of Rudge-Whitworth motor-cycle (silver plated), made for the Anglo-American Oil Co.



Night-lighting effect on Mr. Pratley's wayside station.

Realistic Track

Mr. Norris's railway, which is housed in an oblong shed 36ft. by 15ft., represents a typical piece of G.W.R. scenery between Taunton and Plymouth, and artist friends of Mr. Norris have succeeded in conveying this impression. Another feature worthy of mention is the appearance of the track. The whole of the track and conductors are painted a dull, rusty, dirty brown, which was made up of "black in oil" mixed with powdered red-lead and thinned down with turpentine alone. This, covering the sleepers and ballast near the rails, gives an absolutely "life-like" appearance.

Recently Lord Brabazon of Tara, who is now a director of Kodak, Ltd., and, as readers know, a keen model railway enthusiast, has been arranging the taking of a colour film of Mr. Norris's railway. I had the opportunity of viewing this the other day, and although I am quite critical when it comes to models and can usually spot in a professional film or photograph whether it is the real thing or "only a model," I must admit that in several shots of Mr. Norris's line, had I not known it to be a model railway, I should have been wrong in my conclusion.

Perfection in anything in this life is next to impossible to obtain, but when one comes so near as Mr. Norris, I think it gives encouragement to others who have aspirations in this direction, to strive their hardest.

"The Model Railway Handbook"

Writing of model railways reminds me that I have just perused a copy of the new edition of "The Model Railway Handbook," by W. J. Bassett-Lowke. This interesting book, which forms a practical guide to the building and equipment of model railways, tells the reader all he wants to know about miniature railway systems, from "OO" gauge to 15in. gauge passenger-carrying railways. The chapter giving the history and development of the popular "OO" gauge is specially interesting, as also is the description of gauge "O" locomotives and rolling stock.

Steam Locomotives.

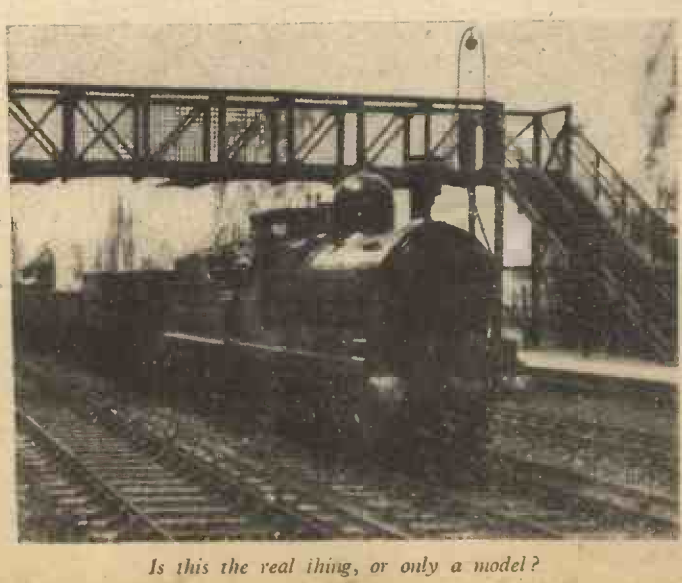
There is a chapter on steam locomotives of all gauges, and this is followed by practical details of track planning and construction. Signals and signalling are fully dealt with, and there are several practical hints on the manipulation of model locomotives—clockwork, steam-driven and electric. A feature of this invaluable book is the fine photographic illustrations, many of which depict the extraordinary realism which can be attained by the painstaking model railway enthusiast.

Specialised Model Work

Some years ago the Anglo-American Oil Company used to present to the winners of certain events in motor-cycle racing an exact replica, silver plated, of the machine they rode in the contest.

In looking through my collection of photographs of models I came across this picture of a trophy RudgeWhitworth model, which is a fine example of specialised model work of the 1920's.

A picture like this has a topical significance to-day, for by the time this article appears, the motorcycle will be well on the way to being "laid up" for the duration, as the basic petrol ration ceases in November.



Is this the real thing, or only a model?

Miniature Liners.

Other fine examples of specialised model work are the scale models of liners to be seen in the windows of various shipping companies in London, and other large cities.

PHOTOGRAPHY

Copying Old Prints or Photographs

The Type of Apparatus Necessary, and Details of Exposure and Development

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

SOONER or later every camera owner wishes to try making a copy of some specially attractive print, engraving, colour-picture or even an old photograph; this desire may come about as the result of another hobby, such as the collecting of old prints, autographs, foreign stamps or historical documents, or it may occur as the result of the loss of a negative.

It is quite interesting work, demanding rather more thought and care in its manipulation than is usually assumed, and it has its limitations, for successful copying cannot be accomplished with any type of camera; there must be the means for accurately focusing the picture or photograph that is to be copied, and this can only be well done with a camera having a focusing screen at the back and extending bellows. Without the provision for focusing the work becomes very much a case of "hit or miss."

I would therefore not advise the attempt being made with the box form, or cheap camera, or even a folding type, unless it is fitted to take plates and has the glass at the back for focusing.

Stand Camera Necessary

For the purpose of making the instructions clear, consider that it is one of those small engravings about 5in. by 3in. that is to be copied, and that the camera to be used is of the "stand" type taking half-plates (6½in. by 4¾in.), it has a fairly good lens, a rising and falling front, focusing screen and extending bellows; in fact, it is just one of those cameras which every photographer of thirty years ago was pleased to possess, and they are still in use in most studios, especially where "commercial" work is being done.

It is necessary that the print to be copied is placed on an easel in a rectangular position; the camera is then placed facing the print with the lens pointing straight at the centre of it. It should be on a bench where it can be moved easily without diverging to left or right, and it must be absolutely square with the easel and print, for parallelism is most essential. To ensure this, those who are constantly doing this work will, after they have focused, carefully measure the lines of the image, and also test them with a T-square to make quite certain that the angles at the corners are correct. One reason for this extreme care is that if the negative is to be used for making an enlargement of the original then the fault will also be enlarged, and will be so noticeable as to spoil the work.

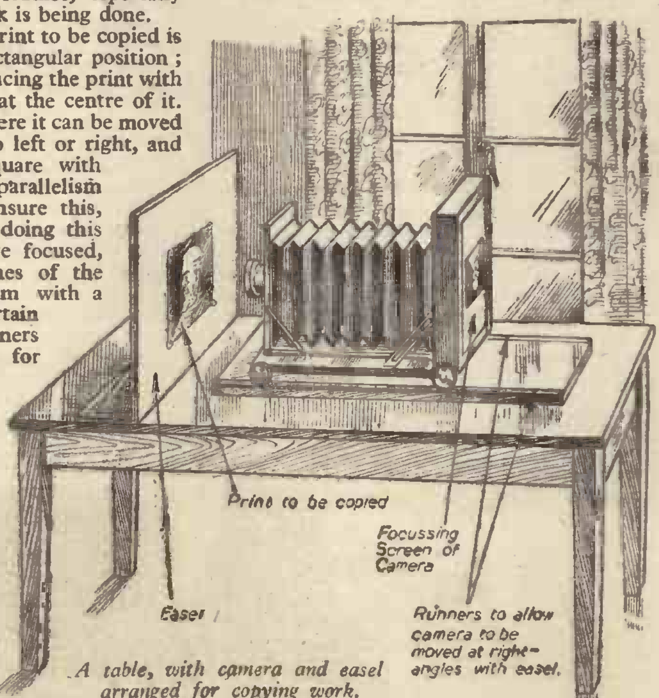
You will by now have realised that the camera is very close to the print, and you will also realise that that is the reason why the work cannot be done with a box camera or one with a fixed focus lens, unless a supplementary lens or a "copying magnifier" is fitted to the existing lens, such as some of you have for taking "close-up" portraits; but unless you know the focus of the lens you will still be working in the dark, for, as you will see, so much of the preliminary work is controlled by this factor.

Size of Copy

When making a copy the same size as the original it is easy to remember that the distance between the copy and the lens must be twice the focus of the lens. To explain this more fully let us assume that the lens on the camera in use is of 5in. focus, and the nodal point—the actual position on the lens from which the focus is measured—is situated on the front glass of the lens; in that case the distance from that point to the focusing screen at the back of the camera is 5in., and in order to make our copy the same size as the original that same point must be exactly 10in. from the photograph or print that is to be copied.

There is another formula which it is well to remember at this stage, as it will help very considerably in arriving at the correct distances between lens and copy and lens and plate, and this is linked with the linear dimension of original to the same dimension of the copy which is known as the "ratio." Here is the formula: multiply the focus of the lens by one more than the ratio to get the distance between the original and the lens. Example: Our original has a base-line of 12in. but the plate in use will only permit a maximum of 6in., the size it is intended to work to; the ratio of these two measurements is 2, add one to this $=3$, the focus of the lens is 5, $5 \times 3 = 15$in., so for the copy we are making the distance between the lens and easel must be 15in. If we intended to make the copy only 4in. across then the ratio is 3; this, plus 1, gives 4, the focus $5 \times 4 = 20$ for the distance between original and lens.

It must be noted, however, that to make use of this method of calculating the distance it is necessary to know exactly what spot on the lens is claimed to be the nodal point, or from where the focus of the lens is measured.



A table, with camera and easel arranged for copying work.

You will have seen that a double-extension camera presents no difficulty, for with a good lens, and the advantage of the rack and pinion focusing arrangement, together with two or three examples for calculating the distances, it becomes a simple matter for copying to any size within the limits of the plates in use, and where the original is much too large for the plate, then it is equally simple to make the copy a proportionate size and to enlarge from the negative up to the size of the original, if desired.

Lighting

This is an important factor. At one time it was customary to use daylight for the purpose, but this is now considered to be much too variable and uncertain and to-day we can make use of a medium more constant; for the professional or industrial photographer there is a nest of electric bulbs or the tubes of mercury vapour, but for the amateur a couple of bulbs can be adjusted to satisfy the requirements. It is difficult to get even illumination with one light, because of the falling off on that side of the object farthest away from the source of light; the ideal arrangement and position of the two bulbs is one at each side, and as close up to the easel as it is possible to get them without letting any of the light flash back into the lens. For this purpose it is better to bend two pieces of tin into semi-circular troughs about 10in. long, contrive to hang your bulbs in such a manner that these troughs can also be hung at the back of each bulb, thereby cutting off and preventing any light reaching the lens, and at the same time throwing all the light possible, not only from the bulbs, but also from the reflectors which the troughs will form. In order to avoid any "hard" points of light it will be found an advantage to use the frosted or opal bulbs rather than the plain ones. If for some reason it is only possible to use one bulb, then I would suggest that this be placed, for one half of the exposure, on one side of the original and then on the other side for the other half; you will be more likely to overcome uneven lighting than if the whole exposure be made with the light on one side, or from the top of the original.

Exposure when Copying

Even in the work of copying it is easy to make mistakes in exposure. It is unfortunately quite a common mistake with amateurs, for they are dealing with something that is so very different to ordinary outdoor subjects; in the print to be copied there may be just as long a range of tones between black and white as in a landscape, but the difference is the lighting. In the print every tone receives the same amount of light and there are no blocks of shadows on which to calculate as those shadows in the print are just flat dark colours. The fact that we are working close up to the original means that the camera is racked out, or that the lens is farther from the plate than usual, and this, you will remember, has altered the value of the "stops." You know that the opening for F8 on a 5in. lens is five-eighths of an inch in diameter, i.e., five divided by eight, but if the camera is extended to double, then, so far as the work in hand is concerned, that F8 stop is no longer F8, but F16, because the diameter of it is still the same, viz., five-eighths, but it is contained 16 times in 10in., the distance now between the lens and plate, and therefore the exposure time, must be increased. There are certain factors which have to be considered when judging for exposure; the chief of these are (1) lighting, (2) character of original, (3) speed of plate or film, and (4) aperture of lens. These are of such a varying character that it would take too much space to attempt to give any assistance, and it might confuse rather than help, so I must again remind you of that best of all aids to correct work, the "trial-strip." This is quite easy with a camera where the plates are in a dark slide fitted with a draw-out shutter, four or six exposures in strips can be made by drawing the shutter about an inch farther out for each; another way would be to cover up a portion of the original for each strip, taking note, of course, of each exposure. Here is a little guide which will save some time. A black and white sketch, engraving or print on a matt paper will require an exposure of one unit. Two units for a similar subject on glossy paper. Four for a brown or sepia print, and eight for a print where the dominating colour happens to be red. Usually it will be found advisable to use slow plates; if the original is black and white, then there is no purpose in using colour sensitive plates unless the original is faded and showing signs of yellowing through age. In that case it would be wise to make use of a yellow filter to overcome the discoloration. For coloured drawings, stamps and other items where colour is the main feature, it is necessary to make use of panchromatic plates with the filters suitable for the colouring.

Development of Copy Negatives

Where the subject was a plain black and white one, and it is desired to get brightness and a fair amount of contrast in both the negative and subsequent prints, I would advise the use of a solution developer known as "Contrast" developer; it is clean working and possesses that little extra power we sometimes want in our solutions, to get a sparkle in the ultimate results. For any other subjects I suggest using a regular developer, Azol, taking care to avoid either under or over development, correct development being essential in copy work.

Scrap-heap Logic

Many Ways in which Wastage of Machine Parts Could be Avoided

By F. L. BERRY, M.I.Mech.E.

"TWO men looked out through iron bars. One saw mud, the other stars."

So might two men look at a scrap heap. One seeing a heap of junk, where the other sees ideas, inspiration and a source of information. A scrap heap fed by several large works resembles a broker's yard, inasmuch as it has great possibilities if looked at in the right light. Each will contain gear that has failed at the outset, and some that has come to the end of a useful life.

It is said that the members of one profession hide their failures under feet of mother earth, but no such refuge is open to the engineer; his failures mock him from the scrap heap until they find oblivion in the melting furnace, to be born again in another and better form. A scrap heap very often contains the condensed information which gathered normally would be the work of years of observation. There it is all parcelled up. A book, every page of which tells a story of good practice and bad; and next to knowing what to do, it is important to know what to avoid. In these days when so many are doing work of which their experience is limited, a visit to the broker and the scrap heap is useful; often the university of the man who designs and builds, and uses gear.

If one fitter, for instance, had realised that a sharp scratch or cut on a piece of steel may have far-reaching effects, there might not be lying on one dump two lengths of 6in. forged shafting; originally there was only one, but a fracture divided the shaft into two parts as cleanly as though it had been separated with a saw. The oxidised fracture shows a long term gradual failure, and the starting-point is around a keyway, from which the fracture radiated like a crescent.

The fitter in squaring up the end of the keyway dug his chisel too deeply into the bottom of the groove, and left a V-shaped impression as a result, probably not realising that on such a large shaft it could have any bad effect. Under the alternating stress and strain due to a heavy drive, and an overhung gear-wheel, that groove began to spread as shown in the sketch, and at the end of three years the shaft parted. Wear was negligible and the shaft in excellent condition, but, unfortunately, in two pieces.

The scrap heap often reveals the folly of making large single-stage reductions in shaft diameters, instead of easing them off by two stages, or even three at times. The result is a sharp concentration of torque or bending strain at the weakened portion with various results; all troublesome. It is better and cheaper to break down at couplings by the simple expedient of fitting smaller diameters to suit the reduced call for power. Also, it is apparently worth while to fit heavy gears and pulley as near to bearings as possible, but many people seem to prefer the middle of the span.

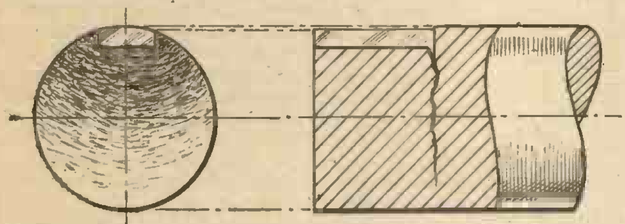


Fig. 1.—Sketch showing fractured shaft which failed owing to the gradual spreading of a crack from the bottom of the key seat, the start of the crack being a "V"-shaped notch left by the point of a chisel used to clean up the end of the key seat.

Worn Out

The term worn out is misleading, the actual reduction in weight which places a new mechanism in the category of the worn out is surprisingly slight; probably an estimate of 5 per cent. would be a generous allowance for wear. This fact trips up many who buy material on the basis of first cost. First cost fascinates many people, low cost looks well on the books, but a maintenance man knows the other side, and that running costs are more important and less obvious.

The work of machining and erecting does not vary greatly between one metal and another, neither does the cost of hold-ups, and common sense would suggest the advisability of reducing stoppages to a minimum, but the lure of low first cost ignores all this and often adds greatly to their number.

One man buys at, say, £20 per ton, expecting a life of six months, then come the upset of replacement and loss of output; his cost per month per ton being £3.3 plus cost of stoppages for replacements. Another man buys better metal at £30 a ton and carries on for 18 months, or £1.8 per ton per month, which in itself is a saving, but little compared with that due to cutting out two stoppages out of three. On a 5 per cent. of wear basis one man pays £400 per ton, the other £600, which difference is reduced in machining and erection, and the great advantage of the threefold life of the expensive stuff.

Replacements

Wear and replacements are the best friends of the men in overalls, but the scrap heap shows how increasing attention is now being paid to the problem of reducing wear, and neutralising its effects to the last degree possible, and instead of scrapping a heavy expensive part of a job, to so design the part that only the relatively small portions exposed to wear need be renewed, and these more easily and at far less cost.

One example may be taken from a pile of worn-out hauling drums from the in-and-out hauling gear of a large aerial ropeway. These drums were replaced at intervals of three months, and hung up the machine two turns on each occasion. Then a drum was adapted to receive a set of wearing pads, which were made of special, very expensive alloy steel. The pads were light, and could be easily replaced in a single turn. The first set of pads lasted three years, and, owing to their good shape being maintained, the wear on the wire rope used for hauling was much less in need of attention, and the rope had as a result a longer life than was possible on the original drums into which the rope quickly gouged a path of its own.

Conservation of High-class Metals

This saving of valuable metals and alloys was being feverishly developed in Germany before the war, and no doubt the Germans are now feeling the benefit of the policy. Most machines and gear are subject mostly to local wear, and yet, to meet this, the practice has been to build a whole part of high-grade steel, for instance, when such use was only justified for such areas as are liable to wear. The Germans set out to get over this by coating these vulnerable areas with deposits of metal specially suitable for resisting wear or corrosion. Only in very special cases did they use high-class metal throughout.

Fig. 2.—A fractured stone-breaker frame.

This system has resulted in the saving of much valuable metal and alloy; it also enables a user to get a longer life from a cheaper article, and affords the possibility of lighter repairs. It is a method which must be countered in the battle for trade after the present struggle is over.

On one dump is a large copper pipe; it had to stand considerable pressure, and was consequently fairly heavy and expensive. It could not be made of steel on account of corrosive action which had to be withstood. The pipe is now obsolete; a steel pipe much thinner being used for the job, and the corrosion is neutralised by means of a thin coating of copper deposited by chemical action on the steel surface. The cost is very considerable but less than that of the copper pipe, and repairs are less frequent.

Gauges on the Dump

As an instance of building up, or mechanical "face lifting," the following instance may be of interest. One large firm used in their inspection department a large number of steel plug gauges, ground to fine limits, which were in need of attention weekly, and constant replacement by new ones.

Now these same old discarded gauges have been given a coating of a very hard and highly resistant metal, which may be renewed as required, the gauge being used over and over again after a simple face-lifting operation which gives a life about eight times that of the best steel originally used.

Fig. 3.—This heavy casting was part of a 750 h.p. locomobile engine.

Object Lessons of the Dump

In Fig. 2 is shown a cast-iron stone breaker frame weighing several tons and costing over £500. It is of open box pattern, and is an open frame without top or bottom covering. The designer or pattern-maker neglected a very elementary maxim. He failed to fit fillets in the corners, or the fillets were so small in comparison with the 6in. of metal forming the frame, that they were practically non-existent.

The frame carried the gear used for crushing down granite spalls of 3 cwts. to cubes of 4in., and had to stand the hammering and jars due to 180 terrific blows per minute. After a few weeks' battering of this kind, cracks appeared in the corners of the frame. Welding up the cracks was not a success, the cracks spread until the casting was fractured, and the end came, as shown. New gear costing £500 went on to the dump.

Engine Frame

Fig. 3 shows another instance of faulty design on the part of a famous continental firm of engineers. It proves that even the best designers may err at times, and do things which are hard to explain. This frame of heavy cast iron was the main frame carrying the gear and motion work of a 750 h.p. cross-compound condensing locomobile engine, the frame being mounted on the top of the boiler.

In this case the crosshead pin was inserted from the open side of the frame, the nuts and cotter pins were therefore adjusted from the back or blind side, and in the cramped space available, a satisfactory tightening of the lock nuts was very difficult and required special equipment. For years the engine ran all right, but after one adjustment the crosshead pin got loose, and before the engine could be brought to a dead stop it had come out. The result was disastrous, cylinders were smashed and the frame was in several pieces—six tons of broken metal.

Had the crosshead pin been inserted through a hole made in through the back side of the guide, and nutted up on the front or open side of frame, where it could be seen and easily adjusted, this accident would not have occurred, and a repair bill of £1,500 would have been avoided.

Luckily a stoppage of five months was averted by a very courageous and risky repair job in which the frame was tacked together by welding, then reinforced by steel brackets and a very large amount of heavy welding. The frame stood up to the work and carried on for several years, apparently as good as ever.

Gearing

Probably no class of machinery is more abused in action than heavy spur and bevel gearing; until one has seen examples on the dump one would not believe a user would pay high prices for cut, or machine-moulded, gears, and then by callous neglect proceed to ill-use them and replace them when they wilted, or had so much backlash that the noise demanded their removal to the scrap heap.

One common failing seems to be due to a lack of appreciation that gears are designed to run at fixed centres, and any departure from the correct centre distance is bound to have detrimental effects. The most obvious fault is a tendency to exceed the correct distance, which in itself causes too much play in the gear teeth and would reduce their life by being in effect thinner and weaker at the outset. Gears also are too often housed in bearings that allow the gears to slightly spring apart under the stress of working. The result is a ridge on the teeth, and once this is formed there is nothing that can be done about it.

Probably there is no class of gear that is more badly used than bevel and mitre wheels engaged on heavy drives, often at high speeds. They have naturally a side and end thrust which is peculiar to themselves. Each is a cone upon which the mating gear tends to travel, forcing themselves apart axially and at right angles. In these circumstances the bearings have several functions; they must resist the side thrust and that along the shaft, the latter being taken by the bearing through collars on the shaft, or by the boss of the wheel being so arranged that the thrust is taken direct.

Naturally the bearing tends to recede axially and rock on the holding-down bolts, and stability depends on the width of the bearing base which acts as a fulcrum, and the position and number of the bolts engaged. Far too often bevels are housed up with bearings that are suitable for line shafts, or even spur gears, but are definitely unsuitable to take the end thrust of bevels.

To hold a bevel gear steady the bearing should have four bolts widely spread and the widest possible base to prevent rocking and ensure stability. It is not enough to anchor the bearings to the top of a concrete block and grout them in, they should be housed in a good sole plate and, better still, the sole plate should be of the double right-angle type, which will carry both bearings keyed up to the horns of the plate after setting, to automatically prevent any spreading of the centres, and if the thrust collars are adjusted and kept in order, the job is as near fool and wear proof as possible.

The concrete pillars should, of course, also be in one piece reinforced at the elbow. Then with an oil bath, or grease case for lubricating the teeth, quiet running and long life can be expected, always provided that they are well up to the power required.

Pulleys

These too often fall by the wayside and bear evidence of having had a hard, if short, life. From the dump one may gain some idea of what happens for instance, to wrought-iron and built-up pulleys when they are overloaded.

Any comparison between cast iron and steel is apt to rouse varied emotions, depending on the experience of those using them, and of the men installing and designing the layout. That is where the success or failure is decided. But one thing is obvious, that a wrought-iron pulley does not develop the silvery face of a cast-iron pulley and there is little doubt of the holding power of the latter. As the millwright says, it is "kind to the belt." It does give a grip that is soft and clinging, and it is as near the ideal as one may hope for.

Wrought-iron built-up pulleys have a harsher grip, and seem "dry," and those on the dump indicate that one is apt to rate their driving power too highly and overload them. The inevitable result being doses of resin, and various belt pastes and other aids to increasing power, not the least of which is the old method of tightening up belts until the tension is more than the belt should be expected to take.

The result is easy to forecast; continual doses of belt paste build up an artificial crown on the pulleys, in some cases half an inch high. Balata belts shed their inner plies, and leather belts unequal to the constant tightening process are soon in need of repair and renewals. Very few belts will stand the effect of the heat generated by slipping and overload. The pulleys on the dump show scarified surfaces, blue in parts, bright and shiny in some. There are many cases of pulleys in which the spokes have left their moorings, and whose ends project through the rim, which, pressed down by the load, leaves the ends of the spokes free to cut into the belts and hasten the destruction.

A little study of such pulleys would convince any sensible user of the true economy of being well on the top side of the power to be transmitted, and the folly of cutting down the width of pulleys and belts.

Useful Gear on Dumps

It does not by any means follow that when a load of scrap reaches the scrap heap, it is absolutely finished with. There are many cases, for instance, of such expensive gear as crane hooks which are in perfect condition, and suitable for use on other cranes. Many such have been retrieved to the great advantage of the buyer, who for a few shillings has become the owner of a hook which would have cost as many pounds. Shafts, too, may be turned down for other jobs; excellent material which has worn below the limits. In many cases shafts are taken back to the forge and drawn out to smaller diameter driving shafts. Old rails form the basis of hundreds of thousands of handsaws of good ordinary quality, and socketed shovels may at one time have carried a main-line express train

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on back cover must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the reader. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

Compressed-air Motor

I HAVE been experimenting with a view to making a compressed-air motor, consisting of a Pelton wheel driven by a jet of compressed air and suitably geared to transmit 1 to 1½ h.p. I would be very grateful if you could assist me by giving the following information :

(a) The size and capacity of air tank and the pressure of the air that would drive the motor for about 2 hours at 1 h.p.

(b) The size of the jet suitable for the above time and h.p. I had thought of fitting the motor and tank to a cycle. Do you think this would be possible ?—F. Tiplady (Newton Abbot).

THE proposed method of storing energy by compressing air and recovering it by using the air to drive a turbine is comparatively wasteful, and the overall efficiency is not likely to exceed 50 per cent.

The total energy corresponding to 1 h.p. for 2 hours is $120 \times 33{,}000 = 3{,}960{,}000$ft. lb. The energy of V cu.ft. of air at a pressure of P lb. per sq. in. is 144 P.V. ft. lb. Assuming a turbine efficiency of 70 per cent., the energy of the stored air would need to be $\frac{3960000}{0.7}$ $= 5{,}650{,}000$ ft. lb., and assuming an air pressure of 100 lb. per sq. in.

$$144 \times 100\ V = 5650000,$$

whence $V = 392$ c. ft.

This would correspond (for example) to a cylinder 8ft. diameter and 8ft. long.

For a pressure of 500lb. per sq. in. the cylinder would be 4.7ft. diameter and 4.7ft. long. The diameter of the jet would have to be varied with fall of pressure in the reservoir, or, alternatively, a number of nozzles might be used according to the power required.

Armature Connections

I SHOULD be much obliged if you could give me the following information :

What are the connections for a fractional h.p. (A.C.) armature with 9 slots and 27 segments to the commutator ?—E. E. Bevan (Bristol).

WHEN winding and connecting up a 9-slot armature with a 27-part commutator, the 27 coils are usually former-wound and taped up in sets of three, each coil having the start, two loops, and one finishing end left out for connection to the commutator. The loops, of course, form the finish of one section, and the start of the next already connected up, so that when winding the wires need not be cut until the triple coil is completed. The pitch of the armature connections to the commutator bars will depend on the relative positions of brush centre line and field pole centres. The rule is, after making all the junctions ready for connecting, to place one coil at right angles to the centre line of the poles in the field magnet, and then take its starting and finishing ends down to the two adjacent commutator bars, which lie nearest under the centre of one of the brushes. This will be the "neutral" or commutating position, in which the armature will run equally well in either direction. The remaining coils are then connected up in the same order. Should the rotation be in the wrong direction to suit the work all that is necessary is to interchange the two ends of the field coils, where at present connected. Details such as these will be found fully explained in A. H. Avery's "Practical Armature Winding."

Gas Producer Unit for Car

CAN you give me any information in regard to a gas producer unit for a 12 h.p. car, such as general working, maintenance, and constructional details ? Also, could you please recommend a book that deals comprehensively with the subject ?—John Sullivan (Stockport).

THERE are several producer units, suitable for 12 h.p. cars, at present on the market, among the best known being the Cowan (52, Grosvenor Gardens, S.W.1), the Hale (British Coal Utilisation Research Association, Rickett Street, S.W.6), B.V.P. (120, Pall Mall, S.W.1). The Government Emergency Transport Producer, though rather heavy in its standard form, could readily be adapted for a small car. This producer is one of the most successful, and information about it can be obtained from one of the licensees, e.g., Neil and Spencer, Ltd., The Cross Roads, Effingham, Surrey.

Regarding information in book form, we are afraid this is scanty. The "Hartley Report" on producer gas as an emergency fuel for motor vehicles, published by H.M. Stationery Office, price 9d., is the most useful, and provides a concise account of the subject. Articles on producers with reports on running-tests have appeared in the motoring press from time to time and inquiries to the publishers would enable you to obtain the back numbers containing such information, if they are unobtainable at your local library. The chemistry, physics and thermo-dynamics of producer gas are given in books on fuel, such as "Coal and Its Scientific Uses," "Bone and Himus," Longmans ; "Producers and Producer Gas," Wheeler Fuel Publications, Ltd. ; "Fuels," Haslem and Russell, McGraw Hill. The information given in these text-books on stationary producers applies equally well to vehicle producers.

A transport producer consists, in general, of three units :

(1) The generator, which may be "cross draft" or "up draft," according to the opinions of the designer, in which the fuel (anthracite or low temperature coke) is converted into carbon monoxide, the draft for this purpose being provided by the suction of the engine.

(2) The coolers, which are simply tubes through which the hot gases are led, and which are atmospherically cooled. They also provide a certain amount of dust removal.

(3) The gas filter, which is provided to remove the dust which would otherwise cause serious engine wear. Its design is one of the most important items of a producer, and one on which wide differences of opinion exist. It can be wet or dry with a great variety of packings, such as sizal grass, hessian, glass fibre, or a porous material such as coke. Whichever method is adopted, simple cleaning or replacement of the filter media is essential. Alternatively, an electrical method of dust precipitation can be used.

Maintenance of a vehicle producer, though not difficult, requires thoroughly understanding and conscientiously carrying out. The fuel bed must be kept clean and free from clinker ; the coolers must be cleaned and kept air-tight.

Electric Gas-lighter

WILL you kindly inform me as to what type of wire is required for an electric gas-lighter worked off a dry-battery ? What is the gauge and length of wire needed to give a red glow with (a) a 1½-volt cell, (b) 2 1½-volt cells, i.e., 3 volts ? Where could I obtain the wire ? Also, can you explain why a dud dry-cell which I had gave a full voltage reading on the metre, and yet would not light a bulb ?—L. V. J. Reid (Newry, Co. Down).

NICKEL-CHROME wire of about 40 S.W.G. will be suitable for your purpose. A few inches only will be required, the best length being found from actual trial. It only requires to redden visibly in air, but in the gas stream will incandesce brightly. The wire is obtainable from the British Driver-Harris Co., Ltd., Gaythorn Mill, Albion Street, Manchester. Referring to the other inquiry, a dry-cell will frequently give full voltage on a voltmeter reading if the instrument is of sufficiently high resistance, but an "open-circuit" voltage such as then obtained is little guide to the condition of the cell. If its internal resistance is high and the cell nearly spent, the open-circuit voltage would immediately drop directly any appreciable amount of current were taken from it. For that reason a lamp test is more reliable as it ensures a definite current output from the cell at the same time as the test is being made.

Electro-gilding and Plating

I WISH to construct a small gilding and silver plating plant, and shall be glad if you will give me any information on

this subject. I want it to work off the mains A.C. 230 volts, 50 cycles. I have all the vats and solutions, as I have run a plant for several years on D.C. mains, but I have now moved to a house where there is only A.C.

Would a large A.C. transformer do this work—230-volt primary to 8-volt at 6 amps., or 230-volt to 20-volt at 4 amps? Can you give name of firm supplying parts for a small plant?—A. S. Sherlock (Portsmouth).

IF you have now moved to a district where only alternating current is available, an ordinary step-down A.C. transformer will not meet your requirements, unless you contemplate also putting in a dry rectifier of the copper-oxide or selenium type. Electro-depositing, of course, necessitates direct current, and your output from the low voltage terminals of an A.C. transformer would still be alternating. Particulars of rectifiers can be obtained from Messrs. Crypton Equipment, Ltd., North Acton Road, Park Royal, N.W.10, or from the Westinghouse Brake & Saxby Signal Co., Ltd., York Road, London, N. In our opinion, however, it would be preferable to install a ½ h.p. A.C. induction motor operated from the main 230-volt A.C. supply, and direct-coupled to a D.C. 4-6-volt D.C. shunt generator, with an output capacity of about 25 amperes. Electro gilding requires from 2 to 4 volts terminal pressure at the vats. All equipment for plating and depositing is obtainable from W. Canning & Co., Ltd., 133-137, Great Hampton Street, Birmingham 18.

Preventing Shrinkage in Plastic Wood

I HAVE been experimenting with plastic wood for the making of small toys and fancy buttons for some time, but I have not had much success as yet. My main trouble is that the plastic wood I have bought, and also made up myself, shrinks considerably as it is drying out. I have been using rubber moulds for casting the above articles. Can you suggest anything to stop this shrinkage?

I have heard there is a formula for making a plastic wood that will not shrink. Should the moulds be made of some other material? If so, can you suggest what same should be made of?—J. W. Edminson (Newcastle-on-Tyne).

ALL plastic woods contract on drying out and hardening, but it is possible that you will be able to prevent this to a large extent by mixing a small proportion of silica flour, or, better still, micro-asbestos with the plastic wood. Micro-asbestos can be obtained from The Turner Asbestos Company, Ltd., Rochdale, Lancs.

If you have trouble with getting the hardened composition out of the moulds, lubricate the latter with an emulsified wax solution, such as Johnson's "Glocoat," which is on sale at the majority of the popular stores. A type of plastic wood composition which is said to shrink less than the ordinary material is that which is based on the use of casein. A typical formula is:

Casein	50 parts (by weight).
Slaked lime	8 ,, ,,
Trisodium phosphate	3 ,, ,,
Sodium fluoride ..	3 ,, ,,
Naphtha	2 ,, ,,
Hardwood sawdust	34 ,, ,,

Make the above into a thick paste with water immediately before use. For the required casein, you can use ordinary casein glue powder, such as "Casco," or any other proprietary brand of such material.

Extracting Carmine from Cochineal

I SHOULD be grateful for any information that you can give me regarding the extraction of carmine from cochineal. I have tried extracting with the various solvents of carmine, such as water, alcohol, and ammonia, and then crystallising, but each time I obtain a different coloured product. The cochineal is rather crude, being just the insects crushed to a fine powder. I am hoping to use the carmine as a dye.—D. Green (West Kilburn).

IN order to obtain carmine from cochineal, extract the crushed insects with water (boiling) until a deep red solution is obtained. This should be filtered off from the residue and the latter again extracted with boiling water. The water extracts are mixed and evaporated down to fairly small bulk. To this concentrated extract add fairly strong common alum solution until no further precipitate occurs. This red precipitate, known as "carmine," contains about 74 per cent. of carminic acid. If you wish to obtain pure carminic acid instead of the carmine, add to a concentrated aqueous extract of cochineal a fairly strong solution of lead acetate or lead nitrate. This precipitates the lead salt of carminic acid. The lead salt is then suspended in water which is gradually made acid with sulphuric acid. Carminic acid is liberated and lead sulphate is precipitated as a white powder. This is removed by filtration, leaving the solution of free carminic acid which is concentrated by heat and then allowed to crystallise.

In the above preparation, it is essential only to add as much sulphuric acid as is required for the decomposition of the lead carminate, otherwise the liberated carminic acid will be contaminated with free sulphuric acid.

MINISTRY OF SUPPLY

Defence (General) Regulations 1939
No. 55. S.R. & O. 1942. No. 1770

AN ORDER

RUBBER MUST NOT BE DESTROYED THROWN AWAY OR MIXED WITH REFUSE

The Minister of Supply in exercise of the powers conferred on him by Regulation 55 of the Defence (General) Regulations 1939, has made an Order which provides as follows:

1 No person shall, except under the authority of and in accordance with a licence granted or a special or general direction issued by the Minister of Supply,

(a) destroy any waste rubber

(b) throw away or abandon any waste rubber

(c) put any waste rubber in a refuse bin or other receptacle used for domestic or trade refuse, or

(d) cause or permit any waste rubber awaiting or in the course of collection or sale to be or become mixed with any material or article other than waste rubber.

Provided that nothing in this Order shall prohibit or restrict the destruction of any waste rubber if and so far as necessary in the course of any process of manufacture, or for the purpose of saving property from immediate danger of destruction or damage by fire.

2 (1) The holder of any licence granted under this Order shall comply with any conditions contained or incorporated in the licence.

(2) If any licence so granted is revoked by the Minister of Supply, the holder of the licence shall forthwith deliver up the licence to the Minister or as directed by him.

3 IN THIS ORDER: "*rubber*" includes reclaimed rubber, liquid latex, gutta percha and balata, and "*waste rubber*" means any worn-out, disused, discarded or waste material or article of the classes or descriptions specified in the Schedule to this Order, but does not include any material or article which is injurious to health or otherwise offensive.

4 This Order shall come into force on the 7th day of September, 1942, and may be cited as the Salvage of Waste Materials (No. 4) Order 1942.

THE SCHEDULE

(a) *Articles or materials of any of the following descriptions made wholly or partly of rubber:—*

Balloons ● Balls — sports and toy ● Bathing-caps ● Beds — inflated and sponge ● Bulbs — horn, surgical, etc. ● Carpet underlay ● Catapult strip ● Corks and Closures ● Corsets — all rubber ● Crepe-soled Footwear ● Cushions Inflated and sponge ● Door-stops ● Draught-excluders ● Ear Plugs ● Elastic Cord and Thread ● Electric Cable and Wiring ● Football Bladders ● Footwear (including Wellingtons and Gum Boots) ● Flooring and Tiling ● Gloves ● Goloshes ● Grips — handlebars, etc. ● Horse-shoes and pads ● Hose and Tubing ● Hot-water bottles ● Jar-rings ● Mats and Matting ● Mattresses — inflated and sponge ● Milking Rubbers ● Pedal-rubbers ● Radiator Hose ● Rollers ● Soles and Heels ● Sponge-backed Flooring ● Sponges ● Squeegees ● Stair-treads and nosings ● Stopper-rings ● Teapot Spouts ● Teats and Soothers ● Tobacco Pouches ● Tubing ● Tyres — Pneumatic (Covers, Tubes and Flaps), Solid and Cushion of all types ● Upholstery.

(b) *Articles or materials of any other description made wholly or mainly of rubber.*

THIS ORDER CAME INTO FORCE ON SEPT. 7

THE Cyclist

Editor: F. J. CAMM

VOL. XI OCTOBER, 1942 No. 248

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

Phone: Temple Bar 4363

Telegrams: Newnes, Rand, London

Comments of the Month By F. J. C.

Road Accidents

MR. P. J. NOEL-BAKER, M.P., Joint Parliamentary Secretary to the Ministry of War Transport, stated in a note that the number of children killed on the roads in July shows a reduction, compared with last July, of nearly one-third. They are still substantially higher than they were in peace-time, notwithstanding the gradual reduction in the number of mechanically propelled vehicles on the road. In the first seven months of 1939 the number of children killed on the roads was 572. In the same period of this year, when there were far fewer vehicles on the road, the death roll was 736. There is, moreover, a danger that now that private motoring is practically abolished except for essential work, pedestrians may be tempted to take chances. Parents may be inclined to relax their usual vigilance. Drivers may seize the opportunity afforded by a clear stretch of road to drive a little faster than is consistent with safety. The facts do not give cause for complacency or relaxation. Every ten minutes of the day somewhere on the roads of Great Britain a child is knocked down and injured. Every month more than 100 children die from their injuries, and a great many more are so badly hurt that they may have to go through life permanently maimed or disfigured. So long as a single life is marred or lost as a result of an avoidable accident no one can afford to relax efforts. Each of us has a personal duty in the matter to do everything possible to eliminate what has become a social disgrace.

That is briefly the text of Mr. Noel-Baker's note. In order that we may see the whole problem in its correct perspective it is necessary to go back a little and to consider some of the statements of past Ministers of Transport. Before the war new vehicles were coming on the roads at the rate of hundreds a week, and Mr. Hore-Belisha ascribed the rise in the number of accidents as due to this increase in road vehicles, as well as to excessive speed. This argument is somewhat paradoxical, for if the roads were becoming congested as a result of an increase in the number of vehicles using them, it is obvious that speeds would be reduced perforce, not increased. This, as a fact, is the official view, for statistics published before the war show that the average speed of vehicles through London was about seven miles per hour. The speed limit was abolished for a time, but as accidents continued to rise it was re-introduced by Mr. Hore-Belisha at the increased level of 30 miles per hour. Still the accidents rose, and perhaps the worst aspect of the problem is that they rose in built-up areas which were subject to the speed limit, and showed in many instances a decline on roads not subject to the speed limit. All of this goes to show that we have been tackling an effect instead of a cause, and that speed *per se* is not a prime cause of accidents.

The erection of pedestrian crossings and Belisha beacons, and island roundabouts has not reduced them. The solution to the problem lies in a drastic reform in our road policy. We are trying to make an obsolete road system work by a process of inflicting penalties and regulations on those who have paid heavily to have the roads modernised. The money, as we know, has gone to balance the Budget. There has been a vast increase in the Highways Rate in recent years, and it is true to say that almost everyone has contributed to the making and upkeep of roads. We want more roads; we want duplicated trunk roads. We do not want to make present roads do by segregating cyclists to cycle paths and creating penalties for road users which do no more than to fill the police courts without contributing an iota to the problem of accident reduction.

The Bressey Report for the re-planning of London was shelved before the war because it would have cost £20,000,000 to carry it out. In view of present taxation and the possibility of further taxation which may be necessary after the war to carry out post-war reforms, it seems likely that the Bressey Report will be shelved for very many more years.

At a time when mass slaughter is going on all over the world there are some who may think it insignificant to consider a few hundred people who are killed on the road every month, but this is the period when everyone is talking about post-war plans. We do not want to wait for peace to descend before anything is done. War-time resolutions about the post-war, like sick-bed promises, are likely to fade like a cloud upon the silent summer heaven. The time to plan is now; war or no war. We cannot afford to go on losing valuable lives. The sooner that Ministers of Transport regard themselves as Ministers for the development of roads, the sooner will they cease to need to regard themselves as the recording angels of accidents.

The Mass-start Problem

AFTER an examination of the various Acts, and after consultation with Government officials, we express it as our opinion that mass-start racing is not illegal provided that it is run in accordance with the law. Such a race must not be run to cause obstruction; it must not endanger other road users. Cycles are not specifically mentioned in the Act which forbids games on the highway. In fact, the Act was passed in the pre-bicycle era and could not possibly therefore have been intended to apply to bicycles.

Now the N.C.U. is opposed to it. Certain riders want mass-start racing. It is not in the best interests of cycling for certain riders and certain clubs to oppose the ruling body. If their wish is general, they can obtain their ends in the constitutional manner by a special general meeting, by a petition, and in other constitutional ways. The best method is usually the quickest method. To ask for permission, and then to defy if the permission is not granted, is a challenge to authority.

To run such races without asking permission is worse. The fact that the police have co-operated in the running of certain mass-start races suggests that in certain districts the police would not oppose them.

No doubt the N.C.U. has the matter well in hand, and as a democratic body will consider the matter impartially; and if club cyclists want mass-start races they will permit them. We support their attitude in refusing to give way to defiance. The R.T.T.C. is supporting the N.C.U. in the matter. Wise counsels should prevail, otherwise if the movement gathers momentum, rival bodies claiming to be national bodies will be created. This has happened before, and it can happen again. We do not need more national bodies; we could do with far less. Those which have become recognised have the machinery and the long experience necessary for controlling all branches of the pastime, but they must be sufficiently flexible to change their rules and their policy if necessary to meet the changing times.

A governing body must view the matter *impartially* and without *bias*. Perhaps the whole question of mass-start races could be considered by the National Committee on Cycling and an announcement be issued stating the policy of organised cycling generally. This is a far better plan than for officials of various bodies to issue opinions which quite often conflict, and thereby cancel out one another. If the National Bodies cannot agree others may step in and decide the matter for them.

Traffic Lights at Night

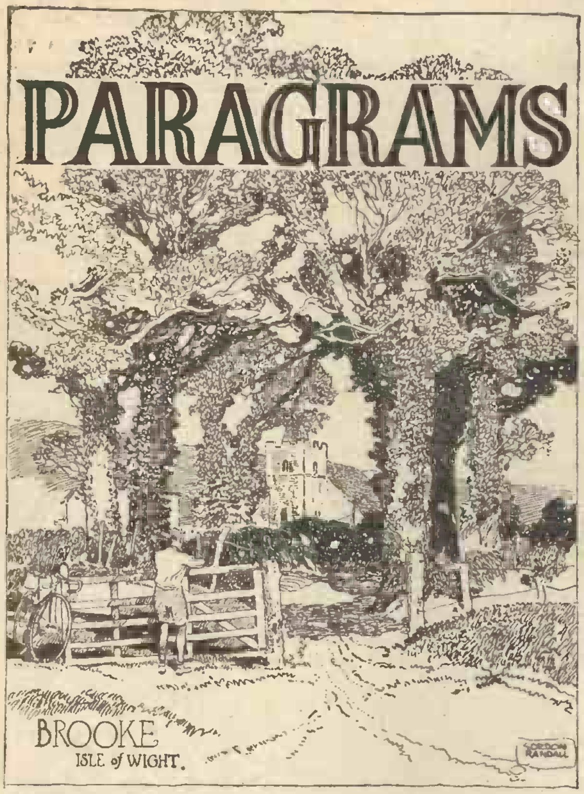
TRAFFIC lights may be switched off altogether at night time.

The Ministry of War Transport has received from the National Committee on Cycling a suggestion that the masks of the lights should be removed and so show them at full strength in the day time. To save electricity, the Committee add that, in view of the reduction in motor traffic, all traffic lights might safely be switched off at night time.

"Consideration is at present being given," the Ministry replies, "to the possibility of shutting down signal installations, or operating them for reduced hours, where traffic volumes have so diminished that signal control would be a hindrance rather than a help to the traffic remaining.

"The Committee will appreciate that during the winter months it is not possible to extinguish signals where there is a considerable volume of traffic during black-out hours as, for example, for the early evening."

Since this announcement the Ministry of War Transport have stated that they propose to black out a large percentage of traffic lights for the duration of the war.



Club Meeting Aids Charity

OVER £550 was raised by Brentwood Road Club at an athletic and cycling meeting held in Brentwood. The money was donated to charity

Veteran's Fatal Accident

THE Rev. Sidney Swann, who died at Lindfield, Sussex (the village of which he was formerly Vicar) was one of the finest all-round athletes known. He excelled in cycling, running, swimming, sculling, rowing and football. The famous veteran died as the result of a fall when cycling.

Tandem Tricycle Records Broken

R. MORFORD and George Lawrie lowered the London–Bath–London and 12-hour tandem tricycle records by substantial margins. They went to Bath and back in 10.50.34 and did approximately 232½ miles in twelve hours. They have beaten three National records this year.

Club Founder in R.N.V.R.

WELL KNOWN in County Durham, a founder member of the West Pennine C.C. and a member of the South-east Lancashire Road Club, Percy Scholes is now a lieutenant in the R.N.V.R.

T.T. Secretary Missing

CHAMPION and Time Trial Secretary of his club at the outbreak of the war, Sergeant E. Saunders, of the Wing S. and S., is reported missing in the Middle East. He was with the R.A.F.

Club Members Missing

K. S. CHURCH and J. Cartwright, East Midland Clarion C.C., are reported missing in the Far East

Club's 100 Awards

BARNSLEY Road Club members have secured well over 100 awards in open events this year.

Well-known Riders Killed

HARRY ROSENBERG, well-known Vegetarian C. and A.C. short distance rider who was prominent in several open events prior to the war, has been reported killed in action in the Middle East.

David Burness, former time-trialist of Zenith Wheelers, has died of wounds in Egypt. He was with a Scottish regiment.

Young Club Riders

ALTHOUGH only 15 years old, Ron. White, Poole Wheelers, has returned 1.7.53 for a "25." His 17-year-old clubmate, Vivian Dicks, has clocked 2.19.59 for a "50."

Club Champion Missing

TOMMY FRITH, former club champion of Withington Wheelers, is reported missing off Malta. He was with the R.A.F.

Dulwich Clubman's Marriage

DOUG. BENNETT, Dulwich Paragon C.C., and Rose Martin, Fountain C.C., have married.

Club News in Middle East

CLUBMEN in the Middle East are kept well informed of latest club news by a cycling column in a Middle East pictorial weekly edited by J. Walker, well-known London clubman, who is now a staff sergeant.

Club Secretary Killed in Action

FOR several years secretary of his club, David Kinseld, Walsall C. and A.C., has been killed in action in the Middle East.

A Fast "50"

BY clocking 2.9.48 to win the Glasgow Nightingale "50," George Hannah, West of Scotland Clarion C.C., clocked the fastest "50" to date ridden in Scotland for two years.

Fastest War-time "100"

THE fastest war-time "100" of 4.29.27 was clocked by D. K. Hartley, Dukinfield C.C., when he won the classic Bath Road "100."

Affiliations to R.T.T.C.

OVER 30 clubs, approximately half the pre-war figure, are affiliated to the North Midlands D.C. of the R.T.T.C.

An Amazing "100"

AN amazing ride was performed by R. J. Brown, the one-armed rider from Hounslow, when he clocked 4.44.2 in the Bath Road "100."

Veteran's T.T. Win

A BRILLIANT ride of 214½ miles was accomplished by Arthur Rogerson, veteran member of Spen Valley Wheelers, in the Nor-o'-London 12-hour time trial. He won the event by ten miles.

Comet C.C.'s "25"

THE open "25" promoted annually by the Comet C.C. has attained its coming-of-age.

Team Race Record Beaten

THE Eastern Counties Cycling Association's 25-mile team race record was beaten by the Clyde C.C. trio (A. Hobbs, F. Weeks and E. W. Yorston) when they aggregated 3.11.15 in an E.C.C.A. event. Hobbs clocked 1.3.6 to make fastest time.

Veteran Passes Over

BY the death of Harry Osborne at the age of 85, an early link with the old record days is severed. He figures in the R.R.A. handbook as the first holder of the London-York record in 1889 with the time of 21 hrs. 10 mins.

Three Fast "25's"

JACK SIMPSON, Barnsley Road Club, registered three rides inside 61 minutes for 25 miles in three consecutive events.

12-Hour Events

SPLENDID results have been obtained in 12-hour events. In the North Road "12" the winning distance by R. Kitching, Yorkshire Road Club, was 233¾ miles and in the South Western "12" J. G. Whitcombe, Twickenham C.C., rode 236 miles to win.

"Unknown" Rider's Fast "50"

A COMPARATIVELY "unknown" rider, 22-year-old Arthur Overton, Kingston R.C., beat many well-known and fancied riders, in an important open "50" by clocking 2.9.37.

"Ordinary" Record Holder's Death

J. F. WALSH, familiarly known as "Conger" Walsh, has died. He was 79 and held road records on the "Ordinary" at 50 and 100 miles, in 12 hours and 24 hours respectively

Old Timer Passes Over

ANOTHER old timer to pass over is P. H. Beveridge, one of the North Road C.C. life members. He was 71 and a well-known figure on the road.

Clubman's Fatal Accident

ACCIDENTS in road time trials are rare, but in the Manchester and District T.T.A. "30," H. Collier, Burslem Olympic Wheelers, was involved in a collision with a heavy lorry and sustained injuries from which he died.

Lord Dunedin

THE death of Lord Dunedin recalls that he was a keen cyclist. He once cycled 400 miles from his constituency to the Houses of Parliament and parked his machine in the House of Commons. For this, as would naturally be expected at the time, he was severely criticised—the main criticism being that he was "lowering the tone of the House."

Recommendations for Rural Britain

AMONGST recommendations by the Committee on Rural Land Utilisations are that national parks should be established, that level crossings should be abolished, and that where main roads cannot be improved satisfactorily they should be replaced by new trunk roads.

Outcry Against Excessive Frame Prices

CYCLE trade circles are protesting against the high charges being made by certain firms for light-weight bicycle frames. One firm is reported to be selling these for about £18. The frames have the best of equipment and are chromium plated. It is considered that the material and time needed to make such a frame would be better put into utility machines.

Fined £100 for Receiving Stolen Bicycles

JOSEPH TODD (34), motor driver, of South Shields, was fined a total of £100 at South Shields last month on nine charges of receiving stolen bicycles. His brother, Alexander Todd (28), also a motor driver and of South Shields, was fined £20 for receiving one bicycle. Both men denied the charges.

A 16-year-old boy had previously been bound over at the juvenile court for stealing the bicycles.

Catering for the Holidaymaker

LATE holidaymakers and week-enders are being given special consideration by the Scottish Y.H.A. this year. A large number of hostels are to remain open throughout the winter.

Glasgow's Move

ONE-WAY traffic in 12 thoroughfares and operation of three sets of automatic traffic lights have been abandoned in Glasgow for a period of three months, when the matter will be reconsidered.

Hostel in Calder Valley

A NEW hostel has been opened at Mankinholes, near Todmorden, in the Calder Valley, West Riding. It has room for 36, and is close to Stoodley Pike, a well-known Yorkshire landmark.

New Hostel at Saffron Walden

SAFFRON WALDEN, the Essex town known to many London cyclists, is to have a youth hostel. A Tudor house has been secured from the Society for the Protection of Ancient Buildings, and is being converted into a hostel.

A Penny Off

THE West Riding Regional Group of the Youth Hostels Association has taken the penny formerly charged for cooking off its rates. The surcharge is still made at the hostels of the Lakeland Regional Group, however.

Scottish Hostel Reopens

TIGHNABRUAICH Youth Hostel, on the Kyles of Bute, has reopened after being closed for some two years. There is accommodation for forty.

Scrapping the Signposts

OLD-TYPE signposts made of iron are to be salvaged for scrap where their removal would not entail great labour or expense.

Three Months for Bicycle Thefts

A COWDENBEATH man was sent to prison at Stirling for the theft of six bicycles from various places in Edinburgh, Stirling, and Dunfermline.

Stole Mate's Bicycle

A MAN who stole a fellow-employee's bicycle from a rack at a Renfrewshire munition factory was sent to prison for thirty days at Paisley Sheriff Court.

Dutch Bicycles for Germans

WHEN the Nazis in Holland requisitioned men's bicycles recently it was thought that the bicycles might be needed for anti-invasion exercises.

Hundred Frames Await Owners

DURING the past summer many hundreds of bicycles were stolen in Scotland. It is suspected by the police that the thieves sell the stolen machines to dealers for £2 or £3 each, the latter then re-selling them at a profit.

At one Glasgow police station there are 100 bicycle frames awaiting their owners. The frames have all been recovered by the police in the last 18 months.

A view of the Keep, Farnham Castle, Surrey. Dating from the 12th century, it was once one of the greater castles of Surrey, standing close to the Pilgrims' Way.

Around the Wheelworld

By ICARUS

The Hard Core

THOSE clubs which have not suspended activity during the war have been enabled to carry on because there is a hard core of older members beyond military age who are able to take over the various offices and continue the activities of the club. In most of the old clubs it is inevitable that there will be a considerable number of members between the age of 50 to 70 or more. The new generation, or rather the younger generation, do not always regard these oldsters in a kindly light. They refer to them as "dead-beats" or "has-beens," and are quite unmindful of the fact that but for these old members who laid the foundations of the club it would not be in existence.

Most of the younger cyclists are without experience of running clubs, and so the older members act as mentors, and train the younger ones in the duties of secretary, editor, or treasurer. It is wise to have a sprinkling of younger men on the committee if only for training purposes. I agree that in some cases the older men become inordinately proud of their past exploits and endeavour to live too long on a reputation which has gone before. Because they broke a record in the days when it was comparatively easy to break a record (and this holds true for nearly all the old records), they like to bask in the waning sunlight of publicity, and the adulation of the younger ones who like to wear a halo of reflected glory. A lot of these oldsters are vainglorious people, and become club bores to be avoided.

They did some mildly spectacular thing in their early days and want to live on their reputations for ever. Because of this mild past feat to which in many cases quite an undeserved glory attaches (some of the early races were run on very questionable lines; professionalism had entered the ranks of amateurism and many a race was bought!) these conceited nonentities presume that they know all about cycling. They are few in number and form a somewhat noisy minority. Equally, there are many youngsters with a large bump of conceit who think that cycling started when they entered the sport. By and large, however, the older men become mellowed with the years; their conceit fades, and they view their past exploits through a mental magnifying glass, because such have paled into microscopical insignificance. They can become amusingly reminiscent, and fortunate indeed is the club that has them in its ranks.

One of the conceits of the undesirable old member is the fact that he still rides a bicycle, and his measurement of any other individual is according to whether he still does ride a bicycle. If he does not, he is a moron, a social outcast. Provided that a man retains his interest in cycling he has the qualifications for membership. It is the interest which counts. It keeps the club alive, whilst the man who is a member merely because he rides a bicycle is using the club for selfish interests. It provides him with good fellowship, and an audience to listen to his exaggerated stories of his past deeds of derring-do.

A Memory

I HAVE the following interesting letter from Mr. G. Latham of Old Colwyn. He says: "Whilst cycling through the Conway Valley recently, I was reminded of an incident which occurred some years ago, 27 years, to be exact. I recollect quite clearly exactly what happened, the very words used, and it was because I met an old exponent of the sport recently that the memory came vividly back to my mind. It was the year 1915. I was stationed at picturesque Potter Heigham in Norfolk; a member of the Royal Sussex Cyclist Battn., and had joined my pal, Bert Harrow, of the same company, on a run to Gt. Yarmouth, which is a matter of 10 miles from Potter Heigham. It was a grand evening in September and we were both young, and well trained as cyclists. I was never anything *extra*, but I could do a steady 12 to 15 miles per hour, and an occasional sprint around the 20 to 25 m.p.h. mark. Bert Harrow, however, was, without doubt, 'some' cyclist. Well built and six foot in his socks, he was well known on the Gt. North Road, etc., and once he got going I had all my work cut out to keep him in sight. Well, we got well under way and Bert made the pace. Very nice road and good conditions generally. Our machines were of the club variety and around 75 or so. We left most other road users going our way, in the first 10 minutes, after which we heard no sounds other than the swish of well-oiled chains and that caused by our tyres on the gravel road. There was nothing near us either way, then suddenly, we heard the sound of other tyres than our own, in our rear! Someone was *well* down to it. 'Don't look round,' said B. H. to me— 'we'll lose him'—and with that, he trod on the pedals good and hard. I managed to cling on to the pace, but only *just*, and still that noise of speedy tyres in our ears. I thought to myself, this is no good to me—a joke is a joke, etc., and I gasped out to pal Bert: 'Let him go, Bert,—must be W. A. O.' (W. A. Ormiston was in our Battn.). 'Not me,' replied he, 'I'm as good as the next man.' So we stuck it until we just *had* to ease off a bit. And as we eased up, alongside came what I can only describe as 'A figure on wheels.' I never saw such a sight, and have never seen anything to compare with it since. The figure of an old man—a cross between Bernard Shaw and Old Moore—long beard, spindle-legs, etc. And the 'bike'—I could hardly believe it: *up-sloping* frame, solid tyres, plunger brake, etc., and before I could recover from the shock, a thin piping voice hailed us. 'Lovely evening, young fellers—great game this cycling—don't do so bad for an "old un," do I?—85 next birthday—84 gear'—Then (shooting past) 'Excuse me, won't you, I got to be in Gorleston by 8.30.' And that was the last we saw of him.

"'Would you believe it'—gasped B. H., nearly falling from his saddle—'fancy that old "So and So" dusting us up like that—it's time we packed up the Cyclists and joined the Air Force!'"

From an Old Timer

HEREWITH another letter from Old Timer, A. Eastwood, of Lee-on-Solent:

"The first bicycle I rode was a heavy, and I think 'solid' iron-framed 'Juno,' which I believe cost about £16. This was 50 years ago. This machine had solid tyres (not more than an inch thick) but the design and riding position were very little different from the 'latest' model of to-day.

"One thing is very apparent, to every thinking cyclist—it is this—that he is using the strength in his legs to propel the 'bike', and that because of his awkward position on the miserable perch—called a saddle—he cannot throw the weight of his body on to the pedals. We see children and young people standing on the pedals in order to gain power and speed—but there is no cycle I have ever seen so designed as to allow the rider to bring his weight into action.

"One's knees soon ache pedalling a bike when even the slightest hill is encountered. The frame between the 'seat' and the handle-bars is too short to allow the seat to be slid into a better position—in fact the frame is all wrong. I think a far better contrivance than the average bicycle could be fixed up with a seat moving a few inches uy and down, operating a crank. The rider would not pedal at all. The bicycle would be shaped something like a scooter. The rider would sit in a comfortable bucket type seat, with both feet resting on a low platform just conveniently clear of the ground. Surely some of your mechanically gifted readers could evolve the details of these ideas. Such a cycle should be a lot faster and more easily propelled than the wretched device called a bicycle at present."

Make Your Bicycle Thief-proof

Simple and Effective Methods of Circumventing the Cycle Thief

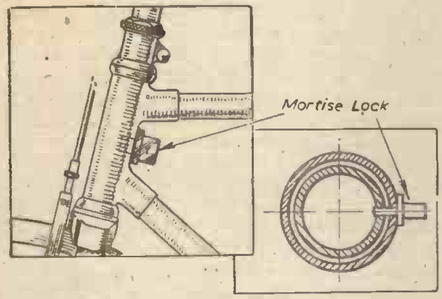


Fig. 1.—Building a lock into the steering head to hold it immovable.

NOW that the demand for cycles is such that it is practically impossible to purchase new or even second-hand machines, it should be the duty of all cyclists to go to a little expense and trouble to fit some form of locking device to their machines, to safeguard them from thieves whilst left unattended. We have often stressed the importance of immobilising unattended cycles in our contemporary journal *The Cyclist*, which, through paper shortage, has been reduced to the form of a supplement which is now incorporated in this journal. As soon as conditions permit, however, *The Cyclist* will once more revert to weekly publication.

Shortly before the war a competition was run in *The Cyclist* asking readers to submit ideas for foiling the cycle thief. Hundreds of entries were received, most of which had the merit of being both simple and ingenious. Over a hundred prizes were awarded and the prize-winning entries appeared in *The Cyclist*. Now that cycle thieves are more active than ever, we think this an opportune moment to reproduce a selection of the cycle-locking devices which were published at the time of the competition.

Locking the Steering Head

In Fig. 1 is shown a method of building a lock into the steering head to hold it immovable. The lock also serves to prevent the cycle slipping, when left by a kerb or wall, through the bars turning, and on every other occasion when the cyclist is inconvenienced by the flexibility of the machine, such as inverting it, lifting it over an obstacle, etc. A disadvantage with this device, however, is that the bicycle could be wheeled away, and nothing could stop it being stolen by someone so minded, but even if he passed the police, which is unlikely (it would look extremely suspicious lifting the bicycle round corners), the thief would be discouraged from further thefts by his difficulty in disposing of it.

Combination Stand and Locking Device

The combination of stand and locking device, protecting the cycle from damage as well as from theft, is certainly ingenious. As shown in Fig. 2, a piece of iron strip (⅜in. by ⅛in.), spring metal for the clip and a few nuts and screws, are all that is required. The clip is attached to the mudguard and the stand to the frame, double nuts being used to allow the stand to be moved freely.

A Safety Brake

All that is needed for this device is a brake block, a piece of flat metal threaded at one end to screw into the brake block, and another piece of flat metal with turned-up ends to fit between the seat stays. This piece of metal should have a hole or slit in it through which the metal with the brake block has to pass. To set the brake to prevent the cycle from being moved, press down the part with the brake block as far as possible, and when you are sure that the cycle will not move, mark the part between the two spars, which are between the seat stays, and bore a hole there. A peg can now be inserted in this hole to keep the metal in position. When not in use the metal can be drawn up and held by the peg above the metal cross-piece, which can be brazed on or fixed in some other way. This device can be very effective if adjusted properly. (Fig. 3.)

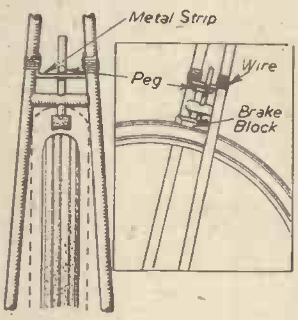


Fig. 3. —A brake locking device.

Device for Front Forks

The device shown in Fig. 4 could be attached to the front forks, or to the seat tube stays. A swivel eye is fixed to one leg of the fork, and a fixed eye to the other. To the rim of the wheel another eye can be fixed between the spokes, if so desired, and a large-headed bolt is passed through the eyes. The end of the bolt has a hole in it for the hasp of a padlock. When the lock is not in use, it can be withdrawn and dropped vertically through the eye on the front fork and the padlock inserted again. The shield on the wheel side of this eye would prevent the padlock from swinging inwards towards the spokes of the wheel.

Fork Crown Fitting

Another design for a cycle lock fitted to the forks is shown in Fig. 5. The circular bolt could be made of hardened steel, and would be held in brazed guides to the forks, and if the lock was solidly fixed by the maker and was of good quality with non-interchangeable keys, many cyclists would pay a reasonable extra charge for such a device. The lock is shown as an external fitting, but obviously there is no reason why a maker, designing the fork crown to suit, could not hide the whole of the working parts inside the crown and fork.

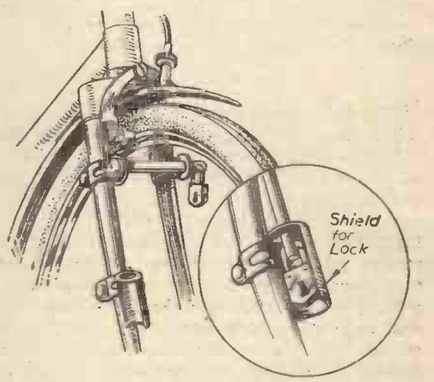


Fig. 4.—An attachment for fitting to the front forks.

A Valve-locking Bar

This method of foiling the thief takes the form of a forked bar which is slipped through two slotted carrier bars, the slotted bars being permanently through the slots in the carrier bar with the cycle wheel in such a position that the valve takes up a position central and opposite the locking-bar legs. The locking bar is then pushed through the slots in the suspension piece, thereby locking the wheel. Finally, a padlock or combination lock is used to lock the device through the holes in the locking bar and carrier bar.

With regard to the fixing of the device to the cycle stays, it is very important that the legs of the locking bar lie flush against the face of the cycle rim centre, with the locking-nut of the valve lying between the legs of the locking bar, so that any wheel movement shall be shared by the locking bar legs and the valve locking-nut. (Fig. 6.)

(To be continued.)

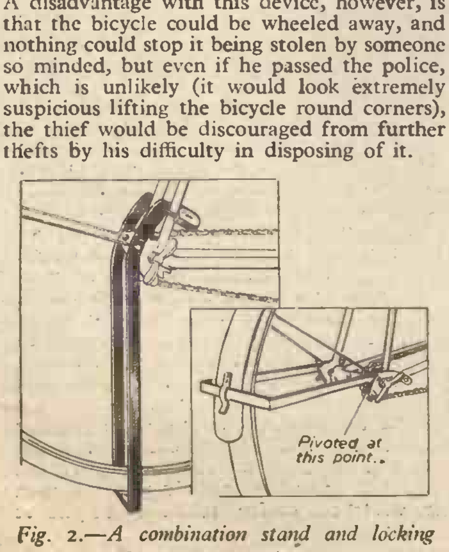


Fig. 2.—A combination stand and locking arrangement.

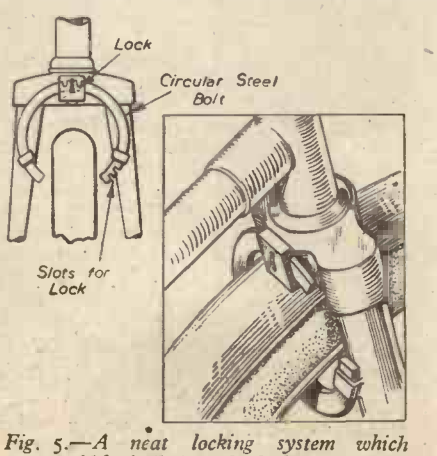


Fig. 5.—A neat locking system which could be built into the fork crown.

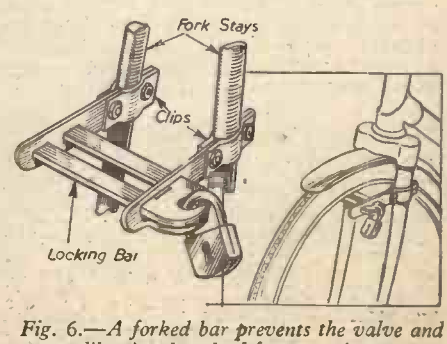
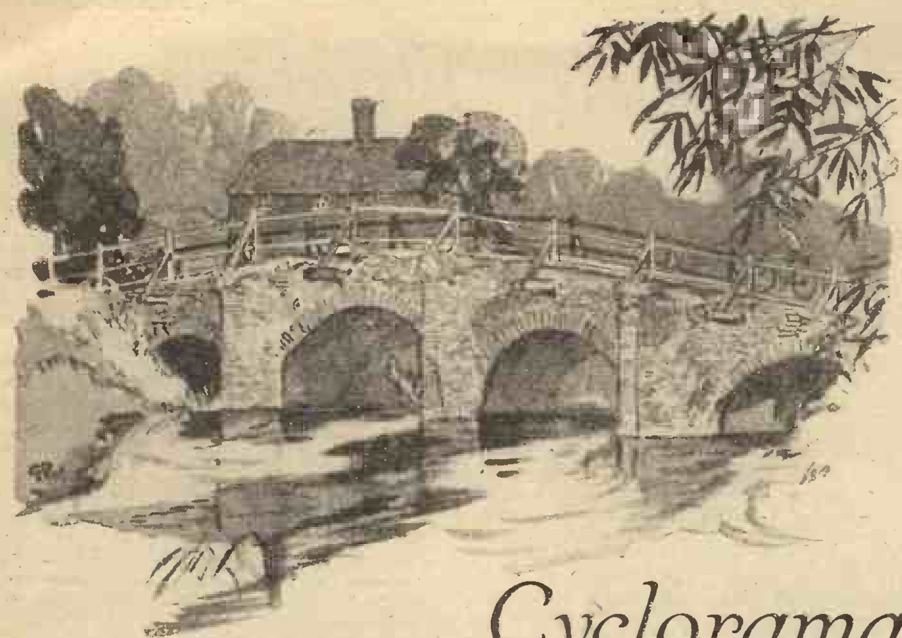


Fig. 6.—A forked bar prevents the valve and likewise the wheel from moving.

Cyclorama

By H. W. ELEY

The Cycle Thief : Methods of Child Conveyance : Cycle Dealers and Window Display : Great Memories : Charms of Essex



Tilford, Surrey. The picturesque old East Bridge over the Wey, dating from the 13th century.

The Cycle Thief

HE has always been with us, but perhaps not quite in such disturbing numbers as at present. Cycle thefts are very prevalent, and the old question comes up again as to whether it would not be wise for cycle manufacturers to send out machines fitted with some secure type of lock as part of the original equipment. There may be difficulties in putting such a suggestion into force these days, and the best alternative is for every cyclist to see that his, or her, machine is securely locked when left unattended. To leave a machine without any locking device fitted is to invite its loss, and a lost bicycle to-day is indeed a serious matter.

Methods of Child Conveyance

NOW that the baby car is no longer available for so many families the question of some safe method of conveying a child on a bicycle is of special interest. The past era of easy motoring has established family outings by road on a firm basis. The habit will persist now that bicycles have to be used. It is interesting when on the road to observe the varying ways in which parents convey small kiddies on their machines. There is the little side-car attached to the bicycle in which the child is often encased in a celluloid-cum-wooden box affair which cannot be too happy an arrangement. On a hot day one imagines such a conveyance must be distinctly uncomfortable. There is the carrier in front of the handle bars in which a very small child seems to sit with some degree of comfort. For the older child many parents fix a small saddle on to the cross bar so that the child sits in front of the cyclist and is given a fair measure of protection. Whether this method entails inconvenience and discomfort for the person pedalling I do not know. It would be interesting if family cyclists pooled their experiences of child conveyance methods.

The Cyclist Comes Into His Own

LITTLE did we dream a few years ago that the roads in England would ever be so free from motor traffic. To take a bike out now is to feel that the cyclist is indeed a king of the road. This last week-end I did several miles awheel, and only met army lorries and very few private motor-cars. To the older generation of cyclists it is like turning back the pages of time and living once again in the pre-motoring era. Every cyclist should make the most of this set of circumstances which the war has brought about. He should feel a new freedom in touring, and because of the lack of motor traffic be able to concentrate much more happily on the interests and beauties of lane and hedgerow. His new companions of the road will be the ponies and cobs which are now trotting along so merrily between the shafts of governess carts and somewhat old-fashioned traps. The study of the advertisement "smalls" of provincial papers will show how greatly in demand ponies and traps are to-day. Whether the feeding-stuff problem will become so acute as to nip the new fashion in the bud I do not know, but certainly the last week or two I have seen more horses and traps on Midland roads that I have seen since boyhood days. The sight of them has, in fact, set me longing—and I find myself toying with the idea of buying one of those sound Welsh cobs (always quiet to ride and drive!) which are so freely advertised to-day.

Cycle Dealers and Window Display

SEVERAL cycle dealers have mentioned to me how regretful they are at the almost total disappearance of cycle display show cards, window cut-outs, etc. They appreciate the reasons but having for so many years been supplied on a liberal scale with colourful show cards, show sheets, and counter cut-outs, they naturally feel the lack of these items. One or two suggested to me that they would willingly exhibit coloured show bills, or show cards, even if they did not deal particularly with bicycle tyres or cycle accessories, their idea being that they would be performing a useful service in connection with national propaganda if they exhibited show sheets and posters about rubber economy, salvage, etc., and in addition they would be giving their premises a touch of brightness, in many cases sadly needed. This seems a good thought and possibly some of the manufacturers might issue posters which would meet the case. Meanwhile one can only sigh for the good old days when manufacturers' advertising departments kept dealers so well supplied with colourful advertising display material.

The Glory of the Corn

I HAVE had one or two opportunities recently of indulging in that best of all pursuits—leaning over a gate, pipe in mouth, and looking over ripening corn. It was in a Warwickshire village where I looked with joy on two big fields of wheat. The crop was good; and given a little more kindly sunshine that wheat will soon be golden and stand in noble sheaves. It would seem that the corn harvest generally is likely to be good, and if this is so throughout the country, then there will be more reason than ever for those hearty harvest thanksgiving services which are held in English village churches, and which are wonderful events to attend. Harvest is one of the immemorial things, and if a field of wheat, or barley, or oats was always a good sight, it is now something akin to ecstasy.

Great Memories

I HAVE just been looking at the Souvenir Programme of the Dunlop Jubilee Cycle Races, which were held at Herne Hill in June, 1938. What great memories this programme revives! A constellation of cycling stars which has surely never been got together on any other occasion. These magic names leap at one from the pages of this memorable programme—Jeff Scherens, professional sprint champion of the world for six successive years; J. Van De Vijver, the famous Dutchman, who was amateur champion of the world; Elio Meulenberg, of Belgium; A. Richter, the German champion; L. Gerardin, the French champion; and the famous Van Vliet, the champion of Holland. These are only some of the great riders who were got together at Herne Hill on that famous day in June. The meeting was, of course, part of the great Dunlop programme inaugurated to celebrate its jubilee. In that period—1888 to 1938—I suppose that more revolutionary progress in the world of transport was achieved than in any other period in history. The programme is one which I treasure—always with the hope that when the clouds of war have passed away some equally fine meeting of the stars may be arranged to celebrate Victory.

Charms of Essex

ENGLISH counties are so varied and have so many differing characteristics that a shire will often mean one thing to one cyclist and something entirely different to another. Take Essex—there are people who, when they think of Essex, just have a mental picture of Southend. There are others, perhaps more historically inclined, who immediately have a vision of ancient Colchester. Now Colchester *is* ancient. In Roman times it was probably the third most important town in all Britain. The first city the Romans built on the site of Colchester was stormed and burned by the British, who were led, incidentally, by that very intrepid queen, Boadicea. I am told that some very interesting relics of the Roman age are to be seen in the museum in Colchester of the Essex Archæological Society. I have never been there myself, but I am making a note to go. There is a charming old market town in Essex, only some 43 miles from London—Saffron Walden—with a wonderful church of the fifteenth century.

The Parish Church of St. Mary and the old Red Lion Inn, Langley, Bucks.

WAYSIDE THOUGHTS

By F. J. URRY

It is Wanted

I HAVE so much correspondence to attend to that it is in arrears, for many of my friends write long and interesting letters, but the queries raised suggest it is high time a treatise on modern cycling should be in the hands of every bicycle buyer. I know such books can be bought to-day, but my point is that if the cycle industry is keen to advise folk how to ride easily, to keep their property in decent order, and to make the best use of a bicycle, then this information should be printed in one concise volume and given to every bicycle purchaser. I know that is preaching an idealism impossible to attain to-day owing to paper shortage; but it is certainly a thing that badly needs doing immediately circumstances permit, or all my correspondence is very much awry. There is a great confliction of opinion on the best cycle equipment; and it is not surprising when one finds the average lightweight machine fitted with saddle and pedals totally unsuitable to a man who wants the best, but also wants to be comfortable. It seems as if the trade thought the only buyers of the light machine are the youngsters who prefer narrow saddles and shadowy pedals, and a gear in the region of the eighties. No wonder some of my corresponding friends are a trifle critical of my lightweight advice, when they are told by a dealer such is the type of machine I would recommend. My insistence on the first value of cycling is that the rider shall be comfortable, whether he or she be young or middle-aged, whether the desire for travel is to be speed or ease; and the first condition for all or any of these things is comfort. I don't care a rap what type of machine a rider prefers so long as it embodies that first essential principle. Naturally I think my own ideas on fulfilling this question are the best, but then so do you; yet there are many people with less experience on these matters who, if they had access to such a short treatise on the sport and pastime as I suggest, would be all the better cyclists after studying it.

Is it an Awakening?

YOU will have noticed probably that our big firms have been filling their advertising spaces this last month or so with hints as to the best means to be taken to keep bicycles in good running order, or in the case of the rubber companies, how to care for tyres and make them last as long as possible. The reason for this gratuitous advice is the very obvious one that they have little or nothing to offer the public, and so, very rightly, warn their customers to take the very best care they can of their property. This has wanted doing for many a day, but all the firms concerned have been, before the war, so busily engaged in competing with each other that they have had neither time nor money to spend on their ultimate customers. It apparently takes a world upheaval to make all of us realise that the first thing for the benefit of cycling—and therefore for the trade—is to make the public cycling-conscious, and then interest them in the care of the vehicle that makes the pastime more worth while. It is astonishing how ignorant the general public is in reference to cycling, a thing which has been proven to me again and again in my correspondence. And, rightly or wrongly, I believe the cure of that ignorance of what the ownership of a bicycle can mean to an individual, is just the measure of the expansion of the pastime after this war is over. We are all too prone to let people "learn for themselves," instead of giving a helping hand or a word of advice. The trade seems to have come to some such conclusion, judging by their recent publicity, and this raises the point in my mind as to whether this subject ever need be so entirely forgotten again, either by the manufacturers or we cyclists. There ought to be closer contacts between us on this matter of cycling propaganda, each party realising the limitations that exist between making the vehicle and enjoying the pastime. There is a nice balance on this question existing somewhere, which if it could be found and used, would be of inestimable value to the trade and cycling generally.

To-day and To-morrow

THE cuckoo's note became confused with the clack of the mowing machine, and now that predatory bird will be heard no more until April is in the land again. But what a joy we have had o' nights, or those of us who have been fortunate enough to take advantage of the long evenings, and see this land grow to the glory of its harvest. I for one am not complaining, for on several evenings of the sunny weeks the chances have come to me to roll in idle "meditation, fancy free" through the woody ways of Warwickshire, now, alas, losing so much of its noble timber, which one sincerely hopes will be replanted for the joy of the coming generations. On a recent evening I called to exchange a few words with a couple of my farmer friends, and never before listened to such glowing accounts of the harvest prospects; for farmers, as a general rule, are not over-optimistic people. Certainly the countryside has been a picture all the summer, and the satisfaction of the field appears to match that of the war position. In town and country the spirit of the land is high, and "autumn grim and grave" does not seem to suggest the dire possibilities of even a year ago. I feel, and I cannot command the reason for such feeling, that soon I may be able to join in the song of that young poet, a victim of the last war, and say:

"I shall desire and I shall find
The best of my desires,
The rolling road, the autumn wind
That soothes the darkening shires.
And laughter and inn fires."

The good days are nearer, and the fact that we shall all be poorer with their coming does not seem to matter. We ought to be happier, and I think we shall be, if we only remember that it is the simple things in life that are really worth while, the things you achieve—like cycling—rather than the things you possess that have no life linked to yours by exercise. Yes, I shall desire to go on turning a pedal until the end of the story.

Looking Back—and Forward

I WAS turning over a heap of old snapshots the other day, pictures taken in the long ago, before world war No. 1, and when it was still an uncommon sight for a motor-car to be seen on the road; and I was interested in the costumes we wore in 1905-6, particularly those of the ladies, with long flowing dresses and hats which looked like the full jib of a racing yacht. How the poor dears managed to enjoy cycling cumbered in such garments is a mystery. The boys—and I was one among them—wore school caps and the slender knickers of a bygone age, and I'm not at all sure they were not more comfortable than the fulsome clothes of to-day. But apart from the sartorial changes that have taken place, I was reminded that this particular set of pictures was taken in Connemara when a party of 18 toured that delectable area for 10 days and stayed at a different hotel each night. Those were spacious times when hotel folk had a special welcome for the cyclist, and no rider ever thought of carrying food or drink. That habit only became common as a result of the food restrictions of the last war. Of that party of 18 only four remain alive, and being one of the youngest in the group, I suppose I must consider myself lucky; anyhow, I'm glad, for I want to live to see the end of the war, and, I hope, the beginning of "the thousand years of peace." And besides, I should like to go to Connemara again some day when we English and Irish have sorted ourselves out to a better understanding; for I believe Ireland—I like the old name best—can be made a happy holiday ground for the people of Britain, much in the same way as Switzerland is the happy holiday land of the folk of Europe. But before that occurs many changes must take place, and not all of them on the Irish side. Perhaps we shall live to see the conditions of the Atlantic Charter lifting the sectarian mists from the mountains of Mourne.

Those Summer Days

HOW to keep cool in the heat of the day is a problem that no one has satisfactorily solved, except by taking the very simple remedy of resting. Our leisure is so precious to us during these work-crowded days that we resent missing the opportunities of being out and about and at the same time object to alter our habits to fit the hot weather spells. Dress does something to help us keep a cool skin, and here there is a risk that too much exposure of the body's surface to the sun can, and indeed often does, result in painful blistering. Often enough I ride without a coat, but always take care to let my shirt sleeves dangle loosely down my arms, and thus preserve the latter from the discomfort of inflammation. And I happen to be one of those individuals who does not object to early rising and can enjoy those beautiful fresh hours when the dawn is in the sky, the faint mists among the river meadows, the dew on the grass, and the air full of bird song. To take a second breakfast 20 miles from home, under a shady veranda, lending full leisure to the function, is very delightful, and gives you an appreciation of English summertime the later riser seldom enjoys. On such occasions the afternoon can be spent in desultory talk with a friend until both of you fall asleep; or if you are lonely, then a favourite volume may not even provoke your interest sufficiently to keep eyelids from drooping. Yet it seems to me such passages of time are very enjoyable, while some time after the refreshment of tea and six o'clock you can wander home in the cooling air and call your outing a day that will match the healthiness and quiet enjoyment of any other stretch of leisure time. I am not suggesting you do this kind of thing unless you possess the inclination. I can only tell you I salute high summertime in this simple manner, and find the result very satisfactory.

Take It Easily

MANY of my letters in these latter days touch upon the stiffness following a return to cycling. What do people expect? Do they imagine they can just jump aboard a bicycle and go sailing along the road for 20 or 30 miles without feeling the result in limbs untrained to the exercise? It would surely be foolish if they did; yet, curiously enough many of them do, and I believe it is this reaction that is largely the cause of the mental notion that cycling is hard work. On such an assumption so is cricket or football, and tennis and golf and skating, the first game of the season leaving the impact of strain on muscles new to the exercise. The only reason that cycling differs from any other game is that you can measure your miles to conform with your comfort; in other words, start quietly and work up to the happy climax of a full cycling day of 60 to 80 miles. But so many people don't; they think this particular game can be properly played by anyone, and when they are hurt by it, blame the game and not their unfortunate approach to it. It is many years now since I pushed myself to the vigour of cycling for the attainment of speed or distance, and I don't suppose I shall ever do it again; but I'm glad I had those experiences because they have taught me that the supreme joy of cycling is to let the day and the distance take complete charge of the mileage, for the next valley will still be there to unroll its grandeur on the morrow. I often feel the little sorrow that time limits all contracts when I have to turn for home, but since this pleasure of wandering is my very own, I am not going to make a toil of it by stretching its margins beyond comfort.

Cycle Production limited in U.S.A.

AS from October 31st this year bicycle production in U.S.A. will cease, with the exception of one or two firms, who will be allowed to make a maximum quantity of 10,000 machines a month. This is the decision of the Production Board of the U.S. Government; and the reason given for it is the shortage of material. The small amount of bicycle building plant that is to be kept running is mainly for the purpose of supplying military needs. From what I can learn from my American friends there is no intention of cancelling the private use of cars, even though the amount of petrol is restricted. It is argued that so car-minded has become the average American that to deprive him of this form of travel would tend to breed depression and unhappiness. Further, the car habit has had the effect of encouraging town and city workers to seek homes anything from 10 to 30 miles from their daily places of business, frequently in districts not conveniently served by public transport systems; this fact has to be taken into consideration if the life of the community is not to be disrupted. At one time, after America entered the war, it looked as if her people may follow the cycling development which has occurred in Britain, for the demand for bicycles in the early part of this year could not be met; now it will certainly not be met, for it is conceivable that the total allocation allowed by the Production Board will be absorbed by the military authorities. For good or ill, it seems that U.S.A. will never become one of the great cycling countries of the world, more understandable by us if we stop to consider the great distances to be traversed, as compared with our own.

My Point of View

BY "WAYFARER"

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

IT seems to me that the "Free House" sign which is displayed by certain of our inns is a bit of a misnomer. At any rate, it has never been my good fortune to get anything for nothing. I've had to pay every time!

The Bareheaded Way

I APPLAUD the action of Mr. Hugh Dalton, President of the Board of Trade, in boosting the no-hat movement. More and more of us, he says, will have to go without hats. I have been doing so for about 50 years, and I commend the practice to all, especially when cycling. How the exponents of idiocy used to stare when I first appeared with a naked head, and what asinine questions they asked!

Take Care

THE placing into cold-storage of many of our automatic signals, which are rendered unnecessary by the considerable decrease in motor traffic, prompts the remark that cyclists, when using what are now uncontrolled crossings, should always give themselves the benefit of the doubt. In other words, if there is the slightest question concerning the wisdom of going straight across the intersecting road—whether that road is major or minor—come to a standstill and wait for a suitable opportunity. It's a poor bargain to arrive in the next world 25 or 30 years before you're due there, all for the sake of as many seconds! So take care!

Golden Days

HEARING the insistent call of "Caledonia, stern and wild," I dallied with the thought of indulging in a Scottish tour this year. On realising that to carry out such plan would mean a long, tedious and expensive railway journey, which was entirely devoid of justification, that the cost of same would be better devoted, out of sheer patriotism, to the purchase of Savings Certificates, and that it would be improper to occupy train space, I gave up the idea and went to Wales instead. There, in a land of rugged mountains and fertile valleys and tumbling cascades, I spent two long weeks, and I returned home full of vigour and without the slightest feeling of regret that Scotland is off the map for the time being, so far as I am concerned.

I would certainly not have fared better in the Land o' Cakes, the word "fared" being used in its literal sense. I might have looked at grander scenery and at greater quantities of it, but I cry "content," refusing (now, as ever) to indulge in comparisons. If you suggest that Wales is hackneyed, I reply, with emphasis, that it is not. For, just as the Wayside Pulpit says: "No day is commonplace if only we have eyes to see the splendour," so I assert that no country is hackneyed if only we approach it in the right spirit.

Those were golden days that I spent in Wales, and I am now in full enjoyment of the physical and mental tonic they provided. The weather was not too good. There was "rain in places," as the pre-war forecasts used to say (with stupendous erudition and a perfect regard for "Safety First!"), and at intervals gloves and a pull-over would have been welcome. But no word of complaint or criticism has fallen, or will fall, from my lips. How can one grouse when one is conscious of possessing 100 per cent. of happiness?

Starting on July 4th ("Independence Day"—a happy omen!) I spent 8½ days in Shropshire and North and Mid-Wales, scoring 527 miles. I did half a century on the Saturday afternoon, and averaged 60 miles a day for the remaining eight days. Beginning August well (to wit, on the first day) I devoted nine days to Mid-Wales, and to getting there and back again. I accounted for 548 miles, or an average of 61 miles a day, treating every day as a full one, though on three mornings I did no riding at all. On the second tour I traversed some of the ground covered on the first tour. Did it matter? It did not! Nothing like that matters on a cycle tour, especially in the presence of such wonderful scenery.

I ranged from Builth Wells in the south, to Bangor in the north, and Aberystwyth and Harlech in the west, and it was a case of "roses all the way." I ask for nothing better than those golden days which fell to my lot in July and August.

No Mean Achievement

WITHOUT boasting, it seems to be no mean achievement, particularly in war-time, to "put up" six new places of call in the course of a short tour—places to which one desires to return, seeking their further acquaintance. Such was my experience during the first of the holidays above-mentioned. These are the rest-houses I discovered, in the order of finding: (1) A secluded farm on the lower slopes of Cader Idris, a mile from Dolgelley. (2) A cottage standing well back from the Harlech-Barmouth road at Tal-y-bont (about four miles from Barmouth), with a vociferous stream as near neighbour. (3) A wayside house of culture near Glandyfi. (4) A boarding-house overlooking the Rheiddol Valley at Llanbadarn Fawr, near Aberystwyth. (5) A biggish farm standing one field away from the Aberystwyth road, at the foot of the "staircase" between Pen-y-bont and Llanfihangel-nant-melan. (6) A cottage at Knighton-on-Teme, with an arresting view from its windows along the upper valley of the river. I thought that all this was pretty good going—especially, as I say, having regard to the fact that "there's a war on."

My second tour did not yield such ample results, but I felt very satisfied. A nice little "temperance" hotel at Newbridge-on-Wye sheltered me for one night. I had a "great" time on another night in an old-world and remote cottage up the Llyfnant Valley, not far from Machynlleth. A bungalow in a superb position overlooking Tal-y-llyn was my abiding-place on a third night. A total of nine discoveries in the course of what, in the aggregate, was a fortnight's holiday, suggests at once that there is "corn in Egypt," and that my reputed skill—or luck—in finding good rest-houses is not altogether a rumour.

"Corn in Egypt"

LET it be added that, before going away for the first portion of my holiday, I was afflicted by some doubts as to the wisdom of adhering to my usual plan of not making any bookings, and of passing from place to place, "chancing my arm"—and my luck. I had observed that a selection of my younger friends had "played safe" by booking-up for one or two nights at some chosen house, doing radial rides from there, and then moving on to another booked address, where the operation was repeated. After thinking things over, I decided that I would carry on with my usual plan, and I encountered no difficulties. Rather the contrary was the case, and it is significant that I was the sole guest, on August Bank Holiday evening (of all occasions!), at the small "temperance" hotel at Newbridge, already mentioned.

It may also be recorded that I could not have found accommodation at two or three places where I spent the night but for cancellation of bookings by parties whose holiday arrangements were disturbed by the lack of petrol, or by other war-time upheavals. If, then, there was "corn in Egypt" in the sense of accommodation, a like remark applies to the matter of commissariat. I certainly wondered how I was going to fare, and I came back from each tour more than satisfied with results. Sugar, of course, is the real difficulty everywhere—but I found no other difficulty, and that in relation to sugar did not present me with any problems.

Notes of a Highwayman

By LEONARD ELLIS

The First Night of a Tour

ONE may say that some tourists are more fortunate than others in one particular respect. Whereas many are compelled to traverse many weary and uninteresting miles before reaching the delectable spots, others may leave the smoke and grime of their home cities and in a very short space find themselves in surroundings that appeal—in fact some begin "holidaying" at once. Others must tolerate the equivalent of the long, tedious train journey to the seaside. As this may seem to cast a slur on the home surroundings, I do not particularise, but offer it as a general opinion. Perhaps few have ever troubled to analyse their thoughts in the matter of a first-night resting-place, and yet I suppose it is an important item in the holiday. Early thoughts and impressions go a long way towards building up those pleasant memories that constitute one of the abiding joys of touring. We are, at the start, keyed up with excitement and expectation; we are anxious that nothing should spoil that glorious feeling of anticipation. What sort of place, therefore, do we want? It depends upon many things—the particular wishes of the individual, and even more upon the type of tour we are beginning. If we are bent upon "exploration from the start" we shall want a place full of interest, so that we can begin tasting the joys at once. On the other hand if we are out for a long journey to a distant self-contained area like the Lake District or North Wales we are not too anxious to spend a lot of time exploring the places en route, nor are we too willing to pass through and neglect the obvious calls of the town and village.

A Worcestershire Town

BIRMINGHAM cyclists are fortunate in that the city is ringed about with innumerable pleasant towns, with cathedrals, castles, market crosses and the like; ideal first-night stopping places. Tenbury Wells is a typical example and is an ideal "first-night," 36 miles from Birmingham, and on the road to Central Wales or the Forest of Dean, or anywhere else if you care to wander round. It is in Worcestershire, but only just, and there is that added thrill to think that early next morning we shall cross the border into Shropshire or Hereford. The place is interesting and historic, but not overwhelmingly so; in fact, there is not enough of it to keep us long from the serious business of touring. It stands near the River Teme, a delightful stream that in itself is worth a complete tour. The river Kyre, flowing into the Teme, is said to be coldest in the country. The church is Perpendicular, but little of the original structure remains, as, owing to a curious accident, it was wrecked by the overflowing of the river in 1770. A grave was dug near the base of a pillar supporting the roof and the water seeped through and undermined the column. There are several good inns, and an old market hall.

Tenbury as a Centre

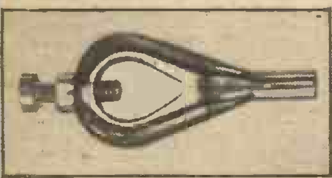
SUPPOSING the cyclist is not dashing away on a long trip he will find that Tenbury is ideally situated for a centre. Only six miles to the north rises the mass of the Titterstone Clee, and another seven separates this from the Brown Clee, a pair of hills well worth serious exploration. Shropshire's many hills and ridges are within easy reach, Corve Dale can be found within a dozen miles, Ludlow—most charming of towns—is but an hour's ride. To the south-east lie the glorious Malverns, and the borders of Wales are but 20 miles distant. At this point we cross the frontier into Radnorshire, much of which is well above the 1,000-ft. mark. If we want towns they lie in profusion all round us—Clun, Bishop's Castle, Knighton, Hereford, Presteigne. Leominster—all easy rides, and all offering an alternative route back.

The Butter Cross at Tenbury Wells.

THE GORDON INSTRUMENT CO.

CLINTON PLACE, WILLIAM ST. SHEFFIELD 10.

13/16in. DIE HOLDERS, 3/- (Phos. Bronze)



LATHE CARRIERS, PHOS. BRONZE
No. 1—½", 2/-; No. 2—¾", 2/6; No. 3—1", 3/-

12/6  12/6

INSPECTORS' LENSE
2" Diameter—5 Diopters.
Telescopic Arm and Universal Joints. Invaluable to Inspectors, Tool-makers, Die-sinkers, Botanists, etc.

INSPECTION MIRRORS
("Dental" Mirrors.)
1" Diameter. 6" Handle.
Swivel Joint.
3/6
Used by Aircraft Inspectors, Turners, Toolmakers, Electricians, etc.

INSTRUMENT MADE MORSE EQUIPMENT

CONE PIVOTS—SOLID NICKEL SILVER CONTACTS

Type K.—Key as illustrated, 15/-.

Type K.B.—Key and Buzzer on Bat. Box, 30/-.

Type B.—Buzzer only, 7/6.

ALL THESE GOODS ARE OF OUR OWN MANUFACTURE and IN PRODUCTION, IMMEDIATE DELIVERY.

INSTRUMENT MADE, ROBUST, and WELL DESIGNED.

TRADE ENQUIRIES INVITED.

COIL WINDING WANTED.

BUY, EXCHANGE OR SELL

Advertisements are accepted for these columns at 5d. per word (minimum 12 words at 5s.—advertisements of less than 12 words are charged at the minimum rate of 5s.). TERMS :—Cash with order. Cheques, Postal Orders, etc., should be made payable to George Newnes, Ltd. *The Proprietors reserve the right to refuse or withdraw advertisements at their discretion.* All advertisements must be received on or before the 5th of the month preceding date of publication and should be addressed to the Advertisement Director, "Practical Mechanics," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

MISCELLANEOUS

MAKE (and Sell) your own TORCH BATTERY Cigarette, Gas and Pipe Lighter. No wheels, wicks, springs nor flints. Tested, reliable, lasts 5-6 months. Materials available. Diagram and full instructions for easy home construction 2/9d. Element included FREE.—P. M. Barham, Hilltop, Bradmore Green, Coulsdon, Surrey.

AUSTIN 7 CHASSIS, several new items, also rear wheel unit shaft drive tricar, £10, exchange fret machine Stanley 55, etc.—48, Warmington Road, Birmingham 26.

FREE electricity from wind, build your own wind electric generator for lighting and battery charging. Simplified drawings instructions to build mast head propeller, 2/6d., post 2½d.—Pearse, Midtaphouse, Liskeard, Cornwall.

TOOLS

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

WATCHMAKING

WATCH AND CLOCK REPAIRERS. Send 9d. for complete list of materials and tools.—Blakiston & Co., Ainsdale, Southport.

WANTED

WANTED.—9 to 14 c.c. Petrol Engine such as "Baby Cyclone," etc. Good price paid.—Lt. M. Smith, White Lodge, Knutsford.

REQUIRED. A Trix or Dublo railway or parts, also a Juneero Outfit. Reasonable prices.—Box No. 136, c/o "Practical Mechanics," Tower House, Southampton Street, Strand, London, W.C.2.

ENGINES WANTED

WANTED URGENTLY.—Stuart Turner Petrol "Lightweight" two-stroke, and the A. E. four-stroke engines, air or water-cooled or kits of parts, or other make considered. Condition immaterial. Particulars to A. Bate, 175, Birmingham Road, Wolverhampton.

"Easily the best soldering fluid obtainable."
This statement by a regular user of "BAKER'S" expresses the general opinion of motor and engineering trades. Sold in 6d., 1/- and 1/6 tins. *Also in Bulk.*

"Baker's" Soldering Fluid

SIR WM. BURNETT & CO. (CHEMICALS) LTD.
Gt. West Rd., Isleworth, Middx. *Hounslow* 0476

ELECTRADIX BARGAINS

NEW RECORDER PARTS. Chart drum and clips, plated, 5/6. Traverse shaft, precision-threaded 4 inches 120 to inch, 9" long, ball bearings, 12/6. Carriage, with guides and brackets, 7/6. Magnetic clutch drive, 6 volts, 25/-.

PLUGS. 5-pin, with panel socket and multi-cord, midget, 4/6 set. 14-way ditto, 7/6. Twin midget plugs, radio 2-pin Belling type, 5/- doz. Socket, pairs on pax, 8d. 5-pair strip, mounted, 3/-.

INSULATORS. Porcelain, in all shapes and sizes. Please state wants.

CONDENSERS. Variable are now scarce, but we can still supply solo variable S/W Formo condensers in their carton for wavemeters and single circuit tuning, .0005 mfd., 3/6.
Fixed type, 2 mfd., G.P.O. for smoothing, 2/6. H.T. Mica, ½ mfd., 4,000v., 10/-. Large 1 mfd., 2,000v., 10/6. 1 mfd. 6,000v., B.I. oil-filled, 35/-. 2 mfd. 4,000v., cased, 45/-.

SPEAKERS. Mov. Coil Perm. Magnet, damaged cone. For home repair. Celestion, 5½" and 6½", 7/6.

PERISCOPES. Folding trench Mark III ex. W.D., with spare mirror, opens 25" high x 4½" x 3", in canvas case with strap, 15/-, post 1/-.

WAVEMETERS. Buzzer type mahog. case, 45/-. Heterodyne Wavemeters, £3 10s.

ENGINES and DYNAMOS. Engines for direct coupling to Dynamos or Pumps. Twin cyl. Douglas air-cooled petrol semi-portable type, fitted fuel and oil tanks and governor. Mag. ignition, 2½ h.p., £15. 1½ h.p., £12.
Pelapone petrol-electric sets, water-cooled single cyl. 500 watts 50v. 10 amps., with tanks and field reg., £27 10s.

DYNAMO BARGAIN. Rotax. 6/12 volts 8 amps. D.C., 3rd brush size, 8" x 4½", 11 lb., cost £10, unused, 15/- (carriage, 2/- extra). G.E.C. double-current Dynamo, 6 volts and 600 volts, ball-bearings, 17 lbs., as new, 25/- (carriage, 2/6 extra). Dynamos. All sizes in stock. Please state wants.

ALTERNATOR. Perm. Magnet Alternator, hand-drive, useful tester and ringer, 10/6. Bells for same, 12/6.

TANKS. Water Storage, for fire or engines. ½ KW Stuart cooling tanks, galv. iron, 5' high, 14" dia. with pipe unions, 45/-.
Small square wall tanks for oil or suds, 6½" x 1½" x 3". High pressure steel, 1/6. Containers for pressure, air or liquid, pint size, 8½" x 2½", new, 3/6.

STEEL PULLEYS for Motors and Dynamos. ½" Vee belt, 5" outside, ½" bore, 4/6 ea.

COUPLINGS, Vernier Simms, for dynamos or magnetos, bronze, ½" bore, 6/- pair.

GAS ENGINE. ½ h.p. horizontal, 2 fly wheels, mag., ignition, second-hand, £7 10s.

ALNICO DISC MAGNETS. 1½" x ½", enormous strength, 2/6.

Please include postage on mail orders. Send stamped envelope for replies to enquiries.

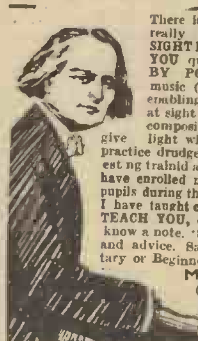
ELECTRADIX RADIOS
19, Broughton St., Battersea, London, S.W.8.
Telephone : Macaulay 2159

HORNBY DUBLO

CONVERT YOUR COACHES TO L.M.S., G.W.R., or S.R. with T. & H.'s Litho Papers. Slight cutting only necessary. 1/6 per set for 3 coaches. Also your own P.O. Wagons, Bolsover, Charrington, P.O.P., Alloa, etc., 4 on sheet, 6d. Sheet of General Railway Station Notices, 6d. Sheet of Doors, Windows, 6d. Slate Roof Sheet, Old Stonework, Concrete Blocks, Smoky Brickwork, New Brickwork, English Bond Brick, Window Paper (Black or Silver), Bovril Adverts (20 different). 3d. per sheet. POSTAGE, 1-11 Sheets, 2½d. extra. 12-18 Sheets, 3d. extra.

TYLDESLEY & HOLBROOK, 109, Deansgate, Manchester 3.

A GOOD PIANIST IS ALWAYS WELCOME



There is a way to become a really FINE PIANIST and SIGHT READER. I will teach YOU quickly and enjoyably BY POST, from ordinary music (no freakish methods) enabling you to read and play at sight any standard musical composition so that you shall give light wherever you go. No practice drudgery, but simple, interesting trainid a child could follow. I have enrolled more than 7,000 adult pupils during the war, during 38 years I have taught over 56,000 and I CAN TEACH YOU, even if you do not know a note. Send for free booklet and advice. Say Moderate, Elementary or Beginner.

MR. H. BECKER
(British by Birth and Descent) (Dept. 158), 69, Fleet St. London, E.C.4.

Easily made from our castings, from 15/- per Set
J. HALLAM & SON, Upton, Poole, Dorset.

MINIATURE PETROL ENGINES for Aeroplanes and Speed Boats
Send 3d. for particulars.

This space will be used to advertise the 'ADEPT' LATHES and SHAPERS in the happier times coming, when we hope to be able to give more prompt deliveries. Meantime we would assure all our friends that we are making strenuous endeavours to give deliveries of the orders we have on hand and ask their kind indulgence.

LARGE DEPT. FOR TECHNICAL BOOKS

FOYLES

★ BOOKSELLERS TO THE WORLD ★
New and secondhand Books on Engineering and other subjects.

119-125, Charing Cross Rd., W.C.2
Open 9 a.m.-6 p.m., including Saturday
Telephone : Gerrard 5660 (16 lines)
W. & G. Foyle, Ltd.

It's as easy as A B C

Learn MORSE CODE in Record time!

First you listen—then you find yourself reading and sending MORSE like an expert. It's easy by Linguaphone, because you learn *by sound*. The principle is the same as in the world-famous Linguaphone language method. Soon after you have started listening to the records in the Course, you will develop amazing speed and efficiency in receiving and transmitting messages.

The Linguaphone Morse Code Course has been prepared, tried and approved by experts. It contains five double-sided records, comprehensive text-book, exercises for practice and full additional information about the various branches of the Code. Send the coupon below for a complete course.

LINGUAPHONE

Morse Code Course

(Dept. A/8.)

Name ....

Address ....

....

To the Linguaphone Institute (Dept. A/8), Linguaphone House, 207, Regent Street, London. W.1. Please send me, post free, a Linguaphone MORSE CODE COURSE, for which I enclose a remittance, value £1. 5s. od.

JUBILEE WORM DRIVE HOSE CLIPS

The long-life clip with the ever-tight grip

The Best Known
For Radiator Joints, Air, Oil and Water Hose Joints

We guarantee a Tight Joint

L. ROBINSON & Co.
25, London Chambers,
GILLINGHAM, KENT

CHEMISTRY

SPECIAL OFFER

A Sample Parcel Containing Many Useful Pieces of

CHEMICAL APPARATUS

(post 3/6 free)

A WIDE RANGE OF EQUIPMENT AND REAGENTS for Experiments at Home can be chosen from our Catalogue —write for free copy, enclosing stamped (1d.) addressed envelope.

BECK (Scientific Dept. A), 60 High St., ... N.16

"Practical Mechanics" Advice Bureau **COUPON**
This coupon is available until October 29th, 1942, and must be attached to all letters containing queries, together with 3 penny stam... addressed envelope

Published about the 30th of each month by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and Printed in England by The Newnes and Pearson Printing Co., Ltd., Exmoor Street, London, W.10. Sole Agents for Australia and New Zealand—Gordon & Gotch, Ltd. Sole agents for South Africa—Central News Agency, Ltd. Subscription Rates: Inland 11s. per annum. Abroad, 10s. 6d. per annum. Canada, 10s. per annum. Registered at the G.P.O. for transmission by Canadian Magazine Post.